



Economic performances of
a Parmigiano Reggiano producer
within a short and a long supply chain

Master thesis in

Business Economics

Management, Economics and Consumer Studies

Author: Monica Salvioli

Registration Number: 931020725050

Supervisor: Dr. ir. Miranda Meuwissen

(Business Economic Group, Wageningen University)

Thesis Code: BEC-80433

Wageningen University 2016/2017

TABLE OF CONTENT

1 - Introduction	1
1.1 <i>Background</i>	1
1.2 <i>Research Problem</i>	1
1.3 <i>Objective</i>	2
1.4 <i>Outline</i>	2
2 - Description of the Parmigiano Reggiano supply chain	3
2.1 <i>The long supply chain actors</i>	3
2.2 <i>Relationships among the actors</i>	5
3 - Review of economic implications of a short supply chain	6
3.1 <i>Definition of Short Food Supply Chain</i>	6
3.2 <i>Economic advantages and disadvantages</i>	7
3.2.1 <i>Qualitative assessments</i>	7
3.2.2 <i>Quantitative assessments</i>	9
3.3 <i>Mixed supply chain models</i>	10
3.4 <i>Applicability of findings in the PR sector</i>	11
3.5 <i>Review of economic indicators to assess economic performances</i>	12
4 - Materials and methods	16
4.1 <i>Conceptual framework</i>	16
4.2 <i>Research methodology</i>	17
4.3 <i>Description of the case study</i>	18
4.4 <i>Data elaboration</i>	19
5 - Research results	22
5.1 <i>The producer's efficiency</i>	22

5.2 <i>Qualitative results</i>	24
6 - Discussion, Conclusion and Recommendations	27
6.1 <i>Discussion</i>	27
6.2 <i>Conclusion</i>	28
6.3 <i>Recommendations for further research</i>	29
Acknowledgements	30
Interviews	31
Bibliography	31

INDEX OF FIGURES

Figure 1: Schematic representation of the long PR supply chain actors.....	3
Table 1: Summary of aspects considered discriminant for a SFSC.....	7
Table 2: The most relevant qualitative aspects of a SFSC.....	8
Table 3: Economic performances of SFSC case studies.....	10
Table 4: Expected outcomes from a SFSC in the Parmigiano sector.....	12
Table 5: Performance indicators in Food SC assessment.....	15
Figure 2: The conceptual framework.....	16
Table 6: Data sources and assumptions made per measured variable.....	21
Table 7: Organizational costs overview divided per business activity.....	23
Table 8: Comparison of efficiency economic performances.....	24
Table 9: Comparison of findings from the case study with the literature.....	26

Abbreviations used	Meaning
PR	Parmigiano Reggiano
PDO	Protected Denomination of Origin (EU standard)
SC	Supply chain
LFSC	Long food supply chain
SFSC	Short food supply chain

1 - INTRODUCTION

1.1 Background

The Parmigiano Reggiano (PR) cheese sector is bounded to the territory and the traditional quality by a Protected Denomination of Origin (PDO) regulation (Reg. EEC n. 2081/92) and a Production Regulation (Consortium of Parmigiano Reggiano Cheese, 2011). The sector supply chain is usually composed by five or more distinct actors, each performing a different processing step (Berti, Canavari, & King, 2005). This cheese sector is facing in the recent years a number of difficulties: many cheese producers are bankrupt (Basile, 2008; Giansoldati, 2015; Persichella, 2015). One of the problems for the cheese producers is the below-cost sales and the reduction of marginal profit (Cortellazzi, 2015). In 2007 a survey showed that 70% of Parmigiano is sold in promotion, including below-cost sales (Sckokai, Soregaroli, & Moro, 2007). The Consortium of Parmigiano Reggiano Cheese is partly responsible for these below-cost marketing campaigns, since its marketing strategy is to introduce an undifferentiated product to the largest part of the population with an aggressive price-cutting campaign (Berti et al., 2005). Studies moreover demonstrate that the financial pressure of those campaigns is on the milk and cheese producers (Sckokai et al., 2007). The retailers indeed have a strong market power over them, so are able to protect their own profit despite the low sale prices by applying very low purchase prices (Grandi, 2003).

1.2 Research Problem

Alternatives to the mainstream long supply chain are possible through vertical integration, forming a short supply chain. According to Mighell and Jones (1963), vertical co-ordination: "...includes all the ways of harmonizing the successive vertical stages of production and marketing". A short supply chain is described by Marsden et al. (2000) as a way to redefine producer-consumer relation by transmitting more information about the origin and quality of the food product. Consequently, a successful translation of this information potentially brings a premium price, since it allows a strategic brand differentiation. Moreover vertical integration should reduce market inefficiencies as the multiple transaction costs (Hobbs, 1996). A transaction cost indeed can be a partial or slow information flow along the chain, or uncertainty i.e. about purchase prices (Aiginger & Finsinger, 2013).

A shorter supply chain can represent a tool to increment the first sector margins and promote innovation. For this reason many studies along the years have focused on demonstrating the market efficiency of shorter supply chains in the food sector (King, 1992). Short Food Supply Chains (SFSCs) are seen as a contrast tool against "the prevailing trend in the agro-food system of the development of global value chains dominated by retailers and characterised by unequal distribution of power between the different actors" (Maciejczak, 2014). Thus the SFSC is seen as a market evolutionary response to existing economic pressures (Fearne,

1998). Beside these academic findings, attention to short food supply chains in agriculture is increased recently also in the Common Agricultural Policy (CAP), where its application is considered as one of the most important tools to strengthen rural development (Bertazzoli, Ruggeri, & Samoggia, 2010).

Cases of all-comprehensive vertical integration *from the stable to the table* are present also in the Parmigiano sector, as exploratory attempts to escape the business pressure. However the eventuality of reduction in producer-consumer distance and its potentiality within the PR chain has never been studied in details so far. As also in other agricultural sectors it has been noticed, the development of supply-chain performance indicators in literature is not simultaneous with supply chain developments, such that there is lack of theoretical explanation upon effective organizations (Gunasekaran, Patel, & Tirtiroglu, 2001).

1.3 Objective

The aim of the present study is to cover the mentioned knowledge gap by comparing the economic performances of a Parmigiano Reggiano producer within a short supply chain and a long supply chain.

To conduct the study, the following sub-questions will be addressed:

- 1 - What are the economic benefits and disadvantages of short supply chains in the food sector?
- 2 - Which are the available economic performance indicators and metrics to assess the Parmigiano Reggiano supply chain?
- 3 - Do the long and the short supply chains perform differently under the selected indicators?

In particular this research focuses on two specific and different actors: the short-chain producer is represented by a fully vertically integrated company, while the long-chain producer is a standard cheese processor from the mainstream supply chain. The comparison between those two companies is meaningful due to the similar basic activity and the capital investment required. The product target market for both chains is intended to be exclusively the national Italian market, therefore no export trades are considered in this research.

1.4 Outline

The paper will develop as follows. In chapter 2 the topic is introduced with a brief description of the PR long and short supply chain. In chapter 3 the first two sub-questions are investigated in order to create the research framework. It is presented a review on benefits and disadvantages of short food supply chains in literature case studies, and a list of economic indicators used to assess food supply chain performances. In chapter 4 they are discussed the conceptual framework, the case study and the research method applied in this research. In chapter 5 results from the collected data are provided, and in chapter 6 they are finally discussed, together with the research conclusions and recommendations for further research.

2 - DESCRIPTION OF THE PARMIGIANO REGGIANO SUPPLY CHAIN

The Parmigiano Reggiano mainstream supply chain is formed by several actors. The main figures are the cattle breeder, the cheese producer, the ripener, the retailer, the wholesaler and the supermarket where the largest part of the product is sold (Berti et al., 2005). Beside them, there are a number of other commercial intermediaries, as the middleman that serves the restoration service and the exporter (Musi, Rinaldi, & Torelli, 2008), that are not taken into account in this paper to simplify the research concept. What is mentioned from now on in this paper as “long” or “mainstream” supply chain of Parmigiano Reggiano is just the one described in figure 1 below.

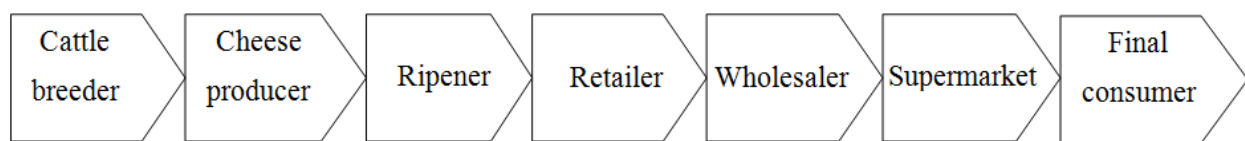


Figure 1: Schematic representation of the long PR supply chain actors

This long chain will be compared to a short one, where only one actor covers the whole chain processes. This means that the cattle breeder is processing its own milk, producing and ripening the cheese until it is not ready to be packaged and sold in its own specialized stores.

Since the focus of this study is on the cheese producer actor, as stated in chapter 1.3, in the following paragraphs it will be described in particular its position and relationship with the other SC actors.

