Università degli Studi della Tuscia di Viterbo
Dipartimento di Scienze Agrarie e Forestali

PhD Program in

Eco-Systems and Production Systems - XXX Cycle

THESIS TITLE

Has the "Dairy Package" affected milk price transmission in Italy?

(**s.s.d. AGR/01**)

Author:
Dott. Beatriz E. Velazquez

PhD Coordinator:

Prof. Silvio Franco

Signature………………..

Tutor

Prof. Alessandro Sorrentino

Signature……………………

Co-tutor

Dott. Luca Cacchiarelli

Signature …………………

A.A. 2016/17

Università degli Studi della Tuscia di Viterbo
Dipartimento di Scienze Agrarie e Forestali

Corso di Dottorato di Ricerca in

Eco-Systems and Production Systems - XXX Ciclo

TITOLO TESI DI DOTTORATO DI RICERCA

Has the “Dairy Package” affected milk price transmission in Italy?

(**s.s.d. AGR/01**)

Tesi di dottorato di:

Dott. Beatriz E. Velazquez

Coordinatore del corso

Prof. Silvio Franco

Firma ……………………..

Tutore

Prof. Alessandro Sorrentino

Firma ………………………

Co-tutore

Dott. Luca Cacchiarelli

Firma………………………

A.A. 2016/17

Table of Contents

1. Introduction

This thesis looks at the functioning of the European dairy market, in particular at how prices pass through along the food chain and across countries. The research question is to what extent the market policy measures put in place within the Common Agricultural Policy (CAP) since October 2012 – the so-called "Dairy Package" as well as the measures introduced with the CAP 2020 reform – have determined changes in the way the market works and fulfils the policy objectives of improving price transmission along the value chain.

Price transmission is symmetric when prices are fully and instantaneously transmitted along the various stages of the value chain; this happens in perfectly competitive markets. Asymmetric price transmission occurs when prices are transmitted with a certain delay in time (different speed) or when only a fraction of the price change is transmitted to the following stage. Market structure influences the way prices are transmitted, e.g. growing concentration of the processing and retail forms are considered the main reasons for asymmetric price transmission and consequently an unequal distribution of welfare along the food chain (Sexton, 2000; Meyer & von Cramon-Taudabel, 2004; Vavra & Goodwin, 2005).

The basic hypothesis is that the dairy package and the subsequent measures incorporated with the CAP 2013-220 reform, would enhance the functioning of the dairy market, leading to improvements in price transmission.

Price transmission in the dairy market is an interesting example to examine for various reasons: milk is a perishable product that needs to be collected on a daily basis, has a considerable share of high fixed costs and is highly dependent on volatile prices in other commodity markets (e.g. energy and agricultural markets). In addition, milk industries enjoy often a situation of a local monopole or duopole. These characteristics make dairy farmers highly dependent on buyers and degrade their position *vis à vis* the processing industry that collects milk.

In addition, the dairy sector can count on a strong and politically powerful producing base concentrated mostly in cooperatives in some key regions, e.g. Netherlands, Northern France, Germany, and Denmark. The dairy farmers have made their voice heard by policy makers in the aftermath of the 2009 crisis, notably in the context of the Dairy High-Level Group (HLG), whose recommendations shaped the 2012 Dairy Package.

One of the main issues the HLG focused on is the balancing of the dairy market and stabilising farmers' income through strengthening their collective bargaining power relative to the processing industry (dairies). These concerns have been translated in a set of measures that promote farmers' horizontal integration through defining producer organisations' objectives, including production planning, adjustment to demand requirements (quantities and quality), optimising costs, stabilising prices, among others. These functions are associated to producers organisations (POs) that aim to improve the "*governance*" of the sector, as opposed to the *commercial* POs, of which cooperatives have historically been the most common example. As the producers´ organisations created by the "Milk package" are not commercial companies but "negotiating groups" , cooperatives are not explicitly mentioned in the legislation (e.g. Common Market Organisation Regulation). As we will see later on, the fact that 2 different European Regulations have called with the same name ("Producers´ Organizations") two completely different economic realities and actors, a commercial company on one hand[1] and a negotiating price group on the other) has created a tremendous confusion which is not still resolved.

Cooperatives, in their various forms, are relevant players in the Italian dairy sector (as well as in other European countries). This thesis will examine the role of cooperatives and linkages with the legislation in further detail when analysing the current legislative setting.

With this background in mind, the ultimate objective of this thesis is to assess to what extent the current policy framework allows for a fair distribution of benefits between agents along the value chain taking into consideration structural inequalities between actors along the chain, i.e. farmers, industry, retailers, while at the same time helping farmers to improve their competitiveness and achieving reasonable prices for consumers. To this end, I examine the current set of instruments aimed at rebalancing unequal market power in the food chain. Particular attention is given to possibilities for horizontal integration for farmers and their organisations, as a way to improve competition. Basic economic theory suggests that higher processors' or retailers' concentration *vis á vis* farmers creates market/buyer power and may lead to lower prices for farmers than desirable. Higher buyer concentration also influences how prices are transmitted along the value chain. Then I will test empirically if price transmission along the dairy chain has changed, e.g. from asymmetry to symmetry, following the implementation of the Dairy Package.

Findings in the literature suggest that market structure and the growing concentration of the processing and retail firms are the main reasons for asymmetric price transmission and

[1] POs activities described in Article 152 paragraph 1a, 1b and 1c of the Common Market Organization (CMO) Regulation are among the exemptions to competition law included in previous regulations as well as the role, legal characteristics and activities of POs.

unequal distribution of wealth along the food chain (Sexton, 2000; Meyer & von Cramon-Taubadel, 2004; Vavra & Goodwin, 2005). Thus, one may expect price transmission in the dairy sector to be asymmetric, and the Dairy Package implementation to determine a change (improvement) in this pattern.

Developments in long-term and short-term fluctuations of agricultural prices have caught a lot of attention of policy makers and researchers since 2000. Price volatility, and the perception that price changes are transmitted differently at different stages of the food chain, has renewed the attention on issues of market power and the limited bargaining power of farmers compared to other actors in the food chain. In addition to price volatility, concerns have also been raised about the cost of inputs. The functioning of the food supply chain has received utmost attention following increasing commodity price volatility in the mid 2000', and greater emphasis on food security issues (European Commission 2009, Mccorriston 2013).

The search for balancing the bargaining power of farmers has led to specific legal solutions within the sector. Experience varied between countries, such as the United States and the European Union, although a common feature is derogations to competition policy (Nash at al. 1996; Del Cont et al. 2012, Garrau 2012; Andries and Garcia Azcarate 2015). Moreover, in Europe the move from price to income support within the Common Agriculture Policy (CAP) has increased farmers' market exposure (Tothova Velazquez 2012; European Commission 2010; Russo, Green & Howitt, 2008; Russo Goodhue & Sexton, 2011). This was evident during the troublesome market situation of 2008-2009 when dairy farmers faced harsh difficulties and calls for improvement in the functioning of the food chain intensified.

In the course of the latest CAP reform, in place since 2015, one of the declared objectives of the revised single Common Market Organisation Regulation (EU) No 1308/2013 is to strengthen the position of farmers. Besides consolidating existing market measures, the CMO

Regulation fully integrated the Dairy Package and extended some of its provisions to the other agricultural sectors. Producer organisations, associations and inter-branch organisations – which used to be recognised in the fruit and vegetable sectors, can be recognised for all agricultural sectors. Member States may introduce the compulsory use of written contracts to all sectors. Moreover, the rules on contractual negotiations (collective bargaining), first suggested for the milk sector as part of the Dairy Package, have been extended to the beef, olive oil and table olives sectors as well as cereals and some other arable crops. In the milk sector specific sectoral rules apply, i.e. POs can collectively negotiate contract terms including the price of raw milk. This rules have been introduced through the Milk Package in 2012 to alleviate the problem faced by producers who are at greater risk in the event of a decrease in prices of dairy products. The idea was that members of POs would have more influence over contractual terms, particularly in setting prices (Ernst & Young, 2013), but also in negotiating the contract contents (Sorrentino, Russo & Cacchiarelli, 2016).

The role and benefits for farmers of integration into horizontal organisations (e.g. POs and cooperatives) is widely recognised in the literature. In particular, it has been demonstrated that, through pooling their agricultural output, farmers can strengthen their bargaining power *vis-à-vis* potential buyers and input suppliers, reduce risks associated with farming activities, gain market access to particular marketing channels and benefit from economies of scale. As members of horizontal organisations farmers may be able to invest collectively in assets or services requiring high fixed costs allowing, for instance, access to new technologies and improvements in efficiency and productivity ultimately leading to higher income (Acharya, Kinnucan, Caudill, 2011; Carrau, 2014; McCorriston, 2002; Sorrentino, Russo & Cacchiarelli, 2016; Van Heck, 2014, Bijman et al., 2012).

In addition to fostering farmers' integration into POs, various initiatives have been launched to improve market transparency. The European Commission has made available statistics covering all stages of the value chain, through its statistics Department: the European Food Prices Monitor Tool. Additional market information, monthly agricultural prices and deliveries are provided by the Dairy Market Observatory. The objective is to provide an early warning of risks of imbalances on dairy markets and also to carry out short and long-term outlooks; as well as prospective analysis in the context of price volatility.

In a first step to interpret the research question of to what extent current legislation fosters a fair distribution of benefits between agents along the value chain, and better define the strategy for addressing it, an intervention logic that links instruments to their objectives and the problems they aim to solve is presented in Figure 1.1. In this light, if objectives are achieved, the expected impacts of the policy implementation would be improved bargaining power of farmers, improved distribution of wealth along the value chain, better market functioning, greater transparency, among others.

Improvements in the distribution of wealth along the value chain, achieved through implementation of the market measures depicted in Figure 1.1 could be evaluated through the analysis of price transmission. The underlying hypothesis is that, as long as buyer market power is exerted by actions on prices and quantities, policy measures aimed at rebalancing power in the value chain should affect price transmission by removing or mitigating any pre-existing asymmetries. This as a consequence of improved power of farmers and association of farmers, as foreseen by the market measures objectives I have chosen the Italian market and its links with two neighbouring countries, e.g. Germany and France, as I aim to verify if price transmission between countries has been modified as well.

Figure 1. 1 – Market measures in the dairy sector - intervention logic

Problem	Objectives	Operational objectives	Solutions	Instruments
Unfair distribution of value added along the food chain	Ensure a viable development of production	Strengthen the bargaining power of farmers	Promote the creation of producer organisation, associations of PO and Interbranch Organisations	MS are required to recognise dairy Producers Organisations (PO)
	Improve the distribution of value added along the value chain	Improve market transparency		Processors to have written contracts with dairy producers (including the provision of written offers)
Growing structural disparities along the value chain	Achieve a fair living standard for farmers		Allow PO, and associations of POs, to collectively negotiate dairy contract terms, including prices	Establishment of interbranch organisations bringing together operators from various stages in the value chain
			Request first buyers to communicate volumes of raw milk deliveries on a regular basis	Compulsory monthly reporting by first purchasers of the volume of milk they collect
Increased volatility of prices	Safeguard production in vulnerable areas	Maintain the quality of cheese production with protected designations	Apply rules to regulate the entire supply of PDO and PGI cheeses	Binding rules to regulate the supply of cheese with protected designations of origin (PDO) and protected geographical indications (PGI)

Why basing the empirical analysis only on prices? Because prices give a world of information about markets, they reflect competing forces at work, condense complex and decentralised information and provide signals for the allocation of resources by economic agents (Lence, Moschini & Santerano, 2017). Moreover, prices are freely and easily available, particularly for the two extremes of the value chain (farmers' and consumers').

At this point, it is worth noting that the price transmission analysis is the optimal tool in cases of buyer/market power where buyers exert market power directly conditioning prices and quantities traded. But, as underlined in recent studies, e.g. Sorrentino, Russo and Cacchiarelli (2016), in some cases buyer power is not exerted through market fundamentals like prices and quantities (*buyer/market power*) by making use of buyer's power during the negotiation process (*bargaining power*) and thus through other variables that define trade conditions, e.g. terms of payment, contract length, etc. In these cases, market equilibrium is not modified through buyers' actions, and price transmission analysis might not be the optimal methodological tool to evaluate market exertion.

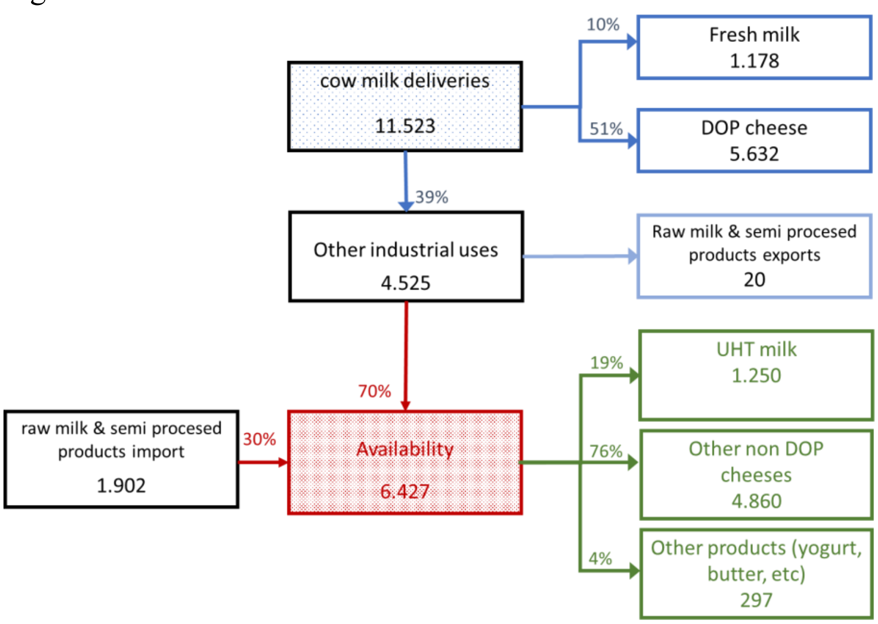
This thesis is organised as follows: the structure and the characteristics of the Italian dairy value chain, including its main features in terms of price formation and vertical integration are illustrated in chapter 2. Chapter 3 provides a critical analysis of current market instruments and their functioning. Chapter 4 contains a review of the theoretical basis of price transmission, examining links between imperfect competition, sources of asymmetry and empirical applications in the dairy sector. The analytical strategy is laid out in chapter 5, which is followed by a presentation of results in chapter 6, and a discussion of the main conclusions (chapter 7).

2. The dairy sector in Italy

2.1 General structure

The Italian agri-food industry plays a relevant role in the country's economy, with a share of 11.3% on the national GDP and a turnover of 132 billion euros in 2016. It is only second to the engineering industry. The number of firms is estimated to have remained stable since 2014 in around 6,850 units, with 385 thousand employees[2]. The Italian agri-food sector as a whole contributed with a surplus of 10.6 billion euros to the overall trade balance in 2016. Within the agri-food system, the dairy value chain is an important asset, as it contributes with a 11.8% to the total agri-food turnover (Table 2. 1).

Figure 2. 1 - Production flow in thousand tons



Source: Ismea

[2] Federalimentare, 17 March 2017
http://www.federalimentare.it/new2016/ms_comunicati_det.asp?ID=845

Table 2. 1 – The Italian dairy sector, an overview

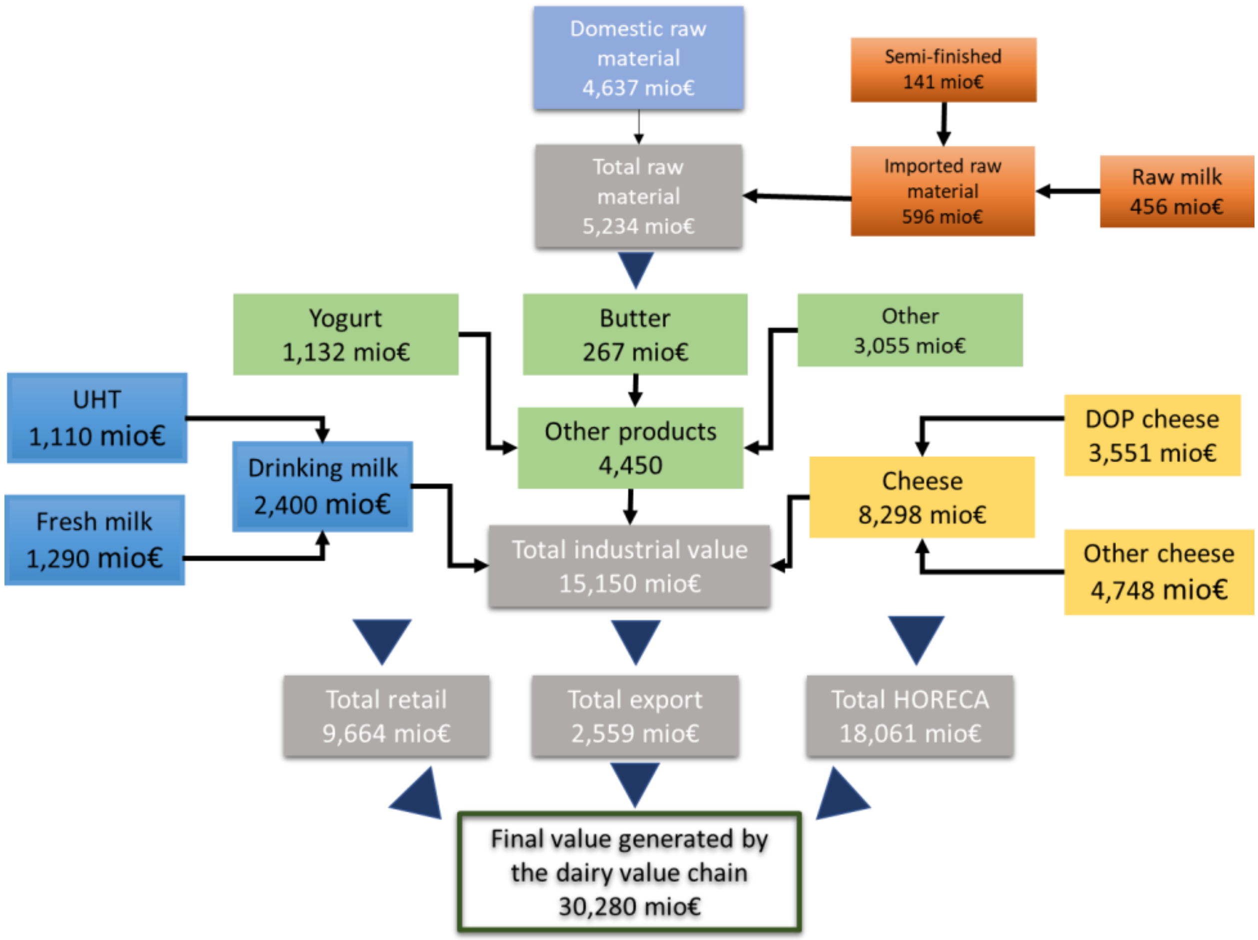
	unit	2013	2014	2015	2016
Structure					
households (i)	number	34,231	32.994	31.478	na
milk cows (ii)	(000)	1862	1831	1826	1822
Supply					
cow milk deliveries	(000 t)	10,701	11,037	11,162	11,523
cow milk value at base prices	(million €)	4794	4,785	4,36	4,086
quote on Total Agriculture sector	(% value)	9	9.5	8.5	8.3
Industrial production					
drinking milk	(000 t)	2,563	2,548	2,511	2,428
cheese	(000 t)	1,158	1,176	1,207	1,232
butter	(000 t)	98	100	95	94
yogurt	(000 t)	318	315	323	316
% of DOP cheese on total cheese	(% volume)	40.7	43	43	na
dairy industry turnover (iii)	(million €)	14.9	15.12	15.422	15.58
% of agri-food industry turnover	(%)	11.3	11.5	11.7	11.8
Trade					
Import	(million €)	3,935	3.894	3.444	3.217
% of total value of agri-food imports	(% value)	9.6	9.3	8	7.5
Export	(million €)	2,393	2.498	2.558	2.711
% of total value of agri-food exports	(% value)	7.1	7.3	6.9	7.1
Balance	(million €)	-1,542	-1.396	-886	-506
Self-sufficiency rate (iv)	*(% volume)*	*69.2*	*70.1*	*70.6*	*75.7*
Demand					
Annual household spending (v)	(million €)	19,164	19.188	19.418	na

Source: Ismea
Provisional figures
(i) Number of farms with dairy cows in production during the campaign (Source: Agea)
(ii) Consistency on 1° December (Source: Istat)
(iii) Source: Federalimentare
(iv) self-sufficiency = (net imports / apparent consumption) *100
(v) Annual household spending for the consumption of milk, cheese and eggs at nominal values (Source: Istat)

Almost 60% of domestic cow milk deliveries is used for immediate consumption of drinking milk (10%) and for production of DOP cheeses (51%), the rest 39% is dedicated to other industrial uses. Production of UHT milk, other cheeses and other products is obtained both from domestic and imported raw materials (*Figure 2. 1*)

A close look at how value is created in the dairy value chain in 2015 highlights, on the one side, the key role that cheese production plays in the economy of the dairy industry compared to other products. Cheese production dominates the industry value, covering 55% of the total, drinking milk counts for 16% and other products for the rest (*Figure 2. 2*).

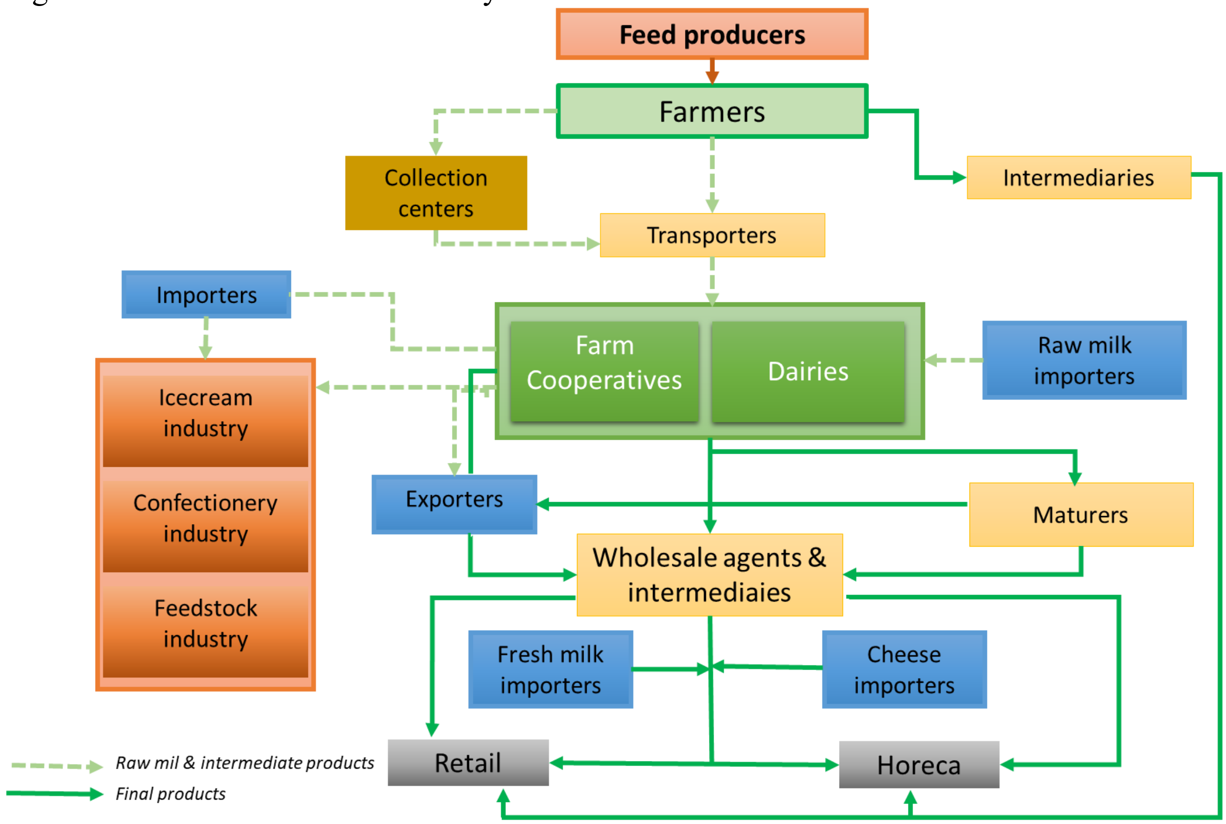
Figure 2. 2 Dairy value creation in 2015



Source: Ismea

A further insight of the dynamics influencing value creation can be attained examining the actors involved in the value chain. Although agents are illustrated without their relative size, one can observe the presence of various intermediaries between farmers and dairies and between dairies and final consumers. As will be shown late in this chapter, the structure of production is more concentrated in the processing and trade stages.

Figure 2. 3 - Actors in the Italian dairy value chain



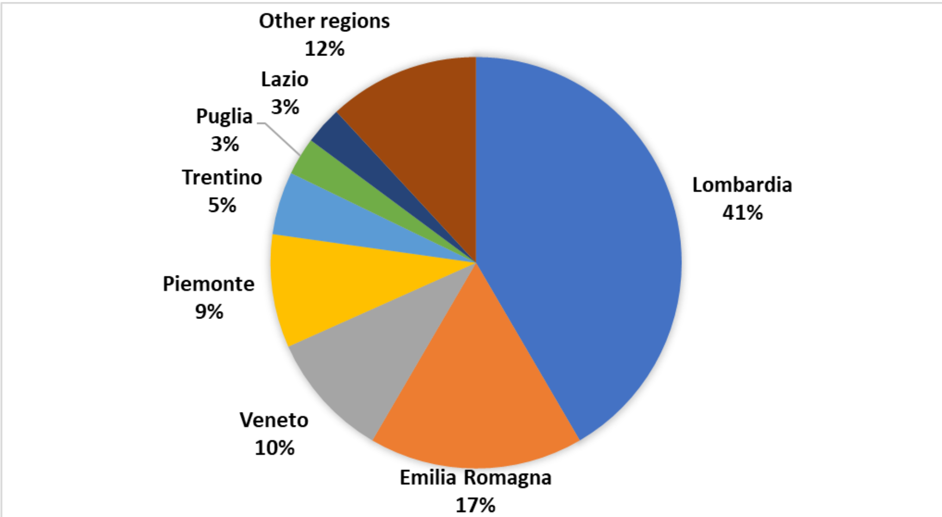
Source: Ismea

2.2 The agricultural base

Milk production is concentrated in four regions (Lombardy, Emilia Romagna, Veneto and Trentino) whose deliveries represent about ¾ of the total. These are the same areas where bigger households are located (Figure 2. 4).

The dairy sector has been slowly but progressively restructuring in the last years, the number of households and cows have been reducing *vis à vis* increased deliveries (Table 2. 1). A dual structure has emerged even more evidently than in the past. For instance, small farms are almost half of the total in number but they contribute with a mere 5% to total dairy production. On the other side, big farms are less in number (21% of the total) but they contribute to the 74% of total production (Figure 2. 5).

Figure 2. 4 - Deliveries of cow milk by region



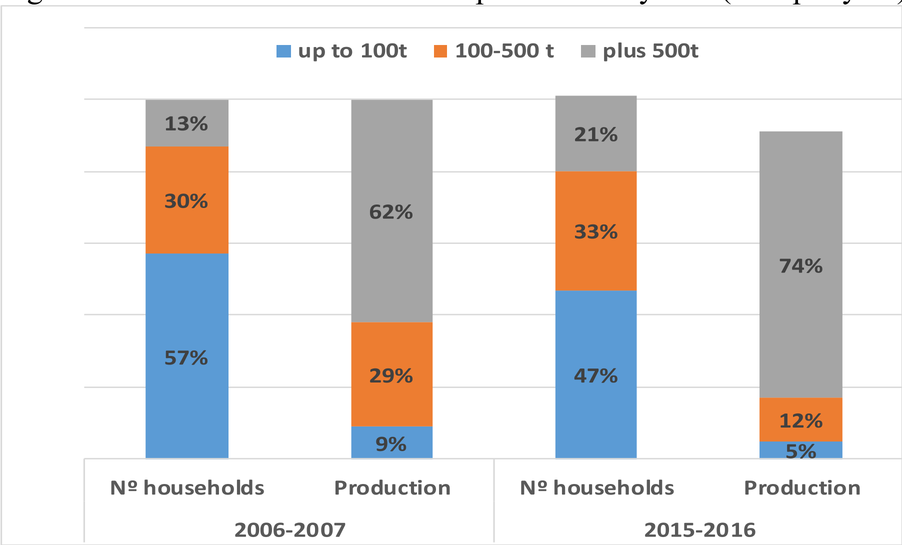
Source: Ismea

Typical small farms are those having less than 30 cows, located in mountain areas of Trentino Alto Adige. Dairy cows belong to the Brown Swiss and Simmental breeds, are grown extensively (graze and feed) and produce 3,500 - 5,000 kg per cow per year. The main destination of milk production is cheese production.

Typical medium farms have a dimension of 50 to 100 cows, and comprise two subcategories: generic medium farms and farms producing Parmigiano Reggiano. Farms producing Parmigiano Reggiano are located in Emilia Romagna. Dairy cows belong to Frisona breed and produce in average of 6,500-7,500 kg/cow/year, they are fed with fresh fodder and hay and the milk is transformed into Parmigiano Reggiano cheese. Generic medium farms are located in the plains of the Centre and Southern regions of Italy and in Emilia Romagna. The difference with respect to the Parmigiano Reggiano consists in the yield which can be a bit higher (6,500-8,000 kg/cow/year) and the feeding system (silage and hay). Production is transformed into kneaded cheese and fresh milk.

Typical big farms count with more than 500 cows, are located in the plains of Piemonte, Lombardia, Trieste, Emilia Romagna and Sardinia. Cows belong to the Friesian breed, are fed with silage and produce 8,000-10,000 kg of milk per cow per year. Production is transformed into fresh milk and DOP cheese.

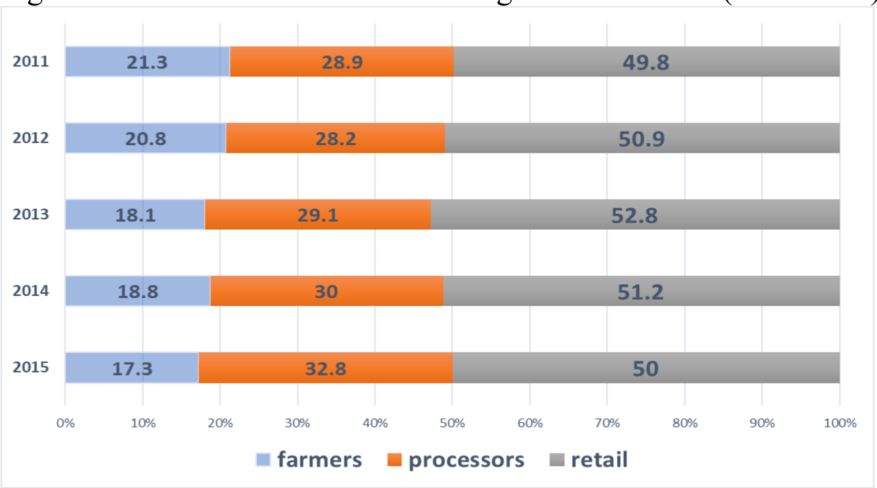
Figure 2. 5 - N° of farms and traded production by size (tons per year)



Source: Ismea

The distribution of value along the main three actors in the value chain during the period 2011-2015 shows a growing share of participation of retailers, from 49.8 to 50%, and processors while farmers' participation decreases from 21.3 to 17.3%. (Figure 2. 6).

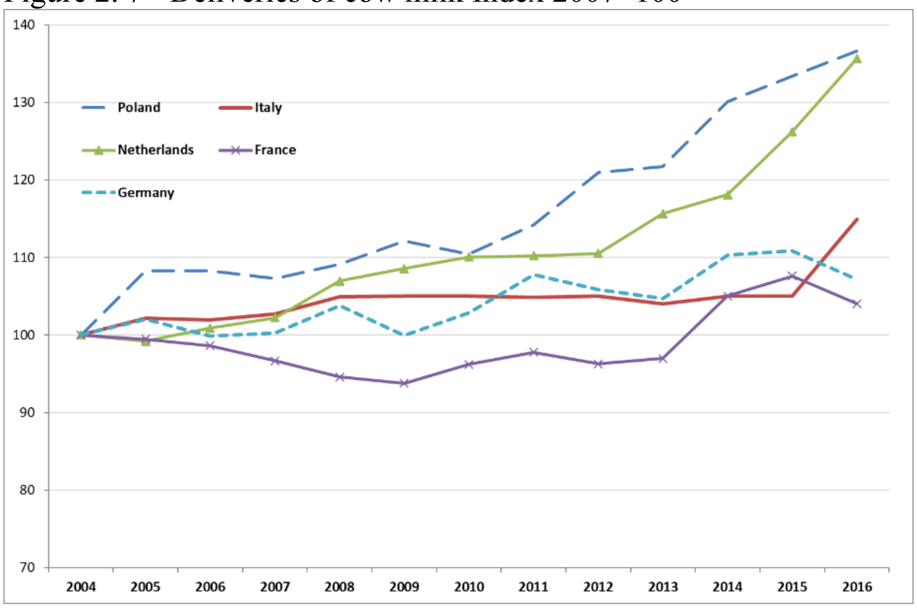
Figure 2. 6 - Distribution of value along the value chain (2011-2015)



Source: own elaboration based on Ismea

Italian Milk deliveries have remained rather stable over the years reflecting the constraint posed by the quota system (*Figure 2. 7*). In the 2015-2016 campaign, with end of the quota regime, deliveries increased by 3% compared to the previous year. In other countries, where quotas has not been a constraint, deliveries has been growing progressively since 2007, in some cases reflecting productivity improvements (e.g. Poland) in others greater efficiency reached through economies of scale (e.g. Netherlands).

