CENTRE OF PLANNING AND ECONOMIC RESEARCH (KEPE)

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CENTRE OF PLANNING AND ECONOMIC RESEARCH (KEPE)

The Centre was initially established as a research unit, under the title "Centre of Economic Research", in 1959. Its primary aims were the scientific study of the problems of the Greek economy, the encouragement of economic research and cooperation with other scientific institutions.

In 1964, the Centre acquired its present name and organizational structure, with the following additional objectives: first, the preparation of short, medium and long-term development plans, including plans for local and regional development as well as public investment plans, in accordance with guidelines laid down by the Government; second, the analysis of current developments in the Greek economy along with appropriate short and medium-term forecasts, the formulation of proposals for stabilization and development policies; and, third, the additional education of young economists, particularly in the fields of planning and economic development.

Today, KEPE is the largest economics research institute in Greece, focuses on applied research projects concerning the Greek economy and provides technical advice to the Greek government and the country's regional authorities on economic and social policy issues.

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PREFACE

The present study by Dr. Ioanna Reziti, researcher of the Centre of Planning and Economic Research, examines the market of milk and related products using price data for both farm and retail prices spanning almost a quarter of a century, from 1989 to 2014. The novel element in this study is the application to this important agricultural market of vertical price transmission analysis by using a threshold error correction autoregressive model. Such a model is especially suited for the analysis of a market that clearly displays elements of imperfect competition, which explains to a large extent the difference in the behavior of the time series for producer and consumer prices.

As with any econometric model, its use is as good as the theory behind it. Dr. Reziti is careful in providing a very good descriptive and informative background of the market for milk, the organization and situation of the producers/dairy farmers and the big milk companies who dominate the industry, as well as the regulatory background at the European level. She also compares dairy production in Greece and other EU countries.

Her economic analysis dictates the appropriate econometric tools to be used to answer the question of the oligopolistic nature of the market. By surveying the relevant literature she judges the advantages and methodological problems of various types of time-series analysis and she explains how and why the properties of time-series data can be used to ask the proper question about the behavior and the market power of economic agents. Some of the sections are quite technical –as they should be– but they are always based on good economic reasoning and characterized by a sound relevance and connection to its subject matter. The methodological non-linearity pursued is a result of a reasonable ex ante *assessment of what is happening in this market, so the fact that the null hypothesis of linear cointegration is rejected comes as no surprise to the reader.*

The study is structured in a way that the professional econometrician will observe a methodologically competent analysis, with many technical questions put and answered, while the econometrically less advanced economist, or indeed the policy maker, can get a good grasp of what is going on in the market.

This study is a welcome addition to KEPE's studies of the Greek economy that deals with an important subject and we hope that it will be studied closely by economists, interested citizens and policy-makers alike.

NICHOLAS THEOCARAKIS
Chairman of the Board
and Scientific Director

CENTRE OF PLANNING
AND ECONOMIC RESEARCH (KEPE)
June 2016

This study investigates the non-linear adjustment between the consumer and producer prices of milk in Greece using data for the period from January 1989 to August 2014. Through this period, the dairy industry underwent significant changes, resulting in the concentration of the pasteurized milk market. On the other hand, in the past five years, the number of dairy farms has decreased dramatically.

We give special attention to the time-series properties of the price data. In particular, vertical price transmission analysis has been examined by using a threshold error correction autoregressive model. The results reject the null hypothesis of linear cointegration in favour of a two-regime threshold cointegration model. A cointegrating relationship is expected only when the equilibrium consumer milk price is decreased more than 34.12% or the equilibrium relative markup is squeezed more than 58%.

The asymmetric price adjustment found in this study shows that relative markups higher than 58% seem to benefit dairy processing companies and retailers and hurt producers and consumers. As a result, farmers often see their prices remain stagnant while consumer prices rise. This has led farmer and consumer associations to accuse food processing and retail companies of abusing their market power to increase profit margins.

IOANNA N. REZITI

April 2016

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INTRODUCTION

The dairy processing industry is the third most important industry in the Greek food and drink processing sector and it is highly concentrated. In 2013, the three biggest dairy processing companies (DELTA 36.9%, OLYMPOS 15.9%, MEVGAL 11.1%) controlled about 64% of the fresh pasteurized milk market, and together with three smaller companies, SERGAL 4%, KOUKAKI FARM 2.4% and KRI KRI 1.2%, controlled about 72%.

In 2006, the Hellenic Competition Authority (HCA) fined seven dairy companies for price-fixing behaviour and anti-competitive practices (horizontal and vertical collusion to impose prices on producers and determine a single retail price for fresh pasteurized milk). The case resulted in a €77 million fine charged for forming a cartel in the milk market.

In 2013, the biggest dairy firm, DELTA, acquired the fourth biggest firm, MEVGAL, and since then they have controlled 48% of the fresh pasteurized milk market. During the period 2000-2008, consumer milk prices increased steadily, whereas cow milk producer prices remained relatively stable. The current increase in feed costs because of higher international grain prices (summer 2010) was almost exclusively absorbed by cow milk producers since producer and consumer prices remained unchanged. Note that, currently, the largest milk processing companies avoid increasing consumer prices for two main reasons: first, lower consumer demand due to the current economic crisis and, second, higher competition from cheaper private label milk. Furthermore, in an attempt to protect their markups these companies have tried to avoid increasing cow milk producer prices despite the higher production costs that cow milk producers faced because of increasing international grain prices. Thus, during 2009-2010, a large number of cow milk producers went out of business. However, farmers have limited bargaining power so that producer prices remain stagnant or decreased steeply, as in 2008-2009, implying that the price of milk is mainly determined by the industry.

During the period 2000-2008, cow milk producer prices remained stable whereas consumer milk prices increased steadily. As a result, the gap between retail and farm prices increased over time. The relationship between prices at different market levels has received considerable attention because it provides insights into market efficiency as well as consumer and farmer welfare distribution. The rising gap between retail and farm prices for agricultural and food markets has also motivated economists to perform empirical analyses of vertical price transmission, in various commodity markets. This gap is known as the marketing margin which represents the costs for all assembling, processing, transporting, marketing and retailing added to the farm products.

Based on a common perception that retail (farm) prices would not respond in the same manner for both increases and decreases in farm (retail) prices, a major issue in price transmission is to investigate whether retail prices react similarly to increases and decreases in farm prices, i.e. to test the symmetry of price transmission. More exactly, retailers tend to pass price increases to consumers more rapidly, whilst it takes longer for consumer prices to adjust to producer prices if the latter decrease. Price asymmetries could be negative or positive depending on its effect. A positive (negative) price asymmetry occurs when a decrease (increase) in prices at the farm level is not fully or immediately transmitted, but an increase (decrease) passes more quickly or fully on to the final consumer (Vavra and Goodwin 2005).

Numerous studies have examined asymmetric price transmission in different products, geographic areas and time periods. However, the majority of studies have focused on the meat market. These studies include an econometric model specification introduced by Wolffram (1971) and later refined by Houck (1977), the error correction model (von Cramon-Taubadel 1994, 1998) and models with a threshold (Balke and Fomby 1997; Goodwin and Holt 1999; Goodwin and Harper 2000; Goodwin and Pigott 2001; Abdulai 2002). Different versions of these models have been extensively used in analysing price transmission and testing for asymmetric adjustment, but there seems to be no specific accepted way of determining which is appropriate and under which setting. However, according to Meyer and von Cramon-

Taubadel (2004) different models remain incompatible with one another and may result in differences in inference and conclusions. Moreover, Frey and Manera (2007) asserted that no attempt has been made to address the issue concerning which of the various asymmetric price transmission models is most reliable or fits a given data set better, despite the numerous empirical researches undertaken. In effect, there has been very little basis for choosing between different methods.

Although most research tends to show that imperfect and asymmetric price transmission is linked to market power at the retail level (Peltzman 2000), product perishability (Ward 1982), adjustment and menu costs (Levy *et al.* 1997; Bailey and Brorsen 1989), search costs in local markets (Benson and Faminow 1985) and public intervention to support producer prices (Kinnucan and Forker 1987), the empirical evidence shows that these findings often remain mixed and vary widely across markets and countries. As indicated by Peltzman (2000), asymmetric price transmission is the rule rather than the exception, and much scholarly work has revealed that asymmetric price transmissions are quite common, especially in agriculture.

The aim of this study is to investigate the asymmetries in the price transmission mechanism between retail and farm marketing channels in the Greek fresh pasteurized milk market by using a Threshold Vector Error Correction Model (TVECM). This approach is a special type of error correction model in which deviations from the long-run equilibrium price relationship lead to price responses only if they exceed a specific threshold level. Thus, TVECMs allow for the existence of an inactive band of price combinations in which there is no response to deviations from the long-run equilibrium. The present study is the first attempt to analyse price transmission between producer and consumer prices in the Greek milk market. Studies such as Fotopoulos (1995) and Vakrou *et al.* (1997) examined marketing issues related to the Greek milk and cheese markets, respectively, whereas those by Ananiadis *et al.* (2003) and Tsakistara *et al.* (2008) investigated competitiveness and market power in the Greek dairy and milk markets, respectively. Regarding the Greek bibliography, the paper by Rezitis and Stavropoulos (2011) is the only study which applied the TVECM to the broiler sector.

TVECMs are a relatively recent addition to the techniques for estimating asymmetric price transmission and, to our knowledge, until now only two studies, i.e. Serra and Goodwin (2003) and Fernández-Amador *et al.* (2010), have applied this approach to the dairy market. In particular, Serra and Goodwin (2003) examined the price relationship and patterns of price transmission among farm and retail markets for a variety of dairy products in Spain, whereas Fernández-Amador *et al.* (2010) investigated the role of asymmetries in the price transmission mechanism for milk products in Austria. The results of both studies suggest that asymmetries are important in the pass-through price process and provide evidence that adjustment tends to take place only when deviations from the equilibrium are large enough. Several empirical studies, however, have applied the TVECM approach to other agricultural commodity markets. Such studies include Goodwin and Holt (1999) investigating the beef price relationship at farm, wholesale and retail levels; Goodwin and Harper (2000) studying hog price relationships; Abdulai (2002) modelling Swiss pork prices; Ben-Kaabia *et al.* (2005) investigating the poultry marketing chain in Spain; and Ben-Kaabia and Gil (2007) studying vertically related prices in the Spanish lamb market.

Several international studies have examined farm retail price relationships in global dairy markets using various econometric models and most of them find evidence for asymmetric price transmission. For example, Carman (1998) estimates retail price response equations for three California market areas using Houck's (1977) model; Lass (2005) uses the approach of Kinnucan and Forker (1987) to analyze retail price responses to farm price changes in Boston, Massachusetts and Hartford, Connecticut; Capps and Sherwell (2007) use Houck's (1977) approach and von Cramon-Taubadel (1998) and von Cramon-Taubadel and Loy (1999) employ an error correction model approach to detect asymmetry in the retail price transmission of fluid milk; Bakucs and Fertő (2008) use Gregory and Hansen's (1996) approach to examine price transmission in the Hungarian milk market; and Tekgüç (2013) employs Threshold Autoregressive and Moment Threshold Autoregressive tests to examine price transmission in Turkey's fluid milk market.

The study is organized as follows. Chapter 1 discusses the main characteristics of the Greek milk market. Chapter 2 presents the EU dairy policy, looking in particular at the different CAP instruments. Chapter 3 analyses the theoretical background of price transmission. Chapter 4 discusses the empirical analysis and, finally, some conclusions and policy recommendations are provided in Chapter 5.

CHAPTER 1

THE MAIN CHARACTERISTICS OF THE GREEK MILK MARKET

1.1. Trends in milk production

Cow milk production in Greece (655,771 tons in 2011-2012) represents only 2.3% of the total production in the European Union-27. However, it is considered an essential agricultural activity, since it makes up 13% of the total Greek agricultural production.

Dairy farming in our country is based on a small population of dairy cows; but is an extremely developed branch of livestock production, since its contribution to the value of the livestock production adds up to 20%. Dairy cows numbered 130 thousand heads in 2011, a fall of 10% (from144 thousand heads) when compared to 2010. The majority of dairy farms (93.4%) has up to 30 cows, 1.8% from 50 to 100 cows and only 0.7% has more than 100 cows.

Data from the Hellenic Organization of Milk and Meat (ELOGAK) show that milk production in the period 2000 to 2011 took its highest value in 2005 (Figure 1.1). Since then and up to 2011, milk production decreased by 78%. Specifically, in 2011/12, national production (655,771 tons) did not meet the national quota (862,282 tons).

After Luxemburg, Greece is the country with the fewest dairy farmers (0.6% of the total EU-25). During the period 2000-2011 the number of Greek dairy farmers decreased extensively by an average rate of 66%, as 8,527 dairy farmers abandoned farming. This was the result of the high cost of production and the low prices of the producers. For the dairy production period of 2013/14, the number of active dairy farmers was just 3,555 while it was 12,042 in 2000.[1]

[1] Data from ELOGAK Tables: Evolution of dairy farmers, production of cow milk and quotas 2000-2009 and 2003-2012. Magazine: *Agriculture-Livestock* (22.9.2006), www.agrotypos.gr.

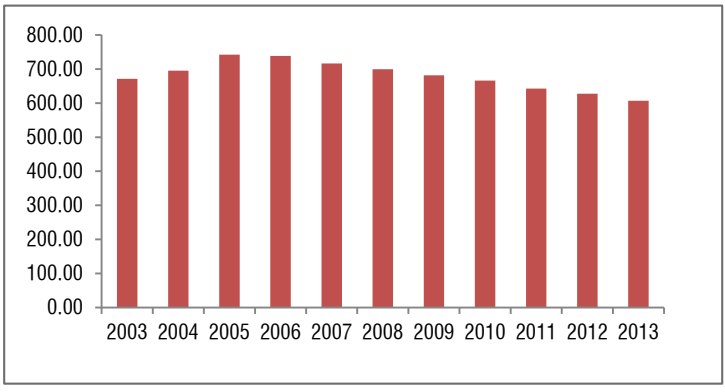
There is a substantial amount of concentration in milk production in several parts of the country. As seen in Table 1.1, approximately 70% of Greek milk is produced in Macedonia and Thrace, 15% in Thessaly and 3% in the region of Epirus.

TABLE 1.1
Farmers and milk production distribution per region (2013/2014)

Region	Farmers	%	Production	%
Attica	23	0.65	8,715	1.42
North Aegean	43	1.21	1,593	0.26
West Greece	176	4.95	18,424	3.00
Epirus	152	4.27	16,641	2.71
Thessaly	287	8.07	94,862	15.47
Ionian Islands	3	0.08	112,683	18.37
Crete	6	0.17	137,781	22.46
East Macedonia and Thrace	555	15.61	102,272	16.67
West Macedonia	554	15.58	26,372	4.29
Central Macedonia	1,206	33.92	296,006	48.26
South Aegean	458	12.88	16,527	2.69
Peloponnese	12	0.34	4,138	0.67
Central Greece	80	2.25	27,515	4.48
Total	3,555	100.00	613,318	100.00

Source: ELOGAK (Hellenic Organization of Milk and Meat).

FIGURE 1.1
Evolution of milk production (in tons)



Source: ELOGAK (Hellenic Organization of Milk and Meat).

During the production period 2013/14, there were 3,555 thousand farmers and most were small-size farmers. Specifically, 91% of farmers deliver annually less than 500 tons of cow's milk while their total deliveries represent 48% of the total deliveries (Table 1.2).

Lately, there has been a great cooperative coalition in the milk sector. According to the Pan-Hellenic Confederation of Unions of Agricultural Co-operatives (PASEGES) figures, in 2009 there were six cooperative organizations (DODONI [5%], NEOGAL [2.5%], TRIKKI [2.2%], PROTO [1.6%], EVOL [1.5%], Cooperative of LAMIA [0.8%]) in Greece which gather and process cow milk and account for 13.6% of the total domestic production yearly.

TABLE 1.2
Dairy farmer distribution according to deliveries (2013/14)

Yearly production	Dairy farmers	%	Deliveries	%
< 10 tons	692	19	2,972.848	0
10-50 tons	1,163	33	29,715.867	5
50-100 tons	422	12	30,387.975	5
100-200 tons	419	12	60,842.059	10
200-500 tons	548	15	173,981.540	28
500-1000 tons	210	6	143,387.260	23
>1000 tons	101	3	172,030.673	28
Total	3,555	100	613,318.222	100

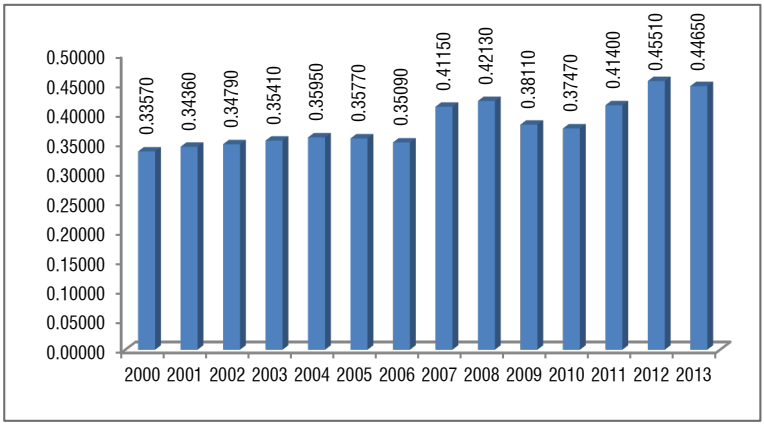
Source: ELOGAK.

1.2. Producer price evolution

In Figure 1.2, the average Greek producer price of milk is presented over the period 2000-2013. From the figure we observe that from 2000 to 2006 the producer price was stable at approximately 0.35 euro/lt. After this stability, in 2007, there was an increase of 17% in relation to 2006 and then a further increase of 2.4% in 2008 compared to 2007. In 2008, prices reached a record high of 0.4213 euro/lt. In 2009 a milk crisis took place where producer prices decreased by 9.5% compared to 2008 due to the price reduction of fresh pasteurized milk initiated by the company DELTA. Consequently, those reductions were followed by most large dairies and small cooperatives. In 2010, milk prices reached the lowest value over the last six years. However,

at the end of 2010 prices started to increase and, in 2012, prices increased by 21%. Correspondingly, the production of milk in January 2012 was 54,821 tons, while in December 2012 it was 49,731 tons, a decrease of 9%.

FIGURE 1.2
Development of the milk price received by dairy farmers, euro/lt (2000-2013)

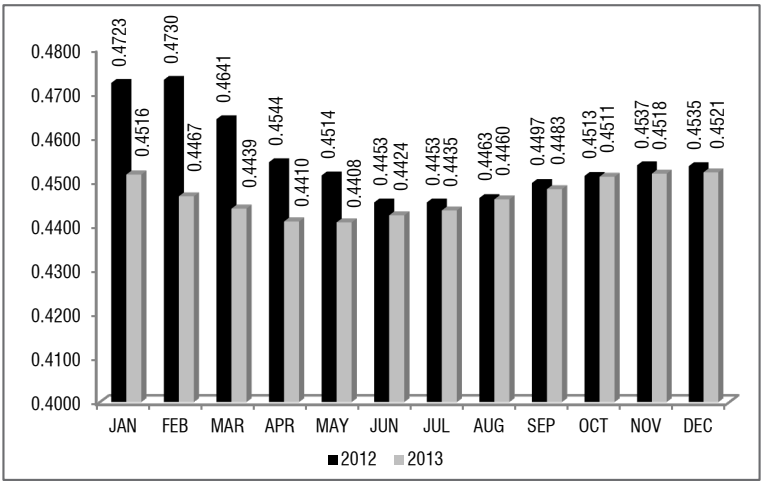


Source: ELOGAK.

Over the first seven months of 2012 the average rate of increase in the producer price of milk was 10.5% with the highest increase of 18% in January 2012 (Figure 1.3). However, in 2013 the price remained stable at €0.44 over eight months and the last three months increased to €0.45. Comparatively, prices in 2013 were lower than prices in 2012 (Figure 1.3). Data capture the trend of dairy farmers abandoning farming due to financial problems in relation to the high prices of feeding stuffs, bad weather and the lack of liquidity in the entire industry.

There was an increase at the beginning of 2012, with a decline (6%) during the first six months. This is mainly due to a decrease in Greek production by 4%. According to ELOGAK, the greatest increase (18%) in price happened in January 2012. Market sources mention that if this increase is kept, the industries will not have much room to absorb the increases. As a result, there will be an increase in retail prices.

