The Dairy Supply Chain in Southern Brazil: Structure – Efficiency – Competitiveness

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Summary

The dairy sector in developing countries and emerging economies such as Brazil, Uruguay, Argentina, India, Colombia among others represents a very important source of income for small family farms. Promoting the competitiveness of processing companies and consequently a market access for the small-scale family farms is important for the economy and the society in such contexts, especially in a rural development setting. In Brazil the dairy sector corresponds to 5,8% of the total value share in national agricultural GDP and 15% of animal production (IBGE, 2017). It also generates around 4.7 million employments. In 2014 1.3 million farms produced 35.17 billion litters of milk making it the fourth largest producer in the world. The total production has been increasing by 84% in the last 15 years.

However, in Brazil, unlike other agricultural sectors that receive large incentives in technology investments, subsidized credit and governmental stocking composition support such as the soybean, meat and sugarcane for example, the dairy sector serves as a "shelter" for small-scale farms that are isolated from those high-tech and already highly concentrated value chains. As an example, 84% of the farms owned less than 50ha corresponding to 60% of the total production quantity and 45% produced less than 10 liters/day. The national productivity average is still under 2,000 liters/cow/day. Therefore, no serious competitive enhancement measures have been launched at national level regarding this supply chain so far. Moreover the low competitiveness of the national dairy industry can be largely attributed to the few investments and low professionalism in the chain, from farmers to processing companies.

The processing companies have been struggling since the 1990s, when a late process of modernization of the supply chain started, in which institutional changes were implemented such as trade liberalization, deregulation of prices, imposition of public and private standards and the creation of the sub-regional trade bloc Mercosur[1] (Chaddad and Jank, 2006). Those changes created a new environment where efficiency and innovation became the most important instruments of competition for retailers, processors, and farmers. In the same way, technological developments changed the distribution of fluid milk from small shops and bakeries to large supermarket retailers, whose relentless quest for cost cutting was passed on to the dairy processors (Escher,

[1] South American trade bloc established by the Treaty of Asunción in 1991 and Protocol of Ouro Preto in 1994. Its full members are Argentina, Brazil, Paraguay and Uruguay.

2011a). An intense competition has then started against the solid dairy industry of other countries (only for the internal market) resulting in the bankruptcy of the less competitive processing companies and consequently the exclusion of thousands of farms from the market.

Therefore this thesis proposes a deep analysis of the dairy sector in Southern Brazil in an attempt to answer the following questions: Why is the dairy sector, especially in the South, running behind the other sectors in the national agriculture in terms of competitiveness and modernization? What measures can be taken in order to upgrade it into a modern supply chain? How to do that while avoiding a high exclusion rate of farmers at the same time? The body of literature about these topics does not provide concrete answers to these issues, thus this thesis contributes to fill such gaps. It describes the organizational structures of the processing companies in the sector, especially the cooperatives, analyze the main determinants of their technical efficiencies and finally identifies the main restriction factors to competitiveness enhancement in Southern Brazil dairy supply chain, but also proposes a set of counterbalance strategies as levers for its competitiveness. It accomplishes such objective with the development of three essays on dairy processing companies in the region. The first essay brings a historical perspective on the evolution of the dairy cooperatives and their organizational structures in the 'Mesorregião Grande Fronteira do Mercosul (GFM)'. Cooperatives have been the base of the dairy sector since it became a formal sector in Brazil and today they still represent the main connection to the market for the majority of producers in Southern Brazil, therefore their importance in the supply chain is high. The GFM is the country's largest dairy production area and one of the most promising and dynamic dairy production areas in the world. This region has the highest concentration of dairy cooperatives of small and medium-sized producers in the country. Nevertheless, the traditional policies and practices of Brazilian cooperatives no longer align with market realities and the exclusion of less efficient cooperatives from the market affects many small family farms. This study about the development of dairy cooperatives located in the GFM aims to identify these cooperatives' vulnerabilities and potential improvements that can increase their competitiveness. Using Cook's (1995) life cycle approach, we describe the evolution of cooperatives in the dairy industry in this region. The results indicate the necessity of new designs for GFM dairy cooperatives' business models and strategies in order to disconnect them from government aid. Measures to enhance their market competitiveness are necessary to promote self-sufficiency in this growing sector and maintain family farms' continued existence.