Figure 2. 7 - Deliveries of cow milk Index 2007=100



Source: own elaboration based on Ismea

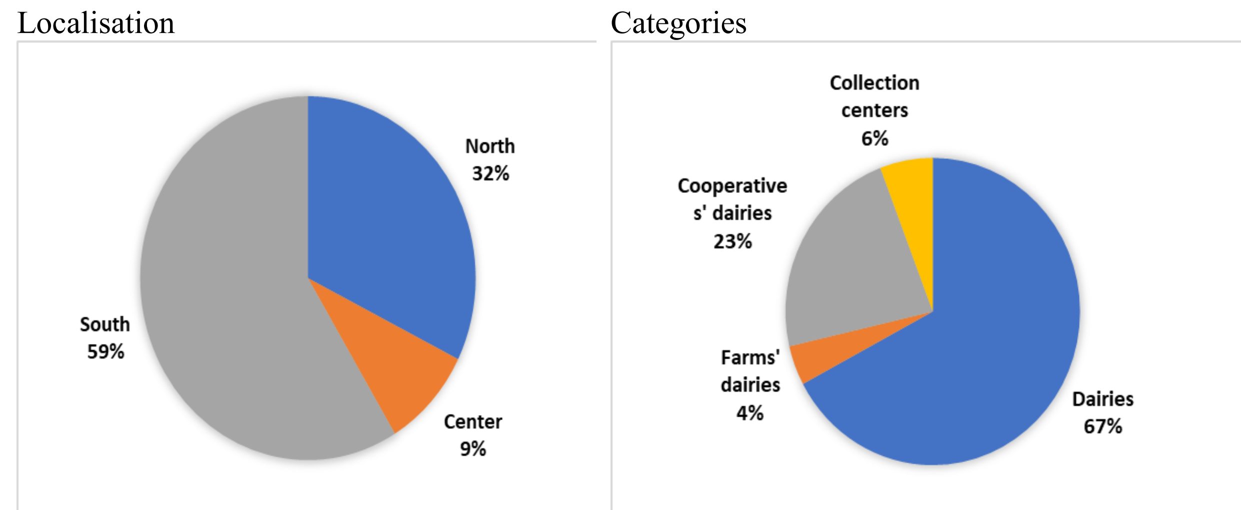
2.3 The processing industry

"First buyers"[3] of dairy production are located mostly in the Southern and Northern regions of Italy. They fall under four categories: dairies; cooperatives dairies, farm dairies and collection centres. Dairies are the most numerous with a share of 67%, followed by cooperatives with 23% (*Figure 2. 8*). These categories have evolved in the last 20 years, with greater

[3] First buyer is the undertaking that purchases milk directly from producers for processing / or handing to one or more processing undertakings.

globalisation and restructuring the cooperatives have declined in number but increased in terms of collected milk by buyer. In 2014/2015 cooperatives collect in average 10,958 tonnes versus 4,861 tonnes by private dairies.

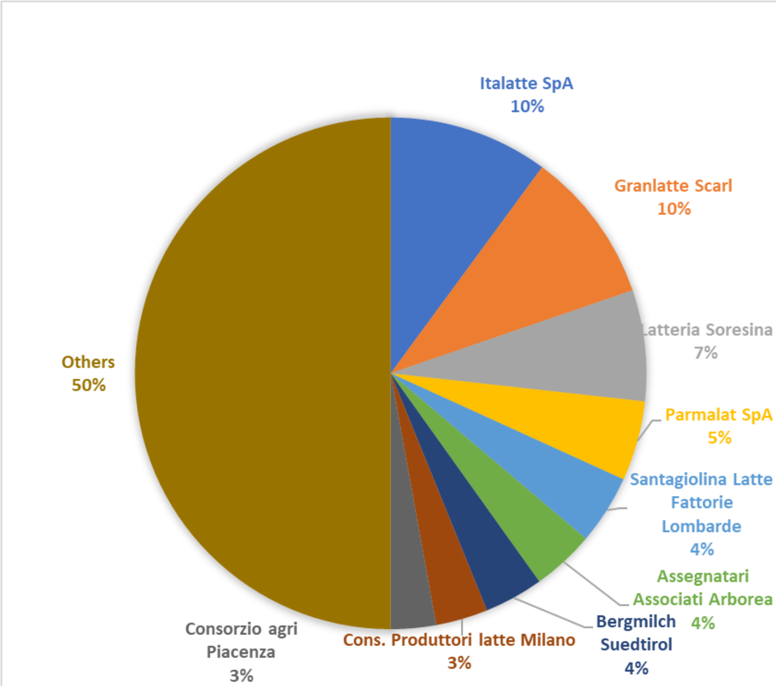
Figure 2. 8 - First buyers: localisation and firms by category



Source: own elaboration based on Istat

Concentration measured as share of Italian cow milk production collected by the first four "first buyers" (CR4), equals 14.6% in the campaign 2014/2015, a value slightly higher (+ 0.3 p.p.) than the previous campaign. If one considers the first 8 buyers (CR8), the share raises to 21.6%. Growing concentration has been a feature in the Italian market following the agglomeration of three firms (Galbani, Caravaggio Latte and Italatte) into Italatte Spa. The three firms that follow Italatte Spa are Granlatte, Latteria Soresina and Parmalat, all of them belonging to the group Italatte. Two of them are private multinationals and two are cooperatives (Latteria Soresina and Granlatte). The following three are cooperatives (Santagiolina, Bergmilch Suedtirol, Assegnatari Associati Arborea) and the Consortium Piacenza latte (*Figure 2. 9*).

Figure 2. 9 - Share of main milk buyers (in terms of milk collected) in 2014/2015



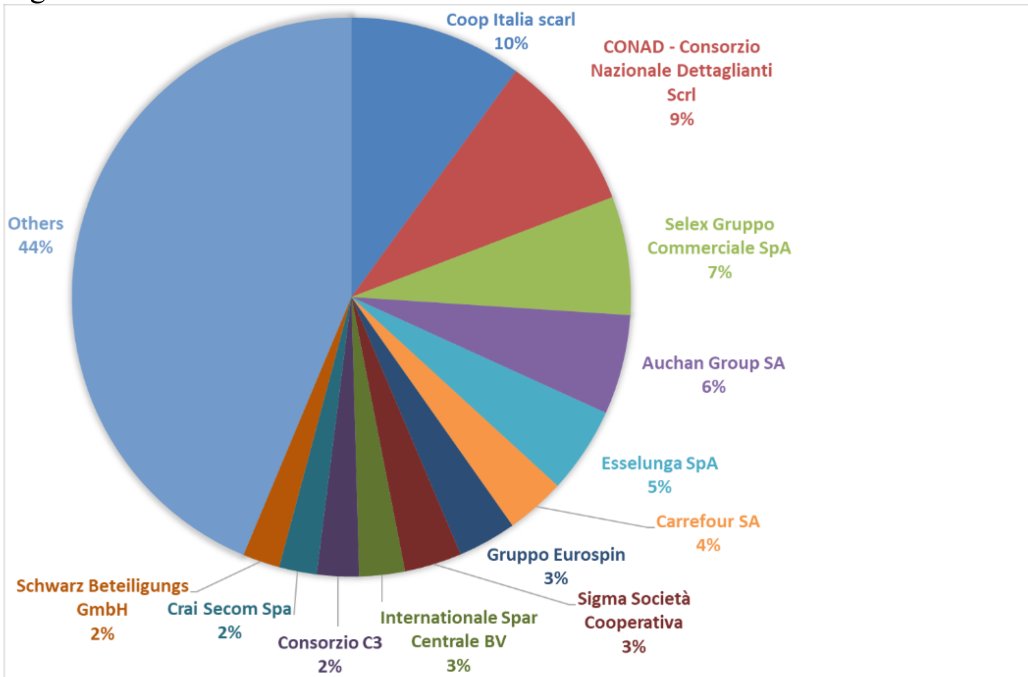
Source: Pieri (2016)

2.4 Retailers and consumption

In 2016 sales in grocery retailers reached EUR128.8 billion sales (Euromonitor, 2017), registering a modest growth of 1% compared to 2015. Coop Italia is the leading channel with a 10% value share, followed by CONAD with 9% and Selex with 6% (*Figure 2. 10*)

Independents and small operators have stated to join large groups like Coralis and Gruppo VéGé in order to take advantage of being part of a larger chain with regard to buying and logistics. On the other hand, major operators like Carrefour and Pam, which have historically been active in hypermarkets and supermarkets, have been aggressively pursuing store expansion through their smaller Carrefour Express and Pam Local banners, usually located in major downtown areas.

Figure 2. 10 - Retailers share of total turnover



Source: Euromonitor

Traditional grocery retailers in Italy continued to account for by far the largest share of outlets. While modern grocers had around 30,000 stores in 2016, there were more than 224,000 traditional grocery outlets. The total number of independent operators continued to decline, but the situation improved for food/drink/tobacco specialists.

Italian consumers continue to appreciate traditional food stores, for various reasons. They shop in independent outlets in order to find better quality products and support these retailers so as to stop them from closing due to competition from modern grocery retailers. Despite being price-conscious, Italian consumers are worried about losing stores in the areas where they live, with this encouraging them to visit independent grocers during the week so as to support them, while also benefiting from their offer of good quality products. Traditional outlets also benefit from offering a more personalised service as well as convenient locations.

2.5 International trade

Although the trade position varies according to the product, the sector as a whole is in deficit. Self-sufficiency has been improving during the last 12 years (reaching almost 76% in 2016, see table x.1) thanks to a increasing exports of quality cheeses. It is important to note that while Italy is a net importer of liquid milk and semi-processed products, it is an exporter and an important player in the European and world market, of quality cheese and other dairy produce (Table 2. 2).

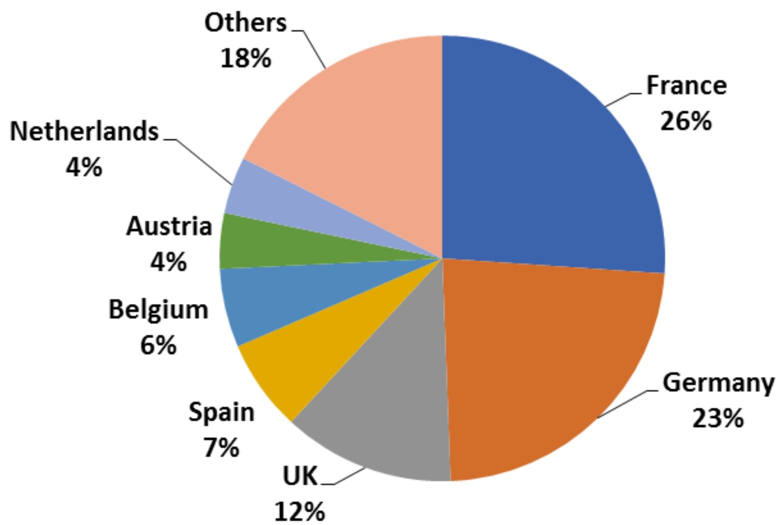
Table 2. 2 - Trade in value

	Export		Import		Saldo	
	2016	*var 2016/ 2015*	**2016**	*var 2016/ 2015*	**2016**	*var 2016/ 2015*
	000 €	%	000 €	%	000 €	%
cream	31,622	137.0	138,011	-0.1	-106,389	-14.7
whole milk	437	75.5	69,052	6.1	-68,615	5.8
condensed milk	5,505	-9.5	28,678	44.4	-23,174	68.1
powder milk	26,477	-41.2	150,120	-17.1	-123,642	-9.2
liquid milk	38,265	17.6	551,548	-17.1	-513,283	-18.9
Total milk and cream	**102,306**	**5.2**	**937,407**	**-12.4**	**-835,102**	**-14.1**
Cheese	**2,417,771**	**7.0**	**1,550,398**	**-3.6**	**867,373**	**33.0**
butter	36,036	-3.3	220,425	-10.9	-184,389	-12.2
whey	132,934	-8.2	178,912	-15.4	-45,978	-31.1
yogurt	22,156	18.2	329,599	7.2	-307,443	6.5
Total other dairy products	**191,126**	**-4.8**	**728,935**	**-4.9**	**-537,810**	**-4.9**
Total dairy	**2,711,202**	**6.0**	**3,216,740**	**-6.6**	**-505,538**	**-42.9**

Source: Ismea trade database

Main destinations of cheese are France, Germany and the UK, which together count for almost 2/3 of Italian cheese exports (*Figure 2. 1*). Most exported cheeses are Grana Padano and Parmigiano Reggiano, followed by grated, powdered, blue-veined cheeses.

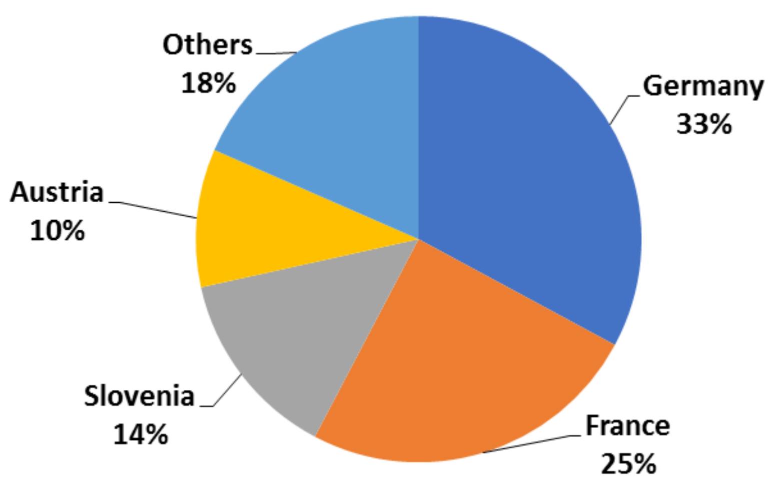
Figure 2. 11 - Main destinations of cheese exports, share of exports in value (2016)



Source: own elaboration based on Istat

Imports are concentrated in two main sources: France and Germany, which account for 58% of total imports. They are followed by Slovenia and Austria. Together these four countries cover 82% of total imports of raw milk (*Figure 2. 12*). The main destination of raw milk imports is direct consumption (UHT milk), non-DOP cheese and other dairy products production (Table 2. 2).

Figure 2. 12 - Main suppliers of raw milk, share of imports in value (2016)

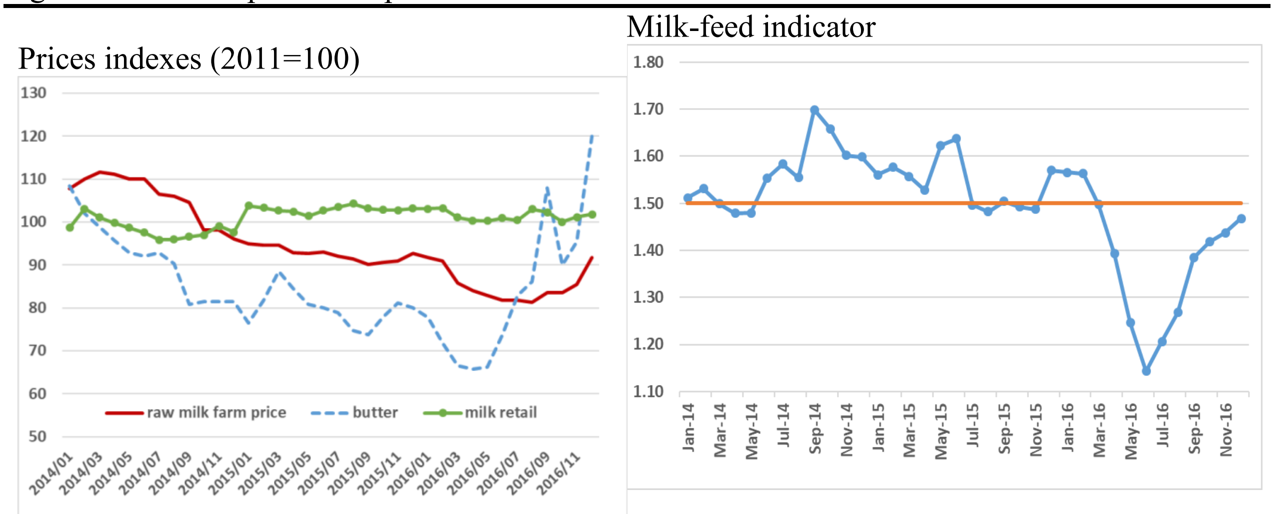


Source: Istat

2.6 Prices and price formation

Price evolution in the recent years shows a diminishing trend in that raw milk and butter prices compared to 2011, while fresh milk retail prices maintained their value. This is in line with a reduced participation of farmers in the value of dairy products and a rather unchanged one for retailers. On the farmers side, it can also be noticed that margins restrained in the period 2014-2016, especially in intensive systems. This is shown in the left-hand side of *Figure 2. 13*, where the milk-feed ratio is presented. The milk -feed Ratio indicator, estimated by Ismea, is the ratio between the farm price of 100 kg of milk and the price of 100 kg of basic feed. A value below 1.5 is considered to be unfavourable.

Figure 2. 13 -Comparison of prices and milk-feed indicator evolution



Source: own elaboration based on Ismea and Eurostat
Basic feed composition (70% corn and 30% soybean meal) has been calculated according to IFCN methodology (http://www.ifcndairy.org/en/output/prices/feed_prices2013.php). - Milk Prices used are National Weighted Average excluding VAT and premiums

Interactions between individual collectors or dairies and farmers have been close and consolidated over time. Dairies, in fact, collect two times a day milk production at the farms. They may collaborate on the management of certain activities, to protect the yield and quality of milk. Normally each dairy /collector has its own "natural" supply basin, where is more convenient to perform the collection. On the other side, in the vast majority of cases, each breeder confers the own milk to a single buyer. However, it happens that breeders do move from one company to another. This can be noticed comparing the number of deliveries to first buyers in 2014/15, equal to 30,360, with the number of farms with deliveries (30,509) in 2011/12-2014/15 (table 2.3). This difference can be attributed to farms that in 2014/15 have changed their buyer of that have delivered to more than one dairy (rare) and that happen to be counted more than once. These are 1.614 with a total production of 852 thousand tonnes. In most cases this is only formal as a firm after riorganisation or change of owner changes its VAT ad is thus counted differently in the Agea database. (AGCM, 2016).

Table 2. 3 – Buyers of cow milk by type of firm in 2014/15

Ownership	**Buyers (n°)**	**Deliveries (milk lt)**	**Deliveries (n°)**
Private	821	3,990,570	13,888
Cooperative	639	7,001,957	18,469
Municipality	1	4,034	3
Total	**1461**	**10,996,561**	**32,360**

Source: Osservatorio sul Mercato dei Prodotti Zootecnici, based on AGEA

Table 2. 4 – N° of farms by number of first buyers in 2011/12 - 2014/15

Deliveries per farm	**Farms (n°)**	**Deliveries (milk lt)**
1	28,895	10,144,748
2	1,427	659,431
3	150	152,775
4	30	24,264
5	5	11,154
6	1	2,834
10	1	1,355
Total	**30,509**	**10,996,561**

Source: Osservatorio sul Mercato dei Prodotti Zootecnici, based on AGEA

Up to 2005 prices were determined through national (or regional) inter-professional agreements (Law 88/88)[4] between Unalat representing farmers (with assistance of farmers associations) and Assolatte representing dairies and collecting companies. The agreements fixed conditions for production and sale of products, and they included a minimum milk price determined based on qualitative characteristics and region of origin. These national agreements contained minimum prices in the 6 main producing Regions and was also a reference for the other Regions. If a national agreement were not reached, regional authorities called for negotiations among regional parties. If no agreement was reached at national or regional level, single contracts always referred to the general criteria and price grids contained in last agreed national inter-professional agreement.

The law 88/88 was abrogated in 2005 after a sentence by the Court of Justice that found it was against the *aquis comunitaire* and an opinion by the Authority of the Ministry of Agriculture that found the nature of these agreements too restrictive. The law was substituted by a framework favouring Value Chain Negotiating tables[5], which represented the reference framework for value chain agreements up to the 2012.

During these years, inter-professional agreements were signed at local or regional level, in certain cases with the mediation of national and regional administrations authorities. In 2007/2008 agreements were signed in Lombardy and Piemonte, representing a point of reference

[4] The law n. 88/88 foresaw negotiations between parties through their representative associations for all agriculture products with the objective to establish minimum prices or criteria for their determination.

[5] Decree 102/2005 "Regulation of agri-food markets" and Decree of the President of Council Ministers of 5th August 2005 "Disposition for the creation of value chain tables".

to the other regions (AGCM, 2016). These agreements, achieved through tough negotiations between parties, faced resistance to be taken as reference in other regions (Cormegna, 2008).

In the years after the adoption of the milk package farm prices have been set locally between producer organisations (POs) and farms associations, on one side, and by dairies, on the other. The Observatory on the Animal Husbandry Market (OMPZ) of the Catholic University conducted a survey on the milk value chain in the province of Cremona, which is a leading area in cow's milk production. From the survey it emerges that less than half (47.4%) of the trade between non-cooperative cow milk "first-buyers" and producers is supported by a written contract that contains a fixed the duration of the contract is set. Very often (80.4%) also the quantities to be awarded are set, but the price to be paid to the producers is specified in only half of the contracts (Pieri et al, 2013).

The greatest difficulty in signing the contract for the transfer of milk to processing companies has always been the fixing of a price that takes account of the high volatility of milk prices at the barn. There have been numerous price indexing attempts, but generally with little success. Among them Pieri and Rama (2016) cite the following:

- Agreement to define an index reached by the Joint Commission on the milk market in the Piedmont Region for the 2011/12 campaign, under the chairmanship of the regional Department for Agriculture and with the support of OMPZ. The Commission is composed by all the agricultural professional organizations of the Region and a group of milk transformers, which together collect about 50% of Piedmont milk. The milk price is determined by means of an index based on a set of indicators, which were grouped together in three sub-pools: one for the national milk market, one for the international market and one for the market of inputs for breeding. The Joint Committee convened periodically to monitor the mechanism and evaluate any adjustments. From the 2012/13 campaign, market conditions in domestic and international did not allow an agreement to maintain the indexation system.

- Negotiations for price indexing at the Milk Table of the Lombardy Region in March-August 2014. The Milk Table, coordinated by the Department of Agriculture, saw the participation of representative producer organizations, dairies and cooperatives of the main consortia of protection of the Lombard Milk District, with technical support by OMPZ. The Table has agreed on the adoption of a price indexing system and has a technical group that prepared a detailed proposal, which is divided into a milk index for Dop cheese and another for the remaining milk. However, this proposal has not been signed by all members of the Milk Table due to divergences concerning the determination of the basic price and the mandatory nature of a single mechanism for all contractual terms;
- Agreement on the indexation system provided for in the Dairy Chain Support Agreement for the dairy sector at the Ministry of Agriculture in November 2015-January 2016. The Advisory Committee includes representatives of production, dairies, cooperatives and retail organizations, with the technical support of Ismea. An indexing mechanism was developed based on 44 starting variables, and 4 product typologies: medium-low seasoning products, foreign products, high seasoning products, production input. The agreement has not been concretised.

At local level, Italatte Group - a branch in Italy of Lactalis, the leader of the European dairy market it proposes a standard contract to breeders as of April 2016. Italatte adopts its own indexing system, which takes into account the European weighted average published by the European Commission Milk Market Observatory. This value, expressed in € / 100 kg of milk, is included in the value of the actual quality provided during the month of competence and will be used as a reference index in the contract between the raw milk producer and Italatte for the purpose of determining the basic farm gate milk price (Pieri, 20016).

The application of this index mechanism has faced first difficulties related to the delay with which the EU average milk price (2 months). To facilitate the application of this method, the parties should agree to calculate an index based on a reference e.g. of January for the milk delivered in March. As the EU base price 28 was fixed per kilogram as Italatte used it as a litre price, a 3% discount was immediately made. Therefore, the 4 cents per litre of milk paid as a premium "on the valorisation of Italian raw materials taking into account the socio-economic factors characteristic of the domestic market" are, at least in part, a banal euphemism (Pieri Rama, 2016).

Italatte requires that volumes of milk in contracts would be equal to those already purchased by Italatte during the 2015 calendar year. Any milk deliveries exceeding the quantities provided in the contract, if accepted by Italatte, will be subject to a price reduction[6]. In addition, Itallatte proposed contracts of a duration inferior to the year as foreseen by Decree Law no. 51 of 05/05/2015[7] . In essence, Italatte, given its weight on the supply market, is able to operate with a strong monopoly power and imposes on its producers the contractual rules (Pieri Rama, 2016).

In December 2016, the situation seemed to improve with the signature of a price agreement between representatives of farmers' organisations (Coldiretti, Confagricoltura, CIA

[6] By 30% of the contract price for surpluses up to 2%; by 50% of the contract price for surpluses between 2 and 4%; and 70% of the contract price for surpluses of more than 4%.

[7] Decree Law no. 51 of 05/05/2015 Article 2 on "Urgent provisions for surpluses of the milk quota system and respect of correct commercial relations in the matter of the sale of agricultural and agri-food products". states that "Contracts, concluded or carried out in the territory of the country, for the supply of raw milk, must have a duration not less than twelve months, unless express renunciation is made in writing by the farmer. ' But in the pre-printed contracts proposed to the breeders by different buyers, about the length of time it is stated: "By express request of the seller, the contract has a duration different from what is prescribed by the Decree Law no. 51 of 05/05/2015 " (Pieri Rama, 2016)

and COPAGRI) and Italatte (Lactalis). The agreement has been received positively by farmers associations and has been taken as references in the Lombardy Region and for contracting in other areas (OMPZ, 2017). In this occasion, the determination of the milk price takes also into consideration the price of Grana Padano cheese, a decision that has been received positively by farmers associations (Coldiretti, 2016).

2.7 Producer organisations in Italy

Community reference legislation for producer organizations (POs) is Regulation (EC) No. 1308/2013. Its national transposition, as far as producer organizations are concerned, has been with Law decree number. 85 of 12 February 2007, subsequently amended by Ministerial Decree no. 387 of 3 February 2016, which establishes the minimum requirements for their recognition, procedures for the control and supervision of their activities, in order to ascertain compliance with the requirements and procedures for withdrawal of recognition.

The minimum size of POs in the milk and dairy sector is set at ten producers and marketed production as at least 1,5 million euros, or alternatively not less than 2% of regional production, expressed in volume or in value. However, by way of derogation from these quantitative criteria, a PO that trades exclusively raw milk of its members must represent a minimum quantity of 4,500 tonnes of cow's milk produced. These dimensions appeared obviously limited and inadequate to provide the PO with the ability to concentrate the supply, balance market power and improve the efficiency of the supply chains (Pieri Rama, 2016).

National legislation leaves the option for individual regions to set more stringent limits, but most of them have in fact maintained the minimum conditions laid down by national law. Only the Region of Lombardy has raised the minimum number of associated to 50 and defined a minimum marketing volume, which, since January 1, 2016, was set at 150 thousand tons of milk.

By July 2016, 28 bovine milk producer organizations were recognized in seven Italian the 4 most specialised ones - Lombardy, Emilia Romagna, Piedmont and Veneto - plus Tuscany, Puglia and Sardinia (2.5).

Table 2. 5 – Cow milk Producer organizations

Name	Localisation	Date of recognition	Production	
			000€	000 tons
OP Piemonte				
Piemonte latte Soc. Coop. Agr.	Savigliano (CN)	20/12/2005	35.000	
Compral latte Soc. Coop. Agr.	Cuneo	06/11/2014	34.084	
OP Lombardia				
Latteria Soresina Soc. Coop. Agr.	Soresina (CR)	01/03/2005		343.967
Santangiolina latte fattorie lombarde Soc. Agr. Coop.	S. Colombano al Lambro (MI)	31/03/2005		225.000
Cooperativa produttori latte indenne della provincia di Brescia Soc. Coop.	Brescia	04/12/2007		113.850
Latte Brescia Soc. Coop. Agr.	Brescia	16/01/2008		135.000
Granlatte Scarl	Bologna	18/03/2008		337.873
Produttori latte associati Cremona (P.L.A.C.)	Persico Dosimo (CR)	16/05/2008		126.643
Agrilatte Soc. Coop. Agr.	Montichiari (BS)	06/02/2013		111.000
Lombardia latte Soc. Coop. Cons.	Bergamo	28/10/2013	0	
OP Veneto				
Latteria di Soligo Soc. Agr. Coop.	Soligo (TV)	02/02/2010	n.d.	
Lattebusche Soc. Agr. Coop.	Busche (BL)	25/02/2010	n.d.	
Latteria sociale cooperativa S. Antonio Soc. Agr. Coop.	Villaverla (VI)	05/04/2013	n.d.	
Latterie Vicentine Soc. Agr. Coop.	Bressanvido (VI)	06/05/2013	n.d.	
Caseificio sociale S. Vito di Povolaro Soc. Coop.	Dueville (VI)	09/10/2013	n.d.	
Caseificio sociale Ponte di Barbarano Soc. Agr. Coop.	Ponte di Barbarano (VI)	14/11/2013	n.d.	
Caseificio sociale Casona di Pozzoleone Soc. Coop. Agr.	Pozzoleone (VI)	20/06/2014	7.105	
Latteria sociale di Trissino Soc. Coop. Agr.	Trissino (VI)	17/07/2014	2.200	
Caseificio Pennar Asiago Soc. Coop.	Asiago (VI)	23/12/2014	7.203	
OP Emilia Romagna				
Consorzio Granterre caseifici e allevamenti Soc. Coop. Agr.	Modena	22/12/2014	5.432	
Agri Piacenza latte Soc. Agr. Cons. a r.l.	Piacenza	26/12/2014	52.196	
Santa Vittoria Soc. Coop. Agr.	Carpaneto Piacentino (PC)	27/12/2014	13.584	
Caseificio cooperativo Casanova Soc. Coop.	Besenzone (PC)	28/12/2014	4.347	
OP Toscana				
Produttori Latte Terre del Granducato	Firenze	12/02/2007	6.880	
Consorzio Soc. Agr. Coop. Produttori Latte Maremma Soc. coop. Agr.	Grosseto	26/10/2009	17.854	
OP Puglia				
Parco Murgia Latte Soc. Coop.	Gioia del Colle (BA)	12/12/2014	.	6.420
OP Sardegna				
3A Assegnatari Associati Arborea Soc. Coop.	Arborea (OR)	18/12/2001	131.183	
Lacesa - Latteria Centro Sardegna Scarl	Bortigali (NU)	22/12/2010	8.760	
Aop Interregionale				
Aop Latte Italia Soc. Coop.	Montichiari (BS)	28/10/2015	0	

Source: Pieri Rama (2016)

The two Piedmont OPs are actually intersector, being recognized for both milk and beef. The PO Granlatte, although having its headquarters in Emilia Romagna, had regional recognition in Lombardy, based on the criterion of the prevalence of the quantities of treated milk. All POs have direct marketing and / or processing activities, with the exception of Lombardy Latte, which is no longer operational.

The Ministry of Agriculture also reports a given quantity, which according to the regions corresponds to the turnover or quantity of marketed milk, but indicates the reference year for Lombardy alone. In this Region, the total amount of milk handled by the seven active OPs is estimated in almost one third of the regional milk production.

The first Association of Producers' Organizations (APO), Latte Italia, was established and officially recognized in 2015, bringing together three Lombardy POs, one Piedmont PO and one Emilian PO (Table 2.6.

Table 2.6 – Associations of producer organizations (2014)

Name	Localisation	N° asoc.	Sales 000€	Quantities tons of milk	Net capital 000€	Social capital 000€
Agrilatte Soc. Coop. Agr.	Montichiari (BS)	97	51.000	111.000	720	535
Cooperativa produttori latte indenne della provincia di Brescia Soc. Coop.	Brescia	64	54.000	129.000	Decreto ministeriale – d 4.800	4.535
Piemonte latte Soc. Coop. Agr.	Savigliano (CN)	210	38.500	93.000	4.000	465
Agri Piacenza latte Soc. Agr. Cons. a r.l.	Piacenza	200	70.000	180.000	531	10
Santangiolina latte fattorie lombarde Soc. Agr. Coop.	S. Colombano al Lambro (MI)	300	105.000	225.000	10.000	4.163
Total		871	318.500	738.000	20.051	9.728

Source: Pieri Rama (2016)

3. Market instruments and their functioning

This chapter examines the current setting of instruments aimed at rebalancing unequal market power in the food chain. Particular attention is given to horizontal integration possibilities for farmers, and organizations of farmers, like derogations to competition policies contained in the Common Market Organization Regulation (EU) 1308/2013 (CMO Regulation). I focus on how these derogations have been defined across agricultural sectors, including the Guidelines tabled by the European Commission. The ultimate objective is to assess whether the current policy framework would allow a smooth functioning of the food supply chain taking into consideration structural inequalities between actors along the chain, i.e. farmers, industry, retailers. At the same time helping producers to improve their competitiveness and achieving reasonable prices for consumers is required by Article 39 of the Treaty on the Functioning of the EU (TFEU).