FIGURE1.3
Evolution of the average producer prices per month (euro/lt)



Source: ELOGAK.

According to the president of the Association of Farmers, the increase in prices in 2012 is due to two more factors. First is the decline in the quantity of cow milk that is imported into our country, either because it is expensive on the European market or because of the lack of trust towards Greece, due to the economic crisis and the lack of liquidity. Therefore, the European Union exporters no longer trust that they will be paid on deferred settlement terms. That is, while in the past the dairy companies paid three months after the takeover of the product, now the exporters demand to be paid before the tankers load. The second reason is that since September 2011, Friesland Hellas began to gather Greek milk for bottling high-temperature pasteurized milk for their brand NOYNOY Family, which until now was done with imported milk.

The EU-27 weighted average farm gate milk price was at 0.3128 euro/lt for August 2012 (which dropped 9% in a year), which is much lower than the Greek price (0.4479 euro/lt) (Table 1.3). However, it is 30% above the price seen in May 2009 at the height of the EU dairy

crisis.[2] Most of the EU member states have faced price decreases. According to European Commission figures, the falling prices came as milk production increased by 3% across the EU, by 10% in New Zealand, 5% in Australia and 4% in the USA.

TABLE 1.3
EU-27 farm gate milk prices (euro/100kg)

	August 2011	August 2012	Difference in %
Cyprus	50.91	51.83	+2
Malta	48.90	50.38	+3
Finland	45.66	45.86	+0,4
Greece	**44.31**	**44.79**	**+1**
Sweden	36.75	35.65	-3
Italy	38.80	35.39	-9
United Kingdom	30.55	32.87	+8
France	35.64	32.11	-10
Netherlands	37.25	32.00	-14
Denmark	36.50	32.00	-12
Austria	34.60	30.66	-11
Ireland	34.57	29.72	-14
Germany	34.73	29.71	-14
Spain	30.87	29.32	-5
Portugal	30.69	29.27	-5
Bulgaria	32.20	28.58	-11
Hungary	31.13	28.45	-9
Poland	29.13	28.19	-3
Slovenia	30.24	28.11	-7
Belgium	32.35	28.03	-13
Luxembourg	32.72	28.01	-14
Czech Republic	33.16	27.51	-17
Estonia	32.49	27.37	-16
Slovakia	31.58	27.24	-14
Latvia	28.67	25.00	-13
Romania	32.20	24.79	-23
Lithuania	26.23	22.34	-15
Average EU-10	32.62	29.56	-9
Average EU-15	35.73	33.03	-7
Weighted Average EU-27	34.39	31.28	-9

Sources: European Commission, DG Agriculture.

[2] A sharp drop in the price paid to milk producers in April 2009 introduced the milk crisis in the EU and worldwide. This has led to demonstrations amongst aggravated European dairy farmers and the European Commission to reflect on the function of the supply chain through a High Level Expert Group on milk.

The prices which milk producers receive from the dairy industries is a sensitive issue for the producers as most of the time the producers are affected by the low prices industries offer producers with respect to the retail price of the product. The lack of agreement and organization of producers into groups and the agreements among the dairy industries in terms of the price offered to producers aggravate the position of producers and favour the dairy industries as they increase profit margins. Since 2010, there has been an interesting development in the field of livestock. Sixty-five cattle raisers from Thessalia and Pieria established the first Producer Group of Cattle Farmers in Greece, named "THESgala", with the aim of negotiating the price of milk with the dairy industries. Through vending machines the group provides consumers in Larissa and Thessalonica local fresh pasteurized milk from the Association of cow breeders of Thessalia and Pieria. It is the first time in Greece where the milk goes directly from production to consumption at a low price.

A new cooperative of cattle farmers from Central and Eastern Macedonia and Thrace was formed in January 2013 called *Supplying Dairy Cattle Cooperative Greek Macedonia–Thrace* in order to defend the interests of milk producers and members of domestic milk production against pressures from dairy companies.

1.3. The Greek dairy industry

The food industry covers 21% of the total Greek production and dairy products account for 5% of the total economy. In addition, dairy products contribute 17% of the total imports. The dairy industry is the third most important industry, which consists of some of the largest industries in the area of food in the country.

The main feature of this industry is defining the domestic primary production of cow milk from the community system of quotas (national quota of 2012: 870,900 thousand tons), which will be removed in 2015 by a decision of the Council of Agriculture Ministers of the European Union. The total domestic production of fresh pasteurized milk is given in Table 1.4 where a decrease is noticed since 2006.

TABLE 1.4
Total production of fresh pasteurized milk (in tonnes)

	Fresh pasteurized milk	%
1998	385,000	-
1999	395,000	2.60
2000	405,000	2.53
2001	410,100	1.26
2002	456,469	11.31
2003	403,199	8.05
2004	505,000	2.39
2005	508,000	0.59
2006	490,000	-3.54
2007	411,234	-16.07
2008	396,633	-3.55
2009	392,780	-0.97
2010	381,896	-2.77
2011	367,906	-3.66
2012	354,000	-3.78

Sources: ICAP (2013), ELOGAK (2007-2011), Ministry of Rural Development and Food.

In the milk market there has been a noticeable increase in the concentration rate, even though a large number of businesses have become active. The three biggest dairy companies make up 64% of the market in fresh pasteurized milk. Specifically, according to IRI figures, DELTA increased its share in 2013 to 36.9% from 29.4% in 2012, OLYMPOS increased its share to 15.9% in 2013 from 14.5% in 2012, and MEVGAL to 11.1% from 14.9%. Small dairy companies have increased their share such as SERGAL from 2.7% in 2012 to 4% in 2013, KOUKAKI FARM from 1.5% in 2012 to 2.4% in 2013 and KRI KRI from 1% in 2012 to 1.2% in 2013.

In 2006, DELTA was merged by VIVARTIA, which had a leading role in the food market (over 31% market share). In 2010, DELTA (100% subsidiary of VIVARTIA) bought 14.8% of MEVGAL for €196 million. Also a preconcert of redemption was signed for the purchase of 43% of MEVGAL for €57 million. It is expected that there may be a consent of redemption from the Competition Commission, activation

of the preconcert of redemption and opening of the process of a merger between DELTA and MEVGAL lasting for about 2 years. Ultimately, VIVARTIA will control 57.8% of MEVGAL. The new company will hold a leading position in the Dairy Industry in Greece (DELTA a leading role in Southern Greece and MEVGAL in Macedonia), thus controlling 33% of the milk market and 24% of the yoghurt market. In 2007, seventeen companies were accused by the Competition Commission of organizing a milk cartel (they had agreed on exercising total control of the prices of milk on the market). Amongst these companies were those of VIVARTIA, MEVGAL, FAGE, NESTLE and OLYMPOS. Finally, VIVARTIA holds the record for the highest fine imposed on a company (€16.1 million), while MEVGAL holds second place with €13.3 million.

In Greece in 2006, the Competition Commission sanctioned infringements relating to the manufacture and distribution of milk and dairy products based on raw cow milk: price fixing, allocation of sources of supply, exchange of information, coordination of discount policies. Additional infringements that were also sanctioned related to vertical agreements to set minimum resale prices, as well as between dairy companies and supermarkets for fixing minimum retail prices.

The financial crisis which manifested itself in the second half of 2008 has limited the demand for dairy products. According to ICAP (2011),[3] the sales of fresh milk in 2008 fell to 2.7% in contrast to 2007, while sales in 2009 increased slightly, by 0.5% in relation to 2008 and decreased by 1.4% in 2010 compared to 2009.

In the beginning of 2009, due to the increase in the prices of fresh milk, consumer demand was reduced. This directly resulted in the fall of sales in branded milk products. The high prices, mostly of fresh milk, had a negative consequence for dairy companies: that the consumers turned to private label products. The reaction was direct. The large companies reduced their prices and, unavoidably, so did the average and small companies.

Furthermore, according to ICAP's information, in 2011 the sales of milk fell by 1.2% and those of other dairy products fell by 4% in relation to the corresponding period of the previous year. This bending of consumption was due to the significant reduction in disposable family

[3] Dairy Products (December, 2011) Table 4.2, page 73.

income. According to a recent survey of ICAP, the average annual growth rate of the total domestic consumption of milk over the period of 1999-2009 amounted to 3.4%.

In spite of this, fresh pasteurized milk still remains the main category of milk since the percentage of total consumption was 42.9% in 2009 (44.4% in 2008). On the contrary, high-temperature pasteurized milk significantly increased its market share and, in 2012, controlled 30.8% of the overall market (25.8% in 2008) (Table 1.5).

TABLE 1.5
Total domestic market of different types of milk

Quantity in thousand tons										
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fresh pasteurized	493	505	508	490	411	397	393	382	368	354
Condensed	274	263	242	244	222	256	252	242	231	217
High-pasteurized	74	85	90	149	196	235	248	255	260	265
Long-life	22	21	21	20	19	24	24	28	24	23
Total	**862**	**874**	**861**	**903**	**848**	**911**	**917**	**907**	**883**	**859**
Percentage										
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fresh pasteurized	57,2	57,8	59	54,3	48,5	43,5	42,8	42,1	41,7	41,2
Condensed	31,7	30,1	28,1	27,0	26,2	28,1	27,5	26,7	26,2	25,3
High-pasteurized	8,6	9,7	10,5	16,5	23,1	25,8	27,1	28,1	29,4	30,8
Long-life	2,5	2,4	2,4	2,2	2,2	2,6	2,6	3,0	2,7	2,7
Total	100	100	100	100	100	100	100	100	100	100

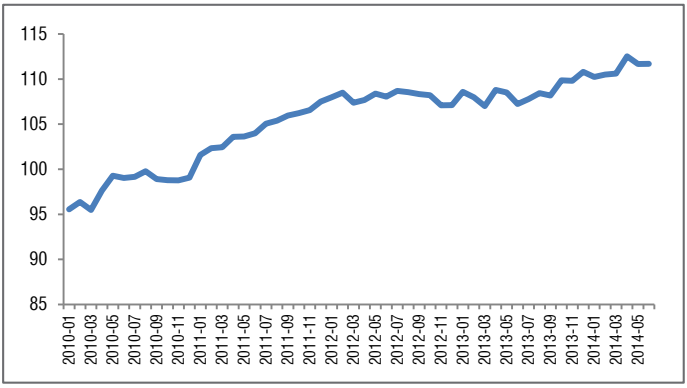
Source: ICAP (2013).

Market factors stress that milk is essential and cannot, even during these difficult times, be eliminated as part of a daily diet. Indicative are the data of the Hellenic Statistical Authority, according to which, in 2008, Greek households spent €30.99 on average for dairy products each month, an amount corresponding to about 9.5% of total monthly expenditures for food purchases.

The evolution of the milk consumer price index from January 2010 is presented in Figure 1.4. During the period January 2010 to January 2012 the consumer price index initially increased by 13% and then started to stabilize and slowly decline. This increase is higher than the

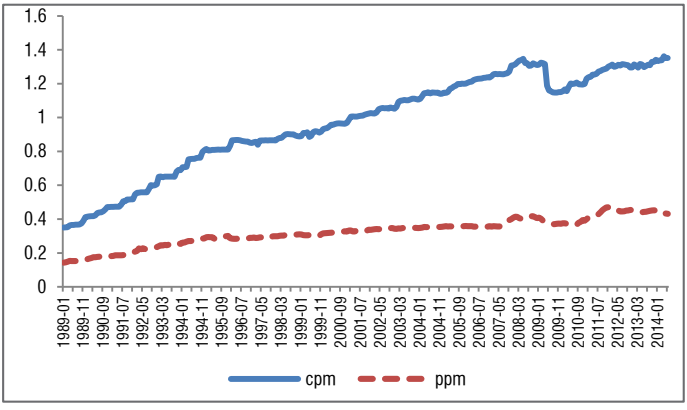
increase of the consumer price index of food and non-alcoholic beverages (5%) over the same period. The evolution of consumer and producer prices during the estimated period is depicted in Figure 1.5, where the increasing gap between the two prices is obvious. Even though producer prices remained stable over the last three years, consumer prices were increasing.

FIGURE 1.4
Consumer price index for fresh pasteurized milk



Source: Hellenic Statistical Authority (ELSTAT).

FIGURE 1.5
Consumer and producer prices of milk



Source: Own calculations.

Table 1.6 presents calculation results of the average producer-consumer price gap for milk between January 2011 and June 2014. During this period the relative price margin (RMU) increased, ranging from 63% to 68% and the absolute markup (AMU) from 83% to 92%. Between the EU member states, the relative price margin ranges from 25% in Ireland to 60% in the Czech Republic.

According to Eurostat figures, Greece is among the most expensive countries in the European Union in dairy products. Specifically, the average price per litre of milk in Greece is €1.50 whereas it is €0.89 in Germany and the Netherlands, €0.99 in Austria, Belgium and Spain and €1.29 in Italy. The Deputy Minister of Rural Development and Food maintains that if the expiration date of milk in shops is extended from five to seven days, the price will fall by at least 5%.[4] However, the farmers' association and milk producers maintain that extending the expiry date of milk and dairy products will have disastrous consequences for hundreds of thousands of small farmers and their families who support the industry.

TABLE 1.6
Producer-consumer milk prices and margins
January 1989-August 2014

	ppm	cpm	AMU	RMU
1989-01	0.143326	0.350697	0.207371	0.591312
1989-02	0.144582	0.351404	0.206822	0.588558
1989-03	0.148257	0.352466	0.204209	0.579373
1989-04	0.153703	0.362257	0.208553	0.575706
1989-05	0.152221	0.365914	0.213693	0.583998
1989-06	0.152156	0.365088	0.212931	0.583233
1989-07	0.152382	0.367329	0.214947	0.585162
1989-08	0.15235	0.367565	0.215215	0.585516
1989-09	0.153832	0.368037	0.214204	0.582019
1989-10	0.157668	0.374761	0.217093	0.579284
1989-11	0.158054	0.390685	0.232631	0.595443
1989-12	0.16218	0.412272	0.250092	0.606619
1990-01	0.163953	0.414867	0.250915	0.604807

[4] See "A facade the reduction of prices from the extending the expiry date of milk" *Agronews* 2/12/13 (in Greek).

TABLE 1.6 (continued)

	ppm	cpm	AMU	RMU
1990-02	0.167852	0.416754	0.248902	0.597239
1990-03	0.170624	0.417108	0.246484	0.590936
1990-04	0.174975	0.417462	0.242487	0.58086
1990-05	0.175072	0.422063	0.246991	0.5852
1990-06	0.176909	0.4361	0.259191	0.594339
1990-07	0.178198	0.439049	0.260851	0.594127
1990-08	0.178069	0.440111	0.262042	0.595399
1990-09	0.177586	0.446598	0.269013	0.602359
1990-10	0.17881	0.457215	0.278405	0.608914
1990-11	0.183742	0.47137	0.287629	0.610197
1990-12	0.183742	0.471842	0.2881	0.610587
1991-01	0.181614	0.472314	0.290699	0.615479
1991-02	0.182227	0.472314	0.290087	0.614183
1991-03	0.186546	0.472904	0.286358	0.605532
1991-04	0.18661	0.473493	0.286883	0.605887
1991-05	0.18661	0.473493	0.286883	0.605887
1991-06	0.186191	0.484818	0.298627	0.615957
1991-07	0.187738	0.505225	0.317487	0.628407
1991-08	0.191735	0.505815	0.31408	0.620939
1991-09	0.194442	0.515723	0.321282	0.622973
1991-10	0.198696	0.515605	0.316909	0.614635
1991-11	0.198277	0.516313	0.318036	0.615975
1991-12	0.199502	0.516313	0.316811	0.613603
1992-01	0.208494	0.546275	0.337781	0.618335
1992-02	0.211588	0.555358	0.34377	0.619006
1992-03	0.226543	0.556656	0.330113	0.593029
1992-04	0.222611	0.558425	0.335814	0.60136
1992-05	0.228315	0.558425	0.33011	0.591144
1992-06	0.223513	0.558425	0.334912	0.599744
1992-07	0.228219	0.558779	0.33056	0.591576
1992-08	0.231248	0.577181	0.345933	0.599349
1992-09	0.233182	0.600537	0.367355	0.611711
1992-10	0.234278	0.597706	0.363428	0.608038
1992-11	0.234826	0.599711	0.364886	0.608435
1992-12	0.234826	0.605609	0.370784	0.612249
1993-01	0.24053	0.65008	0.40955	0.629999
1993-02	0.245494	0.65185	0.406356	0.623389
1993-03	0.243689	0.647249	0.40356	0.623501
1993-04	0.247331	0.650906	0.403575	0.620021

TABLE 1.6 (continued)

	ppm	cpm	AMU	RMU
1993-05	0.245816	0.650906	0.40509	0.622348
1993-06	0.2492	0.65067	0.40147	0.61701
1993-07	0.247041	0.65067	0.403629	0.620329
1993-08	0.246718	0.650906	0.404188	0.620962
1993-09	0.246718	0.650316	0.403598	0.620618
1993-10	0.247782	0.68134	0.433558	0.636331
1993-11	0.256806	0.691013	0.434206	0.628362
1993-12	0.25339	0.688536	0.435146	0.631987
1994-01	0.260738	0.706348	0.445609	0.630864
1994-02	0.262156	0.706466	0.444309	0.628918
1994-03	0.267023	0.708589	0.441566	0.623162
1994-04	0.270278	0.753414	0.483135	0.641262
1994-05	0.270214	0.755301	0.485087	0.642244
1994-06	0.271664	0.756009	0.484345	0.64066
1994-07	0.272696	0.756009	0.483313	0.639296
1994-08	0.275016	0.761081	0.486065	0.638651
1994-09	0.282977	0.762733	0.479756	0.628996
1994-10	0.283944	0.762733	0.478789	0.627728
1994-11	0.28591	0.796587	0.510678	0.641082
1994-12	0.286039	0.80685	0.520811	0.645487
1995-01	0.293484	0.814517	0.521034	0.639684
1995-02	0.29458	0.804845	0.510265	0.633992
1995-03	0.293258	0.806378	0.51312	0.636327
1995-04	0.293129	0.808501	0.515372	0.637441
1995-05	0.284427	0.808501	0.524074	0.648204
1995-06	0.28823	0.809799	0.521569	0.644072
1995-07	0.2862	0.810507	0.524307	0.646888
1995-08	0.287586	0.809917	0.522331	0.644919
1995-09	0.294128	0.811214	0.517086	0.637422
1995-10	0.299704	0.811096	0.511392	0.630495
1995-11	0.299188	0.810861	0.511672	0.631024
1995-12	0.300993	0.810625	0.509631	0.62869
1996-01	0.287038	0.833627	0.546589	0.655676
1996-02	0.284814	0.86524	0.580426	0.670827
1996-03	0.283718	0.866774	0.583056	0.672673
1996-04	0.283364	0.867246	0.583882	0.67326
1996-05	0.285007	0.867364	0.582356	0.67141
1996-06	0.283428	0.865594	0.582166	0.672562
1996-07	0.285878	0.862173	0.576296	0.668422

TABLE 1.6 (continued)

	ppm	cpm	AMU	RMU
1996-08	0.286329	0.860286	0.573957	0.66717
1996-09	0.284556	0.857927	0.573371	0.668321
1996-10	0.285684	0.857691	0.572007	0.666915
1996-11	0.289681	0.851675	0.561994	0.659869
1996-12	0.289842	0.849198	0.559356	0.658688
1997-01	0.291485	0.854152	0.562667	0.658743
1997-02	0.288649	0.856747	0.568098	0.663087
1997-03	0.289713	0.838817	0.549104	0.654617
1997-04	0.291872	0.864061	0.572189	0.662209
1997-05	0.292162	0.864769	0.572606	0.66215
1997-06	0.291776	0.864769	0.572993	0.662597
1997-07	0.294515	0.865712	0.571197	0.6598
1997-08	0.29632	0.864651	0.568331	0.657295
1997-09	0.303185	0.865948	0.562763	0.649881
1997-10	0.29719	0.86583	0.56864	0.656757
1997-11	0.298544	0.86583	0.567286	0.655194
1997-12	0.29864	0.864769	0.566128	0.654658
1998-01	0.299188	0.873969	0.574781	0.657667
1998-02	0.301896	0.878688	0.576792	0.656424
1998-03	0.302315	0.879985	0.577671	0.656455
1998-04	0.30254	0.891546	0.589005	0.660656
1998-05	0.30644	0.900746	0.594306	0.659793
1998-06	0.307471	0.90228	0.594809	0.659228
1998-07	0.307665	0.901572	0.593907	0.658746
1998-08	0.307439	0.900746	0.593307	0.658684
1998-09	0.308052	0.900157	0.592105	0.65778
1998-10	0.307955	0.893905	0.58595	0.655495
1998-11	0.309341	0.890484	0.581143	0.652615
1998-12	0.309728	0.888125	0.578397	0.651257
1999-01	0.309276	0.890484	0.581208	0.652687
1999-02	0.305248	0.908886	0.603638	0.664152
1999-03	0.304377	0.908414	0.604037	0.664935
1999-04	0.304345	0.912778	0.608433	0.666573
1999-05	0.305828	0.885648	0.57982	0.654685
1999-06	0.306376	0.892371	0.585996	0.656672
1999-07	0.3076	0.913958	0.606358	0.663442
1999-08	0.306118	0.919148	0.613031	0.666955
1999-09	0.302863	0.917497	0.614634	0.669903
1999-10	0.300864	0.911363	0.610499	0.669874