2.1 The long supply chain actors

The supply chain for Parmigiano starts with the milk producers. The milk production for PR must be within the PDO area and must follow the Production Regulation. This means the usage of feed coming 70% within the own farm, and no silage (Consortium of Parmigiano Reggiano Cheese, 2011). For this reason the average size of a farm in the PR district is smaller than the average farm for regular milk, and the production costs are higher. In addition, even within the PR region there is difference in size and economic efficiency between the farms in the mountain area, usually smaller and with production costs of around 60,68 €/100 kg of milk produced, and in lowland, with on average 127 dairy cows and production costs of 46,06 €/100 kg (Manfredi, 2005). However the price for the milk destined to PR is quite high, around 50 €/100 kg, and higher in case of special productions (i.e. milk from special cattle breeds, organic, etc). The labor remuneration reaches the 14 €/hour in lowland and 9 €/hour in mountain, against an average of 11.5 €/h for the milk intensive productions in the Po Valley. It is deduced that the PDO milk production has higher marginal profit, but also higher price volatility than the regular milk (Manfredi, 2005).

The milk produced for Parmigiano production is transported to the closer cheese plant twice per day. In the cheese factory every Parmigiano wheel is made from around 550 liters of milk and each wheel weights on average 40 kg, and at minimum 30 kg to be certified and sold as PR (Consortium of Parmigiano Reggiano Cheese, 2011). Thus it is deducted that the cheese yield is around 13.75 liters of milk for 1 kg of cheese. As well as the milk producers, also the cheese processors have to follow the Production Regulation in order to obtain a PDO certified product (Consortium, 2011). The number of cheese plants producing Parmigiano Reggiano in 2015 was 354, and is rapidly declining in the last 20 years (Montanari & De Roest, 2013). On average the processing plant contains 6 to 20 copper boilers, each producing 2 wheels per day. Their annual production was in total 3,302,653 cheese wheels in 2015, corresponding to 132,829 tons (CR.PA., 2016). The production costs of those plants in 2011 were around 15.86 € per 100 kg of milk transformed in the lowland plants, and 17.89 €/100 kg in the mountains (Menghi, 2014).

In 2006, 105.4 million tons of Parmigiano were sold to ripeners (89.8% of the total production of the year), and just 6.4 Mt were destined to direct sales (Musi et al., 2008). In the gross market the processors sell mainly 12 and 24 months-ripened cheese, in standardized format. A cheese processor selling to the ripener in 2015 could obtain on average a price of 7.67€/kg for a 12 month ripened cheese, and 8.83 €/kg for a 24 month ripened cheese. The average price of a 12 month-old Parmigiano in the national supermarkets in 2015 was of 15.33 €/kg, so the consumer paid double the price the producer received (CR.PA., 2016). The costs of ripening for small plants are 72.41 €/ton/month and 70.74 €/ton/month for big ripening centers. 45.9% of the costs are due to losses in product weight (33.52 €/t/month in 2011), while the direct costs of storage are 18.54 €/t/month (Corradini, 2014). Those actors have large ripening plants, collecting also other kind of ripened cheeses beside Parmesan, as Grana Padano, Fontina, Pecorino etc (personal communication *Bertinelli*). This means that they are not only specialized in PR cheese, bounded to the PR chain as the farmers and processors are, but have a more differentiated product investment. Moreover the Production Regulation does not apply on ripeners and next SC actors, therefore they are not bounded to geographical constraints or extraordinary manufacturing activities.

At this point of the chain the product leaves the PDO geographic area and enters in the food retailer generic sector. The ripener after 12 months sells the 24 month-old product to a wholesaler, and has a gain or loss on the difference in PR prices at the purchasing and selling time, detracting the ripening costs (S.I. P-R, 2013). The retailers have a strong market power on the producers, as mentioned in chapter 1, thus the purchasing price is often close to the production costs (personal communication *Bertinelli*). The main ripening brands are: Parmareggio, Nuova Castelli, Zanetti, Ambrosi, Zanari, Boni, Colla and Dalter Alimentari (personal communication *Montanari*).

The wholesaler that buys the cheese has commercial contacts with the major exporters (retailers), and with supermarkets (Berti et al., 2005). In 2005 the exported PR traded by large retailers was 15,100 tons, and the national supermarkets sold in total 53,000 t (Musi et al., 2008).

2.2 Relationships among the actors

“Vertical coordination is the alignment of direction and control across segments of a production/marketing system. Vertical coordination can be achieved through vertical integration - the direct acquisition and control of segments otherwise linked by open market transactions - or through formal contracts between otherwise independent firms” (King 1992).

Most of the literature highlights the importance of understanding the quality of the relationships within a supply chain, for this reason it is interesting to focus further on the quality of relationships the producer within the PR supply chain has upward and downward. This determines in some extent the efficiency of the whole chain, the flow of informations, and the willingness of different actors to collaborate with each other.

The producer’s upward integration with the dairy farm is characterized by three types of contracts that lead to three business structures: (1) the social dairies (latterie sociali), (2) the business cheese factories (caseifici aziendali) and (3) the artisanal cheese factories (caseifici artigianali). (1) The social dairies are the mostly used contracts. They consist of dairy cooperatives that collect the milk mainly from its members to produce exclusively Parmesan. This type of integration is the oldest and most traditional one in the sector, and represented the 66.2% of the total producers in 2013. Despite the large majority used it, this contract is constantly decreasing since 1993, when it covered the 82.7% of the cases (Montanari & De Roest, 2013). The cooperative system nowadays is remained successful especially in the mountains, the most disadvantaged area. (2) The business cheese factories are large farm stables that implemented a processing plant beside as a collateral activity, and process mainly or exclusively their own milk. They covered the 18.5% of total producers in 2013, and they constantly increased in number in the period 1993-2008 (Montanari & De Roest, 2013). (3) The last kind of production plant, called artisanal cheese factory, is the most recent and had a trend in expansion in the last years, reaching the 15.3% of total producers in 2013. Their production is based on milk purchased from external dairies, and they are likely to be the business activity closer to the most efficient dimension, since they are not bounded to historical partners or investments in livestock as the others are (Montanari & De Roest, 2013).

The most common type of contract between producers and ripeners is a verbal one based on established relationships of trust. Such contracts are automatically renewed every year and are mainly based upon customs: the producer will deliver all its production to the same ripener, except any problem occurs. The contracts published in 2016 by the Chamber of Commerce in Parma show standardized quantities of product purchased every three or six months for a fixed price (the market price at the moment of signing the contract). Quite often the ripeners have their own packaging and brand, gaining visibility toward the final consumer, and thus a differentiated product and customer loyalty.

3 - REVIEW OF ECONOMIC IMPLICATIONS OF A SHORT SUPPLY CHAIN

In the recent years research has been conducted widely to describe the effects that alternative supply networks have on existing markets, in particular short supply chain networks. As a further analysis evidenced, literature about this topic focuses in three different areas of research: (1) the economic, (2) the social and (3) the environmental areas. The first looks into the economic and managerial aspects of the activities involved in the short supply chain, the second analyzes the social implications of a shorter network, and the last one quantifies the environmental consequences of the choice to make a shorter, therefore local, supply chain.

The aim of this research is restricted to evaluate the economic performances of a shorter supply chain, therefore the social and environmental forces will be not considered, as not inherent to the research purpose.

3.1 Definition of Short Food Supply Chain

The literature on Short Food Supply Chain is wide but fragmented. A literature analysis evidenced that there is lack of one unique shared definition of SFSC (see table 1 below), as also Bertazzoli et al. (2010) and Maciejczak (2014) reported. This is due to two main reasons: the first is the wide range of possible product chains, each with its peculiar characteristics (Bertazzoli et al., 2010), the second reason is the various aspects of the chain that the definition would like to underline. For example Marsden et al. (2000), Renting et al. (2003), Bertazzoli et al. (2010) concentrated their attention to three dimensions of SFSC, distinguishing: face to face relationships, networks in a spatial proximity and networks spatially extended. On the opposite, Bullock (2000) and Sini (2009) identified SFSC with any form of direct selling that a producer can reach, either through website, farmer shop or network for the local market.

A clear example of misunderstanding that this divergence in interpretation causes can be found in the research conducted by Marsden, Banks and Bristow (Marsden, Banks, & Bristow, 2000). There, is stated that “SFSCs are certainly not immune to the ‘price squeeze’ effects characteristic of conventional markets. [This] is clear from the experience of Parmigiano Reggiano, for which it is reported that sales and farm margins are increasingly under threat”. In that paper the concept of SFSC is overlapping with the concept of PDO product chain, since the definition given to SFSC is of a network linked to the production region.

In contrast with the definition that identifies the SFSC for its value-laden information flow (Ilbery & Maye, 2005) in this paper the information flow and the producer-consumer empathy will be considered a consequence of the SFSC logistic, and not the defining character.

Therefore SFSC is defined in this research as *the supply chain minimizing the number of nodes between the primary producer and the final consumer* (Renting, Marsden, & Banks, 2003).

Table 1: Summary of aspects considered discriminant for a SFSC

It is considerable SFSC if there is..	face to face relationship	spatial proximity (local)	direct sale	link to territory	valuable information flow	small number of SC actors
Bullock (2000)			X			
Marsden et al. (2000)	X	X		X		
Renting et al. (2003)	X	X				X
Ilbery & Maye (2005)					X	
Sini (2009)			X			
Bertazzoli et al. (2010)	X	X				

3.2 Economic advantages and disadvantages

In literature it has been analyzed from many different case studies and researches the economic consequences of the presence of a short SC in the food sector. Its consequences could be either positive or negative, and are presented both in qualitative statements or providing quantitative data in support of it.