First, I examine how CAP of instruments aimed at counterbalancing power inequalities along the chain have been functioning over time, notably if they contributed to improving efficiency, farmers' income and consumers' welfare. Secondly, I assess the current setting of the CMO Regulation, in particular the way derogations to the competition policy are defined (exclusions e.g. producers organizations). I also refer to the way the Commission intends to guide their implementation. The main research question here is if the current setting does, or does not; allow attaining the objective of strengthening the bargaining power of producers, while at the same time avoiding the creation of monopoly power.

3.1 Policy instruments and market power

Although policy implementation varies across countries, main features are exemptions from Competition law and special legislation. Improving the performance of markets through promoting farmers' integration in various forms (producer organizations, cooperatives) are common objectives.

The literature on the interactions of cooperatives and antitrust policy and their role in improving market performance is extensive. Nash et al. (1996) examine issues in the Australian context focusing on differences in effectiveness across sectors and regions, Youde and Helmberger (1966) analyse antirust policies and market power in the US, focusing on marketing associations. They consider cooperative marketing as desirable in atomistic structures where concentration in procurement is needed to reach economies of scale. Both Youde Helmberger (1966) and Bergman (1997) argue that cooperatives with restrictive membership should be treated as any other type of business. Based on results from an empirical model that includes price discrimination, Bergman (1997) sustains that if cooperatives export a small fraction of their production and the degree of vertical integration is low, the presence of cooperatives may increase social efficiency by mitigating the market power of for-profit firms. On the contrary, cooperatives with high market share may discriminate between buyers. In their recent paper, Lianos and Lombardi (2016) acknowledge the different antitrust policies of the US and the EU: while cooperatives benefit from antitrust immunity in the US, the policy setting in Europe is much more complex and difficult to interpret.

Empirical analysis on the impact of measures aimed at strengthening the bargaining power of farmers in the EU has focused so far on the role of cooperatives, association agreements and vertical integration of farmers in facilitating economies of scale, improving farmers' profit, favouring technology adoption and productivity, etc. Larger POs have been found to be more profitable as they can spread their fixed costs over larger sales volumes, and offer better prices as well. Larger POs offer in general also more services to their members than smaller POs, especially when these services are associated with significant investment costs (Van Heck, 2014). This is in line with further evidence in the Italian context, where the use of contracts in the dairy, olive oil, fruit, and vegetable sectors have introduced greater transparency in trade relationships between agro-food firms, with positive impacts on the financial management of farmers and food processors (Ciliberti and Cacciarelli 2013). Based on a series of studies that compared prices paid between POs and investors owned firms (IOFs) Van Hecke (2014) has found that average prices are higher in regions with strong cooperative organizations, and that prices paid by IOFs in these regions are higher as well. Bijman et al. (2012) have performed analysis on the dairy sector; they suggest that a strong cooperative presence makes higher prices paid by all dairies in a country. They also find evidence showing that IOFs may pay even a bit more because they focus on specialties, and thus can afford higher prices. The authors have also found a price-variation-reducing effect of the market share of cooperatives, though this effect was not observed in other sectors under scrutiny (i.e. pig meat). Therefore, participation by POs could ensure a higher income to farmers. Conversely, little evidence exists of higher consumer prices associated with the presence of POs, or the specific impact of policy measures implemented since 2012 on market functioning.

Research on policy modelling accounting for imperfect markets was scarce at the beginning of this century (McCorriston 2002), but a number of application has been developed since then. The work of Russo, *et al*. (2011) highlights that, in presence of market power, benefits from decoupling agriculture support are smaller than under perfect competition (or even negative). They use an approach that relies on shifts in supply, demand or policy to identify and measure market power. Goodhue and Russo (2011) examine the interactions between agriculture policy and market power in the US flour milling industry. Using a non-parametric approach, they demonstrate that US wheat millers are able to increase their margins when farmers receive payments through marketing. In other words, market power might allow redistributing benefits from government intervention. Sexton (2013) develops a theoretical model that takes into account vertical coordination, i.e. contracts between farmers and processors in presence of substantial investment costs and product differentiation. He finds that under these conditions buyers matter about the future and they would pay farmers as much or more than a under a competitive market, but in other settings where vertical coordination is not an issue, the exercise of market power would prevail. Rosa et al. (2015) perform an application of the oligopoly model of McCorriston, further developed by Sheldon, in the Italian dairy chain and found that demand elasticity has a modest impact on consumer surplus, but market power and price changes at farm level are the most important determinants of welfare distribution. They conclude that the measures contained in the single CMO may contribute to avoid the unequal margin distribution caused by the growing market asymmetry.

3.2 The current EU legislative setting

The strengthening of the standing of farmers in the agricultural value chain is a declared objective of the European legislator for changes of the CAP legislation (together with other voluntary initiatives)[8] within the 2013-2020 CAP reform. The reality has been exactly the opposite.

[8] For example, the High Level group on the Functioning of the Food Chain and the Food Chain Initiative.

On one hand, and in line with this objective, the general exemption to agriculture is maintained in the new Common Market Organization regulation (CMO Regulation)[9]. On the other, some specific exceptions are foreseen with some sectorial coverage, for olive oil, beef and arable crops.

The general exception developed initially in the fruit and vegetable sector and extended in the Single CMO Regulation, has not been well received by some of the European Commission Competition services (i.e. Directorate for Competition),which has been trying to limit the scope of the Single CMO Regulation.

The tool competition authorities have used to achieve their objective has been to specifically allow some activities for only 3 sectors, therefore implicitly saying that the same activities are not allowed in the other sectors. As we will see later on, the Court of Justice, in the so-call “endive case” has clearly underlined the scope of the exemption from the competition rules that are applicable to commercial POs and to their associations.

One prominent feature is the extension of the possibility to recognize horizontal, vertical agreements and inter-branch agreements to all agriculture products covered by the CMO, as well as the extension of the possibility of contractual negotiations (joint negotiation) to olive oil, beef and arable crops. POs, associations of POs and IBOs could receive financial support, under certain conditions, within Rural Development Programs[10]. In addition, specific exemptions are defined and dealt on a case-by-case approach (Carrau 2012, Del Cont et al. 2012).

The **general derogation** to EU competition policy rules continues to apply to the commercial activities of farmers within the framework of the CAP (Article 42 TFEU), and is

---

[9] Regulation (EU) 1308/2013
[10] Regulation (EU) 1305/2013 (Article 209)

contained in Art 209 of the new CMO regulation. However, the practical consequences of this general derogation (as specified in the cited Article) are not clear. As long as this ambiguity is not addressed and clarified, the legal certainty for operators relying on Article 209 CMO is reduced and other, sector-specific derogations in the CMO, may become more relevant.

The **horizontal rules on producer cooperation,** which include general rules for the recognition and activities of POs, associations of POs and IBOs, are extended to all products covered by the CMO.

Sector-specific provisions in the CMO that authorize joint activities are defined on a case by case approach. They include joint selling by producers/POs in certain sectors, which go beyond what is permissible under general competition rules for agricultural markets (table 3.1) . They are listed below:

Standard written contracts in the milk sector[11]: the joint sale of raw milk by POs was introduced by the so-called "milk package"[12], where the price payable for the delivery may be set in a so-called model of “written contract”[13]. Unlike the provisions on olive oil, beef and arable crops, the possibility of milk POs to jointly sell (and set prices) for the raw milk of their members is limited only by certain quantitative thresholds (up to 33% of national production per PO).

---

[11] Articles 148 and 149 of the CMO Regulation

[12] This package is one of the remedies to tackle the persistent weakness of this market after the abolition of the Quota Regime

[13] Regulation (EU) 261/2012

Table 3. 1 – Comparison of derogations

	Pre-reform	Milk package (2012)	CAP Reform 2013- 2020
Derogations	Agreements, decisions and practices that: - are part of a national market organization - are necessary for the attainment of CAP objectives - concern the production, sale of agricultural products or the use of joint facilities for the storage, treatment or processing *TFEU Art 101 and Art 42, Regulations 1184/2007, 1234/2007, 330/2010, 1218/2010*	In addition to general derogations: - joint selling of milk and milk products by POs - POs can collectively negotiate contract terms including price of raw milk - deliveries by farmers to their cooperatives cannot be subject to joint negotiations but collecting cooperatives can form POs and negotiate collectively with processors *Regulation 261/2012*	Agreements or practices needed to attain CAP objectives Horizontal, vertical or inter-branch agreements, on a case by case approach *Regulation 1308/2013*
Conditions	No price or quota fixing, no geographical division of markets, unless CAP objectives are jeopardized	Thresholds: volume of milk negotiated by a PO < 3.5% of EU production and < 33% national production in MS	No price or quota fixing, no geographical division of markets (with exceptions) Market share thresholds
Sector coverage	Hops, olive oil, table olives, silkworm, tobacco (Reg. 1234-2007); Sugar (Reg. 318/2006); Fruit and vegetables (Reg. 1182/2007); Wine (Reg.479/2008)	Milk and milk products	All agricultural products covered by Reg. 1308/2013
Sector specificities	<u>Tobacco</u>: IBOs provisions could be extended to non-members, if they pursue specific objectives[14] <u>Sugar</u>: Compulsory delivery written contracts, where price and quantities must be defined <u>Fruit & vegetables</u>: Financial assistance to POs and APOs Market withdrawal by POs POs are required to sell the entire production of their members.		<u>Tobacco</u>: IBOs provisions could be extended to non-members, if they pursue specific objectives[15] <u>Fruit & vegetables</u>: Financial assistance to POs and APOs. Market withdrawal by POs. Joint selling by POs[16] <u>Dairy</u>: specific written contracts including prices (milk package) <u>Olive oil, beef and veal, and arable crops</u>: joint negotiation by POs <u>Sugar</u>: Collective negotiation provision not explicitly mentioned in Reg. 1308/2013 but rules for the sugar sector provide for the collective negotiation, price and quantity are part of the delivery contract(s)

[14] In particular, pursuing research aiming at finding uses that do not pose threats to public health, improving leaf quality, researching environmentally friendly methods permitting the use of plant health products.

[15] In particular, pursuing research aiming at finding uses that do not pose threats to public health, improving leaf quality, researching environmentally friendly methods permitting the use of plant health products.

[16] The General Court considered in its decision T-432/2007 that this obligation requires the PO to be in control of the sale of produce, including the setting of the sales price.

Joint selling by POs in the fruit and vegetables sector: As POs and APOs in the fruit and vegetables sector fulfil a particular role, they are granted Union financial assistance in the framework of operational programs. With a view towards amplifying their effectiveness, POs in fruit and vegetables are required to sell the entire production of their members (with certain exceptions, e.g. for on-farm sale).

The General Court considered in its decision T-432/2007 that this obligation requires the commercial PO to be in control of the sale of produce including the setting of the sales price. Thus, the setting of a sales price is a requirement resulting from the Producer Organization's legal obligation to sell its members' production. The activity, in our, and arguably the Court's view, is implicitly exempted from competition rules (Velazquez and Buffaria 2016). A strength of the regime is fact, underlined recently by the Court of Justice that – unlike collective negotiation possibilities foreseen for negotiating POs in the milk, arable crops, olive oil and beef sectors – there is no market share cap on a commercial Producer Organization and their APO, which intends to engage in joint selling (Carrau, 2012).

Contractual relations in the olive oil, beef and veal, and arable crops sectors. These provisions (Articles 169-171 CMO regulation) are meant as a way of weakening the possibilities for enhanced cooperation for commercial Producer organizations (POs). In the case of "negotiating POs", this was, in addition to what is already permissible under the existing exemptions from competition rules. In other words, the purpose of these Articles is to strengthen the bargaining power of producers, while at the same time avoiding the creation and exertion of market power. Within this objective, the provisions contain safeguards and quantitative thresholds to ensure a level playing field for all operators.

Collective negotiations in the sugar sector. The quota system for sugar applied until the end of the 2016/2017 marketing year (Article 124 CMO Regulation). There is no longer be a guaranteed sugar beet price as from that date. The question arises whether growers will be able to continue to collectively negotiate prices with producers after the end of the quota regime, as is the current practice. Unlike in the milk, arable crops, olive oil and beef sectors there is no explicit collective negotiation provision for sugar beet growers in the CMO. However, the rules for the sugar sector do provide for the collective negotiation of inter-professional agreements between associations of beet growers and sugar manufacturers (so-called 'agreements within the trade'). Two years ago the legislation has been integrated with a Delegated Act[17] opening the possibility to introduce a value sharing formula, including market bonuses and loses, being discussed between beet growers and manufacturers during the negotiation process.

A relevant aspect that merits attention is the concept of Producer Organizations. In Article 152 of the CMO Regulation, the legislator refers to POs using the same words but referring to different entities.

In paragraph 1 of the CMO, producer organizations are defined as entities pursuing, among others, the objectives of: "ensuring that production is planned and adjusted to demand, particularly in terms of quality and quantity", "concentration of supply and the placing on the market of the products produced by its members…" and optimizing production costs and returns on investments…and stabilizing producer prices". Hence, "bargaining" or "governance" might be recognized as producers' organization according to Article 152.

---

[17] Commission Delegated Regulation (EU) 2016/1166 of 17 May 2016

These activities are also those of POs with a *commercial* scope, of which cooperatives have historically been the most common example. The same POs activities described in Article 152 paragraph 1a, 1b and 1c are among the exemptions to competition law included in previous regulations[18]. For instance, the Role, legal characteristics and activities of POs were defined in the former fruit and vegetables legislation[19] and then fully transposed into the CMO Regulation. The French Competition Authority[20] interpreted derogations in this sector as a substantial exemption to competition rules, based on the economic specificities of the sector. The French Authority explicitly referred to any form of PO, including cooperatives.

On the other side, the 2012 "dairy package" included measures aiming at strengthening the power of milk producers selling to Investor-Owned-Firms (IOF). The milk package introduced a new figure also named "producer organization", which can perform joint selling and collective negotiating contracts with IOFs. But these POs are in *governance* POs, and as such a different entity with respect to *commercial* POs.

Both pieces of legislation have been transposed into the CMO[21] Regulation, and certain provisions extended to additional sectors (olive oil, beef and veal, and arable crops) in Articles 169 to 171.

With the objective to help farmers and national competition authorities interpret and apply these provisions, the European Commission has tabled a document containing Guidelines

---

[18] Reg.(CE) 26/1962 applying certain rules of competition to production of and trade in agricultural products (Article 2 as regards "production or sale of agricultural products") and Council Reg. 2200/1996 (Art 11)

[19] See the Council Regulation 2200/1996

[20] Opinion No. 08-A-07 of 7 May 2008 on the Common Market Organization of the fruit and vegetables sector.

[21] See article 152, 160 and 161 of the Reg. 1308/2013

for implementation (EC, 2015). The guidelines specify conditions POs must comply to benefit from the derogations, including the recognition of POs and associations of POs, the pursue of specific objectives, the creation of significant efficiencies, relations between the PO, its members, and the Cap on quantities subject to contractual relations and notifications obligations (Box 3.1).

Box 3.1 - Conditions for benefiting from rules in art 169, 170 and 171 of the CMO regulation

- Recognition of PO and association of POs: needed to benefit the derogation; a PO may be member of another PO (second-tier PO) which trade the output by its member PO, and members of the PO can be producers and other entities which are not producers
- Pursuing specific objectives: at least one of the following: concentrate supply, placing products of members into the market, optimize production costs
- Creating significant efficiencies: by integrating activities in the PO, by generating efficiencies and thus by contributing to the CAP objectives. Efficiencies are measured in terms of volume increase or reduction of costs when the PO carries out at least one activity, or using alternative ad-hoc methods when the POs carries out various activities
- Relations between the PO and its members: producers are only members of one POS (but hey can sell in parallel product to the market) and compliance with existing obligations in cooperative structures
- Cap on quantities subject to contractual relations: the PO should not hold a dominant position: i) Beef and veal: maximum 15% of the total national production of each product, ii) Arable crops: maximum 15% of the total national production of each product, iii) Olive oil maximum 20% of the relevant market
- Notification obligations: volume of production to the competent authorities in the MS

The Guidelines are meant to ensure legal consistency across EU Member States, as requested by the Parliament during the legislative process of the 2013 CAP reform, but their implementation does not seem simple. For example, the concept of significant efficiencies and their measurement has created confusion among farmers' organisations that have consulted the

Commission in various occasion in order to clarify these concepts[22]. The guidelines have been published after a harsh internal debate at the European Commission, in which Competition services have exerted strong pressure on other services (involved officials call it plainly ”abuse of dominant position by Competition services”). For instance, in the Guidelines, the derogation for the joint selling of produce by commercial POs and cooperatives does not appear clearly. They are the better proof of the political will of the Competition services to weaken as much as possible the general derogation created by the fruit and vegetables precedent and extended to the other sectors in the new regulation.

The philosophy behind the guidelines is that a commercial POs or a cooperative is not a commercial company owned by the farmers but a potential producers' cartel. The CMO Regulation forbids the charging of identical prices, joint selling may be seen as equating to charging identical prices. Thus, operations by cooperatives could be exempted only under the general competition rules, if the conditions, i.e. creation of efficiencies, benefits for consumers, no disproportionate restriction of competition, are fulfilled. The exemptions available under general competition rules offer only limited protection for the joint sale of products at a common price, arguably the main purpose of a great number of agricultural cooperatives. It is to note that national competition authorities have not challenged the typical commercial practices of cooperatives as potentially anti-competitive horizontal cooperation among individual producers.

The recent Court of Justice "endive case" has clearly shortcut all those tries to change the historical European legal consensus on the issue, for commercial POs and cooperatives.

---

[22] Source: European Commission services (Directorate for Agriculture and rural Development).

Because of self-assessment, producers and their organizations, as well the national auditing authorities, need positive and clear examples specifying which practices are allowed and under what conditions.

Two recent developments have contributed with references that may clarify the interpretation of existing rules. The first one refer to a recent judgement by European Court of Justice (ECJ) named the "endive case"[23] that put forward two simple rules in relation to exemption of POs to competition rules:

i) practices applied by a commercial PO and its APOs duly recognised by a Member State, remaining solely *within* that PO or APO, are not subject to prohibition of agreements, decisions and concerted practices; and

ii) practices *between* different recognised POs and APOs are governed by Article 101(1) TFEU, in order words, subject to competition rules. The same is true for cooperation by farmers outside of recognised POs and APOs (so in the context of organisations or associations not officially recognised as POs or APOs) or that go beyond what is strictly necessary to achieve the objectives of a PO or APO.

The allowed practices might regard exchanges of information; coordination of volumes of agricultural products put on the market; and coordination of individual agricultural producers, however, the setting of a minimum price within the PO for the sales of products by the members outside a PO is not proportionate.

A second development that has contributed to clarify the existing rules is the Omnibus Regulation approved by the European Council on 12 December 2017[24], which in its agricultural

[23] Grand Chamber Judgement of 14 November 2017 C-671/15 – Endives.
[24] PE-CONS 56/17

part, adopted simplified rules in relation to the single CMO. In particular, it includes an explicit competition derogation for sales and production planning activities of POs and APOs that genuinely exercise an integrated activity of their members. In essence, the PO or APO can rely on a derogation from Article 101 TFEU if they genuinely exercise an integrated activity of its members, concentrates supply and places products of its members on the market. Neither market thresholds not efficiency tests are applied. On the other side, POs that integrate an activity listed in article 152(1) b) i-vii) the CMO regulation can rely on the competition derogation, but POs that according to article 152(1) b) viii) integrate a service activity pursuing the objectives of article 152(1)c, cannot rely on the competition derogation. In other words, allowed activities, if conditions are fulfilled, are production planning, placing on the market, production costs optimisation, contractual negotiations for supply contracts.

3.3 Concluding remarks

Divergent results emerged from studies on the relation between size and profitability or efficiency, with evidence of significant economies of scale. Larger PO would be more profitable as they can spread their fixed costs over larger sales volumes and offer higher prices to farmers. Larger POs may offer more services to their members, especially when these services are associated with significant investment costs. One would also expect to find evidence of a positive relationship between participation in the PO and farm income for instance, thanks to higher prices received by farmers participating in POs. Empirical results collected by Van Herck (2014) are contradictory: some studies point to lower POs efficiency compared to investor owner firms (IOFs) due to overemployment of certain inputs, operating at higher average costs than IOFs, being capital constrained. Others studies cited by Van Herck conclude that POs are equally or even more efficient than IOFs, for example Soboth et at (2012) analyse dairy farms in six

European countries (Belgium, Denmark, France, Germany, Ireland and the Netherlands) applying technical, scale and allocative efficiency using Data Envelopment Analysis. Their results suggest that performance of POs compared to IOFs improved, suggesting that inputs have different roles in both types of firms depending on their objectives.

In relation to policy measures aimed at improving the functioning of the food supply chain, the CMO Regulation relies on Producer Organizations as the main vehicle for producer cooperation. But the new legislative setting could lead to the paradoxical consequence of impeding the functioning, by challenging the existence and/or creation of POs.

One missing piece in the legislation is the definition of a specific legal form for the recognition of a PO. For instance, cooperatives are among the most common organizational forms of establishment in the agricultural sector, especially in Eastern Member States, but they are not legally referenced.

The case of cooperatives provides a hint of the paradoxical situation that could be faced in the future. Uncertainty, divergent interpretations and difficulties for POs in complying with minimum requirements for exemption may represent a deterrent to the existence/recognition of POs (Del Cont 2015), and cooperatives in particular. As an example, activities allowed during periods of severe market imbalance (Art. 222 of the CMO Regulation) appear in contradiction with core activities of fruit and vegetable POs (Art. 152). Moreover, the extension of provisions to the olive oil, beef and veal and certain arable crops has further contributed to terminology confusion of what a POs is.

Widely different conditions apply across sectors without a clear justification. In particular I refer to three notable differences: i) joint selling and price setting are allowed in raw milk in the dairy sector; ii) the possibility for contractual relations is extended to olive oil, beef and veal, and arable crops but under the requirement of fulfilling additional conditions (i.e. generate significant efficiency); iii) POs in the fruit and vegetable sector are required to sell the entire production of their members and according to the European Court of Justice (ECJ) this requires the setting of prices.

Derogations on a case-by-case approach lead to legal uncertainty. Exemptions to contractual negotiations, e.g. in the olive oil, beef and veal, and arable crops sectors need to be better qualified, showing consistency with the general exemption to agriculture. For example, in order to integrate certain activities POs must comply with the additional requirement of generating significant efficiencies (the so-called "significant efficiency test"). Moreover, additional powers for competition authorities were added as safeguards to intervene on a case-by-case basis and to review the relevant product market[25].

Different judgements or interpretations of legislation could result in solutions that are not in the public interest. For instance, a proactive and well-resourced corporate actor in the value chain can exert results to his advantage *vis à vis* state regulators authorities with divergent goals, sometimes situated across different spatial scales of governance (Wood and Alexander 2016).

Two recent developments have contributed with references that may clarify the interpretation of existing rules. The first one refer to a recent judgement by European Court of Justice (ECJ) named the "endive case"[26] that put forward two simple rules in relation to exemption of POs to competition rules. The second one is the Omnibus Regulation approved by the European Council on 12 December 2017[27], which includes an explicit competition

[25]Commission Guidelines on the application of specific rules set out in Articles 169, 170 and 171 of the CMO Regulation (2015/C 431/01)

[26] Grand Chamber Judgement of 14 November 2017 C-671/15 – Endives.

[27] PE-CONS 56/17

derogation for sales and production planning activities of POs and APOs that genuinely exercise an integrated activity of their members.

The approach of the ECJ is simple and appears clearer compared to the Guidelines for the olive, beef and veal, and arable crops, where para 13 defines a PO as "..an association of individual producers and undertakings in its own right for the purposes of applying EU competition law, where it conducts an economic activity". The distinction is between "commercial" POs and "negotiating POs": Obviously, the magnitude of the exception to competition rules is so huge that the organisation (PO or APO) has to be recognised by a Member State, as a "Guarde-fou".

Both the ECJ ruling and the Omnibus regulation are relatively recent (the latter entered into force on 1 January 2018), but they contribute to better understanding and simplification of rules applied to POs and APOs. Their benefits will be seen in the near future.

4. Theory and empirical analysis of price transmission

In this chapter a review of the literature that looks at both vertical and horizontal price transmission is presented. The aim is to understand asymmetric in price transmission along the food chain and across markets and to collect empirical evidence of price transmission analysis in the dairy sector. The chapter is organized as follows: in a first paragraph imperfect types and sources of asymmetric price transmission are illustrated, a second paragraph is devoted to methods for assessing asymmetries. In the last paragraph I look at available empirical analysis on the dairy sector.

Knowing mechanisms of price transmission and advantages and disadvantages of available empirical applications has been essential for choosing the methodology that fits better to the data and research question that drive this thesis.

4.1 Imperfect price transmission

A significant amount of research work has focused on methods for understanding price transmission and identifying asymmetry sources. Asymmetric price transmission (APT) occurs when prices are not fully and instantaneously transmitted through the other stages, but differs in speed and/or magnitude in the transmission of prices through the supply chain. APT can alter timing or welfare changes causing market failure and thus set the scene for policy intervention. ATP policy relevance has driven theoretical and empirical research.

4.2 Types of asymmetry

Asymmetry in price transmission (APT)[28] can be classified based on 4 criteria:

[28] Asymmetry is related to the concept of price rigidity or "stickiness", which was referred for the first time in 1935 (Means, 1972).

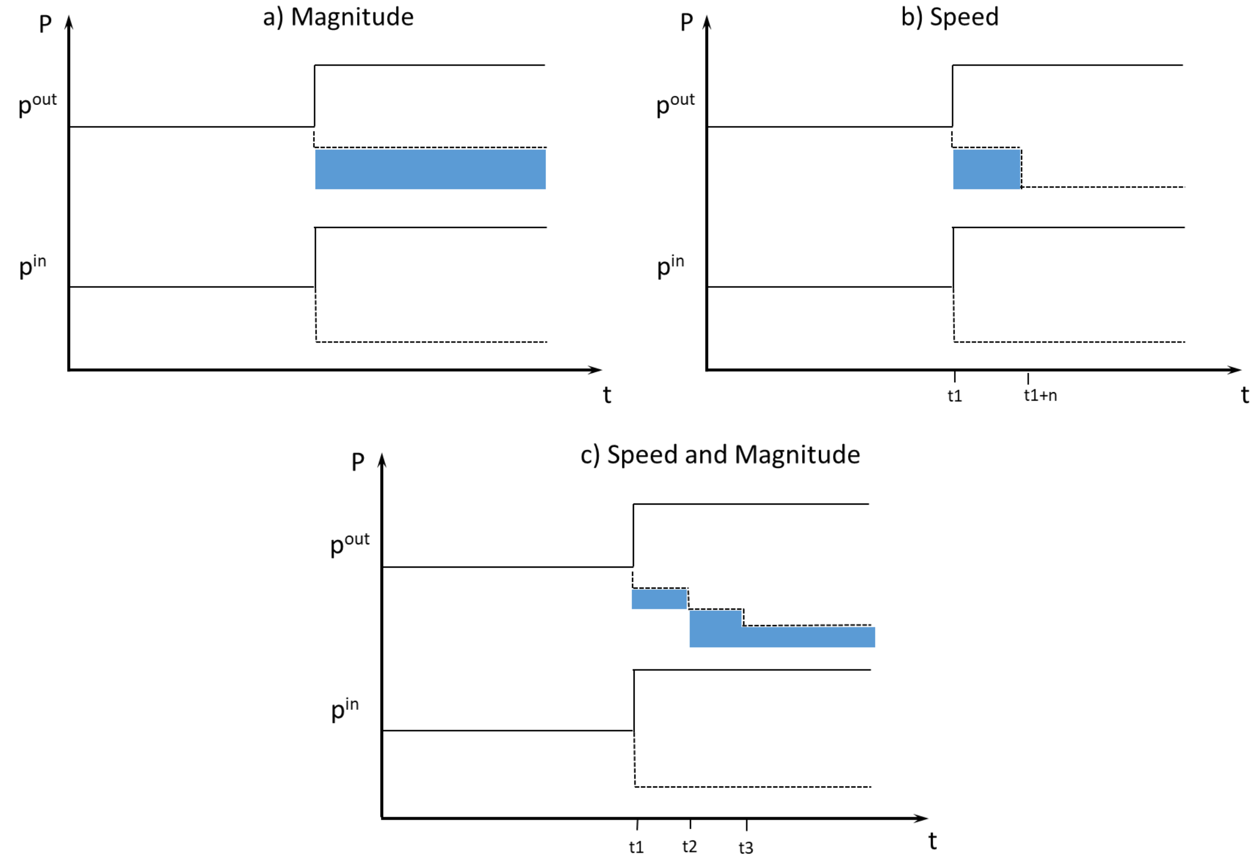
1. Speed and magnitude of the transmission
2. Sign of the price transmission (positive or negative)
3. Vertical or spatial transmission
4. Short-run or Long-run asymmetric transmission

<u>*First criterion: speed and magnitude of transmission*</u>. This criterion refers to the fact that the speed and/or the magnitude of price transmission could be asymmetric. The distinction between the two types of APT is shown in Figure 4. 1 (the source is Meyer and von Cramon-Tudabel, 2004) , where a price (p_{out}) is assumed to depend on another price (p_{in}) that either increases or decreases at a specific point in time.

In the first part of the figure (a), the magnitude of the response to a change in p_{in} depends on the direction of this change; in the second part of the figure (b) it is the speed of the response that depends. Combinations of these two types of asymmetry are may happen. In the third part of the figure (c), 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.

Transfers associated with these types of APT are shown as shaded areas in Figure 4. 1. In order to facilitate their reading it is suggested to consider that the volume of transactions is constant over time, *i.e*. a completely price inelastic demand for the output good. Asymmetry with respect to the speed of price transmission leads to a *temporary* transfer – in this case from buyers of the output good to sellers – the size of which depends on the length of the time interval between t_1 and t_{1+n} as well as the price changes and transaction volumes involved Figure 4. 1(b). Instead, asymmetry with respect to the magnitude of price transmission leads to a *permanent* transfer Figure 4. 1(a), the size of which depends on the price changes and transaction volumes involved. Figure 4. 1(c) shows that asymmetry with respect to speed and magnitude leads to a combination of temporary and permanent transfers. The choice of which type of transfer is of greater relevance depends on the size of changes involved, a large temporary transfer could outweigh the present value of permanent transfer. Moreover, the impact could extend further to welfare if such asymmetry in price transfers is the result of a permanent situation of oligopoly or monopoly pricing.

Figure 4. 1 – Asymmetric price transmission. First Criterion



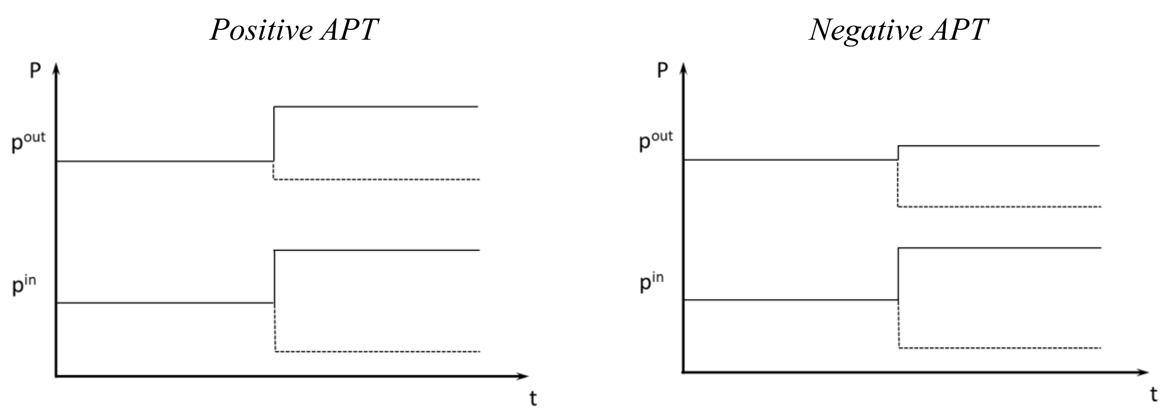
Source: Meyer von Cramon-Taudabel (2004)

<u>Second criterion: sign of the price transmission (positive or negative)</u>. This criterion follows a convention proposed by Peltzman (2000) according to which if p^{out} reacts more fully or more rapidly to an increase in p^{in} than to a decrease, then the asymmetry is said to be “positive”.

On the contrary, a "negative" asymmetry occurs when p^{out} reacts more fully or rapidly to a decrease in p^{in} than to an increase (Figure 4. 2).

A note of attention is needed while interpreting this convention: if p^{in} represents farm gate and p^{out} retail prices, "negative" asymmetry is good for the consumer while "positive" APT is bad, and associated with loses.

Figure 4. 2 – Asymmetric price transmission. Second Criterion



As noted by Meyer and von Cramon-Taudabel, the direction of transmission could be from input to output prices and *vice versa*. In this context it still makes sense to distinguish between speed and magnitude, but the distinction between positive and negative APT needs to be generalized. They propose to define as *positive APT* any price movement that squeezes the margin (i.e. an increase in p^{in} or a fall in p^{out}) and is transmitted more rapidly and or completely (to p^{out} or p^{in}, respectively). Conversely, they define APT as *negative* when price movements that stretch the margin are transmitted more rapidly and/or completely than movements that squeeze it.

<u>*Third criterion: Vertical or spatial transmission*</u>. Vertical price transmission refer to the way prices transmit along the value chain. For instance, farmers often complain that increases in

farm prices are more fully or rapidly transmitted to the wholesale and retail levels than decreases. Frequently vertical asymmetry is associated to unequal “power” between actors.