TABLE 1.6 (continued)

	ppm	cpm	AMU	RMU
1999-11	0.310146	0.917143	0.606996	0.661834
1999-12	0.316012	0.931534	0.615522	0.660761
2000-01	0.316367	0.935899	0.619532	0.661965
2000-2	0.318139	0.937668	0.619529	0.660712
2000-03	0.318268	0.945925	0.627657	0.663538
2000-04	0.31988	0.95725	0.63737	0.665834
2000-05	0.320621	0.956896	0.636275	0.664936
2000-06	0.322007	0.96244	0.640433	0.665426
2000-07	0.323328	0.965153	0.641824	0.664998
2000-08	0.322974	0.965389	0.642415	0.665447
2000-09	0.325198	0.965153	0.639955	0.663061
2000-10	0.325875	0.964327	0.638453	0.662071
2000-11	0.32826	0.962676	0.634416	0.659013
2000-12	0.326648	0.96881	0.642162	0.662836
2001-01	0.33274	0.98674	0.654	0.662789
2001-02	0.332675	1.005142	0.672466	0.669027
2001-03	0.327228	1.006911	0.679683	0.675018
2001-04	0.327228	1.005731	0.678503	0.674637
2001-05	0.334254	1.005613	0.671359	0.667612
2001-06	0.331773	1.008562	0.67679	0.671044
2001-07	0.334867	1.010332	0.675465	0.668558
2001-08	0.33419	1.010804	0.676614	0.669382
2001-09	0.331386	1.016702	0.685316	0.674058
2001-10	0.331515	1.020712	0.689198	0.675212
2001-11	0.337187	1.023897	0.68671	0.670683
2001-12	0.336736	1.026492	0.689756	0.671955
2002-01	0.338895	1.024015	0.68512	0.669052
2002-02	0.3407	1.023189	0.682489	0.667021
2002-03	0.341474	1.030267	0.688793	0.668558
2002-04	0.340797	1.048905	0.708108	0.675093
2002-05	0.341828	1.053387	0.711559	0.675496
2002-06	0.338992	1.057044	0.718052	0.679302
2002-07	0.343794	1.054449	0.710655	0.673958
2002-08	0.343794	1.055275	0.71148	0.674213
2002-09	0.347146	1.05268	0.705533	0.670226
2002-10	0.347468	1.059875	0.712407	0.672161
2002-11	0.347243	1.055982	0.70874	0.671166
2002-12	0.343504	1.05209	0.708586	0.673503
2003-01	0.342215	1.062706	0.720491	0.677978

TABLE 1.6 (continued)

	ppm	cpm	AMU	RMU
2003-02	0.345631	1.092786	0.747155	0.683715
2003-03	0.344632	1.099038	0.754406	0.686424
2003-04	0.347372	1.101397	0.754025	0.684608
2003-05	0.347694	1.103403	0.755709	0.684889
2003-06	0.346663	1.102105	0.755442	0.685454
2003-07	0.347468	1.102223	0.754755	0.684757
2003-08	0.348339	1.106588	0.758249	0.685214
2003-09	0.347855	1.111424	0.763569	0.687018
2003-10	0.34879	1.111542	0.762752	0.686211
2003-11	0.347823	1.108239	0.760416	0.686148
2003-12	0.347501	1.105762	0.758261	0.685736
2004-01	0.348081	1.110716	0.762635	0.686616
2004-02	0.349467	1.126523	0.777056	0.689783
2004-03	0.353818	1.143273	0.789456	0.690522
2004-04	0.352496	1.145632	0.793136	0.692313
2004-05	0.352883	1.149525	0.796642	0.693018
2004-06	0.352883	1.142919	0.790036	0.691244
2004-07	0.352786	1.147992	0.795205	0.692693
2004-08	0.35298	1.147756	0.794776	0.692461
2004-09	0.353528	1.146812	0.793284	0.69173
2004-10	0.353495	1.14693	0.793435	0.69179
2004-11	0.353882	1.139381	0.785498	0.689408
2004-12	0.354559	1.14115	0.786591	0.689297
2005-01	0.356622	1.14693	0.790308	0.689064
2005-02	0.358556	1.145397	0.786841	0.68696
2005-03	0.356235	1.151059	0.794824	0.690515
2005-04	0.357427	1.169107	0.811679	0.694273
2005-05	0.356461	1.175005	0.818544	0.69663
2005-06	0.355171	1.183734	0.828562	0.699957
2005-07	0.356751	1.187862	0.831112	0.69967
2005-08	0.357879	1.198715	0.840836	0.701448
2005-09	0.356815	1.197653	0.840838	0.702071
2005-10	0.356557	1.200012	0.843455	0.702872
2005-11	0.358072	1.199187	0.841114	0.701404
2005-12	0.359587	1.200602	0.841015	0.700495
2006-01	0.35804	1.206028	0.847988	0.703125
2006-02	0.358684	1.210511	0.851826	0.703692
2006-03	0.35833	1.212044	0.853714	0.704359
2006-04	0.355977	1.221599	0.865622	0.708597

TABLE 1.6 (continued)

	ppm	cpm	AMU	RMU
2006-05	0.355945	1.22561	0.869665	0.709577
2006-06	0.354333	1.229031	0.874697	0.711697
2006-07	0.353914	1.229502	0.875588	0.712148
2006-08	0.355139	1.230446	0.875307	0.711374
2006-09	0.355139	1.234339	0.8792	0.712284
2006-10	0.354881	1.235047	0.880165	0.712658
2006-11	0.355655	1.238231	0.882577	0.712772
2006-12	0.358459	1.236698	0.878239	0.710148
2007-01	0.355784	1.243658	0.887874	0.713921
2007-02	0.35833	1.25569	0.89736	0.714635
2007-03	0.357524	1.258403	0.900879	0.715891
2007-04	0.356461	1.256515	0.900055	0.71631
2007-05	0.356686	1.256633	0.899947	0.716157
2007-06	0.360715	1.256397	0.895683	0.712897
2007-07	0.366226	1.255454	0.889228	0.708292
2007-08	0.371899	1.258993	0.887094	0.704606
2007-09	0.378538	1.262177	0.88364	0.700091
2007-10	0.393944	1.271378	0.877435	0.690144
2007-11	0.400261	1.307474	0.907214	0.693867
2007-12	0.408125	1.308654	0.900529	0.688134
2008-01	0.414506	1.314906	0.9004	0.684764
2008-02	0.412959	1.325994	0.913035	0.688566
2008-03	0.40574	1.336375	0.930635	0.696388
2008-04	0.40184	1.338852	0.937012	0.699862
2008-05	0.40458	1.346873	0.942294	0.699616
2008-06	0.405514	1.322573	0.917059	0.69339
2008-07	0.404999	1.319978	0.91498	0.693178
2008-08	0.41441	1.304879	0.89047	0.682415
2008-09	0.416988	1.307238	0.89025	0.681016
2008-10	0.416666	1.319978	0.903312	0.684339
2008-11	0.411316	1.314434	0.903118	0.687078
2008-12	0.406062	1.309598	0.903535	0.689934
2009-01	0.4081	1.312783	0.904683	0.689134
2009-02	0.4018	1.324107	0.922307	0.69655
2009-03	0.3908	1.32104	0.93024	0.704172
2009-04	0.3835	1.315732	0.932232	0.708527
2009-05	0.3784	1.187626	0.809226	0.681381
2009-06	0.3765	1.16026	0.78376	0.675504
2009-07	0.3731	1.15448	0.78138	0.676824

TABLE 1.6 (continued)

	ppm	cpm	AMU	RMU
2009-08	0.3702	1.148699	0.778499	0.677722
2009-09	0.3711	1.147048	0.775948	0.676474
2009-10	0.3727	1.14752	0.77482	0.675213
2009-11	0.3737	1.150351	0.776651	0.675143
2009-12	0.3727	1.150351	0.777651	0.676012
2010-01	0.3756	1.156276	0.780676	0.675164
2010-02	0.3755	1.166077	0.790577	0.67798
2010-03	0.3725	1.155429	0.782929	0.677609
2010-04	0.3699	1.181323	0.811423	0.686876
2010-05	0.365	1.201409	0.836409	0.69619
2010-06	0.3641	1.198263	0.834163	0.696144
2010-07	0.3639	1.199836	0.835936	0.696709
2010-08	0.3677	1.207217	0.839517	0.695415
2010-09	0.3779	1.196811	0.818911	0.684244
2010-10	0.384	1.195359	0.811359	0.678758
2010-11	0.3947	1.194996	0.800296	0.669706
2010-12	0.3906	1.198626	0.808026	0.674127
2011-01	0.3999	1.229239	0.829339	0.674677
2011-02	0.4094	1.238314	0.828914	0.669389
2011-03	0.4117	1.239645	0.827945	0.667889
2011-04	0.4124	1.253439	0.841039	0.670985
2011-05	0.4144	1.254044	0.839644	0.669549
2011-06	0.4213	1.258279	0.836979	0.665178
2011-07	0.4289	1.271226	0.842326	0.662609
2011-08	0.4397	1.275219	0.835519	0.655196
2011-09	0.4531	1.281995	0.828895	0.646566
2011-10	0.4619	1.285383	0.823483	0.640652
2011-11	0.469	1.289497	0.820497	0.636292
2011-12	0.4701	1.30075	0.83065	0.638593
2012-01	0.4723	1.306558	0.834258	0.638516
2012-02	0.473	1.312729	0.839729	0.639682
2012-03	0.4641	1.299298	0.835198	0.642807
2012-04	0.4544	1.303049	0.848649	0.651279
2012-05	0.4514	1.311519	0.860119	0.655819
2012-06	0.4453	1.307526	0.862226	0.659433
2012-07	0.4453	1.31527	0.86997	0.661438
2012-08	0.4463	1.313455	0.867155	0.660209
2012-09	0.4497	1.310793	0.861093	0.656925
2012-10	0.4513	1.309462	0.858162	0.655355

TABLE 1.6 (continued)

	ppm	cpm	AMU	RMU
2012-11	0.4536	1.29591	0.84231	0.649976
2012-12	0.4535	1.296031	0.842531	0.650086
2013-01	0.4516	1.313939	0.862339	0.656301
2013-02	0.4467	1.306679	0.859979	0.658141
2013-03	0.4439	1.2947	0.8508	0.657141
2013-04	0.4411	1.31648	0.87538	0.66494
2013-05	0.4408	1.312971	0.872171	0.664273
2013-06	0.4421	1.297604	0.855504	0.659295
2013-07	0.4435	1.304138	0.860638	0.659929
2013-08	0.446	1.312124	0.866124	0.660093
2013-09	0.4495	1.308978	0.859478	0.656602
2013-10	0.4511	1.329306	0.878206	0.66065
2013-11	0.4516	1.328822	0.877222	0.66015
2013-12	0.4515	1.340801	0.889301	0.663261
2014-01	0.4509	1.333783	0.882883	0.661939
2014-02	0.4503	1.33705	0.88675	0.663214
2014-03	0.4463	1.338381	0.892081	0.666537
2014-04	0.4332	1.361613	0.928413	0.681848
2014-05	0.4332	1.351207	0.918007	0.679398
2014-06	0.4312	1.35157	0.92037	0.680964
2014-07	0.4272	1.3306	0.9034	0.678942
2014-08	0.4263	1.3289	0.9026	0.679208

Sources: ELOGAK, Hellenic Statistical Authority (EL.STAT.) and own calculations for AMU = ppm – cpm and RMU = (ppm – cpm)/cpm.

CHAPTER 2

THE INSTITUTIONAL FRAMEWORK OF THE DAIRY POLICY

2.1. Introduction

The EU's dairy policy dates from the 1960s. It helps to create stable market conditions for EU dairy producers and processors. The policy has been continuously updated and is increasingly targeted at encouraging producers to be more market-oriented.

A common market organization ('regime') for milk and milk products exists including the traditional instruments of the Common Agricultural Policy (CAP) such as import duties and export refunds. Its objectives were to support, directly, dairy product prices and, indirectly, the raw milk price and the incomes of dairy farmers.

The CAP reform under Agenda 2000 has not fundamentally affected the Common Organization of the Market (COM) in milk and milk products established in 1968, which was subsequently revised in depth in 1984 to introduce milk quotas and in 1987 to scale down buying-in.

2.2. The dairy sector and the CAP

The reform of the CAP, agreed in June 2003, fundamentally changes the way the CAP operates. The EU's dairy policy operates in three areas (European Communities, 2006):

- Supporting internal markets
- Using trade instruments
- Making direct payments to farmers

A. Supporting internal markets

The main aim of EU dairy policy has always been to maintain the stability of the EU dairy market, mainly by seeking to balance the supply of and demand for dairy products. This remains the case.

Market support: 'safety-net' intervention

As in other agricultural sectors, dairy market support will be limited in the future, with public intervention (buying into storage) for butter and skimmed milk powder being a measure of last resort. Intervention agencies may only buy-in butter during the period from March 1 to August 31 of any year. When the quantities of butter offered for intervention exceed the thresholds indicated below (during the period March 1-August 31) the Commission may suspend conventional intervention buying and continue buying using a tendering procedure. The thresholds are 50,000 tonnes in 2006, 40,000 tonnes in 2007 and 30,000 tonnes in 2008 and subsequent years.

It was agreed in 2003 that the butter intervention price would be reduced by 25% over a four-year period, beginning on July 1, 2004, with the four-year reductions being three times 7% plus a final cut of 4% in 2007, meaning price levels of:

- €328.20/100 kg until June 30, 2004,reducing to
- €246.39/100 kg from July 1, 2007.

The actual buying in price is only 90% of the intervention price (i.e. €221.75/100 kg on July 1, 2007).

SMP (Skimmed Milk Powder) intervention was already open only between March 1 and August 31 each year, for a maximum quantity of 109,000 tonnes. Beyond this quantity, intervention may be suspended and may be replaced by a tender procedure. The SMP intervention price was reduced by 15% over a three-year period, with reductions of 5% each year for 2004, 2005 and 2006, resulting in the following price levels:

- €205.52/100 kg in 2003/04, reducing to
- €174.69/100 kg from July 1, 2006.

Disposal of dairy products on the internal EU market

To ensure that a healthy market balance is maintained, the EU dairy industry continues to have access to measures to ensure the competitiveness of their dairy products on the internal market. Various schemes for dairy products on the EU market still play a role in the dairy regime, though spending has been decreasing in recent years in most cases.

The main subsidised disposal schemes are:

- Cream, butter and concentrated butter for non-profit organizations, for commercial pastry and ice cream manufacture (still a significant scheme-disposal measures for butter, butter oil and cream covered a total quantity of 600,000 tonnes of butter equivalents in 2004)
- SMP for use in animal feed
- Skimmed milk for the manufacture of casein/caseinates
- School milk
- Aid in the form of dairy products for the most deprived people.

Private storage aid

For butter and certain cheeses (mainly Italian cheeses), cheese producers can obtain financial support (aid) for storage costs. Due to seasonal variations in raw milk deliveries, the production of some products is high for a short period, which can destabilise markets. This aid stabilises prices by helping producers take product temporarily off the market. In the case of butter it also serves as an alternative to intervention.

Milk quotas: providing continued stability in the dairy sector

EU countries are allocated two types of milk quota, one for deliveries to dairies –by far the larger– and one for direct sales to consumers. These quotas are further shared out among individual farmers based on their historical production.

Wholesale quotas are held by milk producers who deliver milk to a purchaser, usually a dairy or co-operative, with which the producer's quota is registered.

Direct sales quotas are held by producers who sell their milk directly to market without going via a purchaser, or who sell products other than milk, such as skimmed milk, cream, butter, yoghurt and cheese. Producers can hold one or both quota types.

Any unused quota may be reallocated to other producers in the same country. Producers may convert their wholesale quota into a direct sales quota or vice-versa to reflect their actual production –and conversions can be permanent or temporary.

They can also transfer and trade quotas to match production, with quota prices determined by the market. But there are huge price differences around the EU for trading milk quotas for farmers who want to produce milk qualifying for EU subsidies.

Milk quotas have a long history of assuming an importance that diplomats say is disproportionate to their significance, even souring the harmony of EU summits and other major meetings.[5]

In 2003, EU heads of state found themselves discussing the quota allocated to dairy farmers in Portugal's remote Azores islands –a long-term grievance held by Lisbon.

That was also said to be the reason for Portugal becoming the only EU country, among the bloc's 15 member states at the time, to vote against CAP reform that year.

Also in 2003, Italy irritated EU finance ministers, trying to clinch a long-awaited savings tax deal, by its refusal to back the plan unless it got a partial write-off on massive fines the EU had imposed on its farmers for overproducing milk.

If production of either or both quota types is above the annual national allowance, those producers who have exceeded their individual quotas must pay a punitive levy on their overproduction after the end of the quota year.[6]

The levy collected is used to offset the cost of storing and disposing of surplus milk within the EU market.

[5] The relevant reference for the milk-quota scheme is Regulation (EC) No. 1255/1999 amending Regulation (EC) No. 3950/1992.

[6] Council Regulation No. 1788/2003 established a levy in the milk and milk products sector and Regulation (EC) No. 595/2004 set out detailed rules for this.

Each year, before September 1, all national milk production figures must be reported to the European Commission for the previous marketing year, which runs from April 1 to March 31.

That fine is calculated at a base rate multiplied by each kilo of quota surplus, after any unused quantities are re-allocated. The so-called super levy dates from 1984 and was designed to dissuade countries from exceeding annual quotas.

In 2007/08, for example, the European Commission slapped a combined fine of €340 million (NZ$775.4 million) on seven EU countries for exceeding quotas.

Italy, yet again, was singled out as the main offender and also came top of the EU league for the preceding four years.

The milk quota regime has brought stability to the EU's dairy sector since its introduction in 1984.

Larger quota increases were discussed but the final 2003 CAP reform deal included a commitment that "no additional general increase in 2007 and 2008 is decided now. The Commission will present a market outlook report once the dairy reform is fully implemented on the basis for which a decision will be taken".

As milk quotas will expire by April 2015, a 'soft-landing' is ensured by increasing quotas by one percent every year between 2009/2010 and 2013/2014 (Table 2.1). In the context of the restructuring of the sector, member states should be permitted to grant additional national aid within certain limits until March 31, 2014. The quota increases decided by Council Regulation (EC) No. 248/2008 of March 17, 2008 amending Regulation (EC) No. 1234/2007 regarding the national quotas for milk and the 1% annual increase, along with the other changes which reduce the likelihood of the surplus levy being incurred, mean that only Italy would be at risk of the levy being incurred on the basis of current production patterns if annual increases of 1% were applied from the 2009/2010 period until 2013/2014.

It is worth mentioning that Greek milk deliveries are below the national quota. Particularly, in period 2009/2010 deliveries were short by 148,472 tons in relation to the national quota while in 2010/2011 deliveries were short by 173,091 tons and in 2011/2012 by 205,444 tons (ICAP, 2013).

TABLE 2.1
Greek quota for milk (2008/2009-2014/2015)

Year	Quota (in tons)
2008/09	836,923,260
2009/10	845,292,493
2010/11	853,745,418
2011/12	862,282,872
2012/13	870,905,700
2013/14	879,614,757
2014/15	879,614,757

Source: EC Regulation No. 72/2009.