From the analysis of this body of literature it is wished to be gained an overview of expectable outputs, for the subsequent application of this analysis at the Parmigiano Reggiano sector. In order to have comparable results, the only literature considered is the one conducted during a recent period of time, concerning forms of short SC in the food sector in developed markets. Since vertical coordination and partnerships are entered in the food sector in the 1990s (Fearne, 1998), the main focus will be on literature written since that period onward.

3.2.1 Qualitative assessments

There are some economic aspects of SFSCs that are reported by almost the totality of the scanned articles. For this reason, due to the unanimity of results, they are considered the most relevant points achieved by the major part of the case studies. A clear overview of them can be gained looking at Table 2 below.

The most interesting economic advantage that a SFSC brings to the primary producer is (1) the possibility to capture a higher proportion of value added of food production. This is possible for multiple reasons: first due to the elimination of intermediate actors and their marginal profits, so the lowering of transaction costs along the chain, as Bullock (2000), Renting et al. (2003), Sini (2009) and Verhaegen and Huylenbroeck (2001) stated. Another reason for obtaining a higher value from the production is the possibility for producers to ask for a higher price (Ilbery & Maye, 2005).

This is possible because of another important advantage of the SFSC: (2) the possibility to have a better information flow along the chain, which links producer and consumer directly. From this contact it derives the customer's willingness to pay more, because of a perceived higher product quality. The product is

charged therefore with also territorial and cultural values, and the human empathy with the producer (Sini, 2009).

Beside these advantages, there are also disadvantages implied in being part of a SFSC. A problematic situation that is reported in literature is (3) the difficulty for producers in managing the SC on their own. It is reported that quite often there is a lack of managerial skills and educational background behind many farmer activities (Bertazzoli et al., 2010; Knickel et al., 2008). It has also been reported by Sini about difficulties in sales forecasts and production adjustments (Sini, 2009).

On the other hand (4) managerial independence and satisfaction for the producers are higher in SFSCs, leading to additional motivation to work (Sini, 2009), and economic advantages on skipping retailer's product requirements (Ilbery & Maye, 2005).

One last problem mentioned in literature is (5) the difficulty to reach an efficient economy of scale, especially for smaller businesses, whose sale volumes do not justify investments in marketing and communication campaigns (Verhaegen & Huylenbroeck, 2001).

To conclude, one last important advantage largely stressed in literature is that the presence of SFSCs brings (6) economic development in the rural areas they operate. From the policy point of view this is the reason for a recent higher interest in SFSCs, especially in the latest CAP 2014-2020, in the Rural Development section (Kneafsey, et al., 2013).

Table 2: The most relevant qualitative aspects of a SFSC

Author, Year	Business sector	Country	Value added	Information flow	Management	Independence	Economy of scale	Rural development
Bullock, 2000	Farms	UK USA	X(pos)	X(pos)		X(pos)		X(pos)
Marsden et al, 2000	Food sector	4 EU ²	X(pos)	X(pos)	X(neg)			X(pos)
Verhaegen, Huylenbroeck, 2001	Farms	B	X(pos)	X(pos)	X(neg)	X(pos)	X(neg)	X(pos)
Renting et al, 2003	Organic farms	10 EU ³	X(pos)	X(pos)			X(neg)	
Ilbery & Maye, 2005	Livestock	UK	X(pos)	X(pos)		X(pos)		
Knickel et al, 2008	Food sector	10 EU ¹		X(pos)	X(neg)		X(neg)	X(pos)
Sini, 2009	Food sector	DC	X(pos)	X(pos)	X(neg)	X(pos)		X(pos)

Bertazzoli et al., 2010	Organic farms	I	X(pos)		X(neg)			X(pos)
Kneafsey et al., 2013	Food sector	EU	X(pos)	X(pos)	X(neg)	X(pos)	X(neg)	X(pos)

¹ The Netherlands, Denmark, Germany, Italy, France, Austria, Switzerland, Latvia, Hungary and Czech Republic.

² Germany, Spain, United Kingdom and Italy.

³ The Netherlands, the United Kingdom, Ireland, Germany, Italy, Spain and France.

DC: Developed Countries

I: Italy

B: Belgium

X(neg): negative aspect mentioned in literature

X(pos): positive aspect mentioned in literature

3.2.2 Quantitative assessments

As well as qualitative analysis, literature presents also quantitative measurements of different outputs comparing long and short SCs. Mostly differences in prices are shown, as well as the producer gross margin and annual turnover, as it can be seen in Table 3.

A logical consequence of the elimination of intermediaries in the short supply chain is the elimination of their profit margins, as just mentioned in the paragraph above. This leads to lower prices for the final consumers and, at the same time, higher prices for the producers (Sini, 2009). This is possible because of the existing difference in the long chain between the price the farmer gets for its products and the price the consumer is paying for that same product in the supermarket or grocery shop. To bring an example, a marketing study in the US measured that farmers' market prices are between 10% and 18% lower than at supermarkets for the same category of products. Within the milk sector in the UK, the cheapest organic milk on the supermarket shelf is sold at more than double the price the farmer gets (about 0.22 € per liter) (Bullock, 2000).

From a different study conducted on organic farms in Italy it has been evidenced that there is a positive correlation between the annual turnover and the type of sales network the farm uses (Bertazzoli, Ruggeri, & Samoggia, 2010). From the study results there is a higher number of farms (19 over 35) performing worst (annual turnover lower than 10.000 €) while using the shortest form of supply chain, that is the direct selling. On the opposite, the farms performing better (annual turnover higher than 40.000 €) use a network approach. This means they are part of a farm network, an aggregation of farmers, and use this network to reach either the consumers or a purchaser. The farms adopting an intermediate strategy, having just one intermediate but not selling directly to the consumers their products, are performing moderately with a turnover between 10.000 € and 20.000 €. From this case study it can be deduced that an effective SFSC model is more efficient when applied with the support of a large organisational structure.

In conclusion, the short supply chain model is not always performing better than the long supply chain (Sini, 2009), but it performs differently depending on the context the company is working on and the structure of the company itself.

Table 3: Economic performances of SFSC case studies

Author, Year	Business sector	Country	Product price	Annual Turnover	Producers gross returns
Bertazzoli et al, 2010	Organic farms	Italy		below 10 M € direct selling; more than 40 M€ with intermediate network	
Bullock, 2000	Farms	UK, USA	Prices 10% to 18% lower than supermarkets in UK, comparing similar quality food	farmers' markets turnover: in Winchester 35'289-61'705 €/day; in Stour Valley 105'780-176'300 €/year*	producers gross returns from USA farmers' market sales: +200 to 250% higher than sales to wholesalers and distributors on average
Marsden et al, 2000	Livestock	Wales	28,5% higher than prices get from producers in traditional SC	999'621 € total extra value added to farming in the region*	Gross margin per farmer 73% higher than for equivalent traditional SC
Sini, 2009	Food sector	Italy	prices 30% lower than corresponding LFSC prices		

* currency value at 13/02/2017, 11:36 am: 1€=0.8501£ (Finanza e mercati, 2017)

3.3 Mixed supply chain models

It is relevant to notice that the coexistence of both supply chains is often mentioned in literature. This means for example that the same food business organization gains access to the mainstream market through a stakeholder from the long supply chain (i.e. a wholesaler) and at the same time runs a direct sales business on its own. This could be seen as an adjustment to overcome the mentioned disadvantages and costs that a short supply chain leads (economies of scale, marketing efforts) (Sini, 2009).

Similarly the need to solve those disadvantages led to the emergence of farmer networks. The farmer networks are community of producers that help the singular to address the final consumer by acting as interface. By this mean the economy of scale grows and extra efforts are shared (Bertazzoli et al., 2010). Also, this kind of spontaneous partnership (a horizontal integration) helps to share knowledge and experience, a source of competitive advantage (Fearne, 1998).

From those findings it is confirmed the statement made by Ilbery and Maye (2005) that in reality there is a “heterogeneous nature of alternative economic practices”. For this reason a distinction in just two models, the long and the short one as done in this research, is just a theoretical simplification (Ilbery & Maye, 2005).

3.4 Applicability of findings in the PR sector

The supply chain of Parmigiano Reggiano has some peculiarities differing from the standard format of mainstream supply chain. Ilbery and Maye (2005) defined it as an alternative food economy (AFE) because of its embeddedness with the local territory, due to the PDO production. An assumption to test is if the PR can effectively benefit from a SFSC network, and if the cheese producer is the main beneficiary of it.

From one side it is a quality product with a high potential that could come from a better information flow about its production and characteristics. It could be expected for this a higher willingness to pay from the consumers of a SFSC. It is also expected to increase the percentage of value added captured by the cheese producer, due to the elimination of a number of intermediaries (the ripener, the wholesaler, the retailer, the supermarket). Those are the actors that actually retain the largest portion of the final price in the long Parmigiano SC.