Spatial price transmission or market integration refers to the degree to which markets at geographically separated locations share common long-run price or trade information. Spatial market integration can be thought as a measure of the degree to which demand and supply shocks in one region are transmitted to another region (Fackler & Goodwin, 2001). Examples of spatial APT would be a raise in German farm dairy prices causing a less pronounced reaction in the Italian dairy wholesale prices than a corresponding reduction of the same magnitude.

Short-run or long-run transmission: distinction between short and long-run asymmetry transmission refer to the time spam when the asymmetry is verified, and assumes relevance because of the different approaches that could be implemented. In short-run analysis one can identify intensity of output price variations to positive or negative changes in input prices. In a long-run perspective other aspects become relevant, e.g. reaction times, length of fluctuations, as well as the speed of adjustment towards a long run equilibrium level (Frey & Manera, 2007).

4.3 Sources of asymmetry in vertical price transmission

The literature suggests several causes of symmetry in vertical price transmission, although various studies have pointed to two main reasons: market structure and the growing concentration of the processing and retail firms as the main reasons for asymmetric price transmission and unequal distribution of welfare along the food chain[29] (Sexton, 2000; Meyer &

[29] It appears relevant to clarify what are the various of "power" typologies that may emerge (market power, bargaining power, etc):

Market power (or monopoly) is the ability of a firm (or groups of firms) to raise and maintain price above the level it would prevail under competition. The exercise of market power leads to reduced output and loss of economic welfare (Khemani & Shapiro, 1993).

von Cramon-Taubadel, 2004; Vavra & Goodwin, 2005). In spite of the numerous theoretical works (see Meyer & von-Cramon Taudabel 2004 and Frey & Manera 2007) excellent reviews of the literature, few studies have tested the link between market power and APT empirically. The work of Peltzman (2000) is one exception, as he performed a broad cross-section analysis for different products in the U.S. He used two proxies for market power: number of competitors and market concentration using the Herfindahl-Hirschman index. But results using these proxies provide conflicting impacts, as asymmetry appears as a characteristic both of "competitive" and "oligopoly" markets. This suggests the need to further investigate vertical market linkages in order to understand causes of APT. Another cross-sector study focusing on a number of EU countries[30] and covering a range of agricultural products during the 90s is that of London Economics (2004), in which no overwhelming evidence of systematic asymmetric transmission in the EU food chains was found. In addition, neither any particular product is more susceptible than others with the exception of dairy[31] nor any particular country has systematically more asymmetric price transmission in the food chain (London Economics, 2004).

Additional sources of APT have been found by others: political intervention, asymmetric information and inventory management, significant fixed costs, adjustment costs, inventory management and perishable products (Acharya, Kinnucan, & Caudill, 2011; Felis & Garrido,

---

Bargaining power refers to “the power to obtain a concession from another party by threatening to impose a cost, or withdraw a benefit, if the party does not grant the concession.” (Kirkwood 2005). The emphasis here is on a specific negotiation among certain parties, disregarding the outcome at industry level.

Buyer power can be defined as bargaining power exerted by a buyer, for example a processing firm with respect to farmers (Sorrentino, Russo, & Cacchiarelli, 2016).

Countervailing power refers to the ability of offsetting, in whole or in part, the market and/or the bargaining power of another firm (Oecd, 2009).

[30] United Kingdom, Austria, Denmark, France, Germany, Ireland, Italy, Netherlands and Spain.

[31] Although results for dairy products were based on data available only from 1995 to 2001.

2015; Fernandez-Amador, Baumgartner, & Crespo-Cuaresma, 2010; Meyer & von Cramon-Taubadel, 2004; Vavra & Goodwin, 2005).

In their review of methods for identifying APT in empirical applications, Meyer and von Cramon-Taubadel (2004) stress that more emphasis is needed in interpreting possible causes of APT and their relation to structure and institutional features of the market being studied. Frey and Manera (2007) have made a step further in this direction though scrutinizing empirical methods for testing a set of classified sources of asymmetry. They test results through meta-regression analysis and concluded that asymmetry is frequent in a wide range of econometric models.

Meyer and von Cramon-Taubadel (2004) found that different methods have led to different rejection rates of the symmetry hypothesis and they conclude that there is little rigorous comparison of strengths and weaknesses in the available methods. They point to additional methodological issues that merit further attention like multi-collinearity, data frequency, data anomalies, distinction between statistically and economically significant APT, and factors that cause asymmetry.

The issue of asymmetric information between firms was scrutinized by Bailey & Brorsen (1989) based on a sample from the US broiler market. They found that larger firms benefit from economies of size in information gathering, and that this may turn into asymmetric information between competing firms. They also point out that asymmetries in price series data can be the result of a distorted price reporting process. A similar 'artificial' APT might arise under institutional arrangements whereby reference or indicative, for example wholesale, prices are determined and quoted on a regular basis by committees of observers, often industry representatives who have vested interests (Meyer & von Cramon-Taudabel, 2004).

4.4 Imperfect Competition and Price Transmission

A branch of research has focused on understanding how the market functions under imperfect competition. Sexton (2013) and McCorriston (2013) identify factors that could be affecting markets and price developments, other than increasing concentration in processing and retailing sectors. These factors are to be found between vertical related markets and within stages or with respect to the nature of vertical linkages between stages. They include vertical coordination and control between farming and downstream marketing stages, private labels, quality and differentiation, e.g. geographic location, certified safe and respecting fair-trade practices, consolidations through mergers, acquisitions and unfair practices between firms in different stages leading to unequal rent distribution or practices inflicting consumer harm. An application of McCorriston et al. (2001) oligopoly model, further developed by Sheldon and Sperling (2006), provide evidence of altered price transmission and consumer surplus distribution along the dairy chain in Italy (Rosa et al 2015). Using a BLP demand model Tiboldo et al (2016) find that national as well as local brands in the fresh milk segment have the lowest own-price elasticity and thus the highest market power. Madau et al. (2016) implement a test proposed by Lloyd et al. (2009) to estimate the presence of buyer power. They notice that a distortive behaviour of retailers and food companies have concurred to enlarge the gap between farmers' and retailers' prices, and call for more research to evaluate buyers' power nature and causes. Bonnet and Zohra (2015), using a model of Draganska, Klapper, and Villas-Boas (2010), observe that value added created by organic label in the French fluid milk market helped to balance bargaining power along the supply chain. Lianos and Lombardi (2016) use a holistic approach in the Global Value Chain framework. They examine market power and concentration through the vertical links between in the chain to understand if and how lead actors can capture value.

An alternative branch of research, studied the role of agriculture policies in mitigating bargaining power imbalances (Cacchiarelli & Sorrentino, 2014; Kinnucan & Forker, 1987; Russo, Goodhue, & Sexton, 2011) or looked at the possible role of POs to counterbalance market power exertion (Cacchiarelli Chiavicchioli Sorrentino 2016).

Kinnucan & Forker (1987) claim that price support in the form of floor prices can lead to APT since they may lead wholesalers or retailers to believe that a reduction in farm prices will only be temporary because it will trigger government intervention, while an increase in farm prices is more likely to be permanent. Cacchiarelli & Sorrentino (2013) arrived to similar conclusions using an Error Correction Model in the semolina chain sector in Italy. (Russo et al., 2011), using a deterministic model under the assumption of imperfect competition at the processors level, argue that in the presence of market power, the social benefit of decoupling agricultural support payments from production is smaller than projected based upon a model of perfect competition and may in some instances be negative. Cacchiarelli, Chiavicchioli & Sorrentino (2016) tested the correlation between average farm size and market power in a series of EU countries. They found significant inverse correlation between average farm size and market power, but at the same time, lack of correlation with farm size increase and farm concentration rate. The authors explain the (unobserved) role played by farm supply concentration, probably, by the various kind of organizations (POs, APOs and Cooperative) supported by the recent CAP reforms.

4.5 Sources of asymmetry in spatial price transmission

When referring to spatial APT p_{in} and p_{out} denote prices for the same product at different locations. Bailey & Brorsen (1989) suggest that spatial price transmission may be asymmetric for four reasons: asymmetric adjustment costs, asymmetric information, market power and asymmetric price reporting. All of these explanations have been proposed in connection with vertical APT and discussed above. Several aspects of these explanations are specific to the spatial context: adjustment costs, market power, flow of information from the center to the periphery.

Adjustment costs include, among others, the costs of transporting goods. Spatial APT might arise if the costs of transportation vary with the direction of trade, when for example infrastructure and handling facilities reflect consolidated past trade direction (Goodwin & Piggott, 2001), or speed and costs of transportation might be asymmetric due to natural conditions. If two locations are separated by asymmetric transportation, then price transmission will only appear to be asymmetric if trade flows reverse from time to time and price movements originating in one or both of these locations are predominantly positive or negative (Meyer & von Cramon-Taubadel, 2004).

Local market power can be hold by a firm if it has no competitors in within a certain area. Partners will not react to price changes requested or charged by this firm up to a certain threshold. Such firms may also ensure that price changes that squeeze its margin are passed on more rapidly than changes that stretch it, thus creating vertical APT thanks to spatial market power. Local market power could be difficult to identify and test with conventional proxies (e.g. concentration indexes) that use spatially aggregated prices. Results of conventional proxies analyzed in cross section across industries and products could be mis-specified (Meyer & von Cramon-Taubadel, 2004).

Asymmetric flows of information between markets could be a cause of spatial APT. Prices at a central market, by virtue of its size and the fact that it is at the center of a network of information, may tend to be less responsive to price changes in individual peripheral markets than vice versa (Abdulai, 2000).

4.6 Testing for Asymmetric Price Transmission

Aside of explaining the causes of asymmetric price transmission, researches have been using various approaches to test for the presence and strength of APT. Agriculture markets and markets for gasoline and financial products are the most tested. In their comprehensive review Meyer and von Cramon-Taubadel (2004) illustrate the chronology of asymmetric price methodologies. The first were the so-called “pre-integration approaches”, then the various cointegrating methods were developed.

4.6.1 Pre-cointegration techniques

Considering that p_t^{out} is a firm’s output in period t, and this price is caused by the input price, p_t^{in}, and assuming symmetric and linear price transmission the following equation can be used to illustrate this dependency:

$$p_t^{out} = \alpha + \beta_1 p_t^{in} + \mu_t \qquad (1)$$

Early techniques to estimate asymmetric adjustment in the agriculture sector followed the seminal work used dummy variables to split the input price into two parts: one variable includes only increasing input prices and another includes only decreasing input prices. From this, two input price adjustment coefficients can be estimated. If these coefficients differ between them, symmetry is rejected. Equation (2) is a translation of their original equation for supply analysis into APT context:

$$p_t^{out} = \alpha + \beta_1^+ D_t^+ p_t^{in} + \beta_1^- D_t^- p_t^{in} + \varepsilon_t \qquad (2)$$

D_t^+ and D_t^- are dummy variables: $D_t^+ = 1$ for increasing values of p_t^{in} ($p_t^{in} \geq p_{t-1}^{in}$) and $D_t^+ = 0$ otherwise, $D_t^- = 1$ for decreasing values of p_t^{in}($p_t^{in} \leq p_{t-1}^{in}$) and zero otherwise. β_1^+ and β_1^- are two distinct input price adjustment coefficients, one (β_1^+) refers to increasing phases of p_t^{in} and the other (β_1^-) to decreasing phases of p_t^{in}. Symmetric price transmission is rejected if β_1^+ and β_1^- are significantly different from one another if tested with a F-test.

This technique was further refined to explicitly include first differences of prices in the estimated equation. In particular Ward (1982) extends previous specification by including lags of the exogenous variables such that the delay in effects and the length of lags, can differ depending on whether the causal price is increasing or decreasing. Boyd and Brorsen (1988) were the first to use lags to differentiate between the magnitude and the speed of transmission. Based on comparisons of individual estimated coefficients, they analyse the speed of price transmission in specific periods and, based on the sums of these coefficients, they analyse its magnitude. The typical specifications involved a regression of price differences on lagged price differences, where the lagged differences are segregated according to sign, so that positive changes are allowed to have a different effect than negative changes (Meyer & von Cramon-Taubadel, 2004).

$$p_t^{out*} = \alpha \mathrm{t} + \sum_{j=1}^{K}(\beta_j^+ \sum_{t=1}^{T} D^+ \Delta p_{t-j+1}^{in}) + \sum_{j=1}^{L}(\beta_j^- \sum_{t=1}^{T} D^- \Delta p_{t-j+1}^{in}) + \varepsilon_t \qquad (3)$$

$$\Delta p_t^{out} = \alpha + \sum_{j=1}^{K}(\beta_j^+ \sum_{t=1}^{T} D^+ \Delta p_{t-j+1}^{in}) + \sum_{j=1}^{L}(\beta_j^- \sum_{t=1}^{T} D^- \Delta p_{t-j+1}^{in}) + \gamma_t \qquad (4)$$

Lag-lenghts in equations (3) and (4) can differ, as there is no reason to expect them to be equal in increasing and decreasing phases.

4.6.2 Asymmetry tests using co-integration analysis

Methods that include tests for non-stationarity and methods for avoiding spurious regression are generally known under the heading “co-integration analysis”. These methods are key to asymmetric price transmission because many price series appear to be non-stationary and, hence, susceptible to spurious regression[32].

In the case of co-integration between non-stationary series p_t^{in} and p_t^{out}, von Cramon-Taubadel & Fahlbusch (1994), von Cramon-Taubadel & Loy (1996) and von Cramon-Taubadel (1998) suggest an error correction model (ECM) extended by the incorporation of asymmetric adjustment terms would be a more appropriate specification for testing APT.

The first step consists in testing if p_t^{in} and p_t^{out} move together in the long-run (if they are cointegrated). This is done estimating equation (1), which could be considered as the long-term equilibrium relationship between p_t^{in} and p_t^{out}.

In a second step, the ECM relates changes in p_t^{out} to changes in p_t^{in} and estimates an error correction term (ECM) which are the lagged residuals from the estimation of equation (1). The ECM measures deviations from the long-run equilibrium, thus including this term in the ECM allows $p_t^{out}$to respond to changes in p_t^{in} and to 'correct' deviations from the long-run equilibrium that may remain from previous periods.

The possibility to split positive and negative deviations from the long-run equilibrium makes it possible to test for APT.

The ECM, including lagged changes in p_t^{in} takes the following form:

$$\Delta p_t^{out} = \alpha + \sum_{j=1}^{K} (\beta_j \ \Delta p_{t-j+1}^{in}) + \varphi^+ \ ECT_{t-1}^+ + \varphi^- \ ECT_{t-1}^- + \gamma_t \quad (5)$$

Splitting Δp_t^{in} into positive and negative components allows more complex dynamics von Cramon-Taudabel & Loy (1996):

32 Regressions involving non-stationary variables or variables that display similar behavior often produce results that are spuriously significant, suggesting the existence of relationships that do not, in fact, exist.

$$\Delta p_t^{out} = \alpha + \sum_{j=1}^{K}(\beta_j^{+}\ D^{+}\Delta p_{t-j+1}^{in}) + \sum_{j=1}^{L}(\beta_j^{-}\ D^{-}\Delta p_{t-j+1}^{in}) + \varphi^{+}ECT_{t-1}^{+} + \varphi^{-}\ ECT_{t-1}^{-} + \gamma_t \quad (6)$$

Three main comments to the previous specifications came from Meyer and von Cramon-Taudabel (2004):

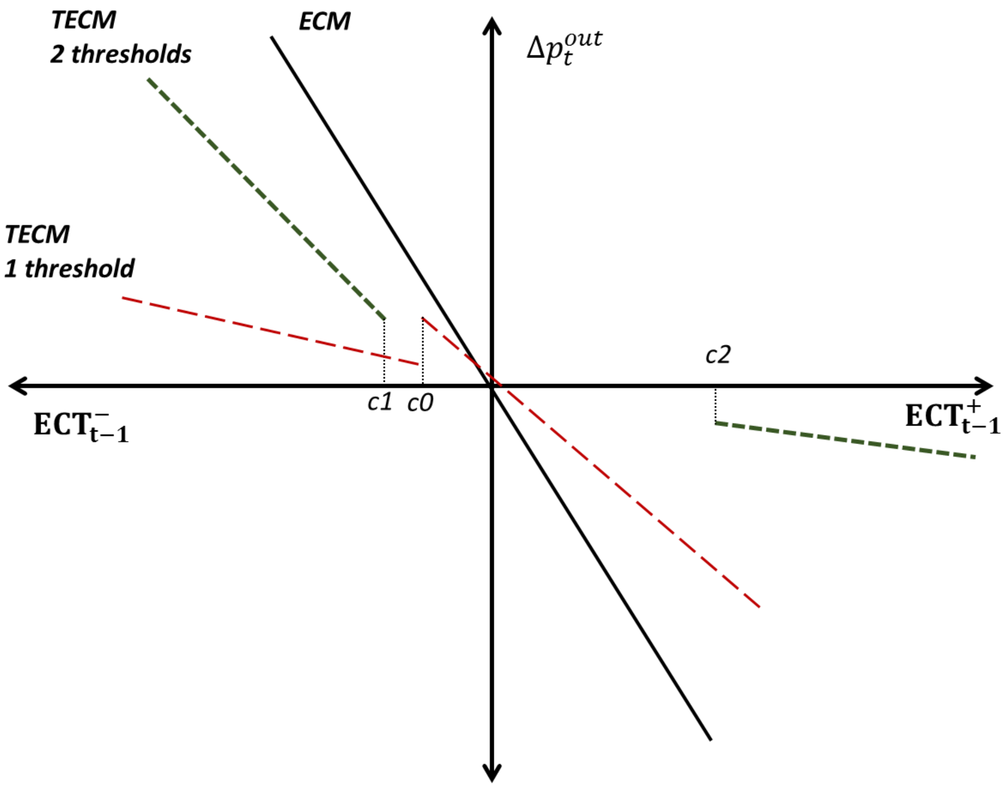
As co-integration and the ECM are based on the idea of a long run equilibrium, which prevents p_t^{in} and p_t^{out} from drifting apart, thus under specifications like in equations (5) and (6) it is only possible to consider asymmetry with respect to the *speed* of price transmission, not the magnitude. APT with respect to magnitude means that there is a permanent difference between positive and negative episodes of transmission; this will, in the long run, set the prices in question apart, with the result that they cannot be co-integrated.

Second, Enders & Siklos (2001), Engle & Granger (1987) modify the standard Dickey-Fuller co-integrating test to allow for asymmetric adjustment. This makes it possible to test for co-integration without maintaining the hypothesis of symmetric adjustment to the long run equilibrium. This corrects a potential inconsistency (invalid inference) in the two-step approach developed by von Cramon-Taubadel & Fahlbusch (1994), because failure to find that p_t^{in} and p_t^{out} are co-integrated in the first step – estimation of (1) – may actually be due to the fact that the standard Dickey-Fuller test is based on the assumption of symmetric adjustment.

Third, both Equations (5) and (6) are based on linear error correction (i.e. constant parameters $\varphi^{+}$and φ^{-}) whereby a constant proportion of any deviation from the long-run equilibrium is corrected, regardless of the size of this deviation. It is also possible to consider a type of ECM in which deviations from the long-run equilibrium between p_t^{in} and p_t^{out} will only lead to price responses if they exceed a specific threshold level.

A simple representation of the various specifications is presented in Figure 4. 3, where ECM and two types of TECM are shown, thresholds are given by c0, c1 and c2.

Figure 4. 3 – Threshold error correction



Source: adapted from Meyer (2003)

Threshold effects occur when larger shocks result in different response than smaller shocks. Dynamic responses may be nonlinear because various combinations of adjustments from alternative regimes are defined by the thresholds.

Note that when the ECT lies between them no error correction takes place. It is likely that this happens in presence of adjustment costs (Balke & Fomby 1997, Azzam 1999, Goodwin & Piggott 2001). The interval $[c1, c2]$ could be interpreted as containing deviations from the long-term equilibrium, which are small, compared to adjustment costs, so small that they will not lead to a price adjustment. The interval $[c1, c2]$ does not need to be symmetric with respect to the origin. Moreover, φ^+ and φ^- could be different, implying asymmetry with respect to the speed of transmission (Figure 4. 3). In a vertical context this holds if adjustment costs are symmetric, while in a spatial context, this might reflect a situation in which transaction costs associated with trade between two markets differ depending on the direction of trade flows.

Threshold co-integration can be specified and estimated as follows:

$$\Delta p_t^{out} = \alpha_1 + \sum_{j=1}^{K}\left(\beta_{1,j}\Delta p_{t-j+1}^{in}\right) + \varphi_1 ECT_{t-1} + \gamma_t \text{ if } ECT_{t-1} < c_1$$

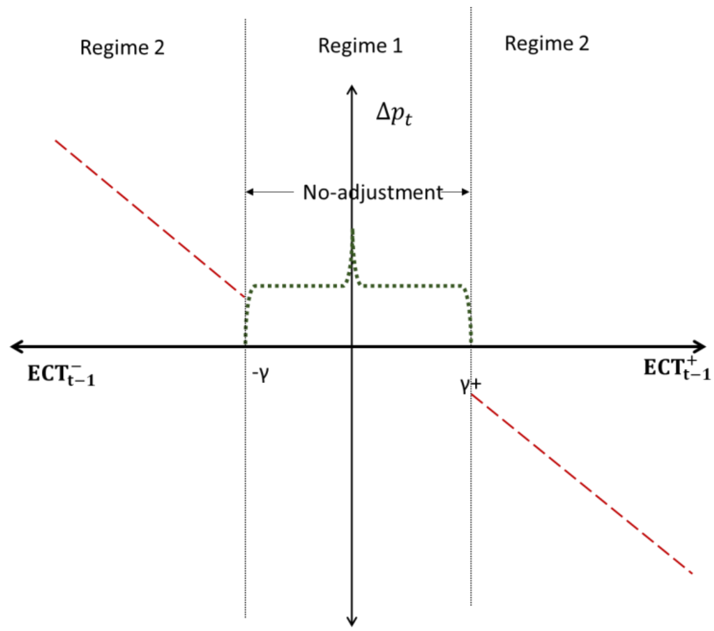
$$\Delta p_t^{out} = \alpha_2 + \sum_{j=1}^{K}\left(\beta_{2,j}\Delta p_{t-j+1}^{in}\right) + \varphi_2 ECT_{t-1} + \gamma_t \text{ if } c_1 \leq ECT_{t-1} \leq c_2$$

$$\Delta p_t^{out} = \alpha_3 + \sum_{j=1}^{K}\left(\beta_{3,j}\Delta p_{t-j+1}^{in}\right) + \varphi_3 ECT_{t-1} + \gamma_t \text{ if } ECT_{t-1} > c_2$$

It is important to note that this specification requires the number of thresholds to be chosen carefully, as this choice may influence results. For instance, in spatial price transmission both the estimation of transfer costs and the speed of price transmission could be underestimated and inferential results depend strongly on the specified number of regimes. Some rightly claim that results based exclusively on price data should be soundly based on economic reasoning (Lence, Moschini, & Santerano, 2017), and suggest to compare results with 1, 2 and 3 regimes. The chosen regime number should be the one whose economic reasoning fits best into the results.

Meyer (2003) proposed an approach of measuring market integration based on price data alone but also considering effects of transaction costs. In order to quantify price adjustment Meyer analyses market integration between pig markets in Germany and the Netherlands using a TVECM, but using a two regimes specification. Under this variant he yields a TVECM based on one threshold but that potentially allows to have a "band of no-adjustment" (regime 1) inside a regime of price adjustment to greater deviations from the long-term deviations (regime 2). Having one threshold makes it testable with respect to threshold significance and provides for an economically meaningful band of no adjustment (Figure 4. 1). This specification can be considered a restricted two threshold model, as c1=c2 = c0 = $|c|$ in Figure 4. 3.

Figure 4. 4 – Two regime TVECM with one threshold



Source: Meyer (2003)

Developments in time series analysis techniques and empirical applications performed thereafter have enhanced the use of nonlinear and threshold-type adjustments methods in error correction models, helping to understand spatial and vertical price transmission in various contexts. See, for example, the methodological contribution of Ihle & Cramon-Taubadel (2008), Greb et al. (2013) or the critical analysis made by Lence et al. (2017) for improving empirical analysis. On spatial price transmission the excellent review of Listorti & Esposti (2012) contains a full list of empirical works. Among additional examples of more recent works see those of Jamora & von Cramon-Taubadel (2016); Greb et al. (2012). TVECM have been increasingly implemented in analysis of vertical transmission. See, for example, Ben-Kaabia & Gil (2007), Fernandez-Amador et al. (2010); Santeramo & Cioffi (2010), Rezitis & Reziti (2011) Pala (2013), Bakucs et al. (2012), Bakucs et al. (2015).

4.7 Empirical analysis of asymmetric transmission in the dairy sector

The bulk of asymmetric price transmission analysis of has focused on commodities (gas, petrol), financial and agricultural markets. What follows are the results from empirical research that focused on the dairy sector.

Asymmetry price transmission in dairy markets has captured a lot of attention in the past. Since the mid-2000s when volatility of markets started to increase and concerns in the European context related to the withdrawal of the quota system have contributed to greater interest in the subject. Asymmetry was found already during the years 1971-1981 from farm milk to four major dairy products - fluid milk, cheese, butter, and ice cream- using the Houck procedure for estimating non-reversible functions (Kinnucan & Forker, 1987).

The hypothesis of symmetric price transmission was rejected in the French dairy market using an econometric model that estimated a demand and supply system for final dairy products, based on annual data from 1977-1993. Results showed that more than 20 of the wholesale-to-retail price margins for dairy products could be attributed to oligopoly-oligopsony distortions (Gohin & Guyomard, 2000).

A study prepared for DEFRA using monthly prices from 1995 to 2001 and conducted on four European countries (i.e. United Kingdom, Denmark, France, Germany) found price different patterns of transmission in the various countries. Causality from farm to retail level was found in all countries, but only the UK shows clear evidence that price developments at the retail end affect the farm gate milk price. In all cases asymmetry was found but the nature of the transmission of price changes along dairy value chain varies across the four countries (London Economics, 2004).

Asymmetry was verified in Spanish dairy markets with a threshold vector error correction model (TVECM), using monthly data from July 1997 until December 2000. Results shown that asymmetries affect a good number of products, although no asymmetry was found in highly perishable dairy products. Such empirical evidence supports the theory that market power could be consistent with symmetric price relationships. Asymmetries found in the sterilized milk branch could be explained menu costs and search costs, among other reasons (Serra & Goodwin, 2003).

Empirical results in the Austrian market, covering years 1996 until 2010, found robust results leading to asymmetry in dairy price transmission. Using a TVECM an inaction band in the adjustment to the long-run relationship is defined and, alternatively, price dynamics differ between periods of increasing and decreasing trends in causal prices. Adjustments happened only when deviations from the equilibrium are large enough (Fernandez-Amador et al., 2010).

Asymmetry is found in the Greek market as well, using data from 1989 and 2009, in a TVECM framework. However results puzzledly show a cointegrating relationship only when the equilibrium consumer milk price decreases more than a threshold (Rezitis & Reziti, 2011).

Empirical results of a study covering the years 1995-2007 in Poland and Hungary showed contrasting results. Using cointegrated vector auto-regression controlling for potential structural breaks, results highlighted short-term and long-term asymmetries for Polish milk prices and symmetries for Hungarian ones. In the Hungarian case results pointed to the presence of a structural break in late 2000. Although the two countries share a number of similarities due to common history, these differences could be due to differences in the sectors' development during transition. In particular, differences in farm structure and market structure at the processing level as well as the role of foreign direct investment (Bakucs, Fałkowski, & Fertő, 2012).

Spatial efficiency has been tested using TVECM in 20 states of the European Union, using monthly data from 2000 to 2014 and farm level prices. Results highlighted a low application of the Law of One Price (LOP), but results do not seem to convince authors who suggest aggregation level (national) of prices may be at the origin of these results (Bakucs, Fertő, Benedeka, & Molnár, 2015). A similar exercise but focused on Serbia has resulted asymmetric horizontal transmission from the rest of the world and Germany to Serbia in 2007-2013 (Popović, Radovanov, & Jeremić, 2013). Finally, transmission in the spatial dimension has been examined in the German context, both looking at producer and wholesale prices during years 2000-2014. Using a vector error correction model it was shown that the observed low price transmission in Germany is in line with a close linkage (cooperation) between farmers and processors, as the latter hold a large share of dairy processing (Graubner, Koller, Salhofer, & Balmann, 2009). The latter could be compared to the situation in Italy, where relations between farmers and dairies have been ruled by close relations in various forms (inter-professional agreements, value chain agreements, contracts).

5. Methodology / Analytical Strategy

In order to understand how dairy price formation works in the Italian dairy market I explore first the vertical transmission from farm to retail, and secondly spatial transmission between Italy and its two main suppliers (Germany and France). To do so, I proceed following the framework proposed in Rapsomanikis, Hallam & Conforti (2003) for the assessment of price transmission and market integration. Their approach consists in performing time series tests on each of the components and then assess the extent of price transmission. The tests and methods are the following:

- Non-stationarity and co-integration
- Causality
- Error correction mechanism
- Symmetry / asymmetry

Each of the above provides evidence about the components of transmission, helping the interpretation of price relations and understanding their nature.

The first two analyses represent preliminary specification tests useful to understand which models use in order to assess price transmission and market integration in the selected food value chain.

5.1 Preliminary specification tests.

5.1.1 Non-stationarity and co-integration

Prices, as other economic time series, show a non-constant distribution over time (e.g. varying means and variances) making these series non-stationary. This characteristic is known as "random walk", and can be represented as follows:

$$y_t = y_{t-1} + \varepsilon_t \qquad (1)$$

where, y_t is this period price, y_{t-1} is previous year price and $\varepsilon_t$is a random error.

Running regressions in presence of non-stationary series could produce spurious results, i.e. results that erroneously indicate relationships among regression variables. For this reason, it is relevant to test for non-stationary before proceeding with estimation. Certain time series are non-stationary but their difference is stationary as the random walk is. These series are said to be difference-stationary or integrated of order *d*, written I(*d*), if they must be differenced *d* times to be made stationary. A stationary variable is integrated of order zero, written I(*0*), a variable which must be differenced once to become stationary is said to be I(*1*), integrated of order one, and so on (Kennedy, 2008).

When two series follow persistent stochastic trends they are called "integrated" or "unit-root" processes if they do not drift too far apart (Engle & Granger 1987). This can be interpreted economically as the presence of a long-run equilibrium relationship between the variables.

Unit-root tests assume the null hypothesis that the true process is a random walk as equation (1) or a random walk with a drift (2):

$$y_t = \emptyset y_{t-1} + \varepsilon_t \qquad (2)$$

where ε_t is independent and identically distributed with N(0, σ^2), a normal distribution with zero mean and variance equal to one. The null hypothesis corresponds to $\emptyset$=1, while the alternative is $|\emptyset| < 1$.

If $\emptyset$ is 1, as the sample increases, the ordinary least squares (OLS) estimator ($\widehat{\emptyset}$) converges to the true value of 1 at a faster pace than it would if the process was stationary.

These series need to be treated carefully as, as depending on whether deterministic trends such as constants and time trends are included in the regression leads to different asymptotic distributions for the test statistic. In this light, a good specification of the null and the alternative hypothesis is essential while performing these tests.

Augmented Dickey-Fuller test

The Augmented Dickey-Fuller (ADF) test assumes as true that the process is either a random walk or a random walk with drift, fitting this model:

$$y_t = \alpha + \delta_t + \emptyset y_{t-1} + \varepsilon_t \tag{3}$$

The null hypothesis corresponds to $\emptyset$=1. Estimating the parameters of (3) by OLS may fail to account for residual serial correlation. The augmented Dickey-Fuller test addresses this issue by augmenting (3) by k number of differences of the dependent variables and testing whether $\beta = 0$:

$$\Delta y_t = \alpha + \delta_t + \beta y_{t-1} + \sum_{i=1}^{k} y_i \Delta y_{t-i} + \varepsilon_t \tag{4}$$

Phillips-Perron test

The Phillips–Perron (PP) test consists in fitting equation (4) and the results are used to calculate the test statistics. Phillips and Perron proposed two alternative statistics, which have been made robust to serial correlation by using the Newey–West heteroskedasticity and autocorrelation consistent covariance matrix estimator.

The PP test applies to 3 cases of unit roots:

1. Random walk without drift and a without constant, i.e.: in equation (4) $\alpha = 0, \delta = 0$
2. Random walk without drift with constant, i.e.: in equation (4) $\delta = 0$
3. Random walk with or without drift, i.e. no specification in (4)

They test ignores any serial correlation in the regression as their test uses a non-parametric estimation of the nuisance parameters of long $\widehat{(\omega^2)}$ and short run $(\widehat{\sigma_u^2})$variance of u_t.

GLS detrended augmented Dickey-Fuller test

This test has been proposed by Elliot et al. (1996) and developed by Ng and Perron (2001), it is similar to the ADF test, with the difference the series are detrended (or demeaned):

$$\Delta y_t^d = \alpha + \delta y_{t-1}^d + \sum_{j=1}^{p} \gamma_j \Delta y_{t-j}^d + \varepsilon_t \qquad (5)$$

Where the suffix *d* means that a detrended process has been applied, and depends on the deterministic component included in the regression, a constant or a constant and a trend. The inclusion of modified information criteria (MIC) for detecting the lag length overcomes the two problems for which the ADF and PP tests suffer. De-trending improves the power of the tests when there is a large autoregressive (AR) root, and reduces size distortions when there is a large negative moving average root in the differenced series.