B. Using trade instruments

Exports

As the EU market price is higher than the world price for dairy products, exports generally take place with the aid of export subsidies. Following the 1994 multilateral trade agreement (Known as the Uruguay Round) of the World Trade Organization (WTO), export subsidies have been restricted, both the quantities exported and the amount of total subsidies paid out are strictly limited.

In practice, only cheese exports have reached the quantitative limit each year. Subsidised exports of other dairy products have been well below the volume constraints.

The European Commission introduced a tendering system for export refunds on butter, butter oil and SMP in bulk in 2004. This system runs alongside the traditional fixed-refund arrangements for all products and has reinforced the more market-oriented approach of the dairy regime post-2003.

Imports

The EU maintains relatively high tariffs on dairy products, in order to sustain the EU market price. There are only minimal imports at full tariff. However, many of the EU's trading partners benefit from special import arrangements –known as Tariff Rate Quotas (TRQs)– whereby imports can come in at lower tariffs. Some of the TRQs are specific to

particular exporting countries; others are open to all under the most–favoured-nation (MFN) system.[7] TRQs are not always filled (i.e. fully utilised). Those for powders (about 70,000 tonnes) are hardly used. There are TRQs for several different cheese types –amounting to just over 122,000 tonnes– the average fill rate is 40%; the butter TRQs of approximately 89,000 tonnes are always filled.

C. Making direct payments to farmers

Apart from the measures to maintain continued market stability, direct aids are also available for EU dairy farmers.

Direct payments to farmers: the dairy premium

By way of compensation for cuts in intervention prices, from 2004 to 2007 milk producers qualified for support payments paid directly to producers.[8] These were paid per calendar year, per holding. The payments consisted initially of two elements: dairy premiums paid equally to all milk producers; and additional payments paid to milk producers according to criteria decided upon by the member states.

The total amounts available for the direct dairy premium in a given year were based on quotas held at the end of the preceding quota year and were set as follows:

- €8.15/tonne of quota for calendar year 2004
- €16.31/tonne of quota for calendar year 2005
- €24.49/tonne of quota for calendar year 2006.

Moving from the dairy premium to the SPS

A central element of the 2003 CAP reform was the introduction of the 'Single Payment Scheme' (SPS) –a decoupled aid payment. Dairy farmers are eligible to receive SPS payments, which are conditional to

[7] MFN requires that every time a member state improves the benefits it gives to one trading partner, it must give the same treatment to all other WTO members, so that they remain equal.

[8] Council Regulation No.1782/2003 introduced direct payments to farmers, and Commission Regulation No.1973/2004 detailed rules for this.

the fulfilment of 'Cross Compliance' requirements whereby farmers receive payments provided they comply with environmental health and welfare standards.

Member states could choose to introduce the SPS in 2005, 2006, or 2007. Dairy payments could be included in the SPS beginning in any one of these years. The SPS, including for the dairy sector, must have been implemented by 2007. A maximum amount of money –a national ceiling– has been calculated for each member state, which total SPS payments in all agricultural sectors must respect.

A reference amount is attributed to each farmer under the SPS, which is calculated by taking the average annual direct aid he received in 2000, 2001 and 2002. The reference amount for dairy farmers will be their reference quantity (quota) held on March 31 of the calendar year the SPS was introduced, multiplied by the dairy premium. Member states have options in how they calculate and make payments. The main difference is whether they base the SPS on what direct payments individual farmers received in the historic reference period, thus producing different levels of SPS for each farmer, or whether all payments are averaged out over a state or region. Member states may also calculate SPS payments using a part-historic/part-flat rate approach.

2.3. 'High Level Experts' Group on milk

After the Health Check decisions in November 2008, the milk sector went through a deep crisis due to a shift in demand away from dairy products following exceptionally high prices in 2007. The crisis also showed some shortcomings in the market orientation of the milk sector. The Commissioner for Agriculture and Rural Development therefore decided to create a 'High Level Experts' Group (HLG) on milk to work on a regulatory framework to be put in place for the medium and long term, which could contribute to stabilizing the market and producers' income and enhance transparency, while respecting the outcome of the Health Check. The HLG held ten meetings from October 2009 till June 2010 and produced a report on June 15, 2010 accompanied by recommendations on seven issues. The recent Council Regulation (EC) No. 261/2012 of March 14, 2012 amends Regulation (EC)

No. 1234/2007[9] and addresses the first four issues of the recommendations: contractual relations, the bargaining power of producers, interprofessional/interbranch organizations, transparency (including the further elaboration of the European Price Monitoring Tool). The recommendations to the Commission from the HLG focused on the following areas (see DG (AGRI) IP/10/742, 15/6/2010):

- **Contractual relations between milk producers and milk processors:** There is a need to increase awareness and reinforce the responsibility of the operators in the dairy chain to better take into account the signals of the market and adapt supply to demand. Therefore, the use of formal written contracts, made in advance, to cover deliveries of raw milk (including price, volume, timing and duration) should be enhanced through guidelines or a legislative proposal. Member states could make the use of these contracts compulsory.
- **Collective bargaining power to producers:** Propose possible provisions to allow producer organizations, made up of dairy farmers, to negotiate contract terms, including price, jointly for some or all of its members' production of dairy, subject to an appropriate quantitative limit expressed as a percentage of EU milk production and to consider whether such a provision should be permanent or of a sufficiently long but temporary duration; and in either case be subject to review. The specific nature of cooperatives should be duly taken into account.
- **The possible role of interbranch organizations in the dairy sector:** Examine whether any of the current provisions for interprofessional organizations in the fruit and vegetable sector could also be applicable to the dairy sector. If so, the applicable legal restrictions

[9] Successive reforms of the CMO covering milk and milk products, now contained in Council Regulation (EC) No. 1234/2007 of October 22, 2007, establishing a common organization of agricultural markets and specific provisions for certain agricultural products, have been aimed at market orientation. That is, letting price signals guide the decisions of farmers in terms of what and how much to produce, so as to strengthen the competitive situation of the dairy sector and its sustainability in the context of globalised trade.

on anti-competitive activities and the Commission's powers to control them, should equally apply, and the proper functioning of the internal market should be safeguarded.

- **Transparency in the dairy supply chain:** Elaborate further on the European Food Price Monitoring Tool, and examine the provision of more information (e.g. on volumes of dairy products) by EUROSTAT and National Statistical Institutes to communicate more information, subject to a reasonable cost.
- **Market measures and futures:** Consider 'green box compatible' instruments to reduce income volatility, including possibly facilitating the use of futures markets, in particular via targeted training programmes.
- **Marketing standards and origin labelling:** Continue the Commission's work on labelling to ensure that imitation dairy products are distinguished properly, thereby avoiding the use of names and terms reserved to dairy products. The Commission should consider the feasibility of different options for obligatory/voluntary 'place of farming' labelling of basic primary dairy products.
- **Innovation and research:** Communication of existing possibilities for innovation and research within the existing framework of Rural Development and research framework programmes. Stakeholders should define clear research priorities for the dairy sector in order to allow better coordination of national and community research programmes. The dairy sector is also invited to intensify its participation in the ongoing developments that take place in the HLG on competitiveness in the food chain which also addresses the issue of innovation and research.

2.4. The operation of the 'Milk Package' provisions

On October 3, 2012, Regulation (EU) No. 261/2012, the so-called 'Milk Package' of the European Parliament and of the Council of March 14, 2012 regarding contractual relations in the milk and milk products sector, was fully implemented and applies until June 30, 2020. This Regulation amends Council Regulation (EC) No. 1234/2007 and establishes a common organization of agricultural markets

on specific provisions for certain agricultural products aimed at market orientation; that is, letting price signals guide the decisions of farmers in terms of what and how much to produce, to strengthen the competitive situation of the dairy sector and its sustainability in the context of globalised trade. The most important provisions and their operation are described below (COM [2014], 354 final).

2.4.1. Compulsory contracts (Article 148)

Contracts delineate the responsibilities of operators in the dairy chain, increase awareness of market signals, improve price transmission, adapt supply to demand and deter certain unfair commercial practices. After the abolition of the milk quota system, contracts are a useful tool for producers and processors to plan their production volumes. Under Article 148, member states can make written contracts between farmers and processors compulsory and oblige purchasers of milk to offer farmers a minimum contract duration. These contracts should be made in advance of delivery and contain specific elements such as the price, volume, duration, details concerning payment, collection and rules for *force majeure*.

All these elements should be freely negotiated between the parties and farmers have the right to refuse an offer of a minimum duration in a contract. Deliveries by a farmer-member to his cooperative are exempted from this contract obligation if the statutes or rules of the co-op contain provisions that have similar effects as the prescribed contract.

2.4.2. Producer Organizations (Article 152[3])

Member states are obliged to formally recognize Producer Organisations (POs) comprised of and initiated by producers in the milk sector who pursue specific aims, which may include (i) ensuring that production is planned and adjusted to demand, particularly in terms of quality and quantity; (ii) concentrating supply and placing products produced by its members on the market; (iii) optimizing production costs and stabilising producer prices. Member states can set a minimum number of members and/or a minimum volume of marketable

production that POs have to fulfil in order to be recognised (see annex, Table 3).

All recognised POs focus on cow's milk, except one solely for ewe's milk in Spain. A large number of the total 228 POs in the EU dairy sector, notably in Germany and Italy, already existed before the Milk Package came into force. Nevertheless, the number of recognitions increased in 2013 (BE +1; CZ + 8; DE + 18; ES + 3, FR + 27). In Germany, one association of POs was recognised in 2013, resulting in a total of two. In several member states' national legislation for recognition came into force only recently.

The rather large variation in minimum requirements shows the difficulty in finding a balance between the ambition to aim at large POs that have a potential to increase the bargaining power of producers and the encouragement to create POs by setting realistic thresholds.

Nevertheless, it should be kept in mind that in a second phase several POs can join an association of POs that has the same opportunities for collective negotiation as a PO, but on a bigger scale.

2.4.3. Interbranch Organisations (Article157[3])

Specific rules for Interbranch Organisations (IBOs) in the milk sector allow the actors in the dairy supply chain to dialogue and to carry out a number of activities that under certain conditions can be partially exempted from competition rules (Article 210). These joint activities concern, amongst other things, the improvement of knowledge and transparency of production and marketing, promotion, research, innovation and improving quality. IBOs should be made up of representatives of the producers of raw milk and at least one or more of the following stages in the supply chain: processing or trade (including distribution).

IBOs for the dairy sector have been recognised in Spain (one for cow, ewe and goat milk), France (one for cow milk, one for goat milk and two for ewe milk), Hungary (for cow milk) and Portugal. They generally operate at the national level, except for the two IBOs for ewe milk in France that have regional coverage. They all comprise production and processing, while retail is only represented in the IBO in Hungary. One practice of a French IBO, notably concerning the dissemination

of certain market information and economic indicators, has been accepted in the context of Article 177a of Regulation (EU) No. 1234/ 2008.

2.5. The Conference of 'The EU dairy sector: developing beyond 2015'

The conference 'The EU dairy sector: developing beyond 2015' held on September 24, 2013 brought together the actors of the dairy supply chain, as well as representatives of the EU institutions, member states and experts from research and economic bodies.[10] The purpose of this conference was to explore the new challenges and the most likely trends that will be faced by the EU milk sector and whether additional instruments were needed and feasible, taking into account the end of the quota system in 2015.

Experts presented the results of various studies carried out in the milk sector, all stressing the challenges represented by the end of milk quotas in 2015 such as grasping the opportunities of new international markets, managing extreme volatility and maintaining milk production in certain fragile areas. The six independent experts coordinated by Ernst & Young came to the conclusion that a reinforcement and a timely use of existing CAP tools would be appropriate to accompany the milk sector beyond 2015. The European Milk Board (EMB) called for more market regulation, presenting the idea of confining price fluctuations within a tunnel and operating a supply management system. The Movement for a World Agricultural Organization (MOMAGRI) also underlined the need for a stronger safety net in the context of extreme volatility and presented a price-based management system. The European farmers and agricultural cooperatives (Copa-Cogeca) presented the market situation and the tools available.

Subsequent discussion took place in two parallel workshops on the above-mentioned topics and continued in a concluding plenary session. The various views expressed during these meetings are summed up below.

[10] See summary report in: http://ec.europa.eu/agriculture/events/dairy-conference-2013_en.hlml.

Market balance and competitiveness

The future of the EU internal market balance will also depend on developments on the world market, which are expected to bring new opportunities for the European milk sector even if some participants warn that such opportunities can only be genuine if they generate enough added value for farmers to cover their production costs.

Volatility (both for dairy product prices and for input prices) is one of the major challenges for the years to come and most of the participants expressed their concerns about its possible impacts at the producer level.

The instruments currently in place in the Single CMO (safety net) proved to be effective in the past, and could be reinforced in periods of serious crises and better targeted. In that respect, a prompt intervention in the market should be ensured, in order to ensure that the measures are not taken too late. For some participants, current instruments are not enough to cope with volatility, and therefore to ensure a decent (cost-covering) price for farmers. There were some positions favourable to adapting the market tools to production costs, e.g. strengthened use of safety nets, voluntary or compulsory freeze of milk production and of milk products (commodities notably) in times of crisis and counter-cyclical payments. Some participants are of the view that a supply management solution might ensure that actors take on board their responsibility in times of crisis.

Many independent experts and participants felt that there is an unbalanced distribution in added value throughout the **supply chain**. Producer organisations (POs) should have an appropriate size to be effective, in particular to deal with the higher concentration of dairies. It has been mentioned that the role of POs and Interbranch Organisations (IBOs) could be quite limited in redistributing bargaining power, given the current concentration at the dairy level. But they might bring other added values in terms of organization of the production, logistics or services. The role of the IBOs should be strengthened at the EU level with calls for the same rules to apply throughout the EU for the dairy sector.

In terms of **transparency**, the idea of implementing a European Observatory announced by the European Commission was broadly welcomed. The Observatory should be able to monitor the margins,

facilitate information at the producer level and take into account the diversity of the milk sector.

Sustainability of milk production including its territorial dimension. In terms of **sustainability**, there is a need to find instruments to counter potential negative effects in most vulnerable regions. Experts presented the divergent developments expected between regions: 25% of countries/regions likely to produce more, 50% of countries/regions expected to produce less.

Some concerns about the sustainability of the two emerging production models have been expressed with environmental, animal welfare and financial limitations on the one side, and production drops or abandonment, loss of employment and decreasing vitality of rural areas affecting many regions on the other side.

It has been noted that better tools should be in place to encourage young people and that the economic and social fabric in the various regions of Europe should be maintained. The diversity of regions is the richness of Europe. The importance of cooperation between farmers has been stressed.

As regards the **territorial dimension** of EU milk production, some experts consider that EU farms will continue with the existing trend, while others consider that milk quota expiry, associated with more volatile and decreasing prices and increasing costs of inputs, will accelerate differences between European regions. In some of the most affected regions, milk production plays a significant role. The point has been raised that the richness created by milk production must be redistributed throughout the Union, notably to counterbalance the transport handicap of the outermost regions with some participants emphasizing the need to compensate handicaps and to use, at best, the new instruments of the reformed CAP.

In conclusion, the Conference stressed, with a large consensus, the need for transparency, so that changing trends can be identified at an early stage and market signals are conveyed to all actors involved without delay. A combination of a Market Observatory with the existing possibilities opened by the CAP reform, in particular with regard to crisis situations, will help accompany the milk sector beyond 2015. Some other ideas for regulating prices and incomes were suggested by participants and need to be further discussed: strengthening the

organization of producers and food chains with stricter rules, strengthening the use of safety nets, voluntary or compulsory freezing the production of milk in times of crisis, and analysing kinds of countercyclical payments.

2.6. National legislative framework

2.6.1. School Milk Programme

The subsidy measure on the consumption of milk and milk products to pupils in educational establishments has been adopted by EC Regulation No. 657/2008. In July 2008, the European Commission expanded the School Milk Programme (SMP) to increase the range of products covered by the subsidy and to ensure that secondary schools would have the same access to the programmes as primary and nursery schools. Member states are given the authority to tailor the SMP on a national level. In Greece, the SMP was applied for the first time in 2013 by the common ministerial decision 268/12728/2013 (B΄247). The subsidy is totally covered by the European Commission and was set at €0.18 per litre. Applications for granting the aid can be filed with authorities who are described in the ministerial decision. For example, such authorities could be an educational establishment or an educational committee, the supplier of the products or an organization acting on behalf of one or more educational establishments or educational authorities established for that purpose. The particular subsidy could be matched with other possible resources from national authorities (municipalities, non-governmental organizations, voluntary organizations) in order for the milk to be supplied for free to pupils.

2.6.2. The Hellenic Dairy and Meat Organization (ELOGAK)

The ELOGAK was established by Law 2127/93 as ELOG (Hellenic Dairy Organization) and was converted by Law 3698/2008 to ELOGAK (Hellenic Dairy & Meat Organization). It belongs to the wider public sector and is overseen by the Minister of Rural Development and Food. The main responsibilities of ELOGAK are:

1. Managing the quota system of cow milk in accordance with EU directives.
2. Controlling the quality of cow, sheep and goat milk in accordance with Greek and European Legislation.
3. Controlling the 'balance of milk' for all units processing and marketing milk and milk products for the legal use of all kinds of milk as raw material.
4. Controlling and complying with the 'balance of meat' for all plants slaughtering, cutting, packing, handling and marketing meat.
5. Providing advice and guidance to farmers to better manage their units and better milk production.
6. Coordinating and implementing community research programs and ads for milk and milk products.
7. Investigating the milk market for the Ministry of Rural Development and other stakeholders.
8. Exercising an advisory role to the Ministry of Rural Development and Food.

2.6.3. Market Regulation (AD 5/2009, 798/Β΄/29.4.2009)

With Market Regulation 5/2009, the Ministry of Development upgraded the protection and comprehensive information of consumers by making compulsory the indication on the packaging of all dairy products of the country origin of the raw material (milk) used for the manufacture and sale of these products to the final consumer. In addition, it sets the obligations of lessees on how to display dairy products at points of sale within their stores.

2.6.4. Amendment to sell dairy products at farmers' markets

Parliament accepted an amendment submitted by an MP of New Democracy regarding the issue of selling dairy products in public markets where they have been produced in an approved establishment, have an identification mark in accordance with the Regulations EC852/2004 and EC853/2004 and comply with the requirements of current legislation on the labelling. Unfortunately, this amendment was not included in Law 4155/2013 as had been planned in May 2013.

2.6.5. Extending the shelf life of fresh milk

In March 2014, the law (polynomoschedio) of the Ministry of Development was passed by the government which incorporates the changes coming to the milk market according to the OECD's recommendations. The new regulations for milk are the following:

- Milk will now be distinguished as 'pasteurized' or 'UHT heat treatment'.
- Legal restrictions for the maximum shelf life of milk pasteurization were removed and the shelf life for both pasteurized and UHT for heat treatment will be determined by the method of pasteurization in each industry as referred to throughout Europe.
- The packaging of each product should include the pasteurization date, expiry date, and the life of milk, e.g. 'milk five days', 'milk seven days', etc.
- A new category of milk was introduced, the 'milk day' packed within 24 hours of milking without high-temperature processing, which reduces its nutritional value.

The Ministry of Development, following the recommendations of the OECD, argues that the extension will reduce the retail price of milk, but the Ministry of Rural Development and Food stresses that, in Greece, there is already long life milk, which is 20% more expensive than fresh, considering this specific movement a 'tombstone' for the livestock sector.[11] Additionally, the Association of Greek Livestock argues that the extension will lead to the extermination of the Greek dairy sector due to the massive imports, the decline of employment in the production, bottling, and distribution of milk and the devaluation of huge investments made all these years in the sector.

2.6.6. Contracts for milk production and producer organizations

The Joint Ministerial Decision (JMD) No. 2133/101443/8.20.2013 on the 'Recognition of producer organizations and their associations and interbranch organizations and contract negotiations in the milk

[11] Newspaper *Ethnos* Economy, 23/1/2014.

and milk products' was published in the National Gazette 2226/B/ 10.9.2013. With regard to the EC No. 1234/2007, EC No. 261/2012, EC No. 511/2012 and EC No. 880/2012, the JMD defines the criteria for recognition of producer organizations for milk and milk products. The purpose of this JMD is to create an appropriate institutional framework for the better organization of milk farmers in order to strengthen their bargaining power and, at the same time, to establish a cooperation among milk producers, processors and distributors through inter-branch organizations and to implement contract farming.