On the other hand, one difficulty in adopting the SFSC could come from the Consortium and its relation with the companies. Right now the Consortium is the institution responsible for the marketing campaign in benefit of all the small enterprises and the farmers with no knowledge in marketing. It is also providing funds for market research and databases improvements within the sector. But in consequence of that, it is also getting the farmers used not to act as businessmen and to avoid independence and responsibilities. This leads to a higher effort to create a parallel action, as one’s own direct channel (theory supported also by personal communication *Bertinelli* and *Montanari*). And last, the economy of scale could be an objective difficult to reach, since the average size of PR production plants can be considered of small dimensions.

Table 4 summarizes the expected outcomes that the short chain in this study should confirm, based on presented literature.

Table 4: Expected outcomes from a SFSC in the Parmigiano sector

	Case study
Value added	<i>Benefit</i>
Information flow	<i>Benefit</i>
Management	<i>Issue</i>
Independence	<i>Issue</i>
Economy of scale	<i>Issue</i>
Rural development	<i>Benefit</i>

3.5 Review of economic indicators to assess economic performances

The literature about supply chain performance measurement is wide, and applies many methods and approaches to assess the economic performances at organizational and supply chain level (Bigliardi & Bottani, 2010). This is the case also in the food sector, where cannot be found a unique theoretical approach in literature, despite the increased interest in this field is relatively recent. This lack of coherence is due among other factors to the variety of every sector's peculiarities and the study purposes. According to Aramyan et al. (2006) supply-chain performance measurement received less attention in the field of food and agribusiness than in other market sectors. As Gunasekaran et al. evidenced in their research, there has been an important development toward vertical coordination in the food sector only around 1990-2000, with some cases like the poultry industry in the US and the beef in the UK developing a vertical network design before the others (Fearne, 1998). Consequently, the study of indicators and metrics have been developed relatively late in the agri-food sector (Gunasekaran, Patel, & Tirtiroglu, 2001).

In many studies conducted over the last period it is possible to see a pattern in the selected supply chain performance indicators and metrics. This means that the applied indicators insist mainly on a few similar aspects, and for this it is possible to group them in five main categories: supply chain efficiency, flexibility, responsiveness, food quality and network. Considering that the objective of this research section is to select the most suitable metrics for the case study assessment, it is expected a higher contribution to the research from a review methodology distinguishing and analyzing one by one those main categories, because it focuses already on the main aspects to take into account during the following selection process. A complete overview of the scanned articles and their metrics is shown in Table 5.

EFFICIENCY

Efficiency is considered an important dimension applied by all the authors reviewed. For efficiency it is meant the measure of how well the resources are utilized by the company (Aramyan et al., 2007). In order to assess efficiency within a food supply chain either costs or profit are used (Pungchompoo & Sopadang, 2015). Those could be measured at different levels as the total supply chain costs, intended as the sum of all operators' costs in the SC, the total costs of one organization within the SC, or the costs referred to a specific production line (Van Der Vorst, 2005). Also, costs could be measured as cost of goods sold (COGS) (Bigliardi & Bottani, 2010), transaction costs and distribution costs (Aramyan et al., 2007). Beside the general costs, focus is driven also to the inventory as another indicator of supply chain efficiency. Various aspects could be analyzed, as the inventory level, thus the number of products in store (Van Der Vorst, 2005), and all costs related to the inventory: the warehousing cost, the capital cost, the service cost (i.e. the stock management, insurances, etc) (Aramyan et al., 2007), the information processing cost (Bigliardi & Bottani, 2010) and the risk costs (costs associated with pilferage, deterioration, damage and losses) (Aramyan et al., 2006). Finally, other measures of efficiency used are purely economic ratios as ROI (return on investment) (Aramyan et al., 2007) and sales growth rate (Claro et al., 2003). Profit is the most common criteria, however it has been criticized by Aramyan et al. (2005) the use of this as the only or main element to measure the efficiency of a business.

FLEXIBILITY

The flexibility is considered as the ability of the chain to respond to changes in environment (Van Der Vorst, 2005). The degree of flexibility could be deducted from a site organization and use as the ability to respond to a change in demand. This can be measured by the capacity utilization, so the percentage of plant capacity used on average, that reflects the possibility to meet extra production requirements (Bigliardi & Bottani, 2010), the variation in stored volumes during a period of time (Aramyan et al., 2007), or the degree of automation. This last measure has been considered index of flexibility by Van Der Spiegel (2004), but as a different and independent class of measurements by Pungchompoo and Sopadang (2015).

Also an indicator of flexibility beside the production schedule is the level of customer service, which includes the number of backorders, late orders and lost sales, the customer satisfaction, the delivery flexibility, the range of product and services and the effectiveness of scheduling techniques (Aramyan et al., 2007). In some extent it has been observed overlap in metrics used in literature that are categorized as flexibility or responsiveness indicators (again, not complete consistence from different literature).

RESPONSIVENESS

The responsiveness counts as the order cycle time (OCT) of the supply chain (Van Der Vorst, 2005). Within the OCT it is possible to distinguish for example the lead time and the customer response time. All delivery

performance measurements in general help analyzing the responsiveness of the company within the SC. The customer complaints and number of backorders, as well as the delivery performances, are considered indicators of the degree of performance of a SC (Aramyan et al., 2007; Pungchompoo & Sopadang, 2015)

FOOD QUALITY

This dimension has been studied carefully by Aramyan et al. (2006; 2007) and occasionally applied by other authors. This is the main dimension differentiating a food supply chain from a manufacturing chain, therefore it summarizes all relevant aspects dealing with product perishability. It is part of the food quality metrics the level of product quality, safety and health, its sensory properties and shelf life. But also not-strictly product characteristics are considered indicative of quality, as the product convenience and its marketing strategy. Also Jongen (2000) and Northen (2000) linked the food quality with the marketing idea, since the concept of product quality can be divided in quantitative measurable standards, and the degree the product meets the consumer needs and expectations. In addition, they are considered part of this category by Aramyan et al. (2006; 2007) also the production system characteristics, that may overlap with the innovativeness of the SC technologies mentioned under flexibility, and the environmental aspects, that in some extent are influencing the economical performances measured. The role of this category of metrics, as the following one (Network), has the role of linking the other measured performances with the environment and stakeholders around the SC.

NETWORK

The last dimension describes the relational governance and the environment the SC is inserted in. To study a SC structure it has to be considered either if there is an environmental instability affecting its functions, and what is the quality of the relationships between actors (i.e. which degree of joint planning and problem solving they have) (Claro, Hagelaar, & Omta, 2003). It is evident that the number of stakeholders and their selection criteria are also affecting the system. The studies take into account the partnership satisfaction, the degree of cooperation in planning and the on-time information sharing as indicative of a SC good economic performance (Fattahi, Nookabadi, & Kadivar, 2013).

Table 5: Performance indicators in Food SC assessment

	Sector investigated	Efficiency	Flexibility	Responsiveness	Food quality	Network
Van Der Vorst (2000)	Vegetables & fruits, chilled salads, cheese and desserts	X		X	X	
Claro et al. (2003)	Potted plants and flowers	X				X
Van Der Spiegel et al (2004)	Bakery	X	X	X	X	X
Aramyan et al. (2006)	Agri-food	X	X	X	X	
Aramyan et al. (2007)	Tomato	X	X	X	X	
Bigliardi, Bottani (2010)	Food industry	X	X	X		X
Vavrina & Ruzickova (2012)	Farmers and food wholesalers	X	X			
Faranak, 2013	Meat industry	X	X	X	X	X
Pungchompoo & Sopadang (2015)	Frozen shrimps	X	X	X	X	

4 - MATERIALS AND METHODS

4.1 Conceptual framework

The presence of a conceptual framework helps selecting and categorizing the most relevant variables to be implemented in the study. In figure 2 it is summarized the conceptual framework that answers the question: Which are the available economic performance indicators and metrics to assess the Parmigiano Reggiano supply chain?



Figure 2: The conceptual framework

Dimensions investigated within this study:

In order to make a reasoned adaptation of the measurements mentioned in chapter 3.5 within the studied PR sector, some of them will not be considered as not applicable or relevant. Lapide (2000) advised when developing a set of metrics for a supply chain performance measurement not to exaggerate in the number of used indicators. He recommends using between 3 and 5 numbers of measures to be tracked in each area, to avoid an unwieldy measurement process. Of opposite advice are Faranak et al. (2013) that included “an unlimited range of performance attributes” in their *technique for order preference by similarity to ideal solution* (TOPSIS) framework. Despite it, it has been considered more important for this research to focus on a limited number of indicators but analyze them in close details. For this reason only the efficiency dimension has been measured with five different metrics, while the other categories are developed in just one

or two concepts. This unequal attention is also due to an observed higher interest from the contacted SC actors for such an economic comparison of the two chains. Moreover, every scanned article measured the efficiency dimension, and this demonstrates the importance of this concept within a food SC assessment. On the opposite, the responsiveness category reported in chapter 3.5 has been excluded from the research points, as also Claro et al. (2003) and Vavřina and Růžičková (2012) did. In fact it is evidenced from table 5 that not all categories have been implemented in the reviewed studies. Within this study it is not possible to apply the responsiveness dimension since there is no public available information about problems experienced by producers with milk deliveries or ripening requirements. This has also never been pointed as an issue during the interviews with the SC actors.