5.1.2 Causality tests

The existence of co-integration between two variables implies the existence of causality between them in at least one direction (Granger, 1989) but co-integration itself cannot be used to make inferences about the direction of causation between the variables, thus causality tests are necessary. Granger (1980) defined causality between two variables based on two principles: i) the cause happens before its effects; ii) the cause has unique information about the future values of its effects. Essentially, he suggested an empirical definition of causality based only on its forecasting content: if p_{1t} causes p_{2t} then p_{2t+1} is better forecast if the information p_{1t} is used, since there will be a smaller variance of forecast error. In other words, p_{1t} is said to Granger-cause p_{2t} . Granger proposed to test the following hypothesis for identification of a causal effect of p_{1t} on p_{2t}:

$$\mathrm{P}\left\{p_{2,t+1} \in \mathrm{A} \,\middle|\, I(t)\right\} \neq \mathrm{P}\left\{p_{2,t+1} \in \mathrm{A} \middle| I_{\_X}(t)\right\} \quad (6)$$

Where, P refers to probability, A is an arbitrary non-empty set, and *I*(t) and $I_{\_X}(t)$ respectively denote the information available as of time t in the entire universe, and in the modified universe in which p_{1t} is excluded. If equation (6) is accepted, one can say that p_{1t} Grange causes p_{2t}.

This definition has important implications in the analysis of price transmission, as Granger causality provides additional evidence as to whether, and in which direction, price transmission is occurring between two series (Rapsomanikis et al. 2003).

5.1.3 Co-integration

As said previously, if two series are non-stationary they may create spurious and inconsistent regression problems. However, in a multivariate context, there might be a linear combination of integrated variables that is stationary. If this is the case, these variables are said to be co-integrated. If two non-stationary series are co-integrated then, by definition, the extent by which they diverge from each other will have stationary characteristics and will reflect only the disequilibrium. In this sense, co-integration is a powerful concept that allows to capture the equilibrium relationship between non-stationary series (if such equilibrium relationship exists) within a stationary model. Co-integration implies that prices move closely together in the long run, although in the short run they may drift apart. As such, with co-integration estimation one is analysing long run economic relationships among non-stationary, integrated variables (Vavra & Goodwin 2005).

Granger and Engle co-integration test

This is a simple procedure to test for co-integration developed by Engle & Granger (1987). It consists in estimating the static co-integrating regression (7) using OLS, and applying unit root tests, such ADF and PP, to the estimated residuals in order to test for the null hypothesis of no co-integration.

$$y_t = \alpha + \beta x_t + v_t \tag{7}$$

If y and x are I(*1*) then the residual v_t from the regression of those series would also be I(*1*), unless they are co-integrated. Thus if the residuals are distributed I(*1*) I accept the null hypothesis of no co-integration, but if the residuals are I(*0*) then I reject the null and accept that *x* and *y* are co-integrated. In other words, tests for co-integration are direct analogues of Dickey-Fuller tests developed for the analysis of unit roots in a single data series, except that here the tests are applied to the residuals of the "co-integrating regression". As, by definition, the process of regression minimizes the variation of the residuals around a mean of zero, the estimated residuals will be biased towards stationary. The critical values for the Dickey-Fuller t-test statistics used to test for co-integration are therefore higher in absolute values than those used to test for the order of integration of the univariate time series. In addition; since the regression creates a mean-zero error term the DF testing equation necessarily assumes that there is no constant (drift term).

Johansen co-integration test

The Johansen co-integration test relies on the relationship between the rank of a matrix and its characteristic root. Vavra and Goodwin (2005) explain its construction and interpretation underlying that it could be viewed as a multivariate generalization of the Dickey-Fuller test. The procedure starts with defining a traditional vector autoregressive model (VAR), selecting the appropriate number of lags on the likelihood ratio tests or alternative AIC statistics, to estimate the vector error correction model and determine the rank of the matrix parameters. The co-integration of the system is tested using the maximum likelihood $L_{max}(r)$ which is a function of the co-integration rank r. Johansen describes two test methods: (1) Trace Test and (2) Maximum Eigenvalue Test.

The trace test is based on the log-likelihood ratio $\ln[L_{max}(r) / L_{max}(k)]$, and is conducted sequentially for r = k-1,...,1,0. The trace test tests the null hypothesis that the co-integration rank is equal to *r* against the alternative that the co-integration rank is k. The latter implies that x_t is trend stationary. The maximum Eigenvalue test is based on the log-likelihood ratio $\ln[L_{max}(r) / L_{max}(r+1)]$, and is conducted sequentially for r = 0,1,..,k-1. The test tests the null hypothesis that the co-integration rank is equal to *r* against the alternative that the co-integration rank is equal to *r*+1.

5.2 Error Correction Models

An error-correction model is a dynamic model in which the movement of the variables in any period is related to the previous period's gap from long-run equilibrium. Co-integration provides a means of partitioning the evolution of time-series data into its two components (i.e. the long-run equilibrium characteristics and the short-run disequilibrium dynamics) using a direct link between co-integration and the so-called error correction model (ECM). This link is formalized in the Engle-Granger Representation Theorem which states that if two series are co-integrated then they will be most efficiently represented by an error correction specification. If the series is co-integrated, and the ECM validated, then it will incorporate any other dynamic specification, for instance the partial adjustment mechanisms. So, if two variables are co-integrated and non-stationary their relationship may be validly described by an error correction representation. The ECM specification is the most efficient way of representing the long-run or equilibrium properties of the system, the short-run or disequilibrium properties, and the nature of the adjustment towards equilibrium (Vavra & Goodwin, 2005).

5.2.1 Engle and Granger procedure to estimate Error Correction Models

Engle and Granger (1987) proposed a relatively simple two-step procedure to estimate an error correction model. In the first step the static co-integrating regression (using OLS) is estimated as in (8) and tests for the presence of co-integration are carried out as described above. If co-integration is accepted, then (8) is said to describe the long-run relationship between *y* and *x* and the parameter vector (α,β) is referred to as the co-integrating vector. In the second step the residuals saved from the OLS first step estimation of the long-run equilibrium are used in the error correction model:

$$\Delta y_t = \rho \Delta x_t + \omega \, \widehat{v_{t-1}} + e_t \tag{8}$$

where $\widehat{v_{t-1}} = y_{t-1} - \hat{\alpha} - \hat{\beta} x_{t-1}$

This model can be transposed to a *Vector* representation of the Error Correction Model (VECM). The VECM can be seen as a vector auto-regression (VAR)[33] model including a variable representing the deviations from the long-run equilibrium. This representation is particularly interesting as it allows to estimate how the variables adjust deviations towards the long-run equilibrium:

[33] Vector auto-regression is a stochastic process model used to capture the linear interdependencies among multiple time series. These models generalize the univariate autoregressive model in which future values of a variable depend on a weighted sum of past values variable, by allowing for more than one evolving variable.

$$\begin{pmatrix}\Delta p_{1t}\\ \Delta p_{2t}\end{pmatrix} = \begin{pmatrix}\mu_1\\ \mu_2\end{pmatrix} + \begin{pmatrix}\alpha_1\\ \alpha_2\end{pmatrix}(p_{1t-1} - \beta p_{2t-1}) + A_2\begin{pmatrix}\Delta p_{1t-1}\\ \Delta p_{2t-1}\end{pmatrix} + \cdots\cdots + A_k\begin{pmatrix}\Delta p_{1t-k}\\ \Delta p_{2t-k}\end{pmatrix} + \begin{pmatrix}v_{1t}\\ v_{2t}\end{pmatrix} \quad (7)$$

where,

v_{1t} and $v_{2t}$are *i.i.d.* disturbances with zero mean ad constant finite variance. The operator Δ indicates that the variables I(*1*) have been differenced to achieve stationarity.

Parameters contained in matrices $A_2 \ldots A_k$, measure the short run effects.

Level variables, p_{1t-1} and p_{2t-1} are included in the equation in the same term as β, which is the cointegrating parameter that characterize the long-term equilibrium relationship between the two prices.

The term $(p_{1t-1} - \beta p_{2t-1})$ measures the error or divergence from equilibrium.

The vector $\begin{pmatrix}\alpha_1\\ \alpha_2\end{pmatrix}$ contains parameters α_i such that $0 < |\alpha_i| < 1, i = 1, 2$, and is called error correction term (ECT).

The ECT measures the extent of corrections of the errors that the market initiates by adjusting prices towards the long run equilibrium relationship. The speed with which the market returns to its equilibrium depends on the value of α_i, the closer α_i is to 1 the faster the speed of adjustment.

The VECM depicts a stylized picture of the relationship between two prices, and provides a framework to test price transmission taking into account factors that may impede full vertical transmission or spatial market integration over time (Rapsomanikis et al. 2003).

5.2.2 Asymmetric ECM and test for asymmetry

The concept of co-integration can be incorporated in models representing asymmetric price transmission by including asymmetric adjustment terms (Meyer & von Cramon-Taubadel 2004). In a nutshell the procedure involves estimating a relationship between prices (for example retail and farm-level) by ordinary least squares (OLS) and testing for the presence of a spurious regression. If the prices are co-integrated the estimated coefficient of the OLS is an estimate of the long-term equilibrium relationship between them. In a second step, an ECM is estimated. The model includes a so-called error correction term which measures deviations from the long-run equilibrium between the two prices. The inclusion of this term allows the estimated price to respond to the changes in the explanatory price, and also to correct any deviations from the long-run equilibrium that may be left over from previous periods. Granger & Lee (1989) proposed an asymmetric ECM where the speed of the adjustment of the endogenous variable depends on whether the deviation from the long run equilibrium is positive or negative.

This ECM takes to following form:

$$\Delta P_t^1 = \alpha + \sum_{j=1}^{k} \beta_j \Delta P_{t-j+1}^2 + \gamma^+ v_{t-1}^+ + \gamma^- v_{t-1}^- + e_t \quad (10)$$

where P_t^1 and P_t^2 are two integrated prices, Δ is the difference indicator (differencing P_{t-1}minus P_t), β_j and γ are estimated coefficients and v_{t-1}^+ and $v_{t-1}^-$are the positive and negative deviations from the long run equilibrium.

This error correction representation, and all its variants, allows testing for asymmetric and non-linear adjustment to a long-run equilibrium. In essence what is tested is if $\gamma^+$and γ^- are equal or if $\gamma^+ - \gamma^- = 0$.

The asymmetric ECM in its vector specification can be represented as follows:

$$\begin{pmatrix}\Delta p_{1t} \\ \Delta p_{2t}\end{pmatrix} = \begin{pmatrix}\mu_1 \\ \mu_2\end{pmatrix} + \begin{pmatrix}\alpha_1^- \\ \alpha_2^-\end{pmatrix} (p_{1t-1} - \beta p_{2t-1})^- + \begin{pmatrix}\alpha_1^+ \\ \alpha_2^+\end{pmatrix} (p_{1t-1} - \beta p_{2t-1})^+ + A_2 \begin{pmatrix}\Delta p_{1t-1} \\ \Delta p_{2t-1}\end{pmatrix} + A_k \begin{pmatrix}\Delta p_{1t-k} \\ \Delta p_{2t-k}\end{pmatrix} + \begin{pmatrix}v_{1t} \\ v_{2t}\end{pmatrix}$$

(11)

The two ECTs, $\begin{pmatrix}\alpha_1^-\\ \alpha_2^-\end{pmatrix}(p_{1t-1}-\beta p_{2t-1})^-$ (ECT-) and $\begin{pmatrix}\alpha_1^+\\ \alpha_2^+\end{pmatrix}(p_{1t-1}-\beta p_{2t-1})^+$(ECT+), reflect positive and negative corrections toward long-run equilibrium.

Like before, asymmetry happens when positive and negative divergences in prices have different magnitude, and thus $\begin{pmatrix}\alpha_1^-\\ \alpha_2^-\end{pmatrix}$ and $\begin{pmatrix}\alpha_1^+\\ \alpha_2^+\end{pmatrix}$ are not equal. The null Hypothesis that prices are symmetrically transmitted against the alternative of asymmetry is tested imposing the equality restriction $\begin{pmatrix}\alpha_1^-\\ \alpha_2^-\end{pmatrix}=\begin{pmatrix}\alpha_1^+\\ \alpha_2^+\end{pmatrix}$.

5.2.3 Threshold Error Correction Models

As already mentioned in Chapter 4, adjustment costs may inhibit adjustments to small shocks such that a shock may have to be of a particular size before a significant response is provoked (Vavra & Goodwin 2005; Stigler 2013). Threshold error correction models allow the estimation of price transmission in the presence of thresholds, in other words, non-linear adjustment to long-run equilibrium. They were introduced by Balke & Fomby (1997), who focused on the long-run relationship representation.

To illustrate this model consider a standard linear co-integration relationship among a group of prices:

$$P_{it}-\alpha-\beta_j P_{jt}-\beta_k P_{kt}=v_t \qquad (12)$$

where P_{it}, $P_{jt}$and $P_{kt}$are three related prices, e.g. retail and wholesale and fam levels or prices at the same level in different regions, β_j and $\beta_k$are the estimated coefficients, and $v_t = \emptyset v_{t-1}+u_t$ represent the residual of the equilibrium relationship (i.e. a deviation from the equilibrium). A co-integration relationship among the prices requires v_t to be stationary, implying $|\emptyset|< 1$. If a three-regime threshold autoregressive model is used, the behaviour of v_t can be modelled as:

$$v_t = \emptyset^{(i)} + u_t, \text{ where}$$

$$\emptyset^{i} = \begin{cases} \emptyset^{(1)} \; if -\infty < v_{t-d} \leq c_1 \\ \emptyset^{(2)} \; if\, c_1 < v_{t-d} \leq c_2 \\ \emptyset^{(3)} \; if\, c_2 < v_{t-d} \leq +\infty \end{cases} \tag{13}$$

and where c_1 and c_2 represent threshold parameters that delineate the different regimes and v_{t-d} represents the variable relevant to the threshold behaviour (often referred to as the "forcing variable"). In most empirical applications, *d* is assumed to be equal to 1, though this is a restriction that can be empirically tested within the threshold model estimation framework.

The extension to a threshold *vector* error correction model (TVECM) has been developed by others, the threshold effect being applied only to the error-correction term (Granger and Lee 1989, Seo 2011) or to the lags and the intercept as well (Hansen & Seo 2002, Chien Lo & Zivot 2001). The vector error representation of the threshold model is given by:

$$\Delta P_t = \begin{cases} \sum_{i=1}^{l} B_i^{(1)} \Delta P_{t-1} + \gamma^{(1)} v_{t-1} + e_t^{(1)} \text{if} -\infty < v_{t-d} \leq c_1 \\ \sum_{i=1}^{l} B_i^{(2)} \Delta P_{t-1} + \gamma^{(2)} v_{t-1} + e_t^{(2)} \text{if } c_1 < v_{t-d} \leq c_2 \\ \sum_{i=1}^{l} B_i^{(3)} \Delta P_{t-1} + \gamma^{(3)} v_{t-1} + e_t^{(3)} \text{if } c_2 < v_{t-d} \leq +\infty \end{cases} \tag{14}$$

where P_t is the vector of prices being analysed and B_i and γ are vectors of parameters to be estimated. The threshold vector error correction model (TVECM) can then be compactly expressed as:

$$\Delta P_t = \begin{cases} B^{(1)\,'}\, x_{t-1} + e_t^{(1)} \;\text{ if} -\infty < v_{t-d} \leq c_1 \\ B^{(2)\,'}\, x_{t-1} + e_t^{(2)} \;\text{ if } c_1 < v_{t-d} \leq c_2 \\ \end{cases} \tag{15}$$

$$B^{(3)\prime}\, x_{t-1} + e_t^{(3)} \text{ if } c_2 < v_{t-d} \leq +\infty$$

where:

$$x_{t-1} = \begin{bmatrix} \Delta P_{t-1} \\ \Delta P_{t-1} \\ . \\ . \\ . \\ \Delta P_{t-1} \\ \Delta P_{t-1} \end{bmatrix} \tag{16}$$

and B is a matrix of parameters. This may also be written as:

$$\Delta P_t = \beta^{(1)\prime} x_{t-1} d_{1t}(c_1, c_2, d) + \beta^{(2)\prime} x_{t-1} d_{2t}(c_1, c_2, d) + \beta^{(3)\prime} x_{t-1} d_{3t}(c_1, c_2, d) + e_t \tag{17}$$

where the d terms are indicator variables that define each regime:

$$d_{1t}(c_1, c_2, d) = 1(-\infty < v_{t-d} \leq c_1)$$

$$d_{2t}(c_1, c_2, d) = 1(c_1 < v_{t-d} \leq c_2)$$

$$d_{1t}(c_1, c_2, d) = 1(c_2 < v_{t-d} \leq +\infty) \tag{18}$$

One of the most important statistical issues for this class of models is testing for the presence of a threshold effect (the null of linearity). As mentioned, Hansen & Seo (2002) proposed a maximum likelihood estimation (MLE) of the threshold model in which they implement an algorithm involving a grid search over the threshold and the co-integrating vector.

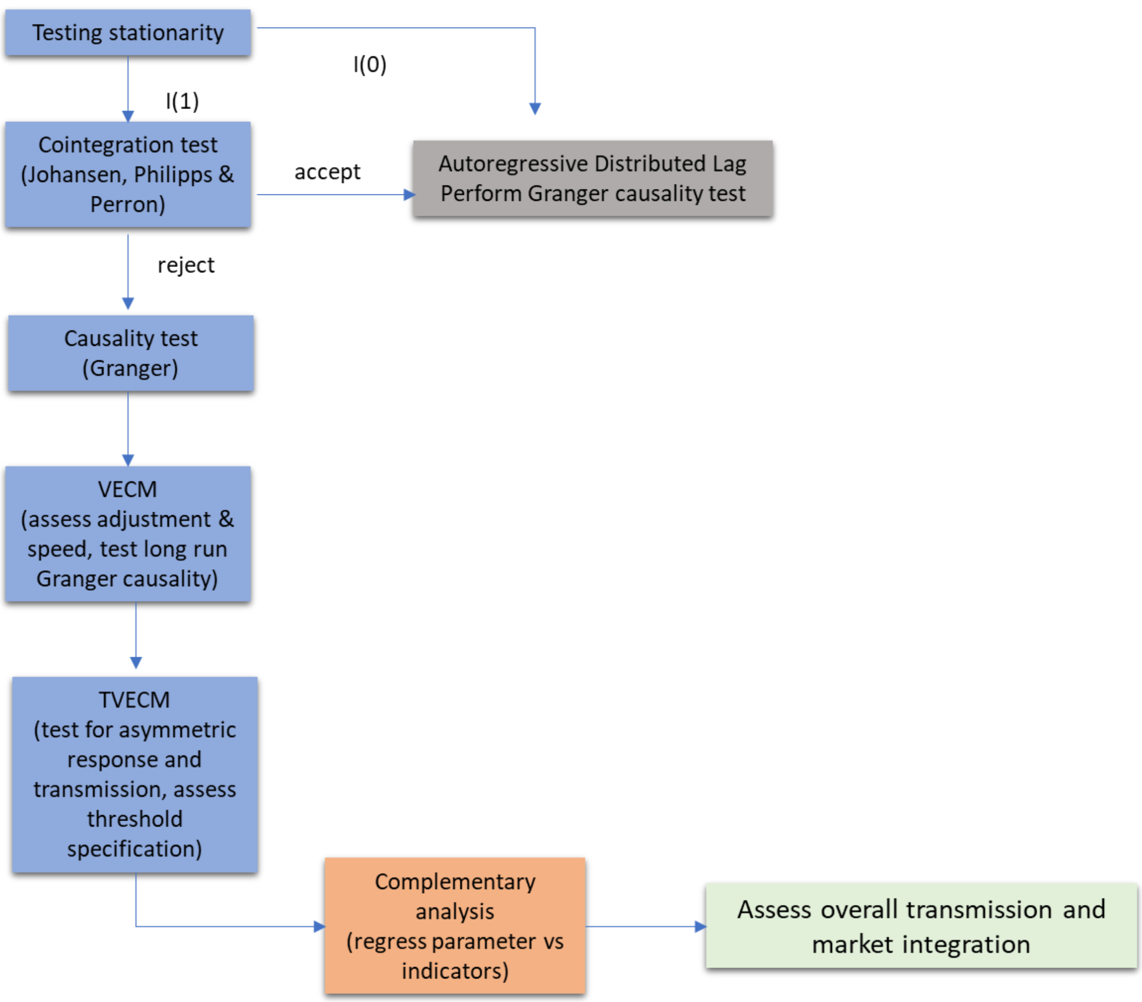
They also developed a test for the presence of a threshold effect. Under the null hypothesis there is no threshold, so the model reduces to a conventional linear VECM. In this case the test can be based on the Lagrange Multiplier (LM) principle, which only requires estimation under the null. Since the threshold parameter is not identified under the null hypothesis, they base inference on a SupLM test.

In a latter work, Seo (2011) provides noteworthy proprieties of the least-squares (LS) estimator of β. He shows that the convergence of the LS estimator of β is $n^{3/2}$ times higher than in the linear model. Moreover, Seo develops first smoothed-LS estimators of β, the threshold parameter and the other short-run parameters.

5.3 Analytical Strategy

I perform an analytical strategy based on Rapsomanikis, Hallam & Conforti (2003) approach, who proposed the empirical tools that can be used to assess the components of market integration and price transmission (Figure 5. 1):

Figure 5. 1 – Steps in the analytical strategy



Source: adapted from Rapsomanikis et al, 2003

For each pair of prices, I start by testing for the ***order of integration*** of each price pair using the Augmented Dickey- the Phillips and Perron tests and Generalized least-squares de-trended ADF tests. The GLS-ADF test proposed by Elliott et al. (1996) is similar to the ADF test. However, prior to fitting the model, it first transforms the actual series via a generalized least-squares (GLS) regression. Elliott et al. (1996) show that this test has better power than the ADF test. The null hypothesis being tested is a random walk with a possible drift with two specific alternative hypotheses: the series is stationary around a linear time trend, or the series is stationary around a possible non-zero mean with no time trend.

I then test for ***Granger Causality*** within a Vector Auto-regression (VAR) framework to assess price transmission between the markets or along the supply chain.

If the tests indicate that the series are integrated of the same order, e.g. I(*1*), I proceed by testing the null of no co-integration against the alternative hypothesis of one cointegrating vector using the *Johansen procedure* or the *Engle-Granger co-integration test* (Schaffer, M.E. 2010). Evidence against the null of no co-integration indicate that prices co-move and that markets are integrated. Neither restrictions nor tests are imposed on the cointegrating parameter estimate β. In the event of no H_0 rejection, the conclusion is that the markets are not integrated, and/or that I am unable to conclude that price transmission along the supply chain or across regions is complete.

If test results indicate that the price series are co-integrated, I proceed to the ***error correction representation*** in the form of a (V)ECM, examining the short run dynamics, the speed of adjustment and the direction of Granger causality in the short or the long run following (Granger 1969, 1980).

Once the VECM is completed I perform two tests on residuals characteristics to verify the model specification: Lagrange multiplier for residual autocorrelation and Jarque-Bera for normal distribution. Autocorrelation in residuals is desirable as well as the fact that residuals are normally distributed, while rejection of the null hypothesis of normality may indicate the presence of structural breaks in the data.

Based on the results tests on residuals and direction of causality, I specify an asymmetric error correction representation and test for the null of symmetry following Granger & Lee (1989) and Prakash et al. (2001).

Based on the results of VECM the next step consists in specifying ***a Threshold Vector Error Correction Model (TVECM)*** using a package in the R developed by Stigler (2013). The package is based on the work of Hansen & Seo (2002) and Seo (2006). TVECM model estimators - the threshold and the cointegrating parameter are assessed using a grid search. For the threshold, Stigler (2010) restricts the search to the existing value of the error correction term (ECT). The statistical package allows estimating a bivariate TVECM with two or three regimes with the OLS estimator (β). The model can be specified with a constant, a trend or none, and the lags can be regime specific or not.

A co-integration test is performed using Hansen and Seo (2002) sup-LM test of a linear VECM against a TVECM with two regimes. Hansen and Seo 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. In the package developed by Stigler (2013) the fixed regressor bootstrap is calculated with 1,000 simulation replications.

In each step and at the end of the procedure I assess the results and comment on the nature of price transmission and market integration, both along the Italian dairy supply chain and across Italian, German and French dairy markets.

6. Analysis of Price Transmission

I apply the strategy illustrated in Chapter 5 to test and analyse price transmission along the dairy value chain in Italy as well as price integration between the Italian dairy market and Germany and France - its neighbours and main sources of dairy imports. The aim is to verify if recent changes to market policy support have contributed, as claimed, to improve farmers' bargaining power.

First, I proceed to analyse vertical price transmission, testing farm and consumer price of fresh milk and Grana Padano cheese in the Italian market. Secondly, I test integration between Italian, German and French markets examining how milk prices are transmitted between the three countries.

6.1 Data

Price transmission is tested using monthly prices of fresh milk and Grana Padano cheese in €/100kg transformed in logarithm at farm, spot and consumer level, with different time and geographic coverage depending on the data source and type analysis – vertical or horizontal transmission. Prices are sourced from the Institute of Services for the Agrofood Market (ISMEA), the European Commission Dairy Market Observatory (E.C.) and CLAL, an Italian Dairy Economic Consulting firm. The length, notation, and source of each price series are summarised in Table 6. 1.

Table 6. 1 – Data sources

Country/ Region	*Variable*	*Name*	*Unit*	*Frequenc y*	*Time coverage*	*Source*
Italy	farm price	Pitfarm	€/100lt	Monthly	2000M1-2016M12	ISMEA
Italy	milk consumer price	Pitcons	€/100lt	4 weeks	2000M1-2016M12	ISMEA
Italy	Grana Padano consumer price	Pitforma	€/100kg	Monthly	2005M1-2014M12	ISMEA
Italy	farm price	Pit	€/100kg	Monthly	2000M1-2017M3	E.C.
Germany	farm price	Pger	€/100kg	Monthly	2000M1-2017M3	E.C.
France	farm price	Pfr	€/100kg	Monthly	2000M1-2017M3	E.C.
Italy	spot price	Pitspot	€/100kg	Monthly	2003M1-2017m8	CLAL
Germany	spot price	Pgerspot	€/100kg	Monthly	2003M1-2017m8	CLAL
France	spot price	Pfrspot	€/100kg	Monthly	2004M1-2017m8	CLAL

The analysis of vertical price transmission in the Italian market consists in comparing national averages of: milk farm prices versus consumer prices and milk farm prices versus Grana Padano cheese consumer prices. The source of prices is ISMEA. Farm level prices are gathered by ISMEA survey network, which register raw milk prices paid to producers for deliveries on their territory. ISMEA collects the information on a regional basis, and estimates a national average quotation, through appropriate weighting, for the purpose of communication to the European Commission required pursuant to Art.2 of the Regulation (EC) no. 479/2010 and subsequent amendments. Milk consumer prices are collected weekly from a Panel of 9000 families which are representative of the Italian universe. A "family" is intended as group of individuals that live together in the same unit and thus share the same consumption basket; collection is performed through scanning of consumed goods. Collection of data in the panel of buying families allows to estimate main quantitative indicators of consumption behaviour, including prices. As consumer prices frequency is 4 weeks, they have been converted to monthly by weighting them based on the number of days belonging to each month. Grana Padano cheese consumer prices correspond to a shorter time spam compared to the other two series, from January 2005 until December 2014. I chose to use this series as it was available with a monthly frequency and does not need further elaboration. They have been collected with the same method as milk consumer prices.

In a subsequent step, I compare the evolution of farm level prices at national level in Italy, Germany and France. I also look at milk spot prices, and at milk farm prices at regional level. The source of national farm prices is the Dairy Market Observatory of European Commission, while spot and regional prices are sourced from CLAL. Foreign spot prices of pasteurized whole milk, which are collected by the Chamber of Commerce of Lodi, are published by CLAL. They refer to whole milk (bulk in a cistern, standardized at 3.6% pv of mg, free delivery to a dairy in Northern Italy) from Germany and France, whose volumes are sold outside any annual contract of long duration. It is relevant to refer to the presence of "spot" foreign pasteurized whole milk because it is an indicator of the trend in product demand (on the other hand influenced by factors such as the increase in consumption of UHT milk / fresh cheeses or the lack of raw material in autumn periods)[34]. Regional prices published by CLAL correspond to farm prices of whole milk paid in Lombardy (source: elaboration by CLAL based on regional, local agreements, or businesses), Bavaria (source: ZMP, from 2009 ZMB) and Rhones-Alpes (source: FranceAgriMer Cow Milk Survey).

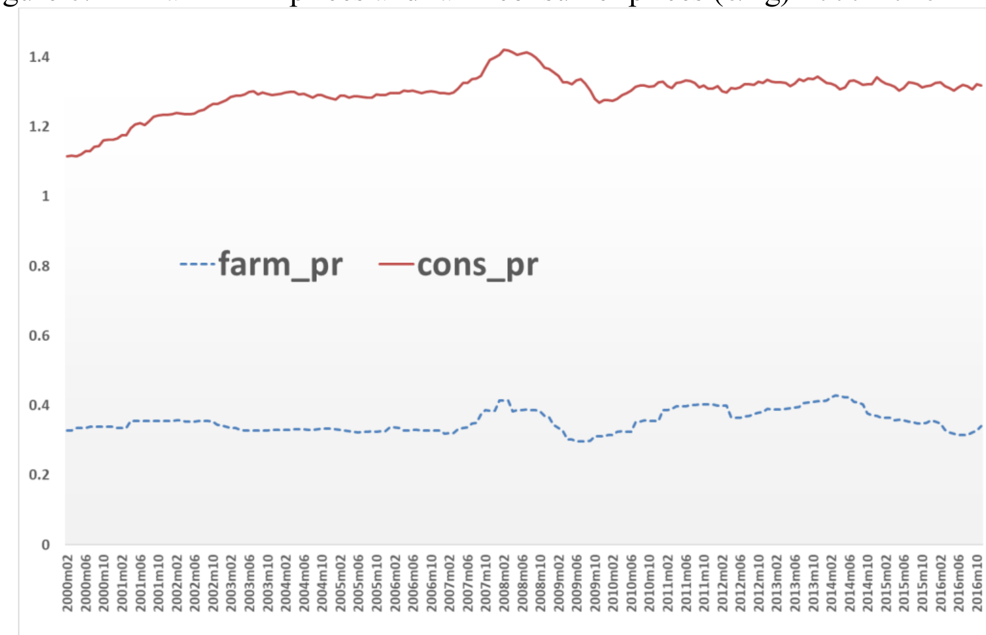
6.2 Vertical transmission

I first use the Akaike Information Criterion (AIC) to choose the appropriate lag length by trading off parsimony against reduction in the sum of squares. The ADF test statistics presented in Table 6. 2 correspond to the regression that has maximized the AIC.

[34] Until the end of 2005 the price of milk was determined in Euro per 1000 litres; from 1st January 2006 the price is determined in Euro per 1000 kg. CLAL publishes the price in Euro per 100 litres in order to compare it with the price of milk at the stable in Lombardy (the largest milk producing region) where the price is defined between the Parties (industry and farmers) in Euro per 100 lt.

Milk farm and consumer prices evolution over time is presented in **Error! Reference source not found.**.

Figure 6. 1 – Farm milk prices and farm consumer prices (€/kg) 2000-2016



Source: own elaboration based on Ismea.

Based on both the ADF, Phillips and Perron and detrended Dickey-Fuller General Least Squares (DF-GLS) tests, both with and without a deterministic trend, I cannot reject the null hypothesis of non-stationarity. But if I apply the tests to the differenced series, I am able to verify that the 3 series (milk farm prices, milk consumer prices, and Grana Padano cheese consumer prices) are I(1).

Table 6. 2 – Vertical transmission series - Unit root tests

	levels				*differences*			
	ADF	PP		DF-GLS	ADF	PP		DF-GLS
	z(t)	z(rho)	z(t)	DF-GLS tau	z(t)	z(rho)	z(t)	DF-GLS tau
Italy Milk farm price	-2.767***	-10.137	-2.297	-3.398**	-10.973***	-171.914***	-11.28***	-4.288***
Italy milk consumer price	-3.742***	-8.167	-3.659***	-1.088	-10.492***	-148.142***	-10.562***	-3.953***
Italy Grana Padano consumer price	-0.995	-2.605	-1.064	-2.339	-6.658***	-138.833***	-13.344***	-5.429***

Note: *, ** and *** stands for significance at the 10, 5 and 1% level, respectively

Granger causality tests have confirmed the existence of causality between variables; farm milk prices granger cause milk consumer prices and vice versa. There is also causality from farm milk prices towards Grana Padano cheese consumer prices, but not from Grana Padano cheese to farm milk prices (Table 6. 3).

Table 6. 3 – Vertical transmission series - Granger causality

	F-Stat.	P-value
H0 : No log(pitfarm)→ln(pitcons)	7.1644	0.067
H0 : No log(pitcons)→ln(pitfarm)	10.979	0.012
H0 : No log(pitfarm)→ln(pforma)	4.0795	0.014
H0 : No log(pforma)→ln(pitfarm)	0.10193	0.899

Co-integration has been tested using both Johansen and Engle & Granger co-integration tests. Results shown in Table 6. 4 indicate there is co-integration between milk farm and consumer prices as the Johansen test provided evidence of one co-integrating relationship being the trace statistic lower than the 5% significance critical value (a similar result is obtained comparing the max statistic although this is not shown in the table for the sake of brevity). These results are confirmed by the augmented Engle Granger test -the parameter statistic value is higher than the 5% significance critical value. Analogous evidence is obtained while testing for co-integration between milk farm prices and consumer prices between farm milk prices and consumer prices of Grana Padano cheese.