2.7. Conclusions

The basis of the European Common Organization of the Markets in Milk and Dairy Products was defined in 1968 by regulation 804/68. It helps to create stable market conditions for EU dairy producers and processors. The policy has been continuously updated and is increasingly targeted at encouraging producers to be more market oriented. It consists of several interrelated policy instruments: a price support programme, government intervention purchases, production quotas, import tariffs and tariff rate quotas, as well as domestic consumption and export subsidies (European Communities, 2006).

From 1984, when milk quotas were introduced, until 1999 the situation of the milk market was rather stable. This began to change in 1999 when reforms to the organization of the milk market were introduced with Agenda 2000. In 1999 the milk market was subject to the same process of reform which started in 1992. Moreover, in 2005 intervention prices were decreased by 15%, in three annual steps of 5%. Dairy farmers were to be partly compensated through direct income payments per kilogram of milk and through the use of a national envelope.

The reform of the dairy sector, in line with the CAP reform of 2003 in general, has aimed to increase competitiveness and market orientation of production, letting price signals guide the decisions of farmers in terms of what and how much to produce. It was intended that by reducing the guaranteed price for butter and skimmed milk powder (SMP) these products would be less attractive to produce and this

would give the industry an incentive to produce more value added products like cheese and fresh dairy products. Increasing the quota at the same time would encourage additional production, facilitate the restructuring of the sector and encourage the entrance of young farmers into the sector.

In the Health Check it was consequently decided that it was necessary to increase quotas gradually in order to ensure a so-called 'soft landing', i.e. a smooth transition towards the expiration of milk quotas in 2015. It was decided to increase quotas by 1% per year from April 1, 2009 until 2013. Already the value is low to zero in several member states whose production is below their quotas. Additionally, under the second pillar of the CAP, support for 'dairy restructuring' was acknowledged as an additional priority theme. This allows member states to use additional funds from modulation to support dairy farmers in preparing for the end of quotas.

CHAPTER 3

THE THEORETICAL FRAMEWORK

3.1. Introduction

Price is the central mechanism by which the various agents in the food supply chain are linked. The relationship between farm and retail prices provides insights into marketing efficiency and consumer and farmer welfare. Because of that, agricultural economists have focused on the farm-to-retail price transmission process.

As such, the process of price transmission through the food supply chain has long attracted the attention of agricultural economists, as well as policy makers. A common concern of policy makers relates to the assertion that, due to imperfect price transmission (perceived to be caused by market power and oligopolistic behaviour), a price reduction at the farm level is only slowly, and possibly not fully, transmitted through the supply chain. In contrast, price increases at the farm level are thought to be passed more quickly on to the final consumer (Vavra and Goodwin 2005).

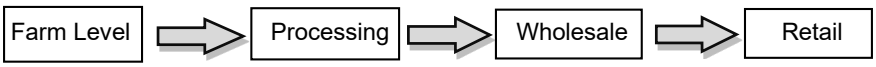
Perfect transmission between prices at different levels of the marketing chain, for example the producer and retail price, is defined as a situation where changes in producer (retail) price are completely and instantaneously transmitted to the retail (producer) price. To the contrary, if price changes are not passed through instantaneously, but after some time, price transmission will be incomplete, and therefore imperfect in the short run but perfect in the long run.

3.2. Price transmission along the agri-food chains

The food supply chain basically connects three main economic sectors: the agricultural sector, the food processing industry and the

distribution sectors (wholesale trade and retail trade). These sectors are linked through transactions carried out at specific prices between the various agents of the chain, e.g. farmers, food processors, wholesalers, retailers, and final consumers (Figure 3.1). The adjustment of the food supply chain to price changes is an important characteristic of the functioning of markets as it reflects the nature, structure and organization of the chain.

FIGURE 3.1
Schematic illustration of the food supply chain



To measure the efficacy, efficiency and competition level of the existing markets along these chains, the most frequently used date are the evaluation of the modality of price transmission along the agri-food chains, and how much and how fast price changes are transmitted from the farm level to the store shelf and to the final consumer. Price adjustment along the chains finally reflects the chain nature, structure and organization and it can ultimately identify the eventual market failure. The "Analysis of price transmission along the food supply chain in the EU" (October 2009),[12] is a study that introduces the main concepts and definitions related to the price transmission analysis and highlights the main factors that influence the intensity, gaps and the eventual asymmetric transmission of price adjustment along the chain. According to this report, price formation along the chains depends on several factors, among which are the following: *product specificity* (perishability, seasonality, storage/preservation and conditions), *market structure* (e.g. intensity of competition at each level in the chain, number of intermediaries on each chain) and *applied public policies.* The evaluation of price transmission along the chains presupposes the knowledge of the following issues:

[12] COM (2009) 591, 28/10/2009.

- price adjustment intensity, or, in other words, how much of the price variation at a certain level is transmitted to the next level in the chain;
- adjustment rate, i.e. how much time is needed for the price variation at a certain level to be transmitted to the next levels (is the transmission made immediately or in several months?);
- price adjustment asymmetry, i.e. to what extent a price increase or diminution is transmitted on a differentiated basis along the chain, with regard to the intensity and rate (for example, whether an increase in prices is transmitted much faster than the diminution of prices).

Additionally, obtaining information on prices at different stages of the chain is not easy. While agricultural and consumer prices are available in most member states, there are great difficulties in collecting prices at the processing stage and for the wholesale trade. Therefore, price transparency along the food chain represents a problem in most EU countries.

The perfect transmission of prices presupposes the fact that the variation that takes place at a certain level of the chain is fully and simultaneously transmitted to the next levels. However, in reality, the price changes at the farm level are transmitted to the next stages, but the variation amplitude is different at the level of the processor or of the retail trader because the agricultural raw material represents only a part of a final food product cost. Hence, the price transmission amplitude depends on the cost structure of products in the different stages of the chain. At present, in the EU countries, the agri-food chains are experiencing a continuous sophistication process, under the pressure of the main economic and social trends (mainly the unprecedented growth of incomes but also the ageing of the population), changes in family lifestyles, urbanization, women's attraction into off-farm activities and, last but not least, concerns for a healthy diet. Thus, at the EU level, the average share of agricultural raw material in the final food product cost reached about 20%, with significant shares being held by labour, energy and marketing costs. These shares are significantly different by product and by country (Alexandri, 2011).

3.3. Imperfect price transmission

Imperfect price transmission might exist when price changes at one end of the supply chain are not immediately reflected at the other end. According to *London Economics* (2003) imperfect price transmission can be of three different types. First, price changes may not be fully transmitted along the marketing chain. Thus, prices at the upstream and downstream ends of the food chain would be independent of each other. This would imply that prices are insulated from any developments or shocks occurring at the other end of the chain. In practice, it is rare to observe full independence of price at each end. However, it has been reported that the flow of the transmission goes in one direction only, e.g. from farm gate to retail, with no evidence of transmission from retail to farm gate. Second, imperfect price transmission is a transmission with some lag. In this case, increases or decreases in one end of the chain are not transmitted instantaneously but instead are distributed over time. For example, an increase in the price at the farm-gate takes a number of periods to be fully transmitted to the retail price. Finally, there could be imperfect transmission in the form of asymmetric reaction to positive and negative shocks. The term 'asymmetry' signifies that the reaction of the price at one level of the marketing chain to a price change at another level depends on whether the initial change is positive or negative.

The literature identifies market structure and the presence of non-competitive behaviour as the main cause for asymmetry in farm-retail price transmission. We will describe the causes of asymmetric price response in a different subsection below.

3.4. Asymmetric price transmission

The term 'asymmetry' signifies that the response of the price at one level of the marketing chain, say the consumer price, depends on whether the change in price at other levels of the chain, such as producer prices, is positive or negative (von Cramon-Taubadel 1998). Most empirical studies point out that the price transmissions are asymmetric. Studies of various products and services, including gasoline,

agricultural products and bank deposit rates, all find that prices are more likely to rise to input increases than they are to decrease in the wake of cost reduction.

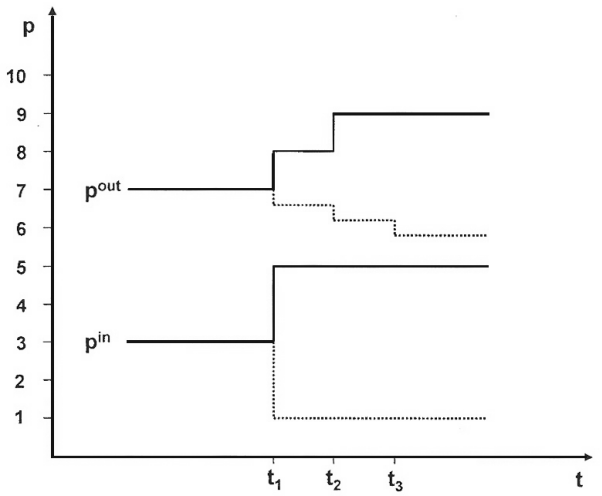
Many researchers have examined the issue of asymmetric price adjustments because such studies could provide policy-relevant information on commodity market structure and welfare distribution. For example, if market power exertion by food processors results in an incomplete price transmission of decreases in input prices (e.g. farm-level prices), this could then lead to increased rents for downstream firms and a potential loss in welfare to consumers (McCorriston *et al.* 2001).

Peltzman (2000) investigates the degree of the prevalence of asymmetric price transmission in commodity markets by analysing price data for 77 consumer and 165 producer goods. He concluded from the empirical results that asymmetric price behaviour is the rule rather than the exception. The result from Peltzman's study confirms consumer suspicions that wholesalers and processors tend to quickly pass on price increases, but are not as eager to transmit price decreases.

The issue of asymmetric price transmission continues to receive considerable attention in the economic literature for two reasons (Varva and Goodwin 2005). First, its presence is not in line with predictions of conventional economic theory which postulates that, under some regularity assumption, prices should respond symmetrically to cost increases and cost reductions. Second, asymmetric price transmission has important welfare and, hence, policy implications. It implies a different distribution of welfare than would be obtained under symmetry, since it alters the timing and size of welfare changes.

Meyer and von Cramon-Taubadel (2004) discuss the definition of asymmetry in the context of price transmission according to three main criteria: a) asymmetry with reference to speed and magnitude, b) asymmetry affecting vertical or spatial price transmission and, c) positive or negative asymmetry. It is evident from Figure 3.2 below that price transmission is asymmetric with respect to both speed and magnitude because an increase in p^{in} takes two periods (t_1 and t_2) to be fully transmitted to p^{out}, while a decrease in p^{in} requires three periods (t_1, t_2 *and* t_3) and is not fully transmitted.

FIGURE 3.2
Speed and magnitude



Notably, if output prices react more fully or rapidly to an increase in input prices than to a decrease, this is termed 'positive' asymmetry. Alternatively, a 'negative' asymmetry results if output prices react more fully or rapidly to a decrease in input prices than to an increase (Meyer and Von Cramon-Taubadel 2004).

Considering the two asymmetries, positive asymmetry is harmful to the consumer while negative asymmetry is beneficial. Positive asymmetry implies that cost increases that squeeze margins are passed on to consumers more rapidly and completely than cost decreases that stretch margins. With negative asymmetry, on the other hand, cost decreases that stretch margins are passed on more rapidly and completely than cost increases that squeeze margins.

Vertical price transmission may be characterized by the magnitude, speed and nature (downwards or upwards) of the price pass-through between different segments of the supply chain. The magnitude of the pass-through measures how much of the initial price change is reflected in the changes in consumer prices observed. The

shorter the lag with which consumer prices follow commodity and producer prices, respectively, the higher the speed of pass-through. Finally, if the speed and the magnitude of the pass-through differ depending on whether there is a price decrease or increase, price transmission is considered to be asymmetric. In order to raise their profit margins, actors along the food supply chain would have an interest in passing on price increases more rapidly than price decreases. As a result the measured pass-through would be higher in the case of price increases than in the case of price decreases (Bukeviciute *et al.* 2009).

The magnitude, the speed and the degree of asymmetry in the pass-through are influenced by cost structures and market conditions, among others (see Zachariasse and Bunte 2003 and Azzam 1999).

3.5. Underlying causes of asymmetric price transmission

Researchers have proposed explanations for the existence of asymmetric price transmission (Meyer and von Cramon-Taubadel 2004) and Frey and Manera 2007). Below, we outline some of the explanations:

- **Market power.** The literature reveals that market power is often perceived as the main potential cause of asymmetric price transmission. The response of retail prices to changes in wholesale or farm-level prices is generally not instantaneous but is instead distributed over time. It is therefore commonly asserted, in the agricultural sector in particular, that imperfect competition allows middlemen to make use of market power (Kinnucan and Forker 1987). In a non-competitive market structure with imperfect information, monopoly (upstream) markets pass on cost increases that squeeze their margin more rapidly and completely than cost decreases that stretch their margin, resulting in positive asymmetric price transmission. Market power can also lead to negative asymmetric price transmission if monopoly firms react less rapidly to price changes that squeeze their margin for fear of losing goodwill (Hein 1980), or risk of having spoilt goods (Ward 1982). Also, negative or positive asymmetric price transmission may result if firms face a kinked demand curve depending on the price expectation of firms as input

and output prices change (Bailey and Brorsen 1989). According to the latter, if an individual oligopoly firm believes that other competing firms will match an increase in output prices as input prices increase, but not a reduction as input prices fall, a positive asymmetric price transmission will result in a kinked convex demand function. On the other hand, if firms believe that competitors are less likely to match output price increases than cuts, the resulting negative asymmetric price transmission will give rise to a concave demand curve. Market power can also give rise to short-run oligopoly collusive agreements if markets are highly concentrated with inelastic demand –although this agreement might break down in the long-run because one firm might have the incentive to surreptitiously cheat.

- **Adjustment cost.** Adjustment cost is the cost of adjusting the quantities and/or prices of inputs and/or outputs. It is assumed that adjustment to increases or decreases takes time. In other words, firms may adjust cost increases and pass these on more rapidly and completely to consumers than cost decreases. Firms may face different adjustment costs depending on whether the quantities and/or prices of inputs and/or outputs are rising or falling (Bailey and Brorsen 1989). One example of adjustment cost in relation to responses to price changes is the menu cost. Menu costs include the costs of changing nominal prices of goods, printing catalogues, dissemination of information about price changes, and cost inflation. For example, the response of agri-food chains retail prices to changes in wholesale or farm-level prices is not immediate, but distributed over time (Kinnucan and Forker 1987). However, Kinnucan and Forker's methodology has some limitations, such as the assumption of a constant return to scale and that of a competitive market beyond the farm gate. They mentioned the following reasons for asymmetry:
    - Normal slow response in agri-food systems associated with storing, transporting and processing agri-food products.
    - Costliness of reprising/adjusting items at retail.
    - The nature of price reporting and collection.

One example for such a delay in response to the changing process could be the evidence from dairy chains, where it takes about six months for retail products prices to adjust fully to change in the farm price of milk (Lamm and Westcott 1981). Blinder (1982) also showed that firms are more concerned with long-term sustained price movements that bring rapid changes to their inventories than with temporary price changes, simply because of menu cost. Additionally, firms would not want to signal to their consumers that the market conditions have changed, because rational buyers would then re-engage in search behaviour.

- **Perishability of the goods.** Ward (1982) carried out price transmission measurements in a chain of fresh vegetables involving price linkages among wholesalers, retailers and shipping points. The results revealed that the wholesale market trends are a major node for pricing and the retail and shipping point prices generally lag wholesale price changes. These results suggest that price changes are not transmitted through the system in the same time period. The analysis suggested that perishability may be a major contributing factor to the asymmetry in price transmission (Aramyan and Kuiper 2009). Hein (1980) proposed that perishability would pose fewer problems compared to commodities with a long shelf life. For commodities with a long shelf life, price changing is costly in terms of both the time taken to put on new labels (menu cost) and in goodwill lost.
- **Government intervention.** Kinnucan and Forker (1987) suggested that government interventions in the pricing policies of farmers could be a source of price asymmetry. The authors explained this suggestion as follows. Retailers and/or wholesalers face uncertainty when attempting to base prices on changes in costs. Governmental interventions to establish a floor on farm products, aiming at protecting the producers' income for some period, may reduce the uncertainty surrounding the interpretation of cost change. An increase in farm prices caused by the implementation of a floor price policy may be viewed by middlemen (e.g. wholesalers) as permanent and be transmitted more rapidly and completely through the marketing system than a decrease in prices. Because

decreases in price support levels occur infrequently, middlemen may view these effects as transitory, which may result in slower and less complete transmission.

- **Inventory management.** Another important aspect in adjustment to input and output price changes is the type of accounting criteria firms use in evaluating their inventory. If a firm adopts historical criteria, i.e. first-in-first-out (FIFO), it does not adjust its output rapidly to cost changes but waits until inventory is depleted. On the other hand, if the firm adopts last-in-first-out (LIFO) criteria, it would adjust prices rapidly in response to changes in input cost (Frey and Manera 2005). The type of convention chosen would influence the speed of adjustment to shocks, because FIFO has a longer lag than LIFO.
- **Demand and supply shift.** Gardner (1975) made certain predictions about how shifts in the demand and supply of food will affect the farm-retail price spread and the farmer's share of retail food expenditure. Under the assumption of long-run competitive equilibrium and constant returns to scale, Gardner (1975) demonstrated that the farm-retail price transmission elasticity differs according to whether observed changes in the market margin are caused by retail-level demand shifts (demand-pull) for food or farm-level supply shifts (cost-push) for agriculture only if the distribution of either the demand or supply shift is predominantly positive or negative. He also stated that the retail-level demand-pull has a stronger impact on the farm-retail price spread than farm-level cost-push. This differential impact could lead to an asymmetric price transmission (Kinnucan and Forker 1987). Von Cramon-Taubadel (1998) pointed out that this will lead to asymmetric price transmission only if the distribution of either the demand or supply shift is predominantly positive or negative.

Despite the fact that many studies have investigated vertical price adjustment along the food chain, results from the empirical literature are inconclusive. Studies generally differ in terms of the goods analysed, countries, time frequencies, time periods and model

specification.[13] Consequently, it is difficult to draw conclusions on which to base policy decisions (Vavra and Goodwin 2005).

3.6. Models used to study price transmission

Different methodologies have been offered in order to evaluate long-run price linkages. The modelling of asymmetric price transmission has been grouped into pre-cointegration and cointegration approaches according to Meyer and von Cramon-Taubadel (2004). The pre-cointegration and the cointegration approaches draw heavily from Houck (1977) and von Cramon-Taubadel and Loy (1996), respectively. However, in recent years there have been a large number of studies that have taken into account transactions and adjustment costs[14]. For this purpose, threshold models have been developed based on the work of Balke and Fomby (1997). However, there are some recent publications where the analysis of price transmission is based on the use of the three methodologies mentioned above (Mogdhaddasi 2008; Ahmadi Shadmehri and Ahmadi 2010; Acquah and Onumah 2010; Hosseini, Nikoukar and Dourandish 2012).

In the next section, we present a review of the methodological approaches that have been applied to detect price transmission. Specific econometric models focus on different aspects of the relation between input and output prices.

3.6.1. Pre-cointegration approach

Farrell (1952) was the first to investigate the irreversible behaviour of the demand function of some habitual goods such as tobacco, beer and spirits in the United Kingdom. Using splitting techniques, Farrell suggested that irreversibility is an important factor in changes in taste or consumer preference. Farrell's model framework has since been adopted in the modelling of asymmetric price transmission in various

[13] Frey and Manera (2007) survey a large number of studies on price asymmetries in the gasoline market, in agricultural products and in financial markets.
[14] See Meyer (2004).

sectors. For example, in agriculture, Tweeten and Quance (1969) used a dummy variable technique to estimate irreversible supply functions of farm products in the United States. The authors investigated the level of aggregate supply (y) and the ratio between input and output prices (x). They split the independent variable x into increasing and decreasing components and use the equation of the form:

$$y_t = \alpha + \beta^+ D_t x_t + \beta^- \left(1 - D_t\right) x_t + \mu_t \tag{3.1}$$

where, D_t takes the value of one if the first difference of x_t is positive, otherwise zero. The dummy variable is used to split x_t into two, with one variable including only increasing input prices with adjustment coefficient β^+ and the other including only decreasing input prices with adjustment coefficient β^-. With this specification Tweeten and Quance (1969) evaluate asymmetry using the F-test. Symmetric price transmission is rejected if β^+ and β^- are significantly different from one another.