Based on this contextualization of the historical challenges faced by the dairy sector in Southern Brazil, specifically by cooperatives, we move on to the second essay where we

measure the efficiency of processing companies in the state of Paraná in Southern Brazil. We use a set of factors identified in the previous study and in the literature as determinants of efficiency. Data from 243 milk processors including firm structure, management capacity, and organizational choice of dairies in Southern Brazil are analyzed. A production frontier is specified to estimate technical efficiency and identify its potential driving sources. An average efficiency of 77% indicates margin for a 23% increase in output, under ceteris paribus conditions. Economies of scale are also detected. The analysis reveals that the management capacity of companies is the main determinant of efficiency and that cooperatives are more efficient than investor owned firms. Idle capacities decrease the technical efficiency and should definitely be reduced. Based on the results, manifold managerial and political implications are derived.

After the identification of the determinants of (in)efficiency of processing companies, we close this dissertation with the third essay, where we conduct an in-depth case study to better understand the results from the previous essays. To check in the field whether they are still valid, and how companies are dealing with the main challenges. As mentioned above, different from other sectors in the Brazilian agriculture, the dairy industry is still immature regarding liberal markets competition, and today faces difficult challenges. Thus this study-case returns to the GFM in Southern Brazil, to identify the main factors affecting the competitiveness in the dairy supply chain. By interviewing the main supply chain leaders we gathered information on their perception about the difficulties that the companies face in their attempts to become more competitive and the successful strategies already implemented to do so. We also attempted to confirm and further understand the main results of the previous chapters. For instance we asked directly about idle capacities and their causes, professionalism in the whole chain, government supporting actions, coordination between producers and processors, among others. Among the main factors retarding the modernization of this supply chain we found: Missing professionalism, formal agreements, investments in marketing and research, technology, development and innovation, technical assistance, high transport and transaction costs, idle capacities and frauds. This study also presents different strategies already implemented by some actors to overcome such barriers. It closes proposing possible solutions to be the target of managers and authorities in a sustainable common project of development for the benefit of whole chain.

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The most powerful tool the humankind could have to progress is EDUCATION. Paulo Freire had once said: "*If education alone does not transform society, without it, neither does society change*". It transforms societies by changing people, and here is where I've found the purpose to continue my education through the doctoral studies. I hope my change would somehow contribute, even if in a very small share, to transform the society for the better, to progress.

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FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GFM	Grande Fronteira do Mercosul
IOF	Investor Owned Firm
LA	Latin America
LCC	Life Cycle of Cooperatives
MAPA	Ministry of Agriculture, Livestock, and Supply
Mercosul(r)	Southern Common Market
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
R&D	Research and Development
RTDI	Research, Technology, Development and Innovation
SIE	Estate Inspection Service
SIF	Federal Inspection Service
SIM	Municipal Inspection Service
SISBI-POA	Brazilian System of Animal Products Inspection
USD	United States Dollars

Chapter 1: General Introduction

1.1 Motivation and Problem Statement

A recent report of the Dairy Reporter draws attention to the fast growing Latin American (LA) dairy market. While companies look to Asia - and China in particular - to expand and provide a lucrative market for dairy products, there is another market that has continuously shown solid growth and opportunity. Latin America is a region where dairy companies have been able to introduce new products to an eager consumer base and capitalize on an established market. Despite being one of the fastest growing in the world, at US$60bn the LA dairy market accounts for less than 15% of global dairy sales. The economic downturn in several markets and a weak demand have been reflected on dairy sales, but the continued urbanization of LA cities (80% of LA citizens now live in urban areas) is pushing dairy forward.