Metrics implemented within this study:

The product price has been used as significant parameter to compare short to long food supply chains already by Bullock (2000), Marsden (2000) and Sini (2009), as reported and discussed also in chapter 3.2. The total organizational costs, that are the total yearly costs of a company, have been inserted by Van Der Vorst (2005) in its theoretical framework for assessing food supply chain networks at organizational level. The cost of goods sold has been used by Corradini (2014) as a tool to compare milk farms' performances in the Parmigiano sector (Milk Money program). Profit has been applied by Aramyan et al. (2007) in the performance measurement of its case study. Here profit of a company is substitute with the measurement of the yearly revenue. The cheese producer marginal profit is used in different reports from CR.PA. as an indicator to compare performances in different years (Corradini, 2014; Menghi, 2014).

Still Aramyan et al. (2006) argued that marketing is an important characteristic for the quality of the product in a food chain, to be taken into account when selecting performance indicators in agri-food production chains. Relational governance is a concept stressed by both Claro et al. (2003) and Bigliardi and Bottani (2010) to measure the quality of the network in food supply chains. Finally, to assess flexibility they have been used: the range of products offered, mentioned by Bigliardi and Bottani (2010) as an interesting factor to include in the evaluation, and the type of supply contract, that in reports about the PR sector is often used as value to distinguish farms in performance classes (Montanari & De Roest, 2013).

4.2 Research methodology

This research is based on one case study. However this choice has been justified in literature when the characteristics explored make it a rare or unique event (Bigliardi & Bottani, 2010). In the PR sector there are no more than 10 companies controlling all the steps from cattle breeding to ripened cheese sales, representing the whole chain in one actor. Among them moreover it is rare to own a proper cheese shop, while the majority has an in-farm shop (personal communication *Morini*). This countryside home-made shop represents a less relevant case study, since it may have different volumes and consumer selection (based on personal relations) not comparable with the supermarket sales. Since the *Bertinelli Gianni & Nicola* farm is a

rare case matching the study requirements for comparison, this is the reason why the model for the short supply chain is based only on this case study.

For the short supply chain all gathered data are primary data. First, a survey was carried through a face-to-face open interview with the farm owner, Dr. Nicola Bertinelli, lasted around 2 hours. The farm owner is considered a knowledgeable informant since he is also the business manager, he has a long working experience in the Parmigiano sector and he has a master degree in business and economics. The aim of the interview was to collect qualitative as well as quantitative informations, and gain an insight on the economic management of the business. The manager remained in contacts with the research developments also in the next steps and provided all the data reported in the study concerning the short chain.

For the long supply chain assessment both primary and secondary data have been used. Primary data, mainly qualitative, have been collected through in-depth interviews with long supply chain experts during the period October-November 2016. Secondary data are obtained from the on-line database for PR sector (S.I.P-R) and literature research.

The contacted experts are:

- Dr. Claudio Montanari, working in CR.PA. S.p.A. (Animal Production Research Center) in Reggio Emilia. The CR.PA. is a research center providing market analysis, data sets and research papers to the Consortium of Parmigiano Reggiano Cheese and its supply chain information system database. Montanari is researching and publishing about the PR sector since more than 10 years, and part of its papers are bibliographic references in this study.
- Mr. Iginio Morini, from the Press Office of Consortium of Parmigiano Reggiano Cheese. He is the organizer of some local initiatives to enhance product diversification in the PR sector, and he is the Consortium's official spokesman.
- Prof. Daniele Rama, director of the School of Management and Economics Agribusiness (SMEA) in the Catholic University of Sacred Heart (Cremona), and professor in the courses of Agricultural and food market institutions and Food marketing. He also personally knows Nicola Bertinelli and its business, and for this reason can provide reflections regarding the case study performances with the widest knowledge.

4.3 Description of the case study

In the PR sector there are few cases of short supply chain, thus totally integrated activities. Approximately they are no more than 10 cases (personal communication *Morini*). One of them, the *Bertinelli Gianni & Nicola* farming company, has been used as case study to assess the economic performances of a short chain. This is the ideal case of short supply chain since its vertical integration covers the whole PR chain from cattle breeding to direct sales in specialized shops.

The business strategy of this company is completely based on differentiation. Since it controls the raw materials provenance starting from feed and cattle breeding, it can claim the highest control on all the production processes, and therefore a high quality PR cheese (PR Millesimato). In order to make the obtained quality difference perceived by the consumers, it developed its own brand Bertinelli, and a sales logistic able to sell the whole product volumes in the owned cheese shops. By this way the Bertinelli company summarize the whole SC steps under one single brand. This is the first company in Europe certified UNI 10939 for its supply chain traceability (Cortellazzi, 2015).

Actually the Bertinelli company is composed by:

- 170 hectares (1.700.000 square meters) dedicated to the cattle feeding. They produce alfalfa (*Medicago sativa*), tender barley and hard barley (*Hordeum vulgare*). The whole production is certified as Organic Farming products and used to feed the farm animals (Cortellazzi, 2015);
- 621 cattle, in a free stall barn, of which around 350 are producing milk (others are bulls, calves and heifers) (Osservatorio Agroalimentare, 2008). The animals are bred to ensure higher protein concentration in the milk, to support a better cheese making process;
- A cheese factory consisting of 8 traditional copper boilers, producing 21 wheels per day of 40 kg each (personal communication *Bertinelli*). In the annex warehouse the cheese ripens in 12, 24, 30 or 36 months, depending on the desired cheese category;
- A direct sale network, consisting in: the “Progetto Latte” shop in Parma’s supermarket Centro Torri, the “Barlumeria” shop in Fidenza’s fashion outlet, and the “Caseificio Della Musica” in Noceto, where the production and ripening plant is situated. This is composed of a traditional cheese shop plus a restaurant where local food is served together with their Parmesan cheese, and a night club.

This case study is a singular reality, and surely has peculiarities not applicable to all similar companies, but still can provide an insight and informations upon how an ideal short SC can be implemented in the sector.

4.4 Data elaboration

The short and the long Parmesan supply chains have some main differences that make their comparison not straightforward. For this reason some research assumptions have to be made. For example, it is wished to compare the consumer price from the two chains, that is the first efficiency metric mentioned in the paragraph above. To do this the two product offers must be comparable. However in the mainstream wholesale market it is traded Parmigiano Reggiano cheese mainly in two standardized qualities: 12 and 24 months ripened cheese (CR.PA., 2016). On the contrary, the case study’s production is differentiated in various formats: there is the 15 months, 24 months, 30 months and 36 months ripened cheeses, in addition to Parmigiano Reggiano Kosher and cheese products for lactose-intolerant and vegan consumers (personal communication *Bertinelli*). To make a meaningful comparison of the product prices the same product

category must be selected for both producers. Therefore the average wholesale price from the Consortium databases is compared to the prices in the Bertinelli's shops for the 15 and 24 months ripened classical Parmigiano.

The different production of the two processing plants leads also to other issues. In order to assess organizational costs, that is the second metric mentioned in paragraph 4.1, other corrective actions have been taken. First, the aggregate data of costs incurred by Parmigiano producers available in S.I.P.-R are differentiated for lowland and mountain plants (Montanari & De Roest, 2013). Since the case study for the short chain is located in lowland, to make production costs comparable the mountain cheese plants, with higher costs, are not considered in the estimation.

The yearly average production of Parmigiano per production plant is also an important information to deduce organizational costs. In literature the transformation costs are divided per dimension into 4 categories: (1) the plants processing up to 3,000 tons of milk, (2) from 3,000 to 6,000 t, (3) from 6,000 to 9,000 t and (4) over 9,000 t (Menghi, Corradini, & De Roest, 2015). The case study can be compared with the second level category, with a corresponding average costs of 15.69 €/100 kg. This is the most comparable value, referred to a plant located in lowland, under direct management (not subcontracting) and processing on average 4,278,000 kg milk. Indeed the case study processes on average 4,015,000 kg milk (personal communication *Bertinelli*), with just a difference of 263,000 kg.

In 2011 the costs incurred by PR producers for their activity of cheese making were 15.86 € per 100 kg of milk processed in lowland plants, that means 0.16 € per liter (Menghi, 2014). Given that the processing factor is 13.75 liters of milk per 1 kg of Parmigiano (Consortium of Parmigiano Reggiano Cheese, 2011), the COGS of an average producer is 2.18 € per kilogram of product, and includes: the costs of assets, raw materials, labor, electricity, one-year ripening place and everything usually needed by a processing plant to produce Parmigiano. Bertinelli company in 2016 declared 1.83 M€ production costs to produce around 292,000 kg of Parmigiano Reggiano Millesimato. This means that the cost to produce 1 kilogram of Parmigiano was on average 6.25 €/kg.

In order to provide a scale dimension of the processing plants in the sector it must be considered that this could widely vary from a minimum production of around 175,000 kg/year - if the cheese plant owns 6 copper kettles - up to maximum 584,000 kg/year - with 20 copper kettles (personal communication *Montanari*). The average dimension has been estimated from the total number of processors and the yearly total production. In 2015 the annual production of Parmigiano Reggiano was 132,829 tons (without distinction between 12 and 24 months-old cheese). Since in 2015 there were in total 354 plants inscribed to the Consortium, roughly each plant was producing 375,223.16 kg of cheese per year on average.