According to the Engle Granger Representation Theorem a couple of series can be represented using an error correction specification if they are cointegrated. In the eventuality the VECM model is validated I could identify long-run properties of the system and other dynamic specifications, like partial adjustment mechanisms. I have already found bi-directional causality and verified the presence of co-integration between milk farm and milk consumer prices, so I can proceed with a VECM representation of these price series.

Table 6. 4 – Vertical transmission series - Co-integration tests

Farm and consumer price of milk

Johansen test N=200			Augmented Engle-Granger test N=200			
Maximum rank	Trace statistic	5% critical value	Test statistic z(t)	1% critical value	5% critical value	10% critical value
0	25.6694	19.96	-3.742	-3.951	-3.367	-3.066
1	6.7299*	9.42				

Critical values from MacKinnon (1990, 2010)

Milk farm price and Grana Padano cheese consumer price

Johansen test N=114			Augmented Engle-Granger test N=114			
Maximum rank	Trace statistic	5% critical value	Test statistic z(t)	1% critical value	5% critical value	10% critical value
0	19.9548	15.41	-4.026	-4.46	-3.861	-3.556
1	1.3583*	3.76				

Critical values from MacKinnon (1990, 2010)

6.2.1 VECM representation

Different VECM models for price transmission between milk farm prices and milk consumer prices have been performed (e.g. with trend and constant, only with trend, etc). Due to economy of space, only one model is presented here (the one with intercept). The VECM representation shaped with milk consumer prices as dependent variable shown in Table 6. 5 highlights a slow long-run rate of adjustment (3% per period) meaning that prices take almost 3 years to fully align. Also short-run reaction to changes in farm milk prices (4.7%) is slow compared to the speed of adjustment to its own past values ($\Delta \text{pitcons}_{-1}$ has a coefficient of 23.2%). Short-run causality as a whole is validated at a 10% of significance. Tests are performed to evaluate the quality of the model, first I test if residuals are correlated, which is not desirable. Tests both at lag 1 and 2 show that there is no autocorrelation in residuals. The model seems satisfactory under this criterion. A second test has been made on the distribution of residuals showing that under the target model where milk consumer prices are the dependent variable residuals are normally distributed and thus the model is acceptable.

Table 6. 5 – VECM representation of price transmission between farm and consumer milk prices

VECM Milk consumer price as dependent variable

	Parameter	Statistic
intercept	0.000109	0.61
ECT	-0.030003	-3.74***
Δpitcons-1	0.2323099	3.27***
Δpitcons-2	-0.049165	-0.7
Δpitfarm-1	0.0469599	2.28**
Δpitfarm-2	-0.02128	-1.01
Long run Granger Causality	-0.37012	-2.48**
Short-run causality as a whole		5.57*

Tests on co-integrating vector residuals

Lagrange-multiplier	Statistic	Prob
lag 1	2.1037	0.7166
lag 2	3.7231	0.4447
H0: no residual autocorrelation		
Jarque-Bera	Statistic	Prob
D_cons_pr	0.932	0.6274
D_farm_pr	395.696	0
ALL	396.628	0
H0: residuals normally distributed		

VECM Milk farm price as dependent variable

	Parameter	Statistic
intercept	0.000083	0.14
ECT	-0.0144896	-1.41
Δpitfarm-1	0.1877644	2.64***
Δpitfarm-2	0.1509544	2.08**
Δpitcons-1	0.2230073	0.91
Δpitcons-2	0.4059234	1.68*
Long run Granger Causality	-2.701	-2.88***
Short-run causality as a whole		4.51

Tests on co-integrating vector residuals

Lagrange-multiplier	Statistic	Prob
lag 1	2.1037	0.71668
lag 2	3.7231	0.44478
H0: no residual autocorrelation		
Jarque-Bera	Statistic	Prob
D_farm_pr	384.766	0
D_cons_pr	0.313	0.8553
ALL	385.079	0
H0: residuals normally distributed		

I also verified transmission between Grana Padano cheese consumer price and milk farm prices. Following results obtained in granger causality tests, I design only a VECM specification, with causality from farm milk prices towards Grana Padano cheese consumer price.

Results shown in Table 6. 6 indicate a slow correction of prices towards long-term equilibrium, i.e. about 5.6% per period, which implies that more than one year is needed to return to long-run equilibrium price relationship or more than one year. I see also no transmission in the short run, as parameters for lagged milk farm prices are not significative both singularly and as a whole.

Table 6. 6– VECM representation of price transmission between farm milk price and Grana Padano consumer price

	Parameter	Statistic
ECT	-0.05655	-1.83*
Δpitforma-1	-0.24839	-2.51**
Δpitforma-2	-0.062911	-0.62
Δpitforma-3	-0.112427	-1.1
Δpitforma-4	-0.186439	-1.82*
Δpitforma-5	-0.069079	-0.67
Δpitfarm-1	0.0583855	0.84
Δpitfarm-2	0.0420765	0.6
Δpitfarm-3	0.0458322	0.62
Δpitfarm-4	0.0110484	0.15
Δpitfarm-5	-0.005927	-0.08
Long run Granger Causality	-0.962412	-7.53***
Short-run causality as a whole		1.81

Tests on co-integrating vector residuals

Lagrange-multiplier	Statistic	Prob
lag 1	2.5413	0.63726
lag 2	4.4288	0.35107
H0: no residual autocorrelation		
Jarque-Bera	Statistic	Prob
D_cons_pr	0.381	0.82672
D_farm_pr	56.909	0
ALL	57.289	0
H0: residuals normally distributed		

6.2.2 TVECM representation

A TVECM seems the natural candidate to represent price transmission patterns that include changing regimes. The first step consists in applying Hansen & Seo (2002) sup-LM test to verify the null hypothesis of linear co-integration against a Two-Regime Threshold Co-integration alternative; to do so I estimate P-values of the fixed regressor bootstrap and residual bootstrap methods as well as the sup-LM. I perform this test using the R-package "tsDyn" developed by Stigler (2013). A grid search is performed for the threshold variables with 1000 points, the total number of threshold candidates is one after excluding the bottom 5 percent of the ordered variables, and after taking into account the possible same values of the threshold variables. The test results suggest rejection of the null hypothesis of linear transmission since the sup-LM statistic is equal to 20.28791 with a p-value of 0.023. As shown in **Error! Reference source not found.**, the sup-LM estimator of the co-integrated vector β is higher than the critical value at 5% significance, this is confirmed by the density graph of the ECT bootstrap distribution. As said, confirms that the mechanism of the price transmission between milk farm and consumer prices is of threshold type. I could proceed implementing the TVEC model.

Table 6. 7 illustrates the estimated parameters of a three regime TVECM representation. As can be seen, only 4 out of 10 parameters are significant. Unfortunately, co-integration relationships ECT_1^1 , ECT_2^1 and ECT_1^2 are among the not significant, consequently I cannot accept this representation. The error correction parameters represent values of the residual term from the co-integrating regression that initiate changes in patterns of responses to shocks. They can be read as the values of shocks, expressed in terms of minimum percentages of the milk consumer and farm prices that will "move" the system to a different regime, determining a change on the patterns of adjustments (Rezitis & Reziti 2011), thus their relevance in the representation. An alternative two-regime representation has been tested and has not provided significant results either.

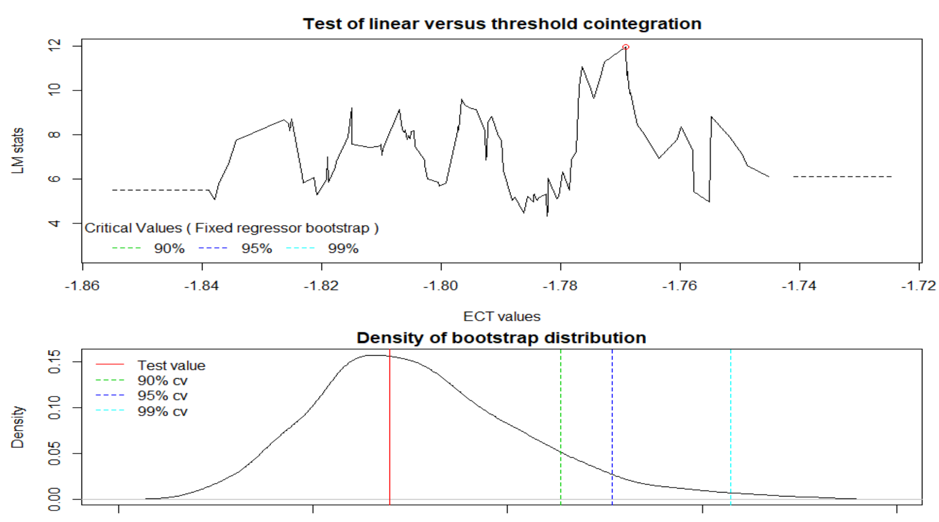
Based on these results I conclude in the timeframe under examination - from January 2000 until March 2017 - price transmission from farm to consumer milk prices in the Italian fresh milk market cannot be appropriately represented using a TVECM. Rather I should accept the linear representation illustrated previously, whose results were validated and significant. In other words, I am not able to verify any change in price transmission patterns which can be linked to changes in market policies. Price transmission in the Italian market seems to be better represented using a VECM, as transmission seems to be symmetric.

Table 6. 7 – Application of a Three-Regime TVECM to farm and consumer milk prices

	Estimated parameters
τ_1 = threshold 1	-0.2534464
τ_2 = threshold 2	0.4687371
n° observations	200
% obs. in each regime	9.5% 84% 6.5%
$ECT_1^1 = \alpha^1{}_1(\omega_{t-1}(\beta))$	0.0075(0.1237)
$ECT_2^1 = \alpha^2{}_1(\omega_{t-1}(\beta))$	0.0023(0.5132)
γ1 (Δp_{t-1})	0.1962(0.0063)***
γ2 (Δp_{t-1})	0.3665(0.1221)
$ECT_1^2 = \alpha^2{}_1(\omega_{t-1}(\beta))$	0.0022(0.1126)
$ECT_2^2 = \alpha^2{}_2(\omega_{t-1}(\beta))$	0.0022(0.0319)**
γ1 (Δp_{t-1})	0.0507(0.0144)**
γ2 (Δp_{t-1})	0.2264(0.0011)***

I have also tested linearity in the cointegration between Grana Padano cheese and farm milk prices against a Two-Regime Threshold Cointegration model representation, following Hansen & Seo (2002) as described above, but neither the value of the sup-LM statistic (13.394) not the residual regressor bootstrap (0.382) allow to reject the null hypothesis of linear co-integration (Figure 6. 2).

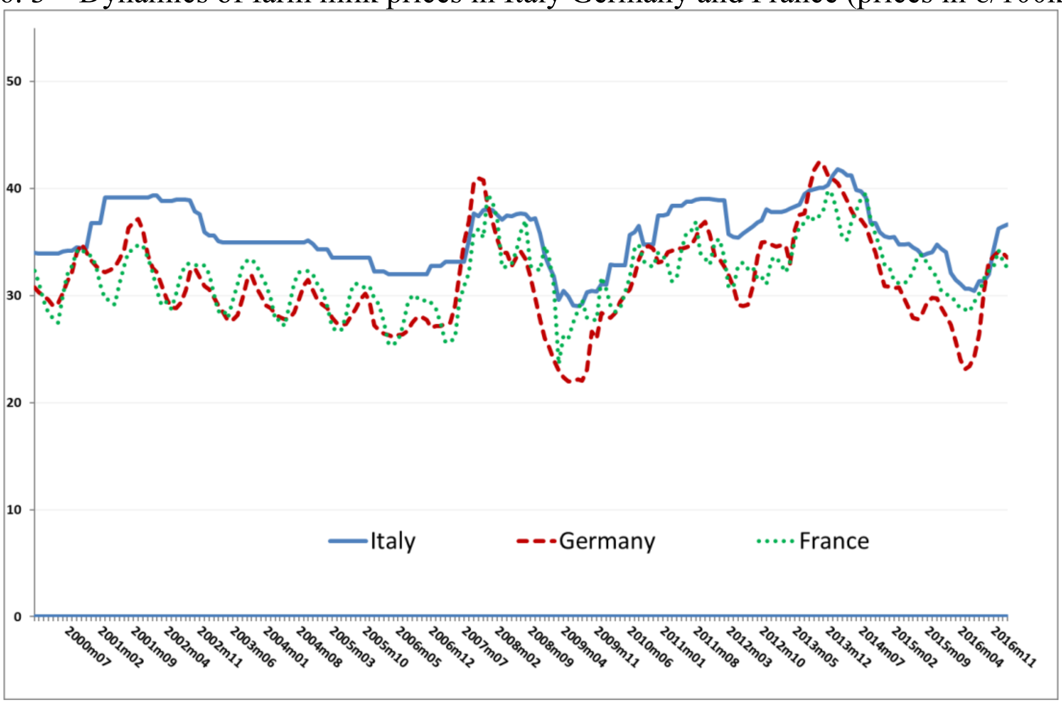
Figure 6. 2– Application of a Two-Regime TVEM to milk farm and Grana Padano cheese prices



6.3 Horizontal transmission

I examine price transmission across borders between Italy, Germany and France using firstly, farm milk prices sourced from E.C. and then spot milk prices sourced from Clal (see paragraph 6.1 for a full description of the series). Prices in the three countries are presented in Figure 6. 3. As can be seen Italian prices seem to show a more stable shape, compared to the intra-year variability that German and French prices show.

Figure 6. 3 – Dynamics of farm milk prices in Italy Germany and France (prices in €/100kg)



Source: Dairy Market Observatory, European Commission

Akaike Information Criterion (AIC) is used to choose the appropriate lag length by trading off parsimony against reduction in the sum of squares. The ADF test statistics presented in Table 6. 8 correspond to the regression that has maximized the AIC.

On the basis of both the ADF, Phillips and Perron (PP) and detrended Dickey-Fuller General Least Squares (DF-GLS) tests, both with and without a deterministic trend, I can reject the null hypothesis of non-stationarity for the three series of spot prices sourced from Clal and for French and German milk spot price series using prices expressed in levels. In the case of Italian milk spot price series I need to apply the tests to the differenced series to be able to verify that the series is I(1) (Table 6. 8).

Table 6. 8 – Horizontal transmission series - Unit root tests

	levels				*differences*			
	ADF	PP		DF-GLS	ADF	PP		DF-GLS
	z(t)	z(rho)	z(t)	DF-GLS tau	z(t)	z(rho)	z(t)	DF-GLS tau
Germany milk farm price	-3.634***	-17.934**	-2.985**	-3.164**	-6.728***	-84.257***	-7.160***	-6.488***
Italy Milk farm price	-3.067***	-12.101*	-2.469	-1.088	-4.811***	-175.862***	-11.519***	-4.818***
France milk farm price	-3.927***	-31.577***	-4.041***	-5.038***	-9.889***	-133.861***	-10.571***	-6.331***
Germany milk spot price	-2.703***	-24.756***	-3.469**	-4.229***				
Italy Milk farm spot price	-2.387***	-23.127***	-3.366**	-4.202***				
France milk spot price	-2.292***	-20.024***	-3.099**	--3.617***				

Note: *, ** and *** stands for significance at the 10, 5 and 1% level, respectively

Causality between variables is verified and found from Italian to German farm prices and *viceversa*, from Italian to French farm milk prices and from French to German farm prices and *viceversa*. Causality between milk spot prices was found between German and Italian prices (in both directions) and from Italian to French milk spot prices (Table 6. 9).

Table 6. 9 – Horizontal transmission series – Granger causality

	F-Stat.	**Prob**
H0 : No log(pit)→log(pger)	21.241***	0
H0 : No log(pger)→log(pit)	39.115***	0
H0 : No log(pit)→log(pfr)	23.41***	0
H0 : No log(pfr)→log(pit)	2.8992	0.575
H0 : No log(pfr)→log(pger)	15.932***	0.001
H0 : No log(pger)→log(pfr)	45.934***	0
H0 : No log(pitspot)→log(pgerspot)	8.6161**	0.035
H0 : No log(pgerspot)→log(pitspot)	12.583***	0.006
H0 : No log(pitspot)→log(pfrspot)	50.683***	0
H0 : No log(pfrspot)→log(pitspot)	25.815	0.544
H0 : No log(pfrspot)→log(pgerspot)	10.83	0.416
H0 : No log(pgerspot)→log(pfrspot)	11.903	0.453

Johansen and Granger & Engle co-integration tests performed for farm and spot milk price series, results are shown in Table 6. 10 and Table 6.11. Results indicate that there is co-integration between milk farm prices in the three markets under scrutiny, as well as between spot price series. In all cases the Johansen test provided evidence of one co-integrating relationship being the trace statistic lower than the 5% significance critical value (a similar result is obtained comparing the max statistic although this is not shown in the table for the sake of brevity). These results are confirmed by the augmented Engle Granger test, indeed the parameter statistic value is higher than the 5% significance critical value.

Table 6. 10– Horizontal transmission spot price series – Co-integration

Italian and German milk spot prices

Johansen test N=176			Augmented Engle-Granger test			
Maximum rank	Trace statistic	5% critical value	Test statistic z(t)	1% critical value	5% critical value	10% critical value
0	22.0795	19.96	-4.931	-3.96	-3.371	-3.069
1	6.00068*	9.42				

Critical values from MacKinnon (1990, 2010)

Italian and French milk spot prices

Johansen test N=164			Augmented Engle-Granger test			
Maximum rank	Trace statistic	5% critical value	Test statistic z(t)	1% critical value	5% critical value	10% critical value
0	21.7201	19.96	-3.7	-3.964	3.374	-3.071
1	8.8518*	9.42				

Critical values from MacKinnon (1990, 2010)

French and German milk spot prices

Johansen test N=164			Augmented Engle-Granger test			
Maximum rank	Trace statistic	5% critical value	Test statistic z(t)	1% critical value	5% critical value	10% critical value
0	24.2007	19.96	-3.994	-3.964	3.374	-3.071
1	8.6137*	9.42				

Critical values from MacKinnon (1990, 2010)

Table 6. 111 – Horizontal transmission of farm prices. Co-integration

Italian and German milk farm prices

Johansen test
N=207

Maximum rank	Trace statistic	5% critical value
0	38.8661	25.32
1	9.3890*	12.25

Augmented Engle-Granger test

Test statistic z(t)	1% critical value	5% critical value	10% critical value
-4.027	-3.95	-3.366	-3.065

Critical values from MacKinnon (1990, 2010)

Italian and French milk farm prices

Johansen test
N=207

Maximum rank	Trace statistic	5% critical value
0	28.2719	25.32
1	6.3815*	12.25

Augmented Engle-Granger test

Test statistic z(t)	1% critical value	5% critical value	10% critical value
-3.649	-3.95	-3.366	-3.065

Critical values from MacKinnon (1990, 2010)

French and German milk farm prices

Johansen test
N=207

Maximum rank	Trace statistic	5% critical value
0	30.984	25.32
1	5.9735*	12.25

Augmented Engle-Granger test

Test statistic z(t)	1% critical value	5% critical value	10% critical value
-4.865	-3.95	-3.366	-3.065

Critical values from MacKinnon (1990, 2010)

6.3.1 VECM representation

I have already found bi-directional causality thus I proceed to define the VECM representation of co-integration between Italian and German prices with each of the two series as dependent variable (Table 6.122). Looking at the model shaped with the Italian farm milk prices as dependent variable I observe a rate of adjustment towards long-run equilibrium of 8% per period and no significant short-run reaction coefficients, with the exception of the first lagged Italian price differential. Short-run causality as a whole is validated at a 5% of significance. The model setting with German farm prices as dependent variable shows a faster rate of adjustment towards long-run equilibrium (17.84% per period), short-run dependencies from German and Italian side and short-run causality as a whole validated by significant parameter statistics. For both specifications, tests performed to evaluate the quality of the model, show that residuals are not correlated, which is acceptable, but I cannot reject the null hypothesis that residuals are not normally distributed. The model specification is thus not fully acceptable.

Table 6.122 – Integration between Italian and German farm prices - VECM representation

VECM Italian milk price as dependent variable		
	Parameter	**Statistic**
intercept	0.0001	0.18
ECT	-0.0864	-2.94***
Δpit-1	0.1117	1.65*
Δpit-2	0.0110	0.29
Δpger-1	0.0110	0.24
Δpger-2	0.1278	2.43
Short-run causality as a whole		8.12**
Tests on co-integrating vector residuals		
Lagrange-multiplier	Statistic	P-value
lag 1	1.833	0.7664
H0: no residual autocorrelation		
Jarque-Bera	Statistic	P-value
D_it	189.134	0
D_ger	94.472	0
ALL	283.605	0
H0: residuals normally distributed		

VECM German milk farm price as dependent variable		
	Parameter	**Statistic**
intercept	0.000038	0.05
ECT	-0.1784	-5.44***
Δpger-1	0.5914	8.77***
Δpger-2	0.2524	2.58***
Δpit-1	0.2237	2.29**
Δpit-2	0.1308	1.33
Short-run causality as a whole		5.26**
Tests on co-integrating vector residuals		
Lagrange-multiplier	Statistic	P-value
lag 1	1.833	0.766
H0: no residual autocorrelation		
Jarque-Bera	Statistic	P-value
D_ger	82.526	0
D_it	197.413	0
ALL	279.939	0
H0: residuals normally distributed		

Integration between French and Italian farm prices is represented using a VECM (Table 6.133). Although adjustment towards long-run equilibrium seems to be achievable at a moderate rate (20% per period), short-run causality could not be verified either from singular price differentials or as a whole. Tests on residuals show that they are not normally distributed. Also this specification is not fully satisfactory.

Table 6.133– Integration between Italian and French farm prices - VECM representation

VECM Italian milk price as dependent variable

	Parameter	**Statistic**
ECT	-0.002392	-0.08
Δpit-1	0.2011182	2.57***
Δpit-2	0.0853231	1.09
Δpit-3	0.0729364	0.94
Δpit-4	0.0787111	0.99
Δpfr-1	-0.027345	-0.68
Δpfr-2	0.055777	1.44
Δpfr-3	0.0036716	0.09
Δpfr-4	-0.025365	-0.64
Short-run causality as a whole		2.51

Tests on co-integrating vector residuals

Lagrange-multiplier	Statistic	P-value
lag 1	0.8477	0.93
lag 2	3.2211	0.52
lag 3	1.9582	0.74
lag 4	1.6954	0.8
H0: no residual autocorrelation		
Jarque-Bera	Statistic	P-value
D_it	254.826	0
D_ger	47.667	0
ALL	302.493	0
H0: residuals normally distributed		

I then test integration between German and French farm prices (Table 6.14). The VECM specification with French prices as dependent variable indicates a fast long-run price adjustment towards equilibrium (49.89%), as well as significant short-term causality from German prices at lags 1, 3 and 4 and from French prices at lag 1 and 2. Diversely, if I set German prices as dependent variable the correction towards long-run equilibrium is slower (9.7%), French prices short-run cause German ones at lags1 and 2, and German ones at lag 2. I can verify causality as whole at 1% level of significance. When in price transmission is examined in both directions. Tests on residuals rejected the null hypothesis of normal distribution for both model specifications, indicating that this model representation is not fully acceptable, either the relationship between French and German prices is not linear or other factors determine integration between the two markets.

Table 6.14 - Integration between French and German farm prices - VECM representation

VECM French milk price as dependent variable			**VECM German milk price as dependent variable**		
	Parameter	**Statistic**		**Parameter**	**Statistic**
ECT	-0.498955	-6.36***	*ECT*	0.097	3.41***
Δpfr-1	0.4516218	5.36***	*Δpger-1*	0.38382	0.19
Δpfr-2	0.2608212	3.43***	*Δpger-2*	0.01574	-1.06
Δpfr-3	-0.12085	-1.6	*Δpger-3*	-0.862298	0.29
Δpfr-4	0.0662267	0.87	*Δpger-4*	-0.23342	-3.23***
Δpger-1	-0.199829	-1.81*	*Δpfr-1*	0.22158	3.56***
Δpger-2	0.0191166	0.17	*Δpfr-2*	0.21444	3.81***
Δpger-3	0.2782475	2.52**	*Δpfr-3*	0.07378	1.33
Δpger-4	-0.304391	-3.11***	*Δpfr-4*	0.03253	0.58
Short-run causality as a whole		13.39***	*Short-run causality as a whole*		27.36***
Tests on co-integrating vector residuals			Tests on co-integrating vector residuals		
Lagrange-multiplier	Statistic	P-value	**Lagrange-multiplier**	Statistic	P-value
lag 1	7.4466	0.1141	lag 1	7.4466	0.11409
lag 2	8.6109	0.0716	lag 2	8.6109	0.0716
lag 3	15.8663	0.0032	lag 3	15.8663	0.0032
lag 4	5.0377	0.2835	lag 4	5.0377	0.28345
lag 5	3.99	0.4074	lag 5	3.99	0.40736
H0: no residual autocorrelation			H0: no residual autocorrelation		
Jarque-Bera	Statistic	P-value	**Jarque-Bera**	Statistic	P-value
D_fr	124.085	0	D_fr	182.894	0
D_ger	152.043	0	D_ger	140.35	0
ALL	276.128	0	ALL	323.244	0
H0: residuals normally distributed			H0: residuals normally distributed		

The verified price transmission between Italian and German markets and between French and German markets using a VECM specification point to linear transmission of prices, but tests on residuals revealed that the linear model representations are not satisfactory. Finally, co-integration could not be verified between French and Italian market thus the VECM representation could not be implemented.

The fact that residuals are not normally distributed is a common feature in all the specifications, and might be indicating the presence of breaks in the patterns of transmission.

Exactly the same model specification has been performed to test spot milk prices integration with different results (Table A.6. 1 to Table A.6. 3 in the annex to this chapter). French and German series were not tested, as causality could not be found in either direction.

A common feature that emerges from tests using spot price series is the higher number of lags that enter the short-run dynamics (e.g. 9 lags both in Italian/German and in the Italian/French VECM specification).

In the model specification where Italian spot prices are the dependent variable, the ECT is not significant, indicating that prices may not converge towards their long-run equilibrium. Instead, short term dynamics are relevant, e.g. I obtained relevant parameters for prices at almost all lags, and causality as a whole could be verified at 1% level of significance.

Diversely, when the German spot milk prices are set as dependent variable, long-run causality can be verified. The ECT has the right sign a value of 16.21% per period and is significant, meaning that the system converges towards equilibrium. Short-run dynamics point out that only Italian prices at lag 6 are significant, and short-run causality as a whole is verified at a level of 1% of significance. The hypothesis of normally distributed residuals is rejected when both Italian and German prices are specified as dependent variable.

As far as the French and Italian spot prices are concerned, causality has been verified for French prices as dependent variable (Causality between variables is verified and found from Italian to German farm prices and *viceversa*, from Italian to French farm milk prices and from French to German farm prices and *viceversa*. Causality between milk spot prices was found between German and Italian prices (in both directions) and from Italian to French milk spot prices (Table 6. 9).

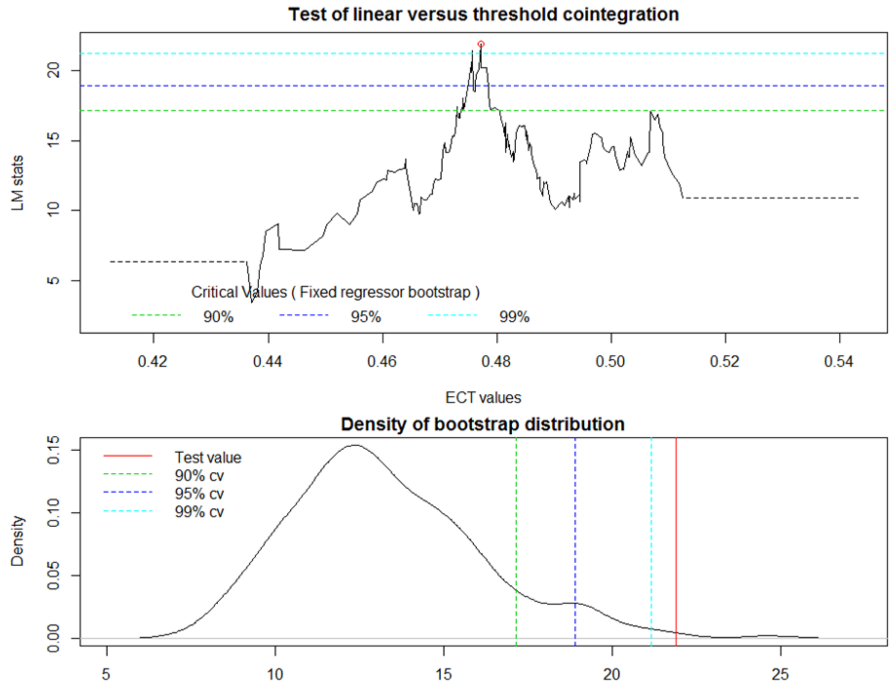
Table 6. 99). The VECM specification shows a significant error correction term (equal to 0.1542) with negative sign meaning that prices converge towards the long-run equilibrium, at a rate of 15.42% per period. French prices enter into short-run dynamics with their first and sixth lagged differentials, and Italian prices through their fifth and eights. Short-run causality as a whole is verified with a level of 1% of significance. Tests on residual allow us to verify that there is no residual autocorrelation, but the hypothesis of normally distributed residues was rejected.

6.2.3 TVECM representation

I proceed specifying a TVECM in order to test for the presence of different regimes in the horizontal transmission of the various prices. As before, I verify the null hypothesis of linear co-integration against a Two-Regime Threshold Co-integration alternative by estimating P-values of the fixed regressor bootstrap and residual bootstrap methods as well as the sup-LM test (Hansen & Seo 2002) for each of the country pairs.

The test performed for the Italian and German markets suggest rejection of the null hypothesis of linear transmission. The sup-LM statistic is equal to 21.90 with a p-value of 0.006. As shown in Figure 6. 4, the sup-LM estimator of the co-integrated vector β is higher than the critical value at 1% significance, this is confirmed by the density graph of the ECT bootstrap distribution. This confirms that I can proceed implementing the TVEC model.

Figure 6. 4 - Hansen and Seo test results for Italian and German farm milk prices



When I apply Hansen & Seo (2002) test to Italian and French farm milk prices, I cannot reject the hypothesis of linear cointegration, as the sup-LM statistic is lower than the critical values, and the p-value is 0.163 (Figure 6. 5). This means that I can implement a TVECM to analyse integration between these two countries.

Figure 6. 5 Hansen and Seo test results for Italian and French farm milk prices

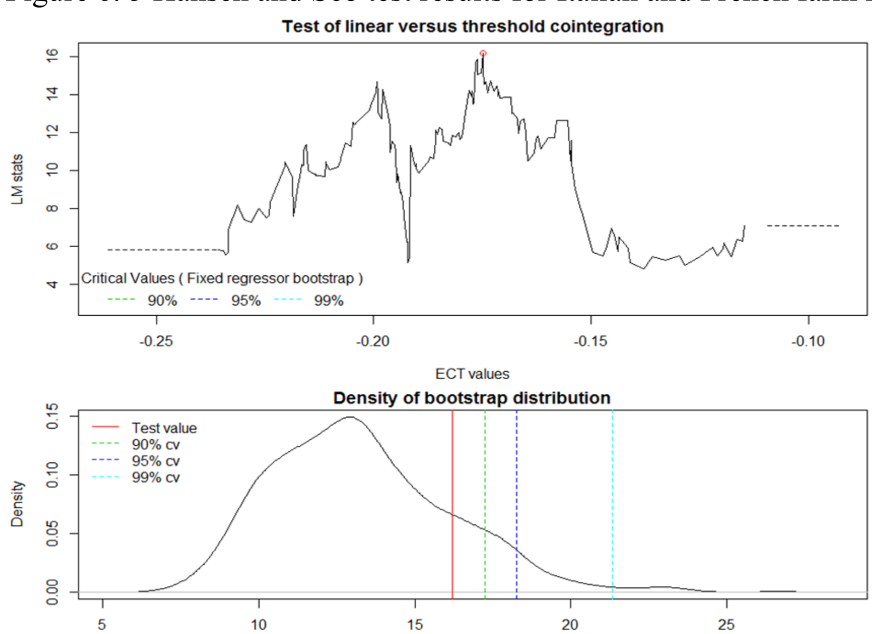
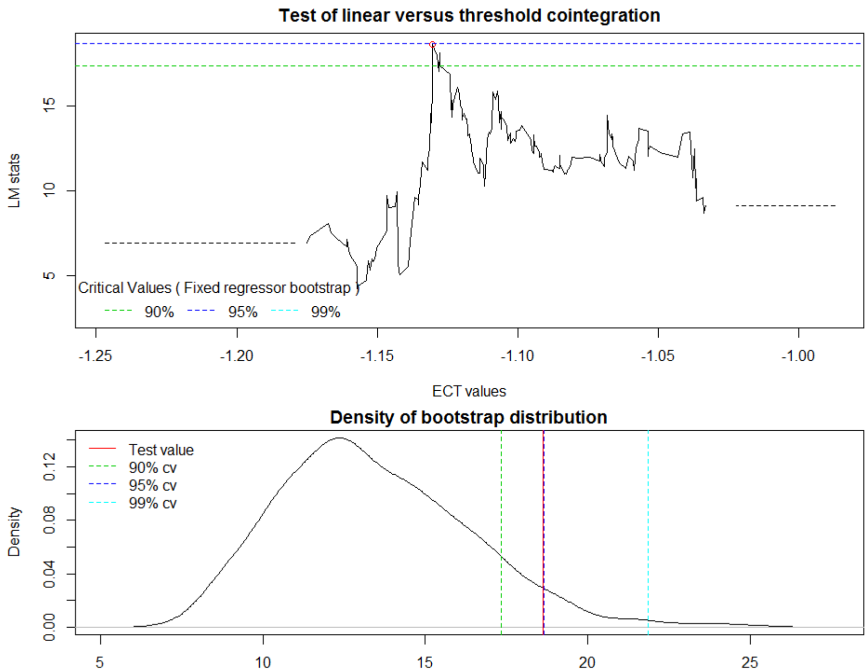


Figure 6. 6 Hansen and Seo test results for German and French farm milk prices



I proceed testing the integration between French and German markets. Tests results point to threshold integration between the two markets. The sup-LM statistic (18.62) is higher than the 5% significance critical value, and the p-value is 0.051 (Figure 6.6). I can proceed with the TVECM representation.