Wolffram (1971) argued that the application of the splitting technique is correct only if the parameter estimates in the individual period are constant –that is, if the influence of the independent variable over the total period of investigation is constant. As a solution, Wolffram modified the model of Tweeten and Quance by redefining the increasing and decreasing components of x_t as the summation up to a time period t of positive and negative change x_t (i.e. Δx_t) as:

$$y_t = \alpha + \beta^+ \left(x_0 + \sum_{t=1}^{T} D_t \Delta x_t \right) + \beta^- \left(x_0 + \sum_{t=1}^{T} D_t \Delta x_t \right) + \mu_t \tag{3.2}$$

where x_0 is the initial value of x_t at $t = 0$, and the value D is as defined in Tweeten and Quance (1969). In equation (3.2), the recursive sum of all positive and all negative changes in the input price are included as explanatory variables. Through the modification, Wolffram's model

considered the effects of cumulative variation in the variable x_t compared to that of Tweeten and Quance where the direct impact of period-to-period variation in x_t is accounted for.

Houck (1977) proposed a work on inventories and prices of milk and beans in the U.S. using a specification that is similar to Wolffram's, but operationally clearer. Unlike equation (3.2), his specification does not take initial observation into account because, when considering differential effects the level of the first observation will have no independent explanatory power. Then his static asymmetric model can be written as:

$$y_t^* = y_t - y_0 = \alpha + \beta^+ \left(\sum_{t-1}^{T} \Delta x_t^+ \right) + \beta^- \left(\sum_{t-1}^{T} \Delta x_t^- \right) + \mu_t . \qquad (3.3)$$

When testing the null hypothesis of symmetry $\beta^+ = \beta^-$ using annual data, Houck finds that, for the milk market only, the variation of the level of inventories over the sample period asymmetrically depends on the contemporaneous impact of cumulative price changes.

Ward (1982) argued that the supply of most agricultural products to the markets is seasonal and a price change is distributed over a time lag. As a result, Ward extended the Houck's specification by including lags.

$$y_t^* = y_t - y_0 = \alpha + \left(\sum_{t=0}^{\kappa} \beta_t^+ \Delta x_t^+ \right) + \left(\sum_{t=0}^{\kappa} \beta_t^- \Delta x_t^- \right) + \mu_t .$$

According to Ward, the lag lengths κ can differ because they are the increasing and decreasing price changes and are not expected *a priori* to be the same. As such, a formal test of the symmetry hypothesis is:

$$H_0 : \sum_{i=0}^{k} \beta_t^+ = \sum_{i=0}^{k} \beta_t^- .$$

Ward investigated the impact of wholesale prices on the retail and shipping point prices of the U.S. fresh vegetable market. Using monthly data of various observation periods, Ward found asymmetry in the fresh vegetable market and also observed significant lag responses during periods of rising and falling prices. Kinnucan and Forker (1987) used the Wolffram and Houck asymmetric models for four U.S. major dairy products (butter, cheese, fluid milk and ice cream). Using monthly data from 1971-1981 the authors found that retail dairy product prices adjust more rapidly and fully to increases in the farm prices of milk than to decreases. They argue that governmental price support and industry concentration cause the asymmetric price response; also they discuss the static marketing margin model of Gardner (1975) and show that farm-retail price transmission elasticities are smaller when price changes are predominantly triggered by cost shifts. However, cost shifters are identified to play only a minor role in explaining the asymmetric price adjustment. Ward's approach has been widely used (e.g. Boyd and Brorsen 1988;[15] Hahn 1990; Aguiar and Santana 2002; Capps and Sherwell 2005).

Von Cramon-Taubadel (1998) has demonstrated that the Wolffram-Houck procedure is fundamentally incompatible with cointegration between two price series. Thus, von Cramon-Taubadel proposed a modification of the standard Wolffram-Houck specification to include an error correction term. This methodology will be presented in the following section.

3.6.2. Cointegration and error correction models

The shortcoming of the asymmetric price transmission models presented in section 3.6.1 is that they fail to account for the possibility of the presence of a long-run equilibrium cointegration relationship in the price data. Cointegration analysis is an alternative procedure for evaluating the presence of stochastic trends in the price series. It was developed and applied in earlier work by Engle and Granger (1987) and Engle and Yoo (1987). Granger and Lee (1989) proposed a modification to the error correction representation that makes it possible to

[15] They did not find asymmetric price relationships in the U.S. pork sector.

test for asymmetric price transmission between cointegrated variables. This involves a Wolffram-type segmentation of the error correction term into positive and negative components.

The first attempt to incorporate the concept of cointegration into models of asymmetric price transmission was made by von Cramon-Taubadel and Fahlbusch (1994). The authors pointed out the potential for spurious regression results in the case of asymmetry tests based on techniques discussed above, in particular the pre-cointegration techniques. Their approach was later elaborated by von Cramon-Taubadel and Loy (1996) and von Cramon-Taubadel (1998). They suggested that in the case of cointegration between the price series, an error correction model extended by the incorporation of asymmetric adjustment terms provides a more appropriate specification for testing for asymmetric price transmission.

Following the Engle and Granger (1987) representation theorem, if y_t and x_t are cointegrated, an error correction model is fitted as follows:

$$\Delta y_t = \alpha + \sum_{t=0}^{k} \beta \Delta y_{t-1} + \sum_{t=1}^{l} \gamma \Delta x_{t-1} + \mu ECT_{t-1} + \varepsilon_t \qquad (3.4)$$

where, the error correction term ECT_{t-1} is given as:

$$ECT_{t-1} = y_{t-1} - \alpha - \beta x_{t-1}.$$

The ECT measures the deviation from the long-run equilibrium between the y_t and x_t, and allows y_t not only to respond to changes in x_t but also to correct any deviations from the long-run equilibrium that may be left from previous periods. Granger and Lee (1989) proposed a modification to equation (3.4) that involves a Wolffram-type segmentation of the error correction term into positive and negative components. This (i.e. positive and negative deviation from the long-run equilibrium $-ECT^+$ and ECT^-) makes it possible to test for asymmetric price transmission.

$$\Delta y_t = \alpha + \sum_{t=0}^{k} \beta \Delta y_{t-1} + \sum_{t=1}^{l} \gamma \Delta x_{t-1} + \mu^{+} ECT_{t-1}^{+} + \mu^{-} ECT_{t-1}^{-} + \varepsilon_t. \quad (3.5)$$

Using an F-test, the null hypothesis of symmetry can be tested by checking whether the coefficients of the positive and negative errors are identical (i.e. $\mu^{-} = \mu^{+}$).

An alternative approach to model asymmetry within the error correction framework is provided by von Cramon-Taubadel and Loy (1996). They suggested that the contemporaneous response Δx_t can also be split into positive and negative components to allow for more complex dynamics effects such as:

$$\Delta y_t = \alpha + \varphi^{-} \Delta x_t^{-} + \varphi^{+} \Delta x_t^{+} + \sum_{i=0}^{k} \beta \Delta x_{t-i} + \sum_{j}^{q} \gamma \Delta y_{t-j} + \\ + \mu^{-} ECT_{t-1}^{-} + \mu^{+} ECT_{t-1}^{+} + \varepsilon_t. \quad (3.6)$$

A formal test of the asymmetry hypothesis using equation (3.6) is that $\mu^{-} \neq \mu^{+}$ and $\varphi^{-} \neq \varphi^{+}$.

Noticeably, equation (3.6) nests the Houck's model given in equation (3.3). Numerous price transmission studies implement von Cramon-Taubadel and Loy (1996) testing procedures for asymmetric price transmission or some variants of their proposed ECM approach. Von Cramon-Taubadel and Loy (1996) used an ECM to study the spatial price transmission on world wheat markets. Von Cramon-Taubadel (1998) demonstrated that transmission between producer and wholesale pork prices in northern Germany is asymmetric. FAO (2003) provided a review of the application of time series techniques (cointegration, ECM) in testing market integration and price transmission for a number of cash and food crop markets in developing countries. Capps and Sherwell (2007) analysed the behaviour of asymmetry for milk for seven U.S. cities according to the conventional Houck approach and the von Cramon-Taubadel and Loy ECM approach. The empirical results suggested that the farm-retail price transmission process for milk is asymmetric. Acquach and Dadzie (2010) applied the von Cramon-

Taubadel and Loy error correction approach in analysing retail-wholesale maize price transmission in Ghana. In accordance with common belief, they found that retailers react more quickly to increasing wholesale prices than decreasing wholesale prices. Similarly, Acquach (2010) applied the Granger and Lee asymmetric ECM in analysing price transmission between retail and wholesale prices in the Ghanaian maize market.

More recent studies on asymmetric price transmission have advocated the use of threshold cointegration models that explicitly account for both non-stationarity data issues and the possibility of nonlinear and threshold-type adjustments in the price series. These models will be discussed in the following section.

3.6.3. Threshold autoregressive processes

Recent developments in time series analysis techniques have recognized the potential for nonlinear and threshold-type adjustments in ECMs. Threshold cointegration is used to model the possibility that the short-run dynamic relationship depends on whether or not the absolute value (magnitude) of the equilibrium error is within a range defined by a threshold (i.e. lies below or above a critical threshold). This relationship can be represented in threshold autoregressive (TAR) and momentum-TAR (M-TAR) models introduced by Enders and Granger (1998). These techniques are important because they address the inferential limitations of previous studies that failed to account for the nonstationary and nonlinear behaviour of agricultural price series.

An Engle and Granger (1987) linear model that defines the dynamic long-run equilibrium relationship between input and output prices is given as:

$$y_t = \alpha + \beta x_t + \mu_t \,. \tag{3.7}$$

Firstly, Engle and Granger (1987) recommended ordinary least square estimation of equation (3.7), where (y, x) are non-stationary variables, α and β are parameter estimates and μ_t is the error term

which may be serially correlated. The residual from the estimation of equation (3.7) is used to test for unit root (no cointegration) applying the standard Dickey-Fuller test using the following equation:

$$\Delta\mu_t = \rho\mu_{t-1} + \xi_t \tag{3.8}$$

where, ξ_t is a white noise process. If the null hypothesis of no cointegration (i.e. $\rho = 0$) is rejected, the alternative of $(2 < \rho < 0)$ is accepted, implying the long-run equation (3.7) is stationary (cointegrated). Enders and Granger (1998) proposed that the Engle and Granger (1987) unit root test will be misspecified if adjustment is asymmetric. Therefore to test for the stationarity of the error terms and incorporate asymmetric adjustment into the model, Enders and Granger (1998) and Enders and Sicklos (2001) proposed that the alternative specification is to fit a threshold model, for example the threshold autoregressive (TAR) specification where the relation between $\Delta\mu_t$ and μ_{t-1} is supposed to vary across two regimes, depending on the value of μ_{t-1}:

$$\Delta\mu_t = I_t\rho_1\mu_{t-1} + (1 - I_t)\rho_2\mu_{t-1} + \xi_t \tag{3.9}$$

where I_t is an Heaviside indicator function defined as: $I_t = 1 \text{ if } \xi_{t-1} \geq \mathrm{r}$ and $I_t = 0 \text{ if } \xi_{t-1} < \mathrm{r}$, where r is a threshold value.

If the null hypothesis $\rho_1 = \rho_2 = 0$ in equation (4.9) is rejected, then *x* and *y* are cointegrated and the asymmetric ECM which stems from a TAR specification is:

$$\Delta y_t = \sum_{i=0}^{s} \alpha_i \Delta x_{t-i} + \gamma^+ E_{t-1}^+ + \gamma^- E_{t-1}^- + u_t \tag{3.10}$$

where the two error correction terms are defined as:

$$E_{t-1}^{+} = I_t \mu_{t-1}$$
$$E_{t-1}^{-} = (1 - I)\mu_{t-1}.$$

Enders and Granger (1998) proposed a second model for cointegration, known as M-TAR. This name comes from the financial definition of 'momentum' which indicates the rate of acceleration of prices. As the authors assert, M-TAR models are especially valuable when adjustment is asymmetric in a way that the series exhibits more momentum in one direction than in the other. In M-TAR models the threshold is placed on the variation of the first difference of variable ε_{t-1}. To allow for this, the Heaviside indicator is specified as $I_t = 1 \text{ if } \Delta\xi_{t-1} \geq \text{r}$ and $I_t = 0 \text{ if } \Delta\xi_{t-1} < \text{r}$.

TAR and M-TAR specifications have become increasingly popular in the literature on asymmetric price transmission during the last few years. Abdulai (2000) used TAR and M-TAR coitegration models to study the relationship between the central maize market in Techiman and local markets in Accra and Bolgatanga in the country of Ghana. He found the existence of an LR relationship in both Techiman-Accra and the Techiman-Bolgatanga markets. He noticed that wholesale maize prices in the local market respond more rapidly to increases than to decreases in the central price. Abdulai (2002) then went on to examine short-run adjustment in producer-retail price changes of pork meat in Switzerland using TAR and M-TAR cointegration models. Asymmetry was found to exist in the sense that increases in producer prices that lead to declines in marketing margins are passed on more quickly to retail prices than decreases in producer prices that result in increases in the marketing margins. While both TAR and M-TAR models support cointegration, standard information criteria indicate M-TAR as the best fitting specification. Additionally, Awokuse and Wang (2009) applied the TAR and M-TAR models to the analysis of U.S. price data for butter, cheese and fluid milk using monthly data from 1987-2006. They found that the price transmission of changes between producer and retail stages of the marketing chain is asymmetric for butter and fluid milk, but not for cheese prices. Similarly, Stewart and Blayney

(2011) investigated farm-to-retail price transmission for whole milk and cheddar cheese for the U.S., showing that shocks at the farm gate are transmitted with delay and asymmetry to retail. Recently, Tekgüç (2013) used TAR and M-TAR tests to look for empirical evidence of abuse of market power in milk processing firms in Turkey.

3.6.4. Threshold Vector Error Correction Model (TVECM)

Balke and Fomby (1997) extended the threshold autoregressive models (TAR) to a cointegration framework, thus combining non-linearity and cointegration. One of the most important statistical issues for these models is testing for the presence of a threshold effect. They used a two-step strategy for analysing the price dynamics. First, they test the null hypothesis of no cointegration against the alternative of linear cointegration. If the hypothesis of no cointegration is rejected, in the second step, a test of the null hypothesis of linearity against the alternative of threshold cointegration would be examined ('sup-Wald' test).

Lo and Zivot (2001) extended the Balke and Fomby (1997) approach to a multivariate threshold cointegration model with a known cointegrating vector using the tests of Tsay (1989) and the multivariate extension of Hansen (1999). As they indicated, the multivariate threshold cointegration procedures that utilize the full structure of the model have a higher power than univariate procedures. Hansen and Seo (2002) developed a maximum likelihood based estimation theory for the TVECM with the unknown cointegrating vector. They also provided statistics and asymptotic theory for testing the existence of a threshold effect in the two-regime error correction model.

Goodwin and Holt (1999) first proposed the use of TVECM to allow for threshold effects in vertical transmission, and Goodwin and Piggott (2001) is the seminal paper on the use of the TVECM in the analysis of spatial price transmission. Similarly, Serra and Goodwin (2003), Ben-Kaabia and Gil (2007), Rapsomanikis and Hallam (2006) and Falsafian, Yazdani and Moghadasi (2011) used TVECM.

Their results confirmed asymmetries but the effects of these asymmetries are modest and may be economically insignificant. They indicated that the movement towards the long-run equilibrium could not

take place in every time period due to the presence of some adjustment costs on the side of economic agents. In other words, there might be a discontinuous adjustment towards the long-run equilibrium in order for economic agents to move the system back to equilibrium, only when deviations from the long-run equilibrium exceed a certain threshold. Note that, in this case, the benefits of adjustments are higher than the costs. More specifically, threshold cointegration exists when the cointegrating relationship does not take place around a certain range, but comes into effect if the system gets 'too far away' from the equilibrium, i.e., cointegration would occur if the system exceeds a critical threshold.

The method proposed on the above-mentioned studies is described below. Let $p_t = (cp_t, pp_t)$ be a 2-dimentional $I(1)$ time series, where cp_t and pp_t refer to the log prices of consumers and producers, respectively. It is assumed that there exists a relationship between these time series with a cointegrating scalar of $\beta = (1, -\beta_1)$. A linear VECM of order $l+1$ is of the form

$$\Delta p_t = A' X_{t-1}(\beta) + u_t \tag{3.11}$$

where

$$X_{t-1}(\beta) = \begin{pmatrix} 1 \\ w_{t-1(\beta)} \\ \Delta p_{t-1(\beta)} \\ \Delta p_{t-2(\beta)} \\ \vdots \\ \Delta p_{t-l(\beta)} \end{pmatrix}$$

Δ is the first order difference operator, the regressor $X_{t-1}(\beta)$ is $k \times 1$ and A is $k \times 2$ where $k = 2l + 4$. The error u_t is assumed to be a (2×1) vector martingale difference sequence (MDS) with a covariance matrix

$\Sigma = E(u_t u_t')$. Note that $w_{t-1}(\beta) = cp_{t-1} - \beta_1 pp_{t-1}$ is the error correction term. The parameters (A, Σ) are estimated by maximum likelihood under the assumption that errors u_t are iid Gaussian (Aslanidis and Kouretas 2005).

An extension of model (3.11), TVECM with a three-regime takes the form

$$\Delta p_t \begin{cases} A_1' X_{t-1}(\beta) + u_t, & if \;\; w_{t-1}(\beta) \le \gamma_1 \\ A_2' X_{t-1}(\beta) + u_t, & if \;\; \gamma_1 \le w_{t-1}(\beta) \le \gamma_2 \\ A_2' X_{t-1}(\beta) + u_t, & if \;\; w_{t-1}(\beta) > \gamma_2 \end{cases} \tag{3.12}$$

where γ_1 and γ_2 are the threshold parameters. If $\gamma_1 = \gamma_2$ then model (3.12) converts to a two-regime TVECM(2).

$$\Delta p_t = \begin{cases} A_1' X_{t-1}(\beta) + u_t, & if \; w_{t-1}(\beta) \le \gamma \\ \\ A_2' X_{t-1}(\beta) + u_t, & if \; w_{t-1}(\beta) > \gamma. \end{cases}$$

Following Hansen and Seo (2002), the threshold parameters and the cointegrated vector are estimated by using the grid search procedure over the two-dimensional space (β, γ) and relies on the log determinant of the estimated residual covariance matrix of the TVECM. The optimal threshold parameters and cointegration vector can be estimated using the following optimization program:

$$(\hat{\beta}, \hat{\gamma}) = \arg\min(log \left| \hat{\Sigma}(\beta, \gamma) \right|) \tag{3.13}$$

subject to the limitation of β that is:

$\pi_o \le T^{-1}\sum_{t=1}^{T} 1(p_t'\beta \le \gamma) \le 1-\pi_o$, where $\pi_o > 0$ is a trimming parameter.

In the test for linearity, as threshold parameters are not present under the null hypothesis (nuisance parameters), so the test statistic suffers from nonstandard inference. To solve this, Lo and Zivot (2001) developed a sup-LR statistic that tests a TVECM(m), with m regime (for $m>1$) against a linear VECM:

$$LR_{1m} = T\left(\ln\left(\left|\hat{\Sigma}\right|\right) - \ln\left(\left|\hat{\Sigma}_m\left(\hat{\beta},\hat{\gamma}\right)\right|\right)\right) \tag{3.14}$$

where $\hat{\Sigma}$ and $\hat{\Sigma}_m\left(\hat{\beta},\hat{\gamma}\right)$ denote the estimated residual covariance matrices from the linear VECM and TVECM(m), respectively. As the distribution of the sup-LR is nonstandard, Hansen and Seo's (2002) parametric residual bootstrapping procedure was used to compute *p*-values.