Subsequently, to describe in a consistent way the producer's economic performance the company revenue has been taken into consideration. For the long chain it has been deducted from the average of the prices of

the 12 and 24 months-old cheese, assuming a fictitious production of 50% for each type. The result is an average price of 8.25 €/kg, coming from the registered prices in 2015 of: 7.67 €/kg for 12 months-old and 8.83 €/kg for 24 months-old Parmigiano (CR.PA., 2016). Given the average production of 375,223 kg per year found before, and the average price obtained per kilo, the average income for a producing plant is assumed to be 2.4 M€/year. From the case study the revenue is given as an aggregate number from the whole PR production (all qualities of sold Parmigiano are included).

Table 6: Data sources and assumptions made per measured variable

Variable	Data source for the LFSC	Data source for the SFSC	Assumptions and calculations
Product price	CR.PA., 2016	Direct communication	12 month-old Parmigiano will be compared with 15 month-old one.
Organizational costs	Menghi et al., 2015	Direct communication	Only plants with dimension comparable to the case study are accounting for the LFSC.
COGS	Menghi, 2014	Self calculations from available data	Average production over total costs.
Revenue	Self calculations from available data	Direct communication	Average price per average production.
Marginal profit	Self calculations from available data	Self calculations from available data	Average price minus COGS.
Range of products	CR.PA., 2016	Direct communication	
Supply contract	Personal communication Montanari	Direct communication	
Marketing strategy	Personal communication Morini	Direct communication	
Relational governance	Personal communication Montanari, Morini.	Direct communication	

5 - RESEARCH RESULTS

The answers obtained for the dimensions investigated can be distinguished in quantitative and qualitative results. The producers' *efficiency* has been investigated through data comparison, while *flexibility*, *marketing* and *network* have been discussed in general terms with the stakeholders. For this reason this chapter is divided in two sub-sections, each describing in details the findings.

5.1 The producer's efficiency

In the gross market it is traded Parmigiano Reggiano cheese mainly in two standardized qualities: 12 and 24 months ripened cheese. In 2015 the average price the producer could get selling the cheese was: 7.67 €/kg for the younger and 8.83 €/kg for the two years old cheese (CR.PA., 2016). In comparison, at this moment the price in the Bertinelli's shop for 15 months ripened classical Parmigiano is 12.50 €/kg, and for 24 months is 14.90 €/kg (personal communication *Bertinelli*). Thus for similar classes of product the price received by the short chain producer is respectively 63% and 69% higher than the average gross price. In addition it has been pointed that the volatility of the price at the wholesale level is not present at the consumer level (CR.PA., 2016), and for this reason the price volatility is reduced with direct sales.

Given the assumptions discussed before in chapter 4.4, the COGS has been deducted for both chains. Based on data published by Menghi (2014) in 2011 the average COGS was 2.18 € per kilogram of Parmigiano for the producers of the mainstream chain situated in lowland. On the contrary for Bertinelli company the COGS was 6.25 €/kg in 2016, that is 2.87 times higher than the average data.

Beside the cost of cheese production just mentioned, it is interesting also to consider the remaining costs of the case study. Indeed its peculiarity is not to limit itself to be a processing plant, but to include also the milk production and three specialized cheese shops. To produce its own milk Bertinelli declares to spend 1.35 M€ per year, 65% lower than the total costs of 2.08 M€/year that a survey in 2013 showed for farms situated in lowland and producing milk only for PR production (Menghi, Corradini, & De Roest, 2015). The comparison of ripening and sales costs of the standard chain with Bertinelli is not straightforward, since the case study available data are comprehensive of also extra purchasing costs, due to the supply from third parties of additional complementary products to implement the shops' product range. However these costs are presented in table 7 below to offer a complete overview of the cost allocation within the company. In total Bertinelli incurred in 10.93 M€ total costs in 2016 (personal communication *Bertinelli*).

Table 7: Organizational costs overview divided per business activity

Activity	Long chain (€/year)	Case study (€/year)
Milk production	2.086,156.50	1,355,978.00
Processing cheese	629,953.50	1,825,206.00
Ripening cheese	336,836.60	4,169,940.35*
Specialized shop	204,600.00	
Other business activities		3,578,924.00
TOTAL	3,247,546.60	10,930,048.35

* Costs for purchasing products for the shop and other costs

The revenue of the average producer in 2015 was 2.4 M€/year. This value is compared with the almost 8 M€/year that the case study declared coming from the sales of the 14, 24, 30 and 36 months ripened Parmigiano in 2015. All the other collateral products and activities performed by this company carry a total 11.8 M€ revenue per year.

In conclusion, the average producer from the mainstream supply chain has a producing cost of 2.18 €/kg and can ask an average price of 8.15 €/kg, therefore has a marginal profit of 5.97 € per kilogram of product sold. The case study ask for an average price of 13.70 €/kg (just considering 14 and 24 month categories) but has higher producing costs of 6.25 €/kg, thus has a marginal profit of 7.45 €/kg on average, still 25% higher than the ordinary. From this it can be concluded that the efficiency of the case study is higher than the average from the mainstream chain. The short chain perform worst in production costs, but better in price and this leads to a higher marginal profit for the producer.

All the quantitative data described so far in chapter 5.1 are summarized in Table 8 hereafter.

Table 8: Comparison of efficiency economic performances

<i>Indicators</i>	<i>LFSC</i>		<i>SFSC</i>		<i>SFSC performances compared to LFSC</i>
		<i>year</i>		<i>year</i>	
Product price (€/kg)	12 months: 7.67	2015	15 months: 12.50	2016	63% higher price
	24 months: 8.83	2015	24 months: 14.90	2016	69% higher price
Organizational costs:	3.25 M €/year	2013	10.93 M€/year	2016	3.36 times higher cost
Cheese production costs	629,953.50 €/year	2011	1.82 M €/year	2016	2.89 times higher cost
COGS	2.18 €/kg	2011	6.25 €/kg	2016	2.87 times higher cost
Revenue	2.4 M€/year	2015	8 M€/year	2016	3.33 times higher revenue
Marginal profit	5.97 €/kg	2015	7.45 €/kg	2016	25% higher profit

5.2 Qualitative results

The short supply chain compared to the long one has a higher degree of flexibility: the manager of the case study company underlined as very important for the producer to have the opportunity to differentiate its offer, in order to base its business on a wider range of products and to be more independent from the market price fluctuations. This comes by reducing earnings variability by enlarging the product portfolio, which makes the firm more stable. This is the main reason that induced Bertinelli to create other product lines such as the Kosher Parmigiano Reggiano (first and only company to enter the Jewish market with a traditional PDO product), the “Millesimato” extra-quality Parmigiano, and the Organic Parmigiano that follows the most recent consumer trends in food markets. Also the Vegan lactose-free dairy products they produce, even if not properly part of the Parmigiano products, are still related with the same business strategy. It is important in the manager’s view to meet those new consumer needs, and to protect the company from possible market contractions, i.e. market scandals and changes in consumer preferences (personal communication *Bertinelli*). This idea however is absent in most of the mainstream PR producers, focused more on quantity than brand and product diversification (personal communication *Morini*). As also mentioned in chapter 3.3, the difficulty to reach an adequate level of product variety in shop is one of the reasons because farmers need a network when participating in SFSCs: farmers markets often benefit from the presence of different specialized farms to offer a complete and more attractive range of products to the final consumer (Verhaegen & Huylenbroeck, 2001).

The absence of pre-specified and standardized contracts with ripeners or wholesalers leaves more space to entrepreneurship and higher personal satisfaction. This has been another motivational aspect convincing

Bertinelli to start this business. This emotional aspect was expected, since already several authors observed the self-realization as a recurrent motivational force for actors of short supply chains and networks (Bertazzoli et al., 2010; Sini, 2009).

In line with what presented in chapter 3 one of the main difficulties present in short food chains is the product marketing (Verhaegen & Huylenbroeck, 2001). To develop an effective marketing strategy is necessary some knowledge and marketing attitude. This is the case of Bertinelli, but it is considered a rare exception (personal communication *Rama*). The data availability about market trends in the PR sector is wide, since the Consortium of Parmigiano is funding studies and publications from the Animal Production Research Center (CR.PA) and the Supply Chain Information System of Parmigiano Reggiano (S.I. P-R). However the actual farmers' business attitude is quite traditional and based on the intuition "the more I produce the more I gain". For this reason there is lack of interest from the producers' side in gaining a closer overview on the consumer trends, due to low knowledge and experience in marketing decisions. This leads to a high barrier that prevents producers from starting their own supply chain. Marketing investments and sales costs are other barriers (personal communication *Montanari*).