I also performed Hansen & Seo tests using spot prices, for the sake of space tables and figures are included in the annex to this chapter. Under exactly the same criteria I verified a threshold co-integration relationship between Italian and German markets (supLM= 21.39, p-value 0.009). After testing French and Italian markets I could not reject the null hypothesis of normal co-integration (supLM= 10.69, p-value 0.803) and thus I cannot represent price transmission between these two markets using a TVECM (Figure A.6. 1 and Figure A.6. 2). Causality could not be verified either between France and Germany and thus neither a VECM nor a TVECM can be used.

Given the above results, the hypothesis is that other factors seem to be more important when price transmission is analysed using milk spot prices. They could be related to role of other processing costs, firm strategy and agreements between dairies and farmers, among others. These characteristics indicate that a model based simply on price data would not be appropriate. As availability of monthly data on input and labour costs is scarce, not to mention the difficulty to quantify the impact of the price industry strategy, I proceed specifying the TVECM using farm prices, as tests provided reasonable results. The transmission model (TVECM) is not the perfect tool but provides hints to better understand market integration using publicly available data.

The TVECM allows a representation of market integration in the dairy sector that put in evidence the existence of two different patterns of transmission. An extreme one, manifested in those cases where shocks to prices are very low, and where integration is not perfect; and a "typical regime" where adjustments are much faster (Table 6.15).

In Table 6. 15 I present estimates of the thresholds (τ) and adjustment parameters (α_j^i) for the different country pairs and type of prices. Lagged variables parameters (γ_i) are also shown. Suffixes i and j refer to country and regime, respectively and they are indicated between brackets in the column titles. The model representation illustrate foresees one threshold (τ), although I have tested another specification with two thresholds. I have chosen to present this one as based on the number of significant parameters and appropriateness of sign and significance of the adjustment parameters.

Table 6.145 – Horizontal integration – 2 Regime TVECM representation

		Italy (1) - Germany (2) farm milk prices	Germany (1) - France (2) farm milk prices	Italy (1) - Germany (2) spot milk prices
	τ	-0.05875338	-0.07326018	-0.03127182
	n° observations	205	205	174
	% obs. in each regime	13.7% 86.3%	8.8% 91.2%	29.3% 70.7%
Regime 1	$\alpha^1_1(\omega_{t-1}(\beta))$	-0.0795(0.0002)***	-0.0851(0.0047)**	-0.1970(0.0225)*
	$\alpha^2_1(\omega_{t-1}(\beta))$	-0.0203(0.3692)	-0.0187(0.5874)	0.3503(0.0505)*
	$\gamma 1(\Delta p_{t-1})$	0.1268(0.0661)*	0.5960(1.2e-18)***	0.2201(0.0677)*
	$\gamma 2(\Delta p_{t-1})$	0.1008(0.0137)*	0.0777(0.0993)*	0.3172(0.0288)**
Regime 2	$\alpha^1_2(\omega_{t-1}(\beta))$	0.0881(0.0027)**	0.1232(0.0064)**	0.0743(0.2345)
	$\alpha^2_2(\omega_{t-1}(\beta))$	0.1538(2.3e-06)***	0.2371(8.5e-06)***	0.4292(0.0011)**
	$\gamma 1(\Delta p_{t-1})$	0.2868(0.0033)**	0.0516(0.5751)	0.1921(0.0289)**
	$\gamma 2(\Delta p_{t-1})$	0.6455(2.2e-23)***	0.2990(3.4e-05)***	0.2673(0.0116)**

To clarify the interpretation of horizontal price transmission I recall that the starting point for modelling such spatial price behaviour is the spatial equilibrium condition, $p^D - p^I \leq \tau_{I\rightarrow D}$, where p^D is the price on the domestic market, and τ_{ID} are the transaction costs of moving one product from on e market to the other. In this specific setting the spatial equilibrium condition states that price in the destination country should be no greater than the price in the exporting country plus costs of transport. If the product is not homogeneous it will also reflect premia or discounts (Barker et al.; Gilbert 2011 cited in Jamora & von Cramon-Taubadel 2016). Adjustments towards equilibrium should thus respect this principle.

Estimated threshold values are negative in all cases, as prices are expressed in logarithms this indicate that small price differences make the system switch from one regime to another. Taking into account that these are farm level prices this does not seem illogic. Thresholds values range from -0.073 for the pair Germany-France to -0.058 in the case of Italy-Germany. When spot prices are used to test the pair Italy-Germany threshold is lower -0.03. An interesting feature of this representation is that the current setting places the vast majority of the observations in Regime 2, making this the typical regime.

Adjustment parameters $\alpha_j^i(\omega_{t-1}(\beta))$ have all the expected sign, negative in Regime 1 and positive in Regime 2, with the exception of the pair Italy -Germany when spot prices are used. These parameters are key to the model validation as they allow the system to align prices to their long-run equilibrium relationship. All adjustment parameters in Regime 2 are significative, meaning that when prices are in Regime 2 price transmission is performed linearly from one market to the other. In other words, these market pairs are integrated. In addition, this "typical regime" has as well significant lagged variables parameters (γ_i). These previous considerations are valid to the three equations estimated using farm milk prices.

When the estimation is made using spot prices results are less satisfactory. The adjustment parameter of German prices in Regime 1 is positive in sign meaning that prices do not adjust to their long-run equilibrium but diverge, or are not significant indicating no transmission between markets.

6.4 Analysis of results

Based on my results I cannot completely exclude symmetric vertical and horizontal price transmission in the dairy sector in Italy, and between Italy and two of its neighbouring countries.

Aside from the statistical and economic interpretations, I need to take a note in relation to the data frequency used for the analysis, as it may have influenced results. I use monthly prices, in the case of farm prices this choice is due to availability but in the case of spot prices I decided to use monthly prices simply for consistency with the rest of the analysis.

Evidence from empirical works in the literature is not straightforward regarding the impact of data frequency on tests. For example, Frey and Manera (2007) wanted to verify the influence of data frequency on results, so they analysed a long set of empirical papers. They noticed that the majority of works focused on weekly and monthly data and that the number of cases where symmetry does not seem to differ significantly across the two frequencies. Instead, Von Cramon-Taubadel, Loy & Musfeldt (1995) compared results of price transmission tests (using an ECM) using weekly data and generated monthly and quarterly frequency. The ECMs estimated with quarterly data simply reflect the fact that at this level of temporal aggregation, prices in different regions are highly correlated, and provide no basis for tests of APT. Von Cramon-Taubadel & Loy (1996) indicate that data frequency should not exceed the frequency of the adjustment process, e.g. arbitrage in integrated markets. If price transmission happens within days or weeks, monthly or lower price data frequency risk to be inadequate as adjustments are missed.

There is acknowledgement that optimal data frequency depends on the market and product characteristics (Meyer and von Cramon-Taudabel, 2004), but in this case the answer is not straightforward. Farm milk prices are set in advance through contracts and they refer to monthly references. Also the reference contract agreement, signed by Italian representatives of famers' organisations and Italatte, includes a indexation system based on monthly prices of milk and Grana Padano cheese. Spot prices used in the horizontal transmission analysis are the ones published by CLA and refer to monthly prices from the Lodi Chamber of Commerce. These prices are registered prices of goods traded by processors that, considering their significant volumes, are important on the territory. Moreover, the Lodi Chamber of Commerce makes use of technical commissions, expressly assigned, to ascertain the prices[35]. As pointed out in the

[35] Prices ascertained have a pure informative value and refer to the market situation on an indicated period.

previous paragraphs, tests made on monthly spot prices did not allow us to proceed using ECM analysis, due to absence of causality. These results might reflect the fact that other factors (e.g. costs incurred by dairies) play a role in price transmission, and data frequency appropriateness. Therefore, I focused the attention on farm level prices.

In the empirical analysis I examined first vertical price transmission with the aim to verify if the set of market policies implemented in the dairy sector since 2012 have influenced the way transmission of prices happens along the dairy value chain. Using a VECM representation I could verify that price transmission in the Italian fresh milk market is symmetric with an acceptable degree of significance from farm milk prices towards milk consumer prices, but not the way around (from consumer to farm prices) as I could not verify neither long-run not short-run price causality (Table 6.16).

A VECM representation for testing symmetric transmission from milk producers towards Grana Padano cheese consumption prices did not provide satisfactory results, as I could not validate short-run causality. Such result could point to a non-linear relationship between prices or the existence of other factors that impede full vertical transmission and/or determine changes in price dynamics (second column in Table 6.16).

With these results at hand, I then proceeded to specify a different model, which allows different patterns of transmission, i.e. Threshold Vector Error Correction Model (TVECM). Under a TVECM specification, larger price shocks result in different responses than smaller shocks. In other words, deviations from the long-run equilibrium between two prices may lead to a different patter of price responses if they exceed a specific threshold level.

Table 6.16- Vertical price transmission - Summary of results

	Farm milk price -> Milk consumer price	**Farm milk price -> Cheese consumer price**
Number of lags	3	6
Stationarity	I(1)	I(1)
Co-integration	Yes, verified with Johansen and Granger tests	Yes, verified with Johansen and Granger tests
Causality	Bidirectional	From farm to consumer prices
VECM	Farm -> consumer prices: √ Long-run (LR) causality √ Short-run (SR) causality as a whole √ Short term dynamics √ Slow long-run adjustment (3% per month) √ No residual autocorrelation √ Residuals normally distributed Consumer -> farm prices: X no Long-run (LR) causality X no Short-run (SR) causality as a whole √ Short term dynamics	√ Long-run (LR) causality X Short-run (SR) causality as a whole √ Long-run adjustment (6% per month)
TVECM	Farm -> consumer prices: √ Hansen and Seo test: normality rejected √ 2 thresholds, 3 regimes √ vast majority of observations (84%) in central regime X 1 out of 4 adjustment parameters statistically significant X Price adjustments only in upper regime Consumer -> farm prices: X Hansen and Seo test: normality cannot be rejected	X Hansen and Seo test: normality cannot be rejected

The TVECM representation has not provided satisfactory results because the great majority of observations (84%) stay in to one single Regime (the "typical" regime) and, most importantly, because e 3 out of 4 cointegration parameters in the other two regimes were not statistically significant. Cointegration parameters are relevant in the TVECM representation because they can be read as the values of shocks, expressed in terms of minimum percentages of the milk consumer and farm prices, which will trigger a “move” of the transmission system to a different regime, determining a change on the patterns of adjustments (Rezitis & Reziti 2011). I tested an alternative two-regime representation but it has not provided significant results either.

I interpreted these results as an indication that in the timeframe under examination - from January 2000 until March 2017 - price transmission from farm to consumer milk prices in the Italian fresh milk market cannot be appropriately represented using a TVECM. Rather I should accept the linear representation illustrated previously, whose results were validated and significant. In other words, I am not able to verify any change in price transmission patterns, which can be linked to changes in market policies. Price transmission in the Italian fresh milk market seems to be better represented using a VECM.

I have also tested linearity in the cointegration between Grana Padano cheese and farm milk prices against a Two-Regime Threshold Cointegration model representation, following Hansen & Seo (2002) as described above, but I could not reject the null hypothesis of linear co-integration. As neither the linear (VECM) representation nor the TVECM could be validated one may argue that price transmission in the Grana Padano cheese value chain is determined by other factors that are not considered in these models, e.g. transformers and retailers structure of costs, prices of substitutes, retail structure and retail strategies, among others.

I then proceed to a second step and examined horizontal price transmission between Italy and Germany; Italy and France; and France and Germany (Table 6.17).

Integration between Italian and German milk markets using a VECM model shaped with the Italian farm milk prices as dependent variable shows that prices adjust towards long-run equilibrium but there is no significant short-run reaction between prices, with the exception of the first lagged Italian price differential. The model setting with German farm prices as dependent variable shows a much faster rate of adjustment towards long-run equilibrium and short-run dependencies from German and Italian side and short-run causality as a whole are validated by significant parameter statistics. For both specifications, tests performed to evaluate the quality of the model, show that residuals are not correlated, which is acceptable, but I cannot reject the null hypothesis that residuals are not normally distributed. The linear model specification is thus not fully acceptable in either case.

Integration between German and French farm prices represented using VECM specification, and with French prices as dependent variable shows a fast long-run price adjustment towards equilibrium, as well as significant short-term causality in both directions. Diversely, if I set German prices as dependent variable the correction towards long-run equilibrium is slower. I can verify causality in both directions, and causality as whole at 1% level of significance, but tests on residuals rejected the null hypothesis of normal distribution for both specifications, indicating that this model representation is not fully acceptable. Either the relationship between French and German prices is not linear or other factors determine integration between the two markets.

Table 6. 157– Horizontal price transmission - Summary of results

	Italy - Germany	**Italy - France**	**France - Germany**
Number of lags	3	5	5
Stationarity	I(1)	I(1)	I(1)
Co-integration	Yes, verified with Johansen and Granger tests	Yes, verified with Johansen and Granger tests	Yes, verified with Johansen and Granger tests
Causality	Bidirectional	From Italy to France	Bidirectional
VECM	***Germany -> Italy*** **√** Long-run (LR) adjustment (8.6%/month) **√** Short-run (SR) causality as a whole **√** No residual autocorrelation **X** Residuals not normally distributed ***Italy - Germany*** **√** Long-run (LR) adjustment (17.8%/month) **√** Short-run (SR) causality as a whole **√** No residual autocorrelation **X** Residuals not normally distributed	**X No** Long-run adjustment **X No** SR causality as a whole	***Germany -> France:*** **√** Long-run (LR) adjustment (49.9%/month) **√** Short-run (SR) causality as a whole **√** No residual autocorrelation **X** Residuals not normally distributed ***Germany -> Italy:*** **√** Long-run (LR) adjustment (9.7%/month) **√** Short-run (SR) causality as a whole **√** No residual autocorrelation **X** Residuals not normally distributed
TVECM	***Farm prices***: **√** Hansen and Seo test: linear cointegration rejected **√** Threshold: -5.8% **√** 2 Regimes: 13.7% & 86.3% obs. **Regime 1**: DE -> IT transmission (ECT 7.9%) No transmission IT -> DE **Regime 2**: DE -> IT prices (ECT 8.8%) IT -> DE (ECT 15.4%) ***Spot prices:*** **√** Linear cointegration rejected **√** Threshold: -3.1% **√** 2 Regimes: 29.3% & 70.7% obs. **Regime 1**: DE -> IT transmission (ECT 19.7%) IT-> DE no transmission **Regime 2**: DE -> IT prices (ECT 42.9%) IT-> DE notransmission	**X** Hansen and Seo test: linear cointegration cannot be rejected	***Farm prices:*** **√** Hansen and Seo test: linear cointegration rejected **√** Threshold: -7.3% **√** 2 Regimes: 8.8% and 91.2% obs. **Regime 1**: FR -> DE transmission (ECT 8.5%) DE -> FR no transmission **Regime 2**: FR -> DE transmission (ECT 12.3%) DE -> FR transmission (ECT 23.7%)

Instead, co-integration could not be verified between French and Italian market thus I could implement neither the VECM nor the TVECM representation. The evidence of non-linearity appears a reasonable alternative, also based on the strength of the diagnostic tests that allowed the rejection of a linear co-integration against a Two-regime threshold co-integration.

I specified two TVECM using farm level prices to represent market integration in the dairy sector between Italy and Germany and between Germany and France. In both cases I noticed the existence of two different patterns (or regimes) of transmission: an extreme one, manifested in those cases where shocks to prices are very low, and where integration is not perfect; and a "typical regime" (Regime 2) where adjustments are faster. Regime 2 is a typical regime because the vast majority of observations are in it. Both for price transmission between Italy and Germany and between Germany and France, adjustment coefficients in Regime 2 are significant and have the right sign indicating that prices converge versus their long-run co-integration relationship. In other words, farm milk prices in these countries slowly adjust to their long-run co-integration relationship. In both cases Regimes 1 refer to a situation in which adjustment changes happen when the rate of adjustment is very small, which apparently is not a very common situation as the number of observations under this regime is reduced both for integration between Italy and Germany (8.8%) and between Germany and France (13.7%). Regime 1 seems to correspond to the period before 2005, when prices used to fluctuate much less thanks to the wider use of market instruments (intervention, stocks, etc).

I have repeated the same exercise using spot milk prices but results were not satisfactory. I could test only transmission between Germany and Italy, obtaining results somehow similar to the model formulated using farm level prices. As in the vertical price transmission analysis, these divergent results compared to the ones obtained using farm level prices, might be pointing to other factors playing a role in transmission or to data frequency issues.

The summary of results highlights similarities in the estimated parameters of the VECM and those of the typical regime of the TVECM representation. This is true both for horizontal transmission between Italy and Germany as well as France and Germany. In both cases, the vast majority of observations are in Regime 2 and I could verify bidirectional adjustments, while in Regime 1 adjustment coefficients are lower than in Regime 2 and adjustment happens only in one direction. Like in the case of vertical price transmission, I could assume that in the timeframe under scrutiny, markets have been most of the time in regime 2 and only for a short period in regime 1. I associate the latter to years during which prices have been less affected by volatility, i.e. before 2005.

6.5 Annex

Table A.6. 1 – Horizontal integration of Italian and German spot milk prices – VECM

VECM Italian milk spot price as dependent variable		
	Parameter	**Statistic**
intercept		
ECT	-0.0033	-0.08
Δpitspot-1	0.0873	0.74
Δpitspot-2	-0.2112	-1.84*
Δpitspot-3	-0.3662	-3.15***
Δpitspot-4	-0.2439	-2.01*
Δpitspot-5	-0.200535	-1.7*
Δpitspot-6	-0.3953	-3.5***
Δpitspot-7	-0.1186	-1.02
Δpitspot-8	0.0522	0.48
Δpgerspot-1	0.2698	3.03***
Δpgerspot-2	0.2198	2.41**
Δpgerspot-3	0.2969	3.4***
Δpgerspot-4	0.2615	2.88***
Δpgerspot-5	0.1115	1.24
Δpgerspot-6	-0.0419	-0.49
Δpgerspot-7	0.2444	2.89***
Δpgerspot-8	0.1045	1.24
Short-run causality as a whole		30.02***

Tests on co-integrating vector residuals

Lagrange-multiplier	Statistic	P-value
lag 1	5.4984	0.2399
lag 2	1.7606	0.7797
lag 3	8.0173	0.0910
lag 4	9.4052	0.0517
lag 5	3.8621	0.4250
lag 6	6.0097	0.1984
lag 7	10.0268	0.0400
lag 8	5.3811	0.2504
lag 9	7.2138	0.1250
H0: no residual autocorrelation		
Jarque-Bera	Statistic	P-value
D_itspot	8.396	0.01503
D_gerspot	787.248	0
ALL	795.644	0
H0: residuals normally distributed		

VECM German milk farm price spot as dependent variable		
	Parameter	**Statistic**
intercept		
ECT	-0.1621	-2.02**
Δpgerspot-1	0.1476	1.16
Δpgerspot-2	0.2116	1.62
Δpgerspot-3	0.0772	0.62
Δpgerspot-4	0.0248	0.19
Δpgerspot-5	0.1206	0.94
Δpgerspot-6	-0.0304	-0.25
Δpgerspot-7	0.1679	1.39
Δpgerspot-8	0.1623	1.35
Δpitspot-1	0.2341	1.39
Δpitspot-2	-0.0473	-0.29
Δpitspot-3	-0.0915	-0.55
Δpitspot-4	0.0078	0.05
Δpitspot-5	-0.2083	-1.24
Δpitspot-6	-0.5666	-3.51***
Δpitspot-7	-0.0922	-0.55
Δpitspot-8	0.1649	1.07
Short-run causality as a whole		20.6***

Tests on co-integrating vector residuals

Lagrange-multiplier	Statistic	P-value
lag 1	5.4984	0.23987
lag 2	1.7606	0.77968
lag 3	8.0173	0.09095
lag 4	9.4052	0.05173
lag 5	3.8621	0.42499
lag 6	6.0097	0.19842
lag 7	10.0268	0.03998
lag 8	5.3811	0.25038
lag 9	7.2138	0.12501
H0: no residual autocorrelation		
Jarque-Bera	Statistic	P-value
D_ger	94.832	0
D_it	27.074	0
ALL	121.906	0
H0: residuals normally distributed		

Table A.6. 2 - Horizontal integration of Italian and French spot milk prices – VECM

VECM French spot milk price as dependent variable

	Parameter	Statistic
ECT	-0.1542	-2.21**
Δpfrspot-1	0.1922	1.82*
Δpfrspot-2	0.1600	1.52
Δpfrspot-3	0.0693	0.69
Δpfrspot-4	0.1207	1.22
Δpfrspot-5	0.1519	1.52
Δpfrspot-6	-0.2952	-3.03***
Δpfrspot-7	0.0107	0.11
Δpfrspot-8	0.0564	0.53
Δpitspot-1	0.1342	1.07
Δpitspot-2	0.1106	0.83
Δpitspot-3	-0.0129	-0.1
Δpitspot-4	-0.0072	-0.06
Δpitspot-5	-0.3522	-2.75***
Δpitspot-6	-0.2003	-1.56
Δpitspot-7	0.0550	0.41
Δpitspot-8	0.3935	2.97***
Short-run causality as a whole		40.42***

Tests on co-integrating vector residuals

Lagrange-multiplier	Statistic	P-value
lag 1	1.6628	0.79746
lag 2	0.3439	0.98681
lag 3	1.0748	0.89825
lag 4	1.1148	0.89191
lag 5	0.2555	0.9925
lag 6	4.7097	0.3184
lag 7	1.6274	0.80387
lag 8	2.179	0.70288
lag 9	3.0579	0.54818
H0: no residual autocorrelation		
Jarque-Bera	Statistic	P-value
D_frspot	24.431	0
D_itspot	11.257	0.00359
ALL	35.688	0
H0: residuals normally distributed		

Table A.6. 3 - Horizontal integration of French and German spot milk prices – VECM

VECM French spot milk price as dependent variable		
	Parameter	**Statistic**
ECT	-0.2384	-1.48
Δpfrspot-1	0.3868	2.1**
Δpfrspot-2	0.3135	1.65*
Δpfrspot-3	-0.0134	-0.07
Δpfrspot-4	0.0851	0.5
Δpfrspot-5	0.2203	1.35
Δpfrspot-6	-0.1443	-0.91
Δpfrspot-7	0.0549	0.35
Δpfrspot-8	0.0739	0.43
Δpfrspot-9	-0.0084	-0.05
Δpfrspot-10	0.0904	0.54
Δpfrspot-11	0.1538	0.92
Δpgerspot-1	-0.0889	-0.53
Δpgerspot-2	-0.1842	-1.07
Δpgerspot-3	-0.0732	-0.42
Δpgerspot-4	-0.0038	-0.02
Δpgerspot-5	-0.2307	-1.57
Δpgerspot-6	-0.3006	-2.1**
Δpgerspot-7	0.0035	0.02
Δpgerspot-8	0.1478	0.96
Δpgerspot-9	-0.1146	-0.76
Δpgerspot-10	-0.0517	-0.35
Δpgerspot-11	-0.0653	-0.43
Short-run causality as a whole		10.46
Tests on co-integrating vector residuals		
Lagrange-multiplier	Statistic	P-value
lag 1	14.8585	0.0050
lag 2	9.2978	0.05407
lag 3	5.0811	0.27908
lag 4	13.8429	0.00781
lag 5	0.3472	0.98657
lag 6	19.3127	0.00068
lag 7	1.9746	0.74043
lag 8	1.8165	0.76947
lag 9	5.1851	0.26883
lag 10	3.5201	0.47483
lag 11	21.7398	0.00023
lag 12	8.9889	0.06138
H0: no residual autocorrelation		
Jarque-Bera	Statistic	P-value
D_frspot	16.259	0.00029
D_gerspot	75.594	0
ALL	91.853	0
H0: residuals normally distributed		

VECM German spot milk price as dependent variable		
	Parameter	**Statistic**
ECT	-0.1546701	0.374
Δpgerspot-1	0.231709	1.21
Δpgerspot-2	0.200556	1.01
Δpgerspot-3	0.0561438	0.28
Δpgerspot-4	-0.003379	-0.02
Δpgerspot-5	-0.0309047	-0.18
Δpgerspot-6	-0.2140398	-1.31
Δpgerspot-7	-0.0127758	-0.08
Δpgerspot-8	-0.0381683	-0.22
Δpgerspot-9	-0.0025136	-0.01
Δpgerspot-10	0.1626623	0.95
Δpgerspot-11	-0.0791633	-0.46
Δpfrspot-1	0.0484294	0.23
Δpfrspot-2	-0.0678391	-0.31
Δpfrspot-3	-0.0760349	-0.35
Δpfrspot-4	0.0306636	0.16
Δpfrspot-5	-0.0701109	-0.38
Δpfrspot-6	-0.2583243	-1.42
Δpfrspot-7	0.0397523	0.22
Δpfrspot-8	0.2942026	1.5
Δpfrspot-9	-0.0615651	-0.32
Δpfrspot-10	-0.1278829	-0.67
Δpfrspot-11	0.0605561	0.32
Short-run causality as a whole		6.82
Tests on co-integrating vector residuals		
Lagrange-multiplier	Statistic	P-value
lag 1	14.8585	0.005
lag 2	9.2978	0.05407
lag 3	5.0811	0.27908
lag 4	13.8429	0.00781
lag 5	0.3472	0.98657
lag 6	19.3127	0.00068
lag 7	1.9746	0.74043
lag 8	1.8165	0.76947
lag 9	5.1851	0.26883
lag 10	3.5201	0.47483
lag 11	21.7398	0.00023
lag 12	8.9889	0.06138
H0: no residual autocorrelation		
Jarque-Bera	Statistic	P-value
D_frspot	35.58	0
D_gerspot	86.2	0
ALL	121.78	0
H0: residuals normally distributed		

Figure A.6. 1- Hansen and Seo test results for Italian and German spot milk prices

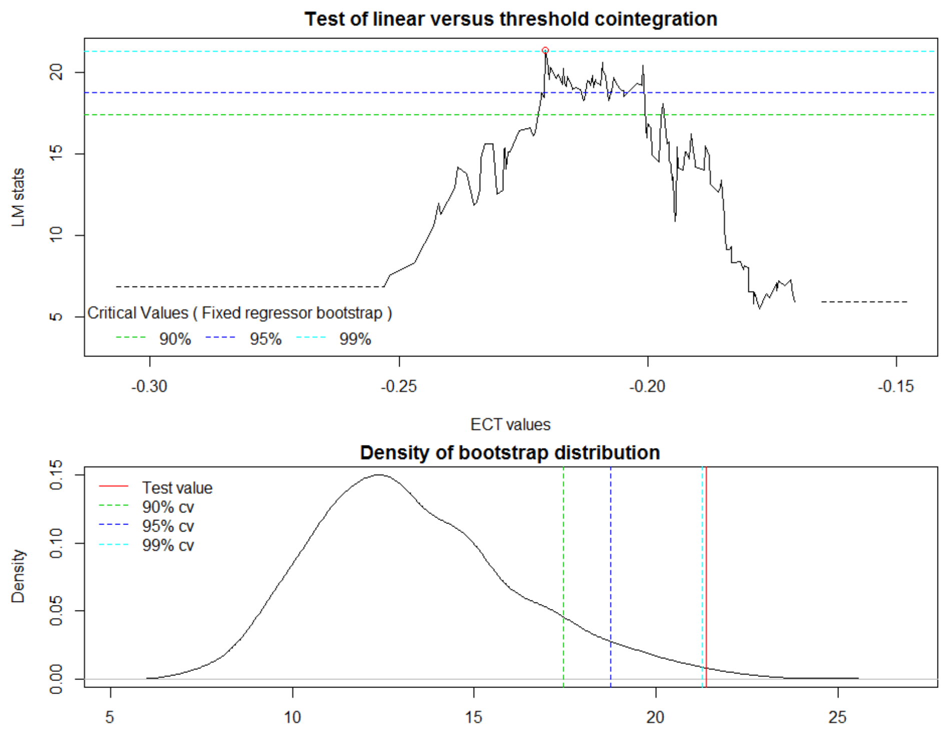


Figure A.6. 2 - Hansen and Seo test results for French and German spot milk prices

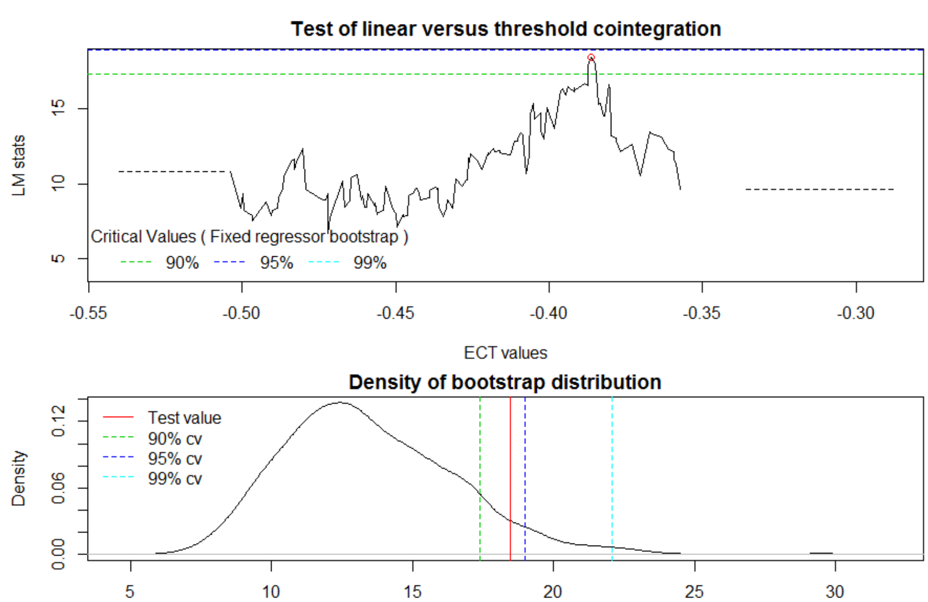
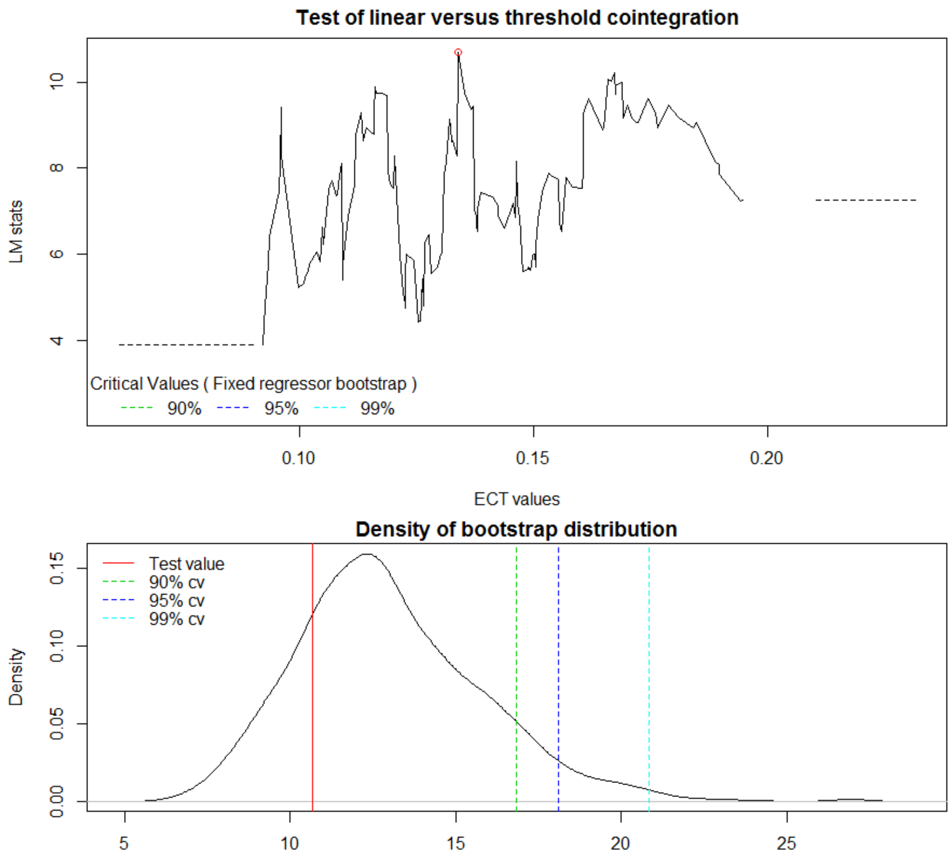


Figure A.6. 3- Hansen and Seo test results for French and Italian spot milk prices



7 - Conclusions

The aim of this thesis was to answer the research question "has the milk package and the other measures contained in the 2013-2020 CAP contributed to a better market functioning through better price transmission?". I worked under the hypothesis that the measures set-up within the package, and the set of changes introduced with the CAP reform 2013-2020 would improve the way prices are passed from farmers to consumers. In other words, I expected that transmission would be symmetric after these policy changes. I looked at the Italian fresh milk and Grana Padano market, and to milk markets in geographically nearby areas, i.e. Italy, Germany and France. Results did not provide a positive answer to the research question.