An alternative method for estimating TVECM suggested by Hansen and Seo (2002) is based on a maximum likelihood method, which involves a joint search over the threshold parameter and cointegrating vector. They developed a test r the linear cointegration null hypothesis against the alternative of threshold cointegration in a two-regime TVECM based on a Lagrange Multiple (LM) statistic. The employed LM statistic is:

$$\begin{aligned} LM(\beta,\gamma) = vec\left(\hat{A}_1(\beta,\gamma) - \hat{A}_2(\beta,\gamma)\right)'\left(\hat{V}_1(\beta,\gamma)\right) + \\ + \left(\hat{V}_2(\beta,\gamma)\right) \times vec\left(\left(\hat{A}_1(\beta,\gamma) - \hat{A}_2(\beta,\gamma)\right)\right) \end{aligned} \tag{3.15}$$

where $\hat{A}_1(\beta,\gamma)$ and $\hat{A}_2(\beta,\gamma)$ are the parameters estimated in the first and second regimes of equation (3.12), respectively. $\hat{V}_1(\beta,\gamma)$ and $\hat{V}_2(\beta,\gamma)$ are the Eicker-White covariance matrix estimators for vec

$\hat{A}_1(\beta,\gamma)$ and vec $\hat{A}_2(\beta,\gamma)$, respectively. Because of the presence of a nuisance parameter, Hansen and Seo (2002) employed the sup-LM statistic as follows:

$$\sup LM = \sup LM(\tilde{\beta},\gamma) \qquad \gamma_L \le \gamma \le \gamma_U \tag{3.16}$$

where $\tilde{\beta}$ is the null estimate of the cointegrating vector and the search region $[\gamma_L,\gamma_U]$ is set so that γ_L is the π_o percentile of $z_{t-1}(\tilde{\beta})$ and γ_U is the $(1-\pi_o)$ percentile. Like the sup-LR, the p-value of the sup-LM has been calculated by Hansen and Seo's (2002) parametric residual bootstrap procedure.

Once the presence of a threshold effect is confirmed, the next question to answer is what kind of threshold model is more appropriate for the data. To this end, Lo and Zivot (2001) suggested the LR statistic to test the null of a TVECM(2) against the alternative of a TVECM(3):

$$LR_{2,3} = T\left[\ln\left(\left|\hat{\Sigma}_2\left(\hat{\beta},\hat{\gamma}\right)\right|\right) - \ln\left(\left|\hat{\Sigma}_3\left(\hat{\beta},\hat{\gamma}\right)\right|\right)\right] \tag{3.17}$$

where $\hat{\Sigma}_2\left(\hat{\beta},\hat{\gamma}\right)$ and $\hat{\Sigma}_3\left(\hat{\beta},\hat{\gamma}\right)$ denote the estimated residual covariance matrices from the unrestricted TVECM(2) and TVECM(3), respectively. The asymptotic distribution of $LR_{2,3}$ is non-standard, and we use Hansen and Seo's (2002) parametric residual bootstrap procedure to calculate related *p*-values.

Hassouneh, von Cramon-Taubadel, Serra and Gil (2012)[16] noticed that the Greb *et al.* (2011a) regularized empirical Bayesian (REB) estimator has less bias and a lower variance than the profile likelihood estimator in Monte Carlo experiments. In addition, Gred *et al.* (2011b)

[16] They described two alternative models, the Smooth Transition Vector Error Correction Models and the multivariate local polynomial fitting.

demonstrated that the REB estimator has these properties in the specific case of TVECM models. This estimator accounts for the variance of the nuisance parameters and does not require any arbitrary restrictions on the number of observations in each regime.

The work of Ihle and von Cramon-Taubadel (2008) provides a comparison of the TVECM and the Markov-Switching VECM together with a literature review of applications of the TVECM to price transmission analysis. They argue that both models allow for non-linear adjustment in the long-run equilibrium.

The Gotz and von Cramon-Taubadel (2008) application to the German wholesale market for apples uses a different threshold cointegration based on the Gonzalo and Pitarakis (2006) test. They support that the proposed approach is particularly suitable for capturing irregular seasonal threshold effects in price transmission typical for fresh fruit and vegetables.

3.7. Empirical literature on the dairy sector

The first paper to focus on dairy product prices was presented by Kinnucan and Forker (1987). Their results highlighted that asymmetries in both magnitude and time of response are found in the retail prices of dairy products (fluid milk, cheese, butter, and ice cream) in the U.S., with larger and speedier reactions when farm prices increase. However, Kinnucan and Forker's methodology has some limitations, such as the assumption of a constant return to scale and that of a competitive market beyond the farm gate. The competitive market hypothesis is of particular importance because long-run asymmetry in price transmission may reflect the market power of middlemen (processor and/or retailers). In addition, the assumption that the farm-retail price spread is independent of the quantity of the agricultural commodity market is limiting. A decrease in the quantity marketed may not result in a corresponding reduction in the use of marketing inputs, which could likely have an impact on the industry's marketing margin. Since Kinnucan and Forker used data from 1971 through 1981 their conclusion may not apply to recent events.

The question of farm to retail price transmission has been revisited often for U.S. fluid milk prices. Lass, Adanu and Allen (2001) examined fluid milk prices in the Hartford, Connecticut and Boston, Massachusetts markets between January 1982 and June 1998. Lass (2005) reported on an extension of that study using data through September 2001. Capps and Sherwell (2007) investigated fluid milk prices in seven cities between January 1994 and December 2002. Most recently, Awokuse and Wang (2009) examined national average fluid milk prices between January 1987 and December 2006. Differences in methodology across these studies complicate efforts to compare their findings. However, all studies find evidence of some type of asymmetry. Stewart and Blayney (2011) investigated farm-to-retail price transmission in the 2000s for whole milk and cheddar cheese. Results showed that price shocks at the farm gate are transmitted with delay and asymmetry to retail prices.

Serra and Goodwin (2003) found evidence for asymmetric price transmission in dairy products in Spain. However, these asymmetries do not seem to be present in highly perishable dairy products. In accordance with McCorriston *et al.* (2001), their results do not suggest a relationship between asymmetric price transmission and market concentration. Based on a dynamic reduced-form model of asymmetric price transmission, Chavas and Mehta (2004) analysed the butter market in the U.S. for the period 1980 to 2001. They found strong support for asymmetry in the adjustment of retail prices, with a stronger reaction when confronting wholesale price increases than wholesale price decreases. However, the evidence for wholesale adjustments is weak and based on the asymmetry of retail price adjustments. These authors suggested search costs, menu costs and imperfect competition as causes of the asymmetry at the retail level.

The European Commission Staff Working Document on "A better functioning food supply chain in Europe" in the October 2009 Communication (COM [2009] 591) analyses the price transmission mechanism in the EU food supply chain, based on specific investigations of the dairy sector in certain member states.[17] The findings for the dairy sector will be discussed in this section.

[17] Selected countries were France, the United Kingdom, Denmark, Germany, Slovenia, Austria, the Czech Republic and Lithuania. The lack of price data along the food supply chain at the national level prevented extending the analysis to other countries.

The far-ranging differences in results between similar products across countries and between products in each country reflect the diversity of the competitive structure and the functioning of the chain in each country as well as differences in the price formation mechanism.

For unprocessed products like butter, bulk cheese and liquid milk, a higher degree of price transmission was detected than for processed products which showed a lower degree of price transmission. In France, the consumer prices seem to have responded with little delay (within the same month or with a month delay) to changes in milk producer prices. Asymmetric price transmission was found in the UK due to the fact that retail prices for most dairy products remain high while farm-gate prices dropped. This may be linked to factors such as imbalanced bargaining power along the dairy chain and/or pricing strategies in the downstream sectors. To the contrary, the empirical evidence for Germany indicated an absence of price transmission from the milk producer level to the consumer level for most dairy products which may be attributed to the high degree of processing in the dairy chain, pricing and marketing strategies of the downstream sectors. Instantaneous transmission for liquid milk and yogurt was shown in Austria; while for cheese and yogurt with fruit, no significant link was shown between changes in the consumer price and changes in the milk producer price. In contrast to what was observed in the abovementioned countries, in Denmark price transmission seems to be higher for more processed products. High price transmission of upwards price movements rather than for price reductions took place in the Slovenian dairy supply chain which may be due to pricing strategies in the downstream sector and imbalanced bargaining power.

The rather low overall price transmission between the agricultural producer stage and the consumer stage may be linked to several factors: the steadily declining share of the milk raw materials into the consumer price of dairy products, potential inefficiencies in the market structure of the chain (either linked to imbalances in bargaining power and/or anti-competitive practices), some specific adjustment constraints and costs (e.g. long-term contracts between economic actors) and pricing/marketing strategies in the downstream sectors. Furthermore, the role of dairies in the price formation mechanism may significantly alter the causality and degree of price transmission between

milk producer prices and dairy consumer prices. Finally, the importance of producer organizations in the dairy sector in many countries may mask some developments in the analysis of price transmission along the dairy supply chain (as producers may receive dividends and/or price bonuses in addition to the observed price of milk) (COM[2009] 591). However, caution is deemed necessary in drawing firm analytical conclusions from the measurement and interpretation of the functioning of the price transmission mechanism owing to the considerable diversity of the food supply chain in the EU across and within member states and product chains.

Despite a large number of studies that have investigated the phenomenon of price transmission in agricultural markets, it is not possible to draw strong conclusions upon which policy decisions could be based. Although many studies seeking imperfect price transmission have found support for it, the evidence is often mixed and varies widely across commodities and countries (Vavra and Goodwin 2005).

Serra and Goodwin (2003) studied price transmission among farm and retail markets for the dairy sector in Spain. They found the presence of asymmetries in vertical price transmission patterns for dairy products with a relatively long shelf life and an absence of asymmetries for highly perishable products. Fernández-Amador *et al.* (2010) empirically assessed the vertical price transmission between producer and consumer prices of milk products in Austria for the period from January 1996 to February 2010. Their results indicated that asymmetries play an important role in the pass-through of prices for milk products in Austria. Bakus and Fertő (2008) found some empirical evidence that regional dairy prices in Hungary are spatially integrated, which supports the symmetrical transmission result in Hungary. On the other hand, Bakucs, Falkowski and Fertő (2012) used the vector error correction model framework allowing for potential structural breaks showing that Polish milk prices, unlike Hungarian ones, are characterized by short-term and long-term asymmetries. Moreover, the causality for Poland runs from retail to farm gate while for Hungary it runs from the farm to the retail sector.

CHAPTER 4

EMPIRICAL ANALYSIS

4.1. Threshold Model[18]

Our empirical analysis utilizes two series of monthly milk prices from January 1989 through August 2014 giving a total of 306 observations. Producer prices were taken from the ELOGAK. Retail prices were calculated from the consumer price index of milk obtained from the Hellenic Statistical Authority and the retail price of milk in 2005 obtained from e-prices.gr. The proposed model follows the threshold ECM of the form presented in Ben-Kaabia *et al.* (2005). A description of the model and a discussion of the estimated method are presented in this section.

The VECM is linear in two ways. First, it is linear in the way that all of the parameters in the model are assumed to be constant over the entire sampling period. Second, it is linear in the way that the left-hand-side variables react linearly to changes in the right-hand-side variables. Numerous studies have shown that in many settings one or both of these types of linearity cannot be expected to hold (von Cramon-Taubadel 1998; Serra and Goodwin 2003; Ben-Kaabia and Gil 2007).

Following Ben-Kaabia *et al.* (2005) and Ben-Kaabia and Gil (2007), let $p_t = \left(pc_t, pp_t \right)'$ be a vector of logged prices of goods at consumer and farm prices. Assuming that the two prices are I (1) time series and cointegrated with cointegrating vector $\beta' = \left(1, -\beta_2\right)$, the linear VECM representation of order k of p_t is given by:

[18] The theoretical description of the model appeared in the article by Rezitis and Reziti (2011).

$$\Delta p_t = \alpha\left[\omega_{t-1}(\beta)\right] + \sum_{i=1}^{k-1} \Gamma_i \Delta p_{t-i} + u_t \qquad (4.1)$$

where $\omega_{t-1}(\beta) = \beta' p_{t-1}$ is the cointegrating vector evaluated at the value $\beta' = (1, -\beta_2)$; α is a (2×1) vector which gives the weights of the deviations from the cointegration relationship in the VECM equations; Γ_i, $i = 1, 2...$ are (2×2) matrices of short-run parameters; and u_t is a vector of error term independently and identically Gaussian-distributed with a positive definite covariance matrix Σ. Equation (4.1) indicates that consumer-producer price changes (Δp_t) are simultaneously explained by deviations from the long-run equilibrium, i.e., error correction term $(\omega_{t-1}(\beta))$, and lagged short-term reactions to previous consumer-producer price changes (Δp_{t-i}). Thus, the VECM can be described as the adjustment process along which the long-run equilibrium is maintained and supposes that such an inclination to move towards the long-run equilibrium is present in every time period.

Balke and Fomby (1997) indicate that the movement towards the long-run equilibrium could not take place in every time period due to the presence of some adjustment costs on the side of economic agents. In other words, there might be a discontinuous adjustment towards the long-run equilibrium in order for economic agents to move the system back to equilibrium, only when deviations from the long-run equilibrium exceed a certain threshold. Note, that, in this case, the benefits of adjustments are higher than the costs. More specifically, threshold cointegration exists when the cointegrating relationship does not take place around a certain range, but it comes into effect if the system gets 'too far away' from the equilibrium, i.e., cointegration would occur if the system exceeds a critical threshold.

Our application analyses asymmetric transmission between consumer-producer milk prices by using Hansen and Seo's (2002) threshold cointegration approach. Note that Hansen and Seo extend the threshold literature by simultaneously estimating the cointegrating vector and the threshold parameter. In particular, Hansen and Seo (2002)

estimate a two-regime Threshold Vector Error Correction Model ($TVECM_2$) with one cointegrating vector and a threshold parameter based on the error correction term. A $TVECM_2$ can be written as:

$$\Delta p_t = \begin{cases} \alpha^1 \omega_{t-1}(\beta) + \sum_{i=1}^{k-1} \Gamma_t^1 \Delta p_{t-i} + u_t^1, & if\ \omega_{t-1}(\beta) \le \lambda \\ \alpha^2 \omega_{t-1}(\beta) + \sum_{i=1}^{k-1} \Gamma_t^2 \Delta p_{t-i} + u_t^2, & if\ \omega_{t-1}(\beta) > \lambda \end{cases} \tag{4.2}$$

where $\omega_{t-1}(\beta)$ is the residuals of the equilibrium relationship of consumer-producer prices representing the threshold variable, and λ is the threshold parameter that separates the two regimes. Equation 4.2 indicates that consumer-producer price changes (Δp_t) are regime-specific since the adjustment towards the long-run equilibrium relationship $(\omega_{t-1}(\beta))$ is regime-specific too. A more analytical presentation of (4.2) is given below:

$$\begin{bmatrix} \Delta pc_t \\ \Delta pp_t \end{bmatrix} = \begin{bmatrix} \alpha_c^1 \\ \alpha_p^1 \end{bmatrix} \left(pc_{t-1} - \beta\, pp_{t-1} \right) + \Gamma^1(L) \begin{bmatrix} \Delta pc_{t-1} \\ \Delta pp_{t-1} \end{bmatrix} + \begin{bmatrix} uc_t^1 \\ up_t^1 \end{bmatrix},$$
$$if\ \left(pc_{t-1} - \beta\, pp_{t-1} \right) < \lambda$$

$$\begin{bmatrix} \Delta pc_t \\ \Delta pp_t \end{bmatrix} = \begin{bmatrix} \alpha_c^2 \\ \alpha_p^2 \end{bmatrix} \left(pc_{t-1} - \beta\, pp_{t-1} \right) + \Gamma^2(L) \begin{bmatrix} \Delta pc_{t-1} \\ \Delta pp_{t-1} \end{bmatrix} + \begin{bmatrix} uc_t^2 \\ up_t^2 \end{bmatrix},$$
$$if\ \left(pc_{t-1} - \beta\, pp_{t-1} \right) > \lambda\,.$$

Note that the methodology of Hansen and Seo (2002) assumes both parameters β and λ unknown and estimated from the data while other threshold methodologies assume these parameters known *ex ante*. Furthermore, Hansen and Seo (2002) propose a sup-LM test statistic

of linear VECM against a threshold VECM with two regimes when the true cointegrating vector is unknown.[19]

The data used in this study are monthly time series containing 247 observations running from January 1989 to August 2014. The consumer price index for milk was obtained from the Hellenic Statistical Authority and the Ministry of Development and Competitiveness. The producer prices of milk were obtained from the Hellenic Organization of Milk and Meat. The variables *pc* and *pp* present logarithms. Descriptive statistics for consumer and producer prices are reported in Table 4.1.

TABLE 4.1
Descriptive statistics

	pc	*pp*
Mean	-0.080	-1.161
STD	0.357	0.279
Skewness	-1.103	-0.962
Kurtosis	3.284	3.415

Notes: *pc* stands for the natural logarithms of consumer prices while *pp* stands for the natural logarithms of producer prices. *STD* stands for standard deviation.

4.2. Integration analysis

This analysis uses two different unit root tests to check for unit root nonstationarity in price series. The first test used is the Augmented Dickey-Fuller (ADF) test proposed by Said and Dickey (1984), the second is the KPSS test introduced by Kwiatkowski *et al.* (1992). The results related to unit root tests are reported in Table 4.2. Test results indicate that consumer-producer prices contain a unit root, i.e., price series are $I(1)$. When first differences are used unit root nonstationarity is rejected, i.e., first differences of prices are $I(0)$. This result opens up the possibility of cointegration among consumer-producer prices.

[19] The sup-LM test is denoted as: $\sup LM = \sup_{\lambda L \leq \lambda \leq \gamma U} LM(\tilde{\beta}, \lambda)$ where β is the $\tilde{\beta}$ estimated.

TABLE 4.2
Unit-root tests

Variables	Augmented Dickey-Fuller (ADF) with trend	
	Level	First difference
pc	-2.858 (1) [0.178]	-14.972 (0) [0.000]
pp	-2.853 (2) [0.180]	-8.803(1) [0.000]
KPSS with trend		
	Level	First difference
pc	0.436	0.148
pp	0.346	0.125

Notes: Figures in parentheses denote number of lags in the augmented term of the ADF test that ensures white-noise residuals. Figures in brackets denote p-values. The null hypothesis of ADF test is 'there is a unit root' while the null hypothesis of the KPSS test is 'there is no root, i.e. stationary series'.

4.3. Cointegration analysis

Once having identified that consumer-producer prices are integrated of the same order, i.e., $I(1)$, a vector autoregression (VAR) model is postulated to obtain a long-run relationship. Then, potential cointegrating relationships are investigated. Taking into account the structure of the model, a test for cointegration between milk prices (i.e., pc and pp) is performed and a VECM, described by equations system (4.1), is estimated.

The Schwarz criterion proposed a lag order of 1, while the Hannan-Quinn criterion proposed a lag order of 2, and so, in order to avoid possible autocorrelation in the residuals, the lag order of 2 was chosen (Dennis 2006). Congregation tests developed by Johansen and Juselious (1990) were estimated. The results of the estimated eigenvalues and the trace test are reported in Table 4.3. The results of both the trace and λ-max tests are presented in Table 4.3 suggesting that the null hypothesis of zero cointegrating vectors is rejected and one long-run relationship exists.

TABLE 4.3
Johansen's test for cointegration between P_{rt} and P_{ft}

H_1: Testing the number of cointegrating vectors				
No. of cointegrating vectors	λ - max	95% λ - max	Trace statistic	95% trace
$r = 0$	41.62	15.89	50.62	20.26
$r \leq 1$	9.00	9.16	9.00	9.16

Once the presence of a cointegrating relationship is established between producer and consumer prices, the associated error correction vector autoregressive (ECVAR) mechanism is estimated and the error correction vector $\left(ect_t = \omega_t\left(\hat{\beta}\right)\right)$, which describes the long-run dynamics, is obtained.

The cointegrating vector is:

$$ect_t = lnPC_t - \beta_0 - \beta_1 lnPP_t = pc_t - \underset{(-3.256)}{0.651} - \underset{(-2.151)}{0.378}\, pp_t \qquad (4.3)$$

where $\beta_0 = 0.651,\ \beta_1 = 0.378$. Note that in equation (4.3) figures in parenthesis denote t-statistics and lower case letters represent natural logarithms of producer and consumer prices. The long-term equilibrium relative markup (*EMUP*) as a percentage of the retail price is obtained from the cointrating vector (4.3) when $ect_t = 0$ and is given by:

$$EMUP = \frac{e^{\beta_0} PP^{\beta_1} - PP}{PC} \ . \qquad (4.4)$$

Note that for the period under consideration the *EMUP* is about 95.37% of the retail price evaluated at the average farm and retail prices while the observed relative markup is about 66.75% of the retail price.