One last important aspect to mention in this supply chain assessment is the relational governance, so the quality of relationships among actors. The types of contracts that the producer could have with supplier and purchaser in the longer supply chain have already been described in chapter 2.2. In this mainstream chain usually there is no equal share of price risk between actors, retailers have larger market power over the producers, creating an oligopsony, and the information flow producer-consumer is blocked (personal communication *Bertinelli*). For the short chain the interviewed manager explained that skipping all actors' relations implies a longer ripening time, so it is a long time investment. However the consumer market he is addressing has lower price volatility than the wholesale market (personal communication *Bertinelli*). Moreover the direct control over raw materials' production ensures a higher final product quality, which is perceived and rewarded by consumers, also thanks to a careful marketing campaign. Advantages for producers skipping retailer's product requirements were also observed in the organic food sector by Bertazzoli, Ruggeri, & Samoggia (2010)

Table 9: Comparison of findings from the case study with the literature

Parameters	Case study	<i>From Literature</i>
Higher range of products	Reduction in earnings variability and protection from market contractions.	<i>Difficult to implement in a small-scale reality (Sini, 2009).</i>
No supply contract	More space to entrepreneurship and higher personal satisfaction.	<i>Higher managerial independence (Bertazzoli, Ruggeri, & Samoggia, 2010).</i>
Marketing	Stressing differentiation and brand awareness.	<i>Limited resources on farms for marketing and communication (Verhaegen & Huylbroeck, 2001).</i>
Relational governance	The absence of a pre-defined contract with suppliers permits a higher control on raw materials' quality.	<i>Advantages for producers skipping retailer's product requirements (Bertazzoli et al., 2010).</i>

6 - DISCUSSION, CONCLUSION AND RECOMMENDATIONS

In order to compare the economic performances of a Parmigiano cheese producer in a short and a long supply chain, this research has build up an answer in a structured way: (1) first it has been analyzed the contemporary knowledge on short supply chains in the food sector in order to build a scenario of possible comparable aspects between the two chains. Then (2) it has been researched the performance indicators available in literature to assess food supply chains. Finally (3) the conceptual framework obtained was used to collect useful data from the case study that permits to compare it to the mainstream chain outputs.

6.1 Discussion

The data and informations collected from the case study are in accordance with the literature scanned in chapter 3. The most important aspects mentioned in table 4 have been met. Indeed it is demonstrated that (1) the producer have the possibility to ask for a higher product price in the short chain respect to the long one, and can therefore gain higher margins, as mentioned by Ilbery and Maye (2005). (2) The information flow between producer and consumer is ensured by the Bertinelli's marketing campaigns (personal communication *Rama*), as it can be observed by the difference in premium price. This is also an aspect mentioned by Ilbery and Maye (2005). (3) The management attitude of the largest part of cheese processors still remains a great limit within this sector (personal communication *Morini*). This is a common pattern in many food sectors since it has been reported by many authors before (Bertazzoli at al., 2010; Knickel at al., 2008). From the case study (4) managerial independence has been mentioned explicitly as a main advantage, in accordance with the literature (Sini, 2009). Finally, (5) the possibility of a spreading trend that enhances more Parmesan cheese factories toward better economic results through a shortening of the chain is seen favourably from the Consortium point of view, because it can counteract the sector crisis mentioned in chapter 1 (from personal communication *Morini*). This means that a short supply chain model can effectively help the rural development of this area, in line with the trend found by Kneafsey et al. (2013) in the food sector.

One last aspect that is difficult to analyze in this research is the scale dimension of the processing plants. It was reported by Verhaegen & Huylenbroeck (2001) the possible difficulties to reach an efficient economy of scale, especially when investments in marketing are required. From the study results is shown that a relatively small producer as the case study has indeed to face higher costs. This can be caused partly by its special productions: the Kosher or organic Parmigiano are more expensive to produce (personal communication *Bertinelli*). In addition, the relation between production costs and quantities are not linear in this sector but more with a stair shape, because of the high fixed investment (i.e. copper kettles) required to

increase the production after the maximum production level is reached. For this reason, there are cases of small plants more cost efficient than big plants (personal communication *Montanari*).

In conclusion 5 over 6 points covered in literature are applicable in the studied sector, that means it has no unexpected behaviours or discrepancies from the short food supply chains reviewed. This comes strengthening the previous existing knowledge on SFSCs. However the outcomes from the case study remain bounded to the PR sector and its peculiarities. This means that the results from literature are applicable in this sector, but the sector's results are not necessarily true for all short chains.

For what concerns the selection of economic performance indicators, not all five described categories of metrics have been considered important or applicable in the Parmigiano SC. In particular responsiveness has been excluded for lack of informations, while the food quality dimension has been restricted to only the marketing component due to the product characteristic. After data research on the selected topics and interviews with sector experts, the research seems to cover all relevant aspects. It can be concluded that the metrics selected are sufficient for the study purposes. However larger data availability would permit a more complete analysis of the sector and the application of a larger number of dimensions.

Finally, the case study selection has been determined by willingness to collaborate. Few (<10) are the actors actually performing a full vertical integrated chain in Parmigiano, and among them the only interested in sharing data and time in this research was Bertinelli. He brought a nice business example, but with uncommon peculiarities (Kosher production, night-club business) that make more difficult a generalization of results for the whole PR sector.

6.2 Conclusion

The aim of this research is to compare the economic performances of a Parmigiano Reggiano producer within a short supply chain to the performances of a PR producer in the long supply chain. The study has answered to each of the three sub-questions in order to gain a final overview, therefore a concise answer will be given per each topic as follows:

Research question number 1 - What are the economic benefits and disadvantages of short supply chain models in the food sector?

From a short supply chain network the food producer gains: a higher portion of value added to its production, the advantages of a better information flow toward the final consumer, higher managerial independence, and an overall rural development of the area. However it has to take into account that the management of the supply chain on its own is challenging and requires skills and aptitude, and that often the efficient economy of scale is difficult to reach with its own production. This is one of the reasons which lead to combine the options of a long and a short supply chain within the same organization, or to use a network to cooperate with other farmers to develop and manage the short chain.

Research question number 2 - Which are the available economic performance indicators and metrics to assess the Parmigiano Reggiano supply chain?

The efficiency of the Parmigiano shorter supply chain is explicated by: the difference in product price from the two chains, the organizational costs and cost of goods sold, the earnings of the company (before interest and taxes) and the marginal profit per kilo of sold product. The flexibility measures that describe better the differences between the two chains are: the range of products sold by the producer, and the type of supply contracts he has both with the milk producer and the purchaser. The difference in food quality of the two SC products can be explained through a comparison of the marketing approaches. Finally, the relational governance of the producer with the other SC actors shows the quality of the network.

Research question number 3 - Do the long and the short supply chains perform differently with regard to the selected indicators?

The two chains perform differently under the selected indicators. The producer in the short chain obtained a product price 60% higher than the average, incurred in higher production and business costs, thus has marginal profit 25% higher than the average from the long chain. The flexibility and independence that the short supply chain ensures are the main reasons behind this positive outcome: a proactive entrepreneurial attitude not bounded to standard supply contracts can enlarge the range of products sold, bringing innovation even in a traditional conservative sector as Parmigiano Reggiano. Differentiation together with marketing and information flow can balance the higher personal investments and efforts implied in the choice of a short supply chain.

6.3 Recommendations for further research

This research topic can be further investigated with more data availability, either from the short and the long PR supply chain. This implies a higher involvement of the chain actors in the research and their willingness to share further sensible business data. A larger and more accurate data pool allows applying a higher number of performance metrics, therefore obtaining an analysis closer to the present situation. Would be interesting as well to distinguish more in details the critical factors of success that led the case study to a positive performance level, through a detailed analysis of cost voices and profit sources. An aspect that needs to be further analyzed in a time period is the PR price trends. It is interesting, but not possible with the data currently available, to measure the price volatility both at wholesaler and consumer level, their eventual correlation, and the trends for the case study product prices. This would give a further insight in the price risk that the choice of a SFSC model implies for a PR producer. Also, the collaboration with a higher number of case studies for the short supply chain model can strengthen the generalization of the conclusions with a statistically relevant sample.

Finally, the research focus could be extended from the lonely producer to also other actors of the supply chain, for a broader and more complete overview of the sector's chain, by conducting a similar study approach on broad scale and multiple different actors.

Acknowledgements

The author is grateful to Nicola Bertinelli and its administration team for their contribution to the field research.

Interviews

Personal communication *Bertinelli*: interview to Dr. Nicola Bertinelli, in Noceto (Parma) - Italy, the 29th November 2016 and subsequent communications.

Personal communication *Montanari*: interview to Dr. Claudio Montanari, in CR.PA. (Animal Production Research Center) Reggio Emilia - Italy, the 16th November 2016.

Personal communication *Morini*: call interviews to Iginio Morini, Press Office of Consortium of Parmigiano Reggiano cheese, the 4th and 18th November 2016.

Personal communication *Rama*: interview to Prof. Daniele Rama, in Università Cattolica del Sacro Cuore, Cremona - Italy, the 18th November 2016.

BIBLIOGRAPHY

Aiginger, K., & Finsinger, J. (2013). Applied industrial organization: towards a theory-based empirical industrial organization. *Springer science and business media* , p. 112.

Aramyan, L., Ondersteijn, C., Van Kooten, O., & Oude Lansink, A. (2006). Performance indicators in agri-food production chains. (C. Ondersteijn, J. Wijnands, R. Huirne, & O. Van Kooten, Eds.) *Quantifying the agri-food supply chain* , pp. 47-64.

Aramyan, L., Oude Lansink, A., Van Der Vorst, J., & Van Kooten, O. (2007). Performance measurement in agri-food supply chains: a case study. *Supply chain management: an international journal* , 12 (4), pp. 304-315.

Basile, N. D. (2008, Settembre 26). Parmigiano, la crisi peggiore. *Il Sole 24 Ore - Economia* , 26.