In this context Brazil stands out, boasting a dynamic dairy sector, which offers significant opportunities for growth and development. Brazil is a traditional strong player in the global agri-food business scenario. It is therefore an important case to be analyzed due to the large consumer market and to comparative and competitive advantages regarding total production. From the demand side it counts on 207 million inhabitants, and US$ 1.8 trillion gross domestic product (GDP) in 2016 (US$ 2.62 in 2010). In recent years the internal demand for dairy products increased significantly with the growing purchasing power of Brazilian consumers since, in the last 10 years, middle-class consumers have grown from 38% to 56% of the population and today include more than 119 million people (IBGE, 2017).

From the supply side, the abundance of resources is remarkable, with 8.5 million km^2, nearly 19% of world's arable land is in Brazil (FAO and OECD, 2015), where only 10% is being used. Moreover, 19% of the planet's fresh water is in Brazil. With a wide range of latitudes and reasonably well-distributed rainfall throughout the year, the country is able to produce a wide range of products all year round. Consequently, agricultural production and productivity have large growth potential through the incorporation of new areas and technology adoption (Farina and Nunes, 2002). It is not surprising that this country has attracted a considerable amount of foreign direct

investment (FDI) to the food sector and especially to the dairy, in the last years. We can pinpoint the following items as being main factors in attracting foreign capital to Brazil: a) dimension of the Brazilian market; b) interest in making Brazil an export base to the Mercosur (and Latin American) trade partners; c) economic stability, unless until recent years; d) fiscal incentives; e) access to raw materials; f) low cost of labor (Farina e Viegas 2005).

The huge potential together with the right investments is translated into a high development of the country's agriculture. We can represent and exemplify the development of the Brazilian agriculture in the last decades by the growth rate of its Total Factor Productivity (TFP). From 1960 to 2000, Brazil's TFP growth rate was only surpassed by that of Australia, the United States and India. Brazil's TFP growth rate of 4.98% in the 2000-2008 period was the highest TFP growth for any country over any period (Bragagnolo et al., 2010). Gasques et al. (2008) show that the TFP growth in Brazil is driven by: changes in the agricultural products in Brazil in terms of greater diversity and added value; better access to rural credit, especially for improved access to new technologies and increases in scale; finally the increase of agricultural research has been another determinant of productivity gains. Mueller and Mueller, (2014) present three basic constituents of the expansion and modernization of agriculture in Brazil: a) the formation of an effective broad system of technological development; b) the expansion of an important class of professional, entrepreneurial, farmers; and c) the constitution and expansion of a dynamic agribusiness sector.

Despite the large potential, the amount of investments and the fast development of the agricultural sector in the country, the dairy supply chain is suffering a much slower process of improvements in productivity and modernization. Today the dairy sector runs far behind in terms of competitiveness compared to other sectors in the country's agriculture such as soybean, maize, pork, poultry, sugarcane and beef where the modernization started earlier and received many incentives (Helfand et al., 2015; Mueller and Mueller, 2014). This is also holds true in comparison to the dairy sector of neighboring countries, such as Argentina and Uruguay, and other countries with similar production systems and environmental conditions. The Brazilian dairy sector has not exploited its full potential so far.

Thus, as the production increases, raising 315% from 1980 to 2014, reaching 35bn liters, some of the sector's stress has been shifted to processors, who are now adjusting to a new reality by increasing their scale and professionalizing in order to become more competitive. The national dairy processing companies have been struggling since the 1990s, when a late process of supply chain modernization started, in which institutional changes were implemented such as trade liberalization, deregulation of prices, imposition of public and private quality and safety standards and the creation of the sub-regional trade bloc *Mercosur*. But even today, these processing companies are not able to supply the domestic demand with products of higher quality and quantity, even less to export. This is reflected in the trade balance, which is historically negative. For example in 2016 the dairy trade balance was negative while the country's exports from the whole agriculture and agro-food industries totaled over US$ 71 billion in 2016 (US$ 60 billion positive balance), accounting for more than 40% of total national exports (FAO and OECD, 2015; IBGE, 2017). Another unfavorable indicator is the decreasing share of processed products in these exports, declining from 69% in 2007 to 56% in 2016 (MDIC, 2016), representing a lower industrial intensification of added value products. Furthermore the low productivity of small producers and the poor infrastructure of rural areas in Brazil increases even more the costs per unit of output, especially for cooperatives who collect the milk of smaller producers in remote areas (Carvalho, 2008).