4.4. Threshold cointegration

The possibility of threshold cointegration is explored by applying the sup-LM test of Hansen and Seo (2002). As they demonstrate, the sup-LM statistic has a nonstandard asymptotic distribution and they suggest two bootstrapping techniques for computing the p-values of the test: one is the fixed regressor bootstrap and the other is the residual bootstrap. Based on Stigler (2010), the fixed regressor bootstrap is calculated with 1,000 simulation replications. The test results suggest the rejection of the null hypothesis of linear in favour of threshold cointegration since the sup-LM statistic is equal to 24,367 with a p-value of 0.006. Note also that the corresponding critical value of the fixed regressor bootstrap at the 5% level of significance is equal to 18,028.

The specification of the $TVECM_2$ is presented in the equations below (4.a & 4.b) and the estimated coefficients in Table 4.4.

$$
\begin{aligned}
&if\ \omega_{t-1}(\beta) \le \lambda \\
&\Delta pc_t = \alpha_1^1 \omega_{t-1}(\beta) + \gamma_{111}^1 \Delta pc_{t-1} + \gamma_{121}^1 \Delta pp_{t-1} + \gamma_{112}^1 \Delta pc_{t-2} + \gamma_{122}^1 \Delta pp_{t-2} + u_{1t}^1 \\
&\Delta pp_t = \alpha_2^1 \omega_{t-1}(\beta) + \gamma_{211}^1 \Delta pc_{t-1} + \gamma_{221}^1 \Delta pp_{t-1} + \gamma_{212}^1 \Delta pc_{t-2} + \gamma_{222}^1 \Delta pp_{t-2} + u_{1t}^1 \quad (4.a)
\end{aligned}
$$

$$
\begin{aligned}
&if\ \omega_{t-1}(\beta) > \lambda \\
&\Delta pc_t = \alpha_1^2 \omega_{t-1}(\beta) + \gamma_{111}^2 \Delta pc_{t-1} + \gamma_{121}^2 \Delta pp_{t-1} + \gamma_{112}^2 \Delta pc_{t-2} + \gamma_{122}^2 \Delta pp_{t-2} + u_{1t}^2 \\
&\Delta pp_t = \alpha_2^2 \omega_{t-1}(\beta) + \gamma_{211}^2 \Delta pc_{t-1} + \gamma_{221}^2 \Delta pp_{t-1} + \gamma_{212}^2 \Delta pc_{t-2} + \gamma_{222}^2 \Delta pp_{t-2} + u_{1t}^2 \quad (4.b)
\end{aligned}
$$

where pc and pp correspond to the natural logarithms of consumer and producer milk prices, respectively.

The individual threshold parameter, i.e., $\lambda = -0.3412$, is reported in Table 4.4. Since only one threshold parameter is found, the price system is divided into two regimes. The threshold parameter represents values of the residual term from the cointegrating regression that initiates changes in patterns of responses to shocks. The threshold can be interpreted as the value of shocks, expressed in terms of minimum

percentage changes to the milk retail price from the long-term equilibrium that move the system to a different regime, thus implying a change in the patterns of adjustment. In this case, a threshold value of -0.3412 implies a minimum decrease of about 34.12% of the equilibrium milk retail price to place the milk market into regime 1. In other words, regime 1 is defined by those monthly retail prices where the absolute decrease from the long-run equilibrium retail price is greater than (or equal to) 34.12%, otherwise the market falls into regime 2. Calculated at average milk retail prices, this deviation should be greater than (or equal to) €0.23 for the milk market to fall into regime 1.

Taking into consideration the threshold parameter λ, the threshold *EMUP* (*TEMUP)* becomes:

$$TEMUP = \frac{e^{\lambda+\beta_0} PP^{\beta_1} - PP}{PC}. \tag{4.5}$$

Note that the *TEMUP* is about 58% of the retail price evaluated at the average farm and retail prices. Thus, in terms of the equilibrium relative markup, regime 1 is defined by those values less than 58%, while regime 2 is defined by values greater that 58%.

Figure 4.1 reports the evolution of producer-consumer prices as well as the evolution of observed relative markup. Based on the estimated results, the first regime covers the period from January 1989 until January 1996 while the second regime covers the period from October 1997 to August 2014. During the period from February 1996 to September 1997 there are shifts from one regime to the other. The first regime contains about 29% of the observations while the second regime contains about 71%. Note that the average observed relative markup in regime 1 is about 61.74% of the retail price while that of regime 2 is about 66.60%.

The estimated $TVECM_2$ coefficients are shown in Table 4.4. Most of the estimated coefficients of the first regime are statistically significant, i.e., eight out of the twelve coefficients. In contrast, only a few coefficients of the second regime are statistically significant, i.e., one out of the twelve coefficients. Note that the key feature in the threshold model is the significance of the adjustment coefficients, i.e., α_i^j where

$i, j = 1, 2,$ associated with the cointegrating vector $\omega_{t-1}(\beta)$. These coefficients can be useful in analysing which prices 'equilibrium adjust', and which do not. In particular, the adjustment coefficients of the first regime, i.e., α_1^1 and α_2^1, are both statistically significant, i.e., at the 10% level of significance, implying that deviations from the long-run price relationship revert to their original level. On the other hand, the adjustment coefficients of the second regime, i.e., α_1^2 and α_2^2, are both statistically insignificant indicating that adjustment takes place only beyond the edge of the threshold.

The first regime is distinguished from the second regime because of lower marketing margins (and relative markups). In other words, if the consumer milk price is decreased more than 34.12% from the long-run equilibrium or the equilibrium relative markup is squeezed more than 58%, then the milk market moves into the first regime. In this case the low marketing margin of the first regime leads to a negative error-correction term, which causes consumer prices to increase faster than producer prices as happens during the period from January 1989 to January 1996 (Figure 4.1).

FIGURE 4.1
Consumer-Producer Prices in euros and Relative Markup (rmu) as a percent of the Consumer Price for the period 1/1/1989-31/8/2014

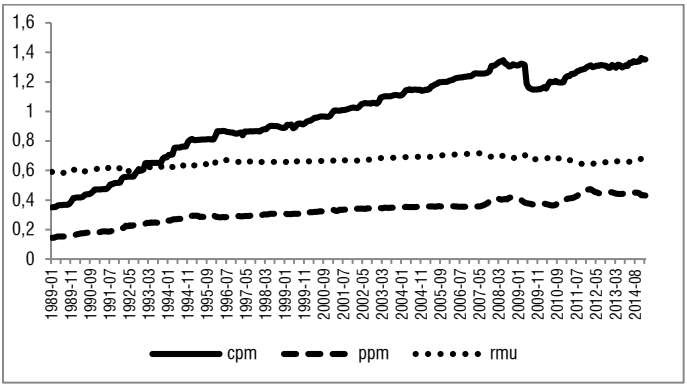


TABLE 4.4
Estimated parameters of the $TVECM_2$

Regime 1[a] $\omega_{t-1}\left(\hat{\beta}\right) \leq -0.3412$		Regime 2[a] $\omega_{t-1}\left(\hat{\beta}\right) > -0.3412$	
Percentage of observations 29%		Percentage of observations 71%	
Equation: consumer		Equation: consumer	
$\alpha_1^1 \quad \left(\omega_{t-1}\left(\hat{\beta}\right)\right)$	-0.0169* [0.0186]	$\alpha_1^2 \quad \left(\omega_{t-1}\left(\hat{\beta}\right)\right)$	-0.0068 [0.4074]
Const	0.0138*** [0.0000]	Const	0.0044 [0.2908]
$\gamma_{111}^1 \quad \left(\Delta pc_{t-1}\right)$	0.1170 [0.1423]	$\gamma_{111}^2 \quad \left(\Delta pc_{t-1}\right)$	0.1514 [0.0590]
$\gamma_{121}^1 \quad \left(\Delta pp_{t-1}\right)$	-0.1556 [0.0790]	$\gamma_{121}^2 \quad \left(\Delta pp_{t-1}\right)$	0.1531 [0.0985]
$\gamma_{112}^1 \quad \left(\Delta pc_{t-2}\right)$	-0.1928* [0.0232]	$\gamma_{112}^2 \quad \left(\Delta pc_{t-2}\right)$	-0.0343 [0.6585]
$\gamma_{122}^1 \quad \left(\Delta pp_{t-2}\right)$	-0.0690 [0.4740]	$\gamma_{122}^2 \quad \left(\Delta pp_{t-2}\right)$	0.1632 [0.0620]
Equation: producer		Equation: producer	
$\alpha_2^1 \quad \left(\omega_{t-1}\left(\hat{\beta}\right)\right)$	-0.0140* [0.0318]	$\alpha_2^2 \quad \left(\omega_{t-1}\left(\hat{\beta}\right)\right)$	-0.0062 [0.4075]
Const	0.0052** [0.0032]	Const	0.0043 [0.2591]
$\gamma_{211}^1 \quad \left(\Delta pc_{t-1}\right)$	0.1601* [0.0276]	$\gamma_{211}^2 \quad \left(\Delta pp_{t-1}\right)$	-0.0111 [0.8782]
$\gamma_{221}^1 \quad \left(\Delta pp_{t-1}\right)$	-0.1625* [0.0439]	$\gamma_{221}^2 \quad \left(\Delta cp_{t-1}\right)$	0.3768*** [0.0000]
$\gamma_{212}^1 \quad \left(\Delta pc_{t-2}\right)$	0.0685 [0.3728]	$\gamma_{212}^2 \quad \left(\Delta pp_{t-2}\right)$	-0.0295 [0.6757]
$\gamma_{222}^1 \quad \left(\Delta pp_{t-2}\right)$	0.1919* [0.0291]	$\gamma_{222}^2 \quad \left(\Delta cp_{t-2}\right)$	0.1203 [0.1299]

Notes: Values in brackets denote *p*-values.

[a] $\omega_{t-1}\left(\hat{\beta}\right) = pc_{t-1} - \beta_0 - \beta_1 pp_{t-1} = pc_{t-1} - \underset{(-3.256)}{0.651} - \underset{(-2.151)}{0.378} pp_{t-1}$

*Indicates 10% significance. **Indicates 5% significance. ***Indicates 1% significance.

This is supported by the finding that the absolute value of α_1^1 is greater than α_2^1 (Table 4.4). This price adjustment brings the milk market into the second regime (October1997-August 2014) after a period of shifts between the two regimes (February1996-September1997).

The empirical results of this study indicate that for the Greek milk industry equilibrium relative markups higher than 58% are typical. Thus, prices will react to deviations in long-run equilibrium relationships only if the equilibrium relative markup is squeezed by more than 58%. This situation seems to benefit dairy processing companies and retailers and hurt milk producers and consumers. The empirical findings of asymmetry in this study could be evidence of the market power (oligopolistic market) of the milk processing and retail sectors (Tsakistra *et al.* 2008) and the limited role of farm cooperatives (Ananiadis *et al.* 2003).

CHAPTER 5

CONCLUSIONS

Threshold cointegration models have gained great popularity in recent years as an estimation approach for analysing time-series processes with potential for linearities. This modelling technique is particularly suitable for the analysis of commodity markets because such models allow for the analysis of price asymmetries and nonlinearities in the price adjustment process.

Asymmetric behaviour in agricultural markets is often observed when an increase in producer price is transmitted more fully and faster to consumer prices while producer price decreases are passed-through the supply chain to consumer prices incompletely and at a slower speed.

This study examines the non-linearity in the price transmission mechanism between consumer and producer prices of milk in Greece using data for the period January 1989 through August 2014. We give special attention to the time-series properties of the price data. In particular, the methodology used involved specifying and estimating a $TVECM_2$ which recognizes the nonstationarity nature of the price data and allows for an asymmetric price response. According to the results obtained, the null hypothesis of linear cointegration between consumer and producer milk prices is rejected in favour of a two-regime threshold cointegration model, with the threshold parameter estimated at 34.12% and the threshold equilibrium relative markup at 58%. Therefore, a cointegrating relationship is expected only when the milk market is found in the first regime, i.e., equilibrium consumer milk price is decreased more than 34.12% or the equilibrium relative markup is squeezed more than 58%. In this case consumer prices ought to increase faster than producer prices in order to restore the long-run equilibrium between consumer-producer milk prices and probably place the milk market into the second regime, since more of the observations

belong in the second regime, i.e., 71%, than in the first one, i.e., 29% (Table 4.4). Note also that the observed average markup in the first regime is about 61.74% while that of the second regime is about 66.60%.

The asymmetric price adjustment found in this study, i.e. relative markups higher than 58%, seems to benefit dairy processing companies and retailers and hurt milk producers and consumers. These findings indicate the possible market power of both the milk processing and retail sectors and the limited role of producer organizations. As mentioned in Section 1.2, only one official cooperative group of dairy producers of Thessaly and Pieria (THESgala) exists out of 3,555 dairy farmers. In parallel, the three big dairy processing industries account for 64% of the total market, and along with another three smaller companies account for more than 70% of the milk market. This implies that concentration in dairy processing is a key characteristic. Additionally, food retailing is characterized by an increasing degree of market concentration even though it is one of the lowest degrees of retail concentration in the EU-27 (with the seven larger retailers accounting for approximately 75% of total sales). The above supports that concentration of supply from farmers is much lower than concentration at the processing and retail levels, which results in the existence of an unequal in bargaining power between these levels. In this context it is worth mentioning the existence of a milk cartel case in Greece which was revealed in 2007 by the National Competition Authority.

Note that the empirical results are in accordance with those of Capps and Sherwell (2007), who considered the presence of price asymmetry as evidence of market power at the retail level in the United States, and those of Fernández-Amador *et al.* (2013), who indicated that asymmetries create positive markups and benefits for retailers in Austria. In addition, the results reinforce the results of Rezitis and Reziti (2011) where the same methodology is used but in a different time period. By contrast, the empirical results for Spain by Serra and Goodwin (2003) and for Turkey by Tekgüç (2013) relate to increasing returns to scale in the dairy processing industry along the framework proposed by McCorriston *et al.* (2001). Furthermore, milk price history at both farm and consumer levels provide support for a threshold relative

markup of 58%. In particular, during the period 2000–2008, relative markups (68%) were well above 58%, since consumer milk prices increased steadily, whereas cow milk producer prices remained relatively stable. In April 2009, the price slashing of fresh pasteurized milk at the consumer level, which was initiated by the dairy company DELTA, was passed on to cow milk producers. Note that the relative markup remained above 58%. Finally, in the summer of 2010 the increase in feed costs, due to higher international grain prices, was almost exclusively absorbed by cow milk producers since both producer and consumer prices remained unchanged.

Based on the empirical results of the study, we support the government's effort to decrease consumer milk prices in September 2014. This is feasible because we are in the second regime where the average relative markup is 66.60%, which is greater than the equilibrium markup (58%). Therefore, the dairy industries have room to decrease prices until their relative markup reaches 58% and the consumer price reaches its equilibrium level.

POLICY RECOMMENDATIONS

The results of the empirical analysis have shown an asymmetric price adjustment between dairy producer and consumer prices indicating the possibility of market power use by processors and retailers and the limited bargaining strength of farmers. As a result, farmers often see their prices remaining stagnant while consumer prices rise. This has led farmer and consumer associations to accuse food processing and retail companies of abusing their market power to increase profit margins. Farmers consequently receive too little and consumers pay too much. Additionally, the growing concentration of the Greek dairy industry is increasing. The three big dairy processing industries account for 64% of the total market, and along with another three smaller companies account for more than 70% of the milk market. The European milk crisis of 2008/2009 triggered much debate

within the European Council on the need to regulate the European agricultural sector and the need to bolster farmers' market power in a context of crisis and at a time when the CAP reforms were expected to move a step forward.

In 2010, the European Commission, based on the recommendations of the High Level Group[20] proposed a series of measures, the so-called "Milk Package"[21] (Regulation [EU] No. 261/2012), to boost the position of dairy producers in the dairy supply chain and to prepare the sector for a more market-oriented and sustainable future. The targets of the Milk Package are focused on: contractual relations, Producers Organisations (PO), interprofessional/interbranch organisations, market measures and futures, marketing standards and origin labelling, innovation and research while also considering the end of the milk quota regime.

Contractualisation is a form of vertical coordination situated between the free market and full vertical integration. The least integrated forms of contracts are *marketing contracts*, in which the farmer and processor agree on the quantity and price (pricing mechanism) of farm products to be exchanged before the product is ready to be marketed, so that the farmer retains total control over the production process and bears all the risks.

Although agricultural contracts have existed in a number of member states for a long time, particularly for perishable agricultural products delivered to the processing industry, such as milk, in Greece they have limited application.

Contract farming is a way that farmers reduce the risks linked to the selling of their product by ensuring markets for all or part of their output. Additionally, medium- and long-term contracts can help to stabilize the farmers' income, provided that they include clauses on prices, and thus improve planning, especially when it comes to investment planning. The dairy industry relies on *marketing contracts,* where the contract may also contain a specification of quality.

[20] See Section 2.3.

[21] http://ec.europa.eu/agriculture/milk/milk-package/index_en.htm

The basic motives for contracting, identified in the economic theory, include incentive alignment, risk sharing, efficiency gains and market power. In the context of recent changes in agri-food systems, the need to improve the efficiency and transparency of the production process tends to be the overriding incentive for contracting (Vavra 2009).

Greece should decide to make the use of formalized written contracts compulsory, under national law, in the milk sector in order to improve imbalances in the supply chain, and to face transparency, rigidities and problems of price transmission in the supply chain of an increasingly concentrated dairy industry with dispersed milk producers and an uneven distribution of the added value.

Producer Organisations (POs) may negotiate contracts for the delivery of raw milk to processors/first purchasers on behalf of their members. Having identified the low concentration of supply (at farm level), there is an imbalance in bargaining power between farmers and first purchasers (processors). This can lead to unfair commercial practices; in particular, farmers having no control over the price they receive for milk and not knowing the price when delivering the milk.

On the other hand, groups of producers have more power in a bargaining situation with processors than individual producers because, as the size of the volume supplied increases, it becomes more difficult for the processor to source from alternative suppliers. Due to their improved bargaining position, members of POs may be able to secure improved contracts and contractual conditions and perhaps improve the price received by members.

EU Regulation No. 261/2012 permits producers to set up dairy producer organisations (POs) that can jointly negotiate contract terms, including price, for the delivery of raw milk to first purchasers as long as they do not exceed more than 3.5% of EU production or 33% of national production by volume; this is a liberalisation that partly relaxes competition law in favour of dairy farmers, but which could potentially hinder the free movement of market forces.

EU Regulation No. 1308/2013[22] (CAP 2014-2020) contains rules on the definition and criteria of recognition of producer organisations,

[22] EU Regulation No.1308/2103 articles 148-158 & 161&163.

their associations and interbranch organisations. Interbranch organisations can play an important part in allowing dialogue between actors in the supply chain, and in promoting best practices and market transparency.

Product differentiation (labels). The regulatory measures taken by the EU include several types of designation that may be used to differentiate agricultural products and foodstuffs.[23] The three EU schemes known as PDO (protected designation of origin), PGI (protected geographical indication) and TSG (traditional specialty guaranteed) promote and protect names of quality agricultural products and foodstuffs.

Shortening the supply chain (getting closer to the consumer). The aim of the farmer is to develop distribution systems that reduce the number of intermediaries between farmers and consumers, i.e. buyers, processing industries, wholesalers, distributors, and so on, so that a large share of the price that consumers pay is returned to the farmers. Direct marketing makes it possible to avoid all middlemen, whereas short supply chains can involve a small number of intermediaries. This initiative is supposed to enable farmers to capture a larger share of the added value of the product and to diversify their income. Shorter chains and direct marketing have a number of societal advantages,[24] such as:

i. contributing to local job creation
ii. keeping the population in rural areas
iii. diversifying and increasing supply
iv. making use of local production and know-how
v. boosting rural tourism
vi. reducing transport-related costs and pollution
vii. decreasing farmer isolation.

The Greek government should adopt the amendment to sell dairy products at farmers' markets into law. Government actions also play a decisive part in the implementation and effectiveness of the abovementioned measures. Both government intervention and private sector

[23] EU Regulation No. 1151/2012 on quality schemes for agricultural products and foodstuffs.
[24] See Danau, A., Flament, J. and Van Der Steen, D., 2011.

investment will play key roles in the context of food related market failures.[25] Market failure can be complex and does not always signal the need for government intervention. In order for government intervention to be justified, the benefits of intervention must exceed the costs and the opportunity cost of the intervention must be appropriate. Intervention is costly and so government policy should be delivered effectively and efficiently with consideration of the appropriate policy instrument and desired outcome. Finally, the role of government is regulatory, to create a suitable investment climate to ensure growth and sustainability.

[25] Types of market failure: imperfect information, externalities, market power and public goods.

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