Bertazzoli, A., Ruggeri, A., & Samoggia, A. (2010). Short supply chain: analysis of the competitiveness of organic horticultural farmers at Italian regional level. *Proceedings of the 118th seminar of the EAAE: Rural development: governance, policy design and delivery*.

Berti, A., Canavari, M., & King, R. P. (2005). The supply chain for Parmigiano-Reggiano cheese in the United States. In G. L. Defrancesco E., *Food, agriculture and the environment. Economic issues* (pp. 117-133). Milan: Franco Angeli.

Bigliardi, B., & Bottani, E. (2010). Performance measurement in the food supply chain: a balanced scorecard approach. *Facilities* , 28 (5/6), pp. 249-260.

- Bimbo, F., Bonanno, A., Nardone, G., & Visecchia, R. (2015). The hidden benefits of short food supply chains: farmers' markets density and body mass index in Italy. *International food and agribusiness management review* , 18 (1), p. 1.
- Brester, G. (1999). Vertical integration of production agriculture into value-added niche markets: the case of Wheat Montana Farms & Bakery. *Review of agricultural economics* , 21 (1), pp. 276-285.
- Bullock, S. (2000). *The economic benefits of farmers' market*. Retrieved from Friends of The Earth: https://www.foe.co.uk/sites/default/files/downloads/farmers_markets.pdf
- Claro, D., Hagelaar, G., & Omta, O. (2003). The determinants of relational governance and performance: how to manage business relationships? *Industrial marketing management* , 32 (8), pp. 703-716.
- Commission Regulation (EU) No 794/2011 (2011, August 8). Bruxelles.
- Consortium Extraordinary Assembly. (2012, April 18). Statute of the Consortium of Parmigiano Reggiano Cheese. Reggio Emilia, Italy.
- Consortium of Parmigiano Reggiano Cheese. (2011, August 29). Production Regulation. Reggio Emilia, Italy.
- Corradini, E. (2014). Un'analisi dei costi di trasformazione. *I supplementi di Agricoltura* (56), pp. 27-28.
- Cortellazzi, M. (2015). *Innovazione di prodotto di mercato nel settore del Parmigiano Reggiano*. Università Cattolica del Sacro Cuore di Milano.
- CR.PA. (2016). *Relazione dell'attività 2015*. Consortium of Parmigiano Reggiano Cheese. Reggio Emilia.
- Dries, L., & Swinnen, J. F. (2004). Foreign direct investment, vertical integration, and local suppliers: evidence from the Polish dairy sector. *World development* , 32 (9), pp. 1525–1544.
- EEC Council. (1992). Reg. EEC n. 2081/92. *Official Journal of the European Communities* , pp. 1-8.
- Fattahi, F., Nookabadi, A., & Kadivar, M. (2013). A model for measuring the performance of the meat supply chain. *British food journal* , 115 (8), pp. 1090-1111.
- Fearne, A. (1998). The evolution of partnerships in the meat supply chain: insights from the British beef industry. *Supply chain management: an international journal* , 3 (4), pp. 214-231.
- Finanza e mercati*. (2017). Tratto da Il Sole 24 Ore: http://finanza-mercati.ilsole24ore.com/quotazioni.php?QUOTE=!GBPVS.FX&refresh_ce
- Giacomini, C. (2008). Il Parmigiano e le Regole del Marketing. *L'informatore agrario* (16), p. 7.

- Giansoldati, F. (2015, August 31). *Parmigiano in crisi: il Reggiano di montagna potrebbe sparire*. Tratto da Il Messaggero - section Finance and Economic:
http://economia.ilmessaggero.it/economia_e_finanza/parmigiano_crisi_reggiano_montagna/1541228.shtml#
- Grandi, A. (2003). The supply chain of Italian Parmigiano-Reggiano: an interpretative analysis of market dynamics. *New Medit* (1).
- Gunasekaran, A., Patel, C., & Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment. *International journal of operations and production management* , 21 (1/2), pp. 71-87.
- Hobbs, J. E. (1996). A transaction cost approach to supply chain management. *Supply chain management: an international journal* , 1 (2), pp. 15-27.
- Ilbery, B., & Maye, D. (2005). Alternative (shorter) food supply chains and specialist livestock products in the Scottish and English border. *Environment and planning* , 37 (5), pp. 823-844.
- Jongen, W. (2000). Food supply chains: from productivity toward quality. In R. Shewfelt, & B. Brückner, *Fruit and vegetable quality: an integrated view* (pp. 3-18). Lancaster: Crc press.
- King, R. P. (1992). Management and financing of vertical coordination in agriculture: an overview. *American journal of agricultural economics* , 75 (2), pp. 1217-1218.
- Kneafsey, M., Venn, L., Schmutz, U., Balazs, B., Trenchard, L., Eyden-Wood, T., et al. (2013). *Short food supply chains and local food systems in the EU. A state of play of their socio-economic characteristics*. European Commission report.
- Knickel, K., Zerger, C., Jahn, G., & Renting, H. (2008). Limiting and enabling factors of collective farmers' marketing initiatives: results of a comparative analysis of the situation and trends in 10 European countries. *Journal of hunger and environmental nutrition* , 3 (2-3), pp. 247-269.
- Lapide, L. (2000). *What about measuring supply chain performance?* Ascet: <http://lapide.ascet.com>
- Maciejczak, M. (2014). Process maturity of short food supply chains. *Journal of central european green innovation* , 2 (4).
- Manfredi, G. (2005). Per ogni distretto del latte un costo di produzione diverso - Indagine ISMEA-CR.PA. lungo tutta la penisola. *Supplement to L'Informatore Agrario* , 3, pp. 12-19.
- Marsden, T., Banks, J., & Bristow, G. (2000). Food supply chain approaches: exploring their role in rural development. *Sociologia ruralis* , 40 (4), pp. 424-438.
- Menghi, A. (2014). Per i produttori spese alte e ricavi bassi. *I supplementi di agricoltura* (56), pp. 24-26.

- Menghi, A., Corradini, E., & De Roest, K. (2015). Costi di produzione e di trasformazione del latte in Emilia-Romagna. *CR.PA. notizie* (1).
- Mighell, R. L., & Jones, L. A. (1963). *Vertical coordination in agriculture*.
- Montanari, C., & De Roest, K. (2013). *I cambiamenti strutturali dei caseifici del comprensorio del Parmigiano Reggiano (1993-2013)*. CRPA S.p.A.: Sistema Informativo filiera Parmigiano-Reggiano.
- Mortenson, W. (1958). Possible future trends of vertical integration in agriculture. *Journal of farm economics* , 40 (5), pp. 1860-1865.
- Musi, V., Rinaldi, L., & Torelli, F. (2008). *Studio di nuove modalità di commercializzazione del Parmigiano-Reggiano - vendita diretta sul mercato nazionale: potenzialità, barriere, strategie*. CR.PA. S.p.A.
- Northen, J. (2000). Quality attributes and quality cues: effective communication in the UK meat supply chain. *British food journal* , 102 (3), pp. 230-245.
- Osservatorio Agroalimentare. (2008). *Il sistema agroalimentare dell'Emilia Romagna, tavolarotonda, presentazione di 4 casi aziendali*. Osservatorio Agroalimentare, Unioncamere e Regione Emilia-Romagna. Bologna.
- Persichella, B. (2015, January 26). Aiuto, nessuno mangia più il Parmigiano, prezzi a picco, molti produttori a rischio. *Corriere di Bologna* .
- Pungchompoo, S., & Sopadang, A. (2015). Confirmation and evaluation of performance measurement model for the Thai frozen shrimp chain. *Business process management journal* , 21 (4), pp. 837-856.
- Renting, H., Marsden, T., & Banks, J. (2003). Understanding alternative food networks: exploring the role of short food supply chains in rural development. *Environment and planning A* , 35 (3), pp. 393-411.
- Sckokai, P., Soregaroli, C., & Moro, D. (2007). *Estimating market power by retailers in the Italian Parmigiano Reggiano and Grana Padano cheese market*.
- Sini, M. (2009). Attualità dell'interesse per la filiera corta. *Agriregionieuropa* , 5 (16).
- Sistema Informativo Filiera Parmigiano-Reggiano. (2013). *Quotazioni medie mensili Parmigiano-Reggiano minimo 12 mesi (da gennaio 2006 a maggio 2012) + costi di stagionatura*. CR.PA.. Reggio Emilia
- Van Der Spiegel, M., Luning, P., De Boer, W., Ziggers, G., & Jongen, W. (2004). Measuring effectiveness of food quality management. *Total quality management & business excellence* , 17 (6), pp. 691-708.

Van Der Vorst, J. (2005). Performance measurement in agri-food supply chain networks, an overview. In C. Ondersteijn, J. Wijnands, R. Huirne, & O. Van Kooten, *Quantifying the agri-food supply chain* (pp. 13-24). Dordrecht: Springer.

Vavřina, J., & Růžicková, K. (2012). Agricultural producer's groups in the Czech Republic: introductory review and discussion of the problem area economic performance measurement. *Acta universitatis agriculturae et silviculturae mendeliana brunensis*, 60 (7), pp. 441-450.

Verhaegen, I., & Huylenbroeck, G. (2001). Costs and benefits for farmers participating in innovative marketing channels for quality food products. *Journal of rural studies*, 17 (4), pp. 443-456.