In this scenario stands out the Southern region of Brazil, currently the largest dairy production area in the country, having a well-established supply chain producing 36% of the national volumes (IBGE, 2017). The dairy production in this area is mostly based on small-scale family farms and cooperatives. The dairy production has an important social function for family farms in this area. It ensures a better income distribution in rural areas, guarantees a job for women, and provides a primary or secondary source of income for most farmers excluded from other sectors, such as pork and poultry for instance. In most cases, the dairy offers the best option for those families in view of the mountainous landscape predominance in several zones of Southern Brazil.

The large potential and the organization of the dairy supply chain have attracted the attention of large foreign processing companies in recent years, like Nestlé and Lactalis for example. Thus, an intense process of concentration

is taking place in this area. According to the last two agricultural census of IBGE of 2006 and 2017, (IBGE, 2006, 2017) 287,979 farmers produced milk as their primary or secondary source of income in the Southern region in 2017, a reduction of -30% from 2006, while the production raised +80% in the same period to reach 12bn liters of milk in 2017. In the processing level, a reduction of -15% of processing companies since 2006 is also noticed, with 383 companies collecting and processing milk in 2017.

From one side it means that only the most efficient and competitive remain and push the development of the entire sector. By the other side this means the exit of less efficient processors, not only cooperatives, but also Investor Owned Firms (IOFs), and the exclusion of farmers. That might be controversially problematic when we look at the several distinct profiles of producers. On one hand there are highly specialized producers with access to information, credit, and latest technology. On the other hand, there are the family farm that sees the dairy production an alternative, especially held by women, to obtain some extra income and survive in rural areas (Spers et al., 2013).

Therefore this also claims for distinct measures and policies to promote and guide the necessary structural changes, increasing competitiveness and contributing to future growth on firms that seek and compete for positioning in the market while avoiding further exclusion and unnecessary prejudices.

In view of this scenario, with the many opportunities waiting to be seized, but also the many hindrances to make them affordable, this thesis brings insights to facilitate this path and promote the progress of this dairy supply chain.

1.2 Processing Companies in Modern Supply Chains

According to the strategic management discipline, the emphasis on competitiveness and competitiveness measures must be placed on specific industries and industry segments rather than on countries because firms that compete in international markets instead of countries (Porter, 1990). Therefore in order to raise the dairy sector's competitiveness, the solution proposed in this thesis passes through the modernization of the dairy supply chain, especially via the enhancement of **processing companies' competitiveness**.

Several definitions of competitiveness have been put forward in the literature based on the different sources and indicators of competitiveness depending on the research objectives of each study (ex.: Cook and Bredahl, 1991; Feurer and Chaharbaghi, 1994; Kennedy et al., 1997), but little consensus exist. Porter provides a well-accepted and largely adopted definition of competitiveness: 'the ability to profitably create and deliver value through cost leadership or product differentiation (customer value)' (Porter, 1980). It was further extended including indicators of competitiveness: 'the sustained ability to profitably gain and maintain market share (Porter, 1985).

Since this thesis has a supply chain perspective, both cost leadership and the customer benefit approach are applicable. Downstream the product differentiation is essential for dairy companies achieve a competitive advantage, but since a large number of close substitutes exist in the markets where dairy companies operate, prices and costs must not be ignored. Companies' costs might also highly vary because of management shortcomings and inefficiencies on the processing plants. In Southern Brazil dairy supply chain, for example, they face a high competition for resources (milk purchase) and for sales of dairy products. Therefore the definition of competitiveness provided by Cook and Bredahl, (1991, p. 1472) seems more appropriated and it is adopted in this thesis. It is itself a further extension of Sharples and Milham, (1990), and also from Porter's. It is defined as the "ability to deliver goods and services at the time, place, and form sought by buyers at prices as good or better than other suppliers while earning at least the opportunity costs on resources employed" in an specific market.

Having this clear, this thesis proposes to understand the external and internal mechanisms refraining or boosting the capacity of processing companies to be competitive in a globalized agri-food chain, studying the case of the dairy supply chain in Southern Brazil.

The external mechanisms refer to those characteristics that may provide a more or less friendly environment to the companies, such as socioeconomic circumstances, market characteristics, customer structure, global cultural context, or any system of market interventions that could be implemented generating price distortions, i.e. the agribusiness environment, according to the contingency approach (Donaldson, 2001). On the other side, the internal factors could be the formal structure of the organization, the resources

available, the age and size of the company, management practices, degree of vertical or horizontal integration within the supply chain and network relationships. Also factors that firms can directly control, such as technical and allocative efficiency and technology adoption where firms should consider to make adjustments on its performance improving the productivity (Grant, 1991; Latruffe, 2010; Nivievskyi, 2009).

Also according to the Dairy Reporter, to become more competitive in global agri-food chains, it is necessary to focus on "sustainability, efficiency and product innovations as industry-specific challenges facing dairy processors, where dairy professionals should learn to reduce waste, cut costs and gain chain efficiency". And achieving this objective is important since processing companies are the guarantee of market access for farmers, and likely the only stakeholder in condition to countervail the bargaining power of retailers and ensure a fair distribution of the value created to farmers (Tybout, 2000). They may also be the main diffusor of technologies to farmers, and provider of inputs and access to higher value markets (Dries et al., 2009) or credit (Farina, 2002). Thus they are of importance as a modernizer agent for the supply chains and the reason of our choice as object of study. By the other side, the literature shows a mixed evidence of the modernization of the processing industry on both inclusion and exclusion of farmers in developing countries (Reardon et al., 2009) depending on their context, level of development, and opportunistic/altruistic behavior of the companies' leaders. However, despite the challenges they pose, when well governed, modern supply chains have the potential for important rural development (Gereffi et al., 2005).

Evidences from the study conducted by Dries et al., (2009) about the restructuring of the dairy supply chains in central and eastern European countries presents examples of such potential. It also reveals a clear path of restructuring steps put in place with the objective of modernization and globalization. They initiate by economical/institutional measures, where in the first moment governments promote higher degree of liberalization, creating an environment where direct competition is crucial for survival. Retailers and processing companies are the first to adapt or exit. Public and private standards are established. In the sequence, processing companies adopt measures of vertical integration in order to solve problems related to the

supply of raw materials. They establish contractual programs with farmers to provide them with technical assistance, inputs access, credits programs for investment, guarantees on bank loans, extension services, management advisory services, among others. These measures serve to upgrade milk quality and to secure their supplier base against losses to other dairies that do offer these valuable services. Furthermore these arrangements need well-established and 'business friendly' institutions that facilitate transactions (Brunetti et al., 1999), as is the case for enforcing contracts for example. We see a similar pattern between these restructuring steps in dairy supply chain of eastern European countries and the Brazilian case in the past years, although in Brazil the process is a more delayed.

However, previous experiences in the restructuring into modern globalized supply chains of other Brazilian agricultural sectors, such as pork and poultry in Southern Brazil for instance, revealed an intense exclusion of farmers in a first moment and a subsequent inclusion of the remaining farmers on higher value markets (Escher, 2011a; Ferrari et al., 2005). Most of those excluded farmers migrated to the dairy production and decided then to integrate and formed traditional cooperatives for milk collection and processing to overcome the power of buyers, controlling the processing chain link and the prices at this step (Chaddad, 2007a). And today, after a late initiative started only in the 1990's, these companies are also facing a process of modernization with all its "pros" and "cons".

The purpose of this thesis is to diminish the effect of those "cons", by proposing possible solutions on how to become a modern supply chain and include the higher number of producers at the same time. In this way diverting from previous experiences and proposing a new form of supply chain modernization. Thus, contributing to the best possible socioeconomic impact on the country.

1.3 Dairy Sector Profile in Brazil

The dairy sector corresponds to 5.8% of the total value share in Brazilian Agricultural GDP and 15% of animal production (IBGE, 2017). In 2017 Brazil produced 33.5 bn liters of milk making it the fourth largest producer in the world. The total production has been increasing by 84% in the last 15 years. This growth is enhanced by the increasing domestic demand. Furthermore,

there is still an important domestic market potential since the Brazilian population consumes only 168 kg of milk per capita/year, which is under the recommendation of FAO of 200 kg per capita/year (256 kg for children and 183 kg for adults) (FAO, 2012) and under the consumption of neighboring countries such as Argentina (216 kg) and Uruguay (242 kg) for example. According to the Brazilian Ministry of Agriculture (MAPA 2016), the predictions for the period from 2015 to 2025 show that the national consumption will increase by 23.6% and the production will rise by 25.6% being able to reach higher levels due the available technology that could be incorporated in the systems of production. This rise is also reflected in statistical key parameters of the Brazilian agribusiness: In the year 1996 there were 1.81 million farmers in Brazil involved in dairy production; thereof only 1.35 million remained in the activity by 2006 and 1.17 million in 2017, showing an exit rate of 35% among dairy producers within only 21 years (IBGE, 1996, 2006, 2017). Meanwhile the total production increased by 81% over the same period to 33.5 billion liters in 2017. The national herd increased until 2014, then decreased to remain the same, around 17.1 million heads in 2017. These figures highlight gains in scale and productivity at the country level. This is also indicated by sector statistics of the five largest producer states in Brazil (Mina Gerais, Rio Grande do Sul, Santa Catarina, Paraná and Goiás), which correspond to 71% of the total national production. Thereby, the productivity average of these regions together in 2014 was 1968 liters/cow/year (see figure 1) and, thus, higher than the country average with 1525 liters/cow/year (IBGE, 2016).

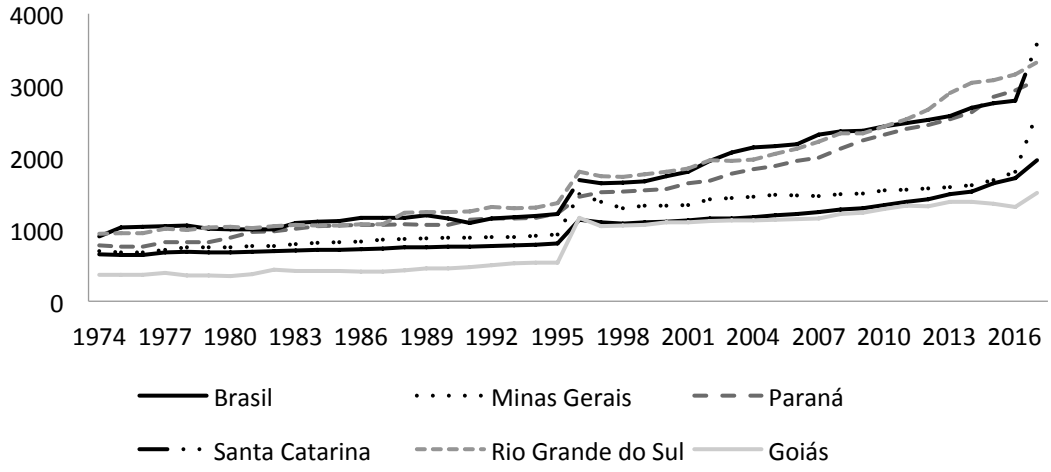

Figure 1-1: Productivity in liters/cow/year.
Source IBGE (2017)[2].

Only the state of Rio Grande do Sul reached the level of 3000 liters/cow/year in 2014 (IBGE, 2014), which was still very low in the international context. When comparing Brazil to countries such as the United States (9900 liters/cow/year), Germany (7300 liters/cow/year) and even New Zealand (4500 liters/cow/year) that have a similar production system, the Brazilian level is still very low (FAO, 2014). After 2014 the herd decreased to 17.1 million in 2017, while the productivity per cow increased by 29% (IBGE, 2017) led by Mina Gerais (62%) and Santa Catarina (33%), the most productive state in the country with 3,580 liters/cow/year. These recent developments highlight the structural changes taking place in Brazil and a higher technification of the production systems reflecting the efforts for efficiency