Firstly, I tested for symmetry in vertical transmission (with a VECM model) along the Italian fresh milk market and the Grana Padano cheese market. To my surprise, results during the years under examination (2000-2016), showed that price transmission in the Italian fresh milk market is symmetric (with an acceptable degree of significance) from farm milk prices towards milk consumer prices. Vertical transmission from farm milk prices to Grana Padano cheese consumption prices did not provide satisfactory results, as I could not validate short-run causality. Such result could point to a non-linear relationship between prices or the existence of other factors that impede full vertical transmission and/or determine changes in price dynamics.

I then proceeded implementing an alternative method (i.e. TVEM), which would allow to point out eventual changes in the pattern of price transmission. I first tested how prices, along the value chain, are transmitted over time, if they have followed a linear (symmetric) transmission pattern or if they switched to/from different patterns of transmission during the years under examination. In the case of the fresh milk market the model that fitted best embraced 3 periods (or “regimes”) with different patterns of price transmission. I therefore proceed to finding out what are the factors that determine the switch from one period or “regime” to another, as well as verifying if transmission in the various regimes was symmetric or not. The model assumes that, for price transmission to switch to a different regime, there has to be a factor that determines changes in how prices relate between them. Such factor is associated with a threshold value above or below which the transmission pattern changes. The threshold model results show the particularity that the vast majority of the observations (84%) fell into a single regime. This indicates that transmission patterns for fresh milk have not changed over time (Table 7.1). On the contrary, I did not obtain satisfactory results when examining transmission from farm milk prices to cheese consumer prices neither in the VECM nor in the TVECM representation. It is likely that price transmission in the Grana Padano cheese value chain is determined by factors that are not considered in these models, e.g. transformers and retailers structure of costs, prices of substitutes, retail structure and retail strategies, among others.

Table 7. 1 – Summary of results

	Vertical transmission		**Horizontal transmission**	
	Fresh milk	Cheese	IT-DE farm milk prices	FR-DE farm milk prices
VECM – Linear transmission:				
LR causality	yes	yes	yes	yes
SR causality	yes	no	yes	yes
Model quality	good	bad	residuals not normally distributed	residuals not normally distributed
TVECM – Non-linear transmission:				
Linearity	no	yes	no	no
Regimes	3	-	2	2
LR Convergence (adjustment parameters)	only in Regime 3	-	yes	Yes
SR causality	yes	-	yes	yes

I have examined horizontal integration between Italian and German as well as between French and German fresh milk markets. Since results are very similar I comment both sets together (a detailed presentation of results is contained at the end of chapter 6). Under a VECM I could verify long-run causality and causality between the two sets of markets, but tests on residuals rejected the null hypothesis of normal distribution for both specifications, indicating that this model is not fully acceptable; either the relationship between prices in these markets is not linear or other factors determine integration between markets. A TVECM model using farm level prices indicated the existence of two different patterns (or regimes) of transmission; an extreme one - manifested in those cases where shocks to prices are very low - and a "typical regime" (Regime 2) where adjustments are faster. Regime 2 is a typical regime, because it is where vast majority of observations are. Both for price transmission between Italy and Germany and between Germany and France, adjustment coefficients in Regime 2 are significant and have the right sign indicating that prices converge versus their long-run co-integration relationship. Regime 1 seems to correspond to the period before 2005, when prices used to fluctuate much less thanks to the wider use of market instruments (intervention, stocks, etc).

These results, both from vertical and horizontal price transmission tests, did not confirm the initial hypothesis that the dairy package and the subsequent measures, incorporated with the CAP 2013-2020 reform, would enhance the functioning of the dairy market, leading to improvements in price transmission. I could not verify changes in vertical price transmission following the application of policy measures aimed at improving market functioning and a better bargaining position of farmers.

There are various factors that could possibly help to interpret these results. One is related to the *methodology* I used, which relies exclusively on prices. It is true that prices provide a world of information about markets; they reflect competing forces at work, condense complex and decentralised information and provide signals for the allocation of resources by economic agents (Lence, Moschini & Santerano, 2017). Moreover, prices are freely and easily available, particularly for the two extremes of the value chain (farmers' and consumer' prices).

But in modern markets, other factors seem to shape the pattern of price transmission as well. For instance, I could not fully reject the hypothesis of symmetric vertical price transmission in the Italian fresh milk sector, as model results validated the hypothesis of linear transmission. It is worth recalling that if, on the one side, one could test for *market power* using information on price transmission. On the other, in the presence of *bargaining power* price transmission analysis is not an adequate analytical tool. This is because in presence of bargaining power buyers exert their power while negotiating trade conditions, e.g. taking advantage of their (better) capacity to negotiate compared to farmers, the possibility to withdraw (or threaten to withdraw) from negotiations, exert and resist pressure, etc.

In the same fashion, I was not able to verify price transmission from farm milk to Grana Padano cheese consumer prices. This may be due to fact that consumer prices are defined based on other factors that go beyond prices, notably trading costs, and they rather depend on the retailer's own promotion strategy. Again, in these cases, analysis based only on prices is not sufficient and/or adequate.

On the other side, results obtained examining horizontal price transmission can be attributed to the reasons above and to factors related to the different sets of market institutions present in the countries under scrutiny that set different marketing conditions, the structure of the dairy sector, etc.

An aspect that may help understanding my results relates to the *policy setting and implementation*. Market policy in the dairy sector comprises a set of compulsory and optional measures that have not been homogeneously implemented across Member States. For example, the number of POs that have been created, their dimensions and the minimum requirements in the various member states reflect the different production structures and institutions. In countries where farmers are associated predominantly in cooperatives, the number of POs created after the dairy package and the CAP 2013-2020 reform is small or null; in addition, in areas where associations of farmers have been in place and functioning since a long time, the introduction of the package has led to minimal changes.

Based on a series of studies that compared prices paid between POs and investors owned firms (IOFs), Van Hecke (2014) has found that average prices are higher in regions with strong *presence of cooperative organizations*, and that prices paid by IOFs in these regions are higher as well. Bijman et al. (2012) have performed analysis on the dairy sector; they suggest that a strong cooperative presence results in higher prices paid by all dairies in a country. Therefore, I may expect to observe a smoother change in the way prices are transmitted from farmers to consumer in countries with a strong presence of cooperatives. The Italian market could be an example of this situation, as cooperatives have collected more than half of the total milk in 2014/15.

Another factor that could explain my results is related to the impossibility to properly measure the *bargaining power* of farmers. The operational objective of improving the negotiation power of farmers is expected to be achieved though the integration of farmers into producers' organisations and joint selling. In theory, POs should result in a better ability from farmers to stand firm to counterparts' negotiation power. POs may have access to capital, services and information to support negotiations that individual farmers may not have.

Unfortunately, although the dairy market measures may have had an impact on the bargaining power of farmers, I could not assess such effect.

It has to be said that the potential to better negotiate is difficult to achieve and measure. Some authors have focused the attention on the impact of POs on the farmers' bargaining power (Sorrentino, Russo & Cacchiarelli, 2016). They claim that in case of negotiations with a giant retailer or dairy, imposed negotiations procedures could barely be refused. For example, after the start of the dairy package implementation in Italy, farm prices have been set locally between POs and farmers' associations on the one side, and by dairies, on the other side. The contents of contracts are explanatory of the bargaining disparities in place. An survey in a leading producing area in Italy showed that less than half of the trade between non-cooperative cow milk first buyers and producers is supported by a contract that contains a fixed duration of the contract; very often (80% of the cases) quantities are defined, but the price to be paid to producers is specified only in half of the contracts (Pieri et al. 2013). The greatest difficulty for farmers has always been the fixing of a price that takes the high volatility of milk prices into account. In Italy, many attempts have been made, with little success (Pieri & Rama 2016). Only in December 2016, an agreed indexation system could be reached between parties, under the auspice of the Minister of Agriculture. This agreement has been adopted as reference in the main producing regions. In previous years, Italatte (the most important buyer in Italy) was able to impose its contractual rules to farmers thanks to its strong monopoly power. Italatte adopted its own indexing system, which takes into account the European weighted average, published by the European Commission Milk Market Observatory with a delay of 2 months. Moreover, Italatte requires that volumes of milk in contracts would be equal to those already purchased by Italatte during the previous calendar year. Any milk deliveries exceeding the quantities provided in the contract, if accepted, were subject to a price reduction. In addition, Italatte proposed contracts of a shorter duration than foreseen by the Italian Law (one year) (Pieri, 2016).

These examples suggest that in increasingly complex and integrated agri-food chains, buyers are able to exercise their power without effectively intervening on the market (reducing quantities and prices). They take control of the negotiating process, by imposing exchange conditions that are more favourable to their interests. In these cases, price transmission models are not any longer an adequate tool for assessing and measuring market power in the supply chain.

Shifting negotiation power is not an easy task in today's food system: a relatively small number of firms organise the governance of the supply chain, setting rules and parameters for transactions. It seems difficult to counterbalance such power with limited horizontal concentration. Bargaining power is the result of two determinants: negotiation power (the ability of imposing the term of trade to the counterpart) and bargaining position (the ability of withdrawing from the transaction if the terms imposed by the counterpart are unfavourable). In markets with a highly concentrated processing industry like the Italian one, the allocation of negotiation power and the initial bargaining position are unbalanced toward the buyer. But the negotiation power depends as well on the institutional framework, for example the existence of clear rules for combating unfair trading practises may help to improve unbalances (Sorrentino Russo & Cacchiarelli, 2016). These rules may help to increase the effectiveness of POs. Indeed, POs can provide farmers with benefits in terms of bargaining flexibility, they may sell to alternative buyers, thanks to the possibility of investing in quality and promotion, and thus reaching new marketing channels.

Approaches and tools needed to investigate and evaluate how policies impact the bargaining power of farmers are completely different from the econometric methods used in price transmission analysis. A suitable approach could be that of the "New Institutional Economics" (e.g. Sykuta Cook, 2001) where the role of organisational structures and incentives in the design of contracts between buyers and sellers of agricultural products is scrutinised for example, looking at contracting practices, agency and property rights, trade conditions, among others.

8 - References

Azzam, A. M. (1999), Asymmetry and Rigidity in Farm-Retail Price Transmission, American Journal of Agricultural Economics 81:525-533

Abdulai, A. (2000). Spatial price transmission and asymmetry in the Ghanaian maize market. Journal of Development Economics, 63(2), 327–349. https://doi.org/10.1016/S0304-3878(00)00115-2

Acharya, R. N., Kinnucan, H. W., & Caudill, S. B. (2011). Asymmetric farm–retail price transmission and market power: a new test. Applied Economics, 43(May 2012), 4759–4768. https://doi.org/10.1080/00036846.2010.498355

Andries, A., Garcia Azcarate T. (2015), Agriculture, PAC et droit de la concurrence: une vision historique. Revue de l'Union Europeenne, N° 585, Fevrier, pp 83-92

Autorità Garante della Concorrenza e del Mercato – AGCM (2016), IC51-Indagine Conoscitiva Sul Settore Lattiero-Caseario, March 2016. Downloaded from: http://www.agcm.it/component/joomdoc/allegati-news/IC51_testoindagine.pdf/download.html

Bakucs, Z., Fałkowski, J., & Fertő, I. (2012). Price transmission in the milk sectors of Poland and Hungary. Post-Communist Economies, 24(3), 419–432. https://doi.org/10.1080/14631377.2012.705474

Bakucs, Z., Fertő, I., Benedeka, Z., & Molnár, A. (2015). Determinants of Horizontal Milk Producer Price Integration. 29th International Conference of Agricultural Economists. Agriculture in a connected world, Milan, August 8-14, 2015. Milan

Balke, N. S., & Fomby, T. B. (1997). Threshold Cointegration. International Economic Review, 38(3), 627–645. Retrieved from http://www.jstor.org/stable/2527284

Bailey D. and Brorsen B.W (1989), Price Asymmetry in Spatial Fed Cattle Markets, Western Journal of Agricultural Economics, Vol. 14, No. 2 (December 1989), pp. 246-252

Ben-Kaabia M. and J.M Gil (2007), Asymmetric price transmission in the Spanish lamb sector, European Review of Agricultural Economics Vol 34 (1) (2007) pp. 53–80 doi:10.1093/erae/jbm009

Bergman M (1997), Antitrust , Marketing Cooperatives, and Market Power, European Journal of Law and Economics, 4:73–92 (1997)

Bijman J., Iliopoulos C., Poppe K.J., Gijselinckx C., Hagedorn C., Hanisch M., Hendrikse G., Kühl R., Ollila P., Pyykkönen P., van der Sangen G (2012), External study: "EP pilot project: Support for Farmers' Cooperatives", November 2012. http://ec.europa.eu/agriculture/external-studies/support-farmers-coop_en.htm

Bonnet C., Zohra B-M (2015), Organic Label, Bargaining Power, and Profit-Sharing in the French Fluid Milk Market, American Journal Agricultural Economics 98(1): 113–133; doi: 10.1093/ajae/aav047

Boyd M.S, Brorsen B.W (1988), Price Asymmetry in the U.S. Pork Marketing Channel, North Central Journal of Agricultural Economics, Vol. 10, No. 1 (Jan., 1988), pp. 103-109

Cacchiarelli, L., Cavicchioli D., Sorrentino A. (2016), Has the Force awakened? Producer Organizations, supply concentration and buyer power in Fruit and Vegetable sector, Paper prepared for the 153 EAAE meeting, New dimensions of market power and bargaining in the agri-food sector: organisations, policies and models, Gaeta, Italy, June 9-10, 2016

Cacchiarelli, L. & Sorrentino, A. (2014). Market power in food supply chain : evidence from Italian pasta chain Market power in food supply chain : evidence from Italian pasta chain, paper prepared for presentation at the 3rd AIEAA Conference “Feeding the Planet and Greening Agriculture: Challenges and opportunities for the bio-economy” 25-27 June, 2014, Alghero, Italy

Carrau, J. G. (2012). EU Competition Framework Policy and Agricultural Agreements: Collation and Comparative Analysis of Significant Decisions at National Level. European Parliament Structural and Cohesion Studies, Brussels. Retrieved from http://www.europarl.europa.eu/studies

Carrau, J. G. (2014). Política Agrícola Común y de la Competencia, Revista de Derecho de la Unión Europea, Madrid ISSN 1695-1085, nº 26 - enero-junio 2014, págs. 135-166.

Chien Lo, M. & Zivot, E., 2001. Threshold Cointegration and Nonlinear Adjustment to the Law of One Price. Macroeconomic Dynamics, 5, pp.533–576

Ciliberti S., Frascarelli A. (2013), Mandatory Rules in contracts of sale of food and agricultural products in Italy: An assessment of Article 62 of Law 27/2012, Paper presented at 104TH EEAE Seminar "Theories an Empirical Applications on Policy and Governance o Agri-food Value Chains", Perugia, Italy, December 13-15, 2013. Retrieved from: http://ageconsearch.umn.edu/bitstream/163350/2/Ciliberti%20Frascarelli_140%20EAAE.pdf

Coldiretti (2016), Latte: Coldiretti, siglato accordo, prezzo minimo a 39 cent/litro, available at: https://www.coldiretti.it/economia/latte-coldiretti-siglato-accordo-prezzo-minimo-a-39-centlitro

Cormegna E. (2008), Firmato l’accordo con il gruppo Italatte, L’informatore Agrario 25/2008, pages 9-10

Del Cont C., Les producteurs agricoles face au marché. Contrats, concurrence et agriculture dans le règlement (UE) n° 1308/2013, Revue De Droit Rural - Revue Mensuelle Lexisnexis Jurisclasseur - Octobre 2015

Del Cont, C., Bodiguel, L., Jannarelli, A. (2012). EU competition framework: specific rules for the food chain in the new CAP. European Parliament Structural and Cohesion Studies, Brussels. Retrieved from http://www.europarl.europa.eu/studies

Draganska, M., and D. Klapper (2007), Retail Environment and Manufacturer Competitive Intensity, Journal of Retailing, 83 (2007), 183–198

Elliot, G., Rothenberg, T.J. & Stock, J., 1996. Efficient Tests for an Autoregressive Unit Root. Econometrica, 64(4 (JulyL, 1996)), pp.813–836

Enders, W., & Siklos, P. L. (2001). Cointegration and Threshold Adjustment. Journal of Business & Economic Statistics. https://doi.org/10.1198/073500101316970395

Engle, R.F. & Granger, C.W.J., 1987. Co-Integration and Error Correction: Representation, Estimation, and Testing. Source: Econometrica Econometrica, 55(2), pp.251–276. Available at: http://www.jstor.org/stable/1913236

Ernst & Young, 2013, AGRI-2012-C4-04 - Analysis on future developments in the milk sector, Final Report, Prepared for the European Commission - DG Agriculture and Rural Development, 19 September 2013. Retrieved from https://ec.europa.eu/agriculture/sites/agriculture/files/events/2013/milk-conference/ernst-and-young-report_en.pdf

Euromonitor (2016), "Grocery Retailers in Italy" Euromonitor International, December 2016

European Commission, (2009) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A better functioning food supply chain in Europe COM(2009) 591

European Commission, (2010) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future COM(2010) 672 final

European Commission, (2015) Guidelines on the Application of the specific rules set out in the specific rules set out in Articles 169, 170 and 171 of the CMO Regulation for the olive oil, Beef and veal an arable crops sectors. Retrieved from http://ec.europa.eu/competition/consultations/2015_cmo_regulation/draft_guidelines%20_en.pdf

Fackler, P. L., & Goodwin, B. K. (2001). Spatial Price Analysis. In B. Gardner & G. Rausser (Eds.), Handbook of Agricultural Economics (pp. 972–1018). Elsevier B.V.

Felis, A., & Garrido, A. (2015). Market Power Dynamics and Price Volatility in Markets of Fresh Fruits and Vegetables (ULYSSES "Understanding and coping with food markets volatility towards more Stable World and EU food Systems"). Retrieved from http://www.fp7-ulysses.eu/publications

Fernandez-Amador, O., Baumgartner, J., & Crespo-Cuaresma, J. (2010). Milking The Prices: The Role of Asymmetries in the Price Transmission Mechanism for Milk Products in Austria (Working Papers in Economics and Statistics No. 21)

Frey, G., & Manera, M. (2007). Econometric Models of Asymmetric Price Transmission. Journal of Econometric Surveys, 21(2)

Gohin, A., & Guyomard, H. (2000). Measuring Market Power for Food Retail Activities: French Evidence. Journal of Agricultural Economics, 51(2), 181–195 https://doi.org/10.1111/j.1477-9552.2000.tb01222.x

Goodhue R., Russo C. (2011), Modelling processor market Power and the incidence of agricultural policy: a non-parametric approach, National Bureau of Economic research, Working Paper 16706, January 2011. Retrieved from http://www.nber.org/papers/w16706

Goodwin, B. K., & Piggott, N. E. (2001). Agricultural & Applied Economics Association Spatial Market Integration in the Presence of Threshold Effects Spatial Market Integration in the Presence of Threshold Effects. American Journal of Agricultural Economics, 83(2), 302–317. Retrieved from http://www.jstor.org/stable/1244674

Granger, C.W.J. & Lee, T.H., 1989. Investigation of Production, Sales and Inventory Relationships Using Multi-cointegration and Non-Symmetric Error Correction Models. Journal of Applied Econometrics Supplement: Special Issue on Topics in Applied Econometrics, 4(S), pp.145–159. Available at: http://www.jstor.org/stable/2096597

Granger, C.W.J., (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. Econometrica

Granger, C. W. J. (1980), Testing for causality: A personal viewpoint. Journal of Economic Dynamics and Control 2, 329-352

Graubner, M., Koller, I., Salhofer, K., & Balmann, A. (2009). Cooperative vs. Non-Cooperative Spatial Competition for Milk in the Presence of Farm Marketing Cooperatives (Paper prepared for presentation at the 113 th EAAE Seminar " A resilient European food industry and food chain in a challenging world " , Chania, Crete, Greece, date as in: September 3 -6, 2009)

Greb F., Jamora N., Mengel C., Von Cramon-Taubadel S., Würriehausen N. (2012), Price Transmission from International to Domestic Markets, Department of Agricultural Economics and Rural Development, University of Göttingen, Report prepared for Rural Policies Thematic

Group of ARD (RPTG), Development and Research Group's Agriculture and Rural Development (DECAR), and Poverty Reduction and Equity Unit (PRMPR), 2012

Hansen, B.E. & Seo, B., 2002. Testing for two-regime threshold cointegration in vector error-correction models. Journal of Econometrics, 110(2), pp.293–318

Ihle R. and von Cramon-Taubadel S. (2008), A Comparison of Threshold Cointegration and Markov-Switching Vector Error Correction Models in Price Transmission Analysis, Paper presented at the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management St. Louis, Missouri, April 21-22, 2008

Jamora, N. & von Cramon-Taubadel, S., 2016. Transaction Cost Thresholds in International Rice Markets. Journal of Agricultural Economics, 67(2), pp.292–307

Kennedy P. (2008), A Guide to Econometrics, Sixth Edition, Blackwell Publishing, Oxford, 2008

Khemani, R. S., and Shapiro D.M., S. (1993). Glossary of Industrial Organisation Economics and Competition Law. Oecd. Paris. Retrieved from http://www.oecd.org/regreform/sectors/2376087.pdf

Kinnucan, H. W., & Forker, O. D. (1987). Asymmetry in Farm-Retail Price Transmission for Major Dairy Products. American Journal of Agricultural Economics, 69(2), 285. https://doi.org/10.2307/1242278

Kirkwood, J. B. (2005), Buyer Power and Exclusionary Conduct: Should Brooke Group Set the Standards for Buyer-Induced Price Discrimination and Predatory Bidding?, Antitrust Law Journal, 72, 625

Lence S., Moschini G. and Santerano G. (2017), Threshold cointegration and spatial price transmission when expectations matter, MPRA Paper No. 80202, posted 17 July 2017. Retrieved from https://mpra.ub.uni-muenchen.de/80202/

Lianos I., Lombardi C. (2016), Superior bargaining power and the global food value chain: The wuthering heights of holistic competition law?, Competition law and policy and the Food Value Chain, On-Topic, Concurrences N° 1-2016. Available at www.concurrences.com

Listorti G. and Esporti R. (2012), Horizontal Price Transmission in Agricultural Markets: Fundamental Concepts and Open Empirical Issues, Applied Economics 2012 vol: 1 (1) pp: 81-108

Lloyd, T., McCorriston, S., Morgan, W., Rayner, T. and Weldegebreil, H. (2006), "Market power in UK food retailing: theory and evidence from seven product groups", paper presented at the International Association of Agricultural Economists Conference, Gold Coast, 12-18 August. Available at http://ageconsearch.umn.edu/bitstream/25712/1/cp060310.pdf

London Economics. (2004). Investigation of the determinants of farm-retail price spreads. Final report to DEFRA. Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:investigation+of+the+determinants+of+farm-retail+price+spreads#0

MacAulay, T. G. (2000). Competition Policy in Agriculture: A Review of Methods by Competition Policy in Agriculture. Presented in the 44th Annual Conference of Australian Agricultural and Resource Economics Society, Sydney 23-25th January 2000

Madau F.A. Furesi R. Pulina P., (2016),"The existence of buyer power in the Italian fresh milk supply chain", British Food Journal, Vol. 118 Iss 1 pp. 70 – 82 http://dx.doi.org/10.1108/BFJ-12-2014-0395

McCorriston, S. (2002). Why should imperfect competition matter to agricultural economists? European Review of Agriculture Economics, 29(3), pp 349–371

McCorriston, S. (2013). Competition in the Food Chain. Working Paper No. 11 TRANSFOP Transparency of Food Pricing, retrieved from: http://www.transfop.eu/papers/

McCorriston, S., Morgan C.W., Rayner A.J. (2001), Price transmission: the interaction between market power and returns to scale, European Review of Agricultural Economics, Vol. 28 (2), pp. 143-159

MacKinnon (2010), Critical Values for Cointegration Tests, Queen's Economics Department Working Paper No. 1227, Department of Economics Queen's University, Ontario, Canada, 2010

Means G.C. (1973), The Administered-Price Thesis Reconfirmed, The American Economic Review, Vol. 62, No. 3 (Jun., 1972), pp. 292-306

Meyer, J. & von Cramon-Taubadel, S., 2004. Asymmetric Price Transmission: A Survey. Journal of Agricultural Economics, 55(3), pp.581–611. Available at: http://doi.wiley.com/10.1111/j.1477-9552.2004.tb00116.x.

Meyer, J. (2003). Measuring Market Integration in the Presence of Transaction Costs -A Threshold Vector Error Correction Approach. In Proceedings of the 25th International Conference of Agricultural Economists (IAAE), Durban, South Africa (pp. 1109–1116). Retrieved from http://ecsocman.hse.ru/data/265/660/1219/091.pdf

Meyer, J., & von Cramon-Taubadel, S. (2004). Asymmetric Price Transmission: A Survey. Journal of Agricultural Economics, 55(3), 581–611. https://doi.org/10.1111/j.1477-9552.2004.tb00116.x

Moro, D., Sckokai, P., Veneziani, M. (2012). Multi-stage Market Power in the Italian Fresh Meat Industry Working Paper No . 7 Transparency of Food Pricing. TRANSFOP, retrieved from: http://www.transfop.eu/papers/

Nash, J., Fagan, M., Davenport, S. (1996). Some Issues in the Application of Competition Policy to Agriculture. Paper presented at the 41st Annual Conference of the Australian Agricultural and Resource Economics Society

Oecd. (2009). Policy Roundtables 2008. Monopsony and Buyer Power. Retrieved from https://www.oecd.org/daf/competition/44445750.pdf

Pala A. (2013), Structural Breaks, Cointegration, and Causality by VECM Analysis of Crude Oil and Food Price, International Journal of Energy Economics and Policy 2013 vol: 3 (3) pp: 238-246

Peltzman S. (2000), Prices Rise Faster than They Fall, Prices Rise Faster than They Fall, Journal of Political Economy, 2000 vol: 108 (3) pp: 466-502

Pieri R., editor (2016), Il mercato del latte, Rapporto 2016, Osservatorio sul Mercato dei prodotti Zootecnici, Franco Angeli, September

Pieri R., Rama D., Benetto E. (2013), La filiera latte in provincia di Cremona: situazione e prospettive, rapporto interno, Cremona

Pieri, R., Rama, D. (2016), Dalla fine delle quote latte alle organizzazioni dei produttori: come cambia il settore lattiero-caseario, AGRIREGIONIEUROPA, 12; (46): [http://hdl.handle.net/10807/96181]

Popović, R., Radovanov, B., & Jeremić, M. (2013). Volatile World Milk Prices and its Effect to National Market – Case of Serbian Milk Market. Paper presented at the 135 EAAE

Seminar Challenges for the Global Agricultural Trade Regime after Doha, 28-30 August 2013. Belgrade, Serbia

Prakash, A.B., Oliver, A.I. & Balcombe, K., 2001. Does building new roads really create extra traffic? Some new evidence Does building new roads really create extra traYc? Some new evidence. Applied Econometrics, 33(12), pp.1579–1585. Available at: http://www.tandfonline.com/action/journalInformation?journalCode=raec20

Rapsomanikis, G., Hallam, D. & Conforti, P., 2003. Market Integration And Price Transmission In Selected Food And Cash Crop Markets Of Developing Countries: Review And Applications, Available at: http://www.fao.org/docrep/006/y5117e/y5117e00.HTM

Rezitis, A. N., & Reziti, I. (2011). Threshold Cointegration in the Greek Milk Market. Journal of International Food & Agribusiness Marketing ISSN:, 23(3), 231–246. https://doi.org/10.1080/08974438.2011.586916

Rosa F., Weaver R.D. and Vasciaveo M. (2015), Structural Changes and Dairy Chain Efficiency in Italy, Internation. Journal of Food System Dynamics 6 (3), 2015, 191-211 www.foodsystemdynamics.org

Russo C., Green R., and Howitt R. (2008), Estimation of Supply and Demand Elasticities of California Commodities, Working Paper 08-001, Department of Agricultural Resources and Economics, University of California Davis, June 2008

Russo, C., Goodhue, R. E., & Sexton, R. J. (2011). Agricultural support policies in imperfectly competitive markets: Why market power matters in policy design. American Journal of Agricultural Economics, 93(October 2009), 1328–1340. https://doi.org/10.1093/ajae/aar050

Santeramo F.G. and Cioffi A. (2010), Spatial price dynamics in the EU F&V sector: the cases of tomato and cauliflower, Paper Prepared For The 116th EAAE Seminar "Spatial

Dynamics in Agri-food Systems: Implications for Sustainability and Consumer Welfare", Parma (Italy), October 27th -30th, 2010

Schaffer, M.E. (2010), Engle-Granger (EG) and Augmented Engle-Granger (AEG) cointegration tests and 2-step ECM estimation. Downloaded from; http://ideas.repec.org/c/boc/bocode/s457210.html

Seo, M., 2006. Bootstrap testing for the null of no cointegration in a threshold vector error correction model. Journal of Econometrics 134, pp 129-150

Seo, M.H., 2011. Estimation of Nonlinear. Econometric Theory, 27(2), pp.201–234

Serra, T., & Goodwin, B. K. (2003). Price transmission and asymmetric adjustment in the Spanish dairy sector. Applied Economics, 35(November), 1889–1899. https://doi.org/10.1080/00036840310001628774

Sexton, R. J. (2000). Industrialization and Consolidation in the U.S. Food Sector: Implications for Competition and Welfare. American Journal of Agricultural Economics, 82(5), 1087–1104

Sexton R. (2013), Market Power, Misconceptions, and Modern Agricultural Markets, American Journal of Agricultural Economics 95 (2013): 209-219

Sheldon I., Sperling A. (2006). Market structure, Industrial Concentration and Price Transmission. Paper presented at the Workshop on "Market integration and Vertical and Spatial Price Transmission in Agricultural Markets", University of Kentucky, Lexington, KY. April 21, 2006

Soboh, R. A., Lansink, A. O., Giesen, G., & van Dijk, G. (2009). Performance measurement of the agricultural marketing cooperatives: the gap between theory and practice. Review of Agricultural Economics 31 (2009): 446-469

Sorrentino A., Russo C., Cacchiarelli L. (2016), European Parliament- Research For Agri Committee - Food Value Chain In The Eu – How To Improve It And Strengthen The Bargaining Power Of Farmers?, 2016. Available at http://www.europarl.europa.eu/supporting-analyses

Stigler, M., 2013. Threshold cointegration: overview and implementation in R, Available at: https://cran.r-project.org/web/packages/tsDyn/vignettes/ThCointOverview.pdf

Sykuta M., Cook M.L. (2001), A new Institutional Economics Approach to Contracts and Cooperatives, Contracting and Organisations Research Institute, University of Missouri – Columbia, Working Paper N. 2001-04, September 2001

Tiboldo G., Lopez R., Hirschb S. (2016), Private label market power: evidence from Italian dairy retailing, Selected Paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31-August 2 2016. Retrived from: https://ideas.repec.org/p/ags/aaea16/235592.html

Tothova, M., Velazquez B. (2012), Issues and Policy Solutions to Commodity Price Volatility in the European Union. Paper presented to the 2nd IFAMA Annual Symposium "The Road to 2050. The China Factor", Shanghai, June 2012

Van Heck, K. (2014). Assessing Efficiencies Generated by Agricultural Producer Organisations. European Commission, 2014. Retrieved from http://ec.europa.eu/competition/publications

Vavra, P., & Goodwin, B. K. (2005). Analysis of Price Transmission along the Food Chain (OECD Food, Agriculture and Fisheries Working Papers No. 3). OECD Food, Agriculture and Fisheries Working Papers. https://doi.org/10.1787/752335872456

Velazquez B. and Buffaria B. (2016), Policy measures and bargaining power along the food chain, a review to help assessing the way ahead, Rivista di Economia Agraria, Anno LXXI, n. 1 (Supplemento), 2016

von Cramon-Taubadel, S. (1998). Estimating asymmetric Price Transmission with the Error Correction Representation: An Application to the German Pork Market, European Review of Agricultural Economics 25:1-18

von Cramon-Taubadel, S. and Fahlbusch, S. (1994). Identifying asymmetric price transmission with error correction models, Poster Session EAAE European Seminar in Reading.

v. Cramon-Taubadel, S., Loy, J.-P. and Musfeldt, E. (1995). Empirische Methoden zur analyse der Marktintegration am Beispiel des EU-Schweinefleischmarktes, Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaus, Vol. 31, pp. 119-137

von Cramon-Taubadel, S. and Loy, J.-P. (1996). Price Asymmetry in the international Wheat Market: Comment, Canadian Journal of Agricultural Economics 44:311-317

Ward, R.W. (1982). Asymmetry in Retail, Wholesale and Shipping Point Pricing for fresh Vegetables, American Journal of Agricultural Economics 62:205-212

Wood S. Alexander A. (2016), Regulation in Practice: Power, Resources and Context at the Local Scale in UK Food Retailing, Environment and Planning A September 2016 48: 1848-1863, first published on May 19, 2016

Youde, J.G. and Helmberger P.G (1966), Marketing Cooperatives in the U.S.: Membership Policies, Market Power, and Antitrust Policy, Journal of Farm Economics, Vol. 48, No. 3, Part 2: Effective Competition and Changing Patterns in the Marketing of Agricultural Products (Aug., 1966), pp. 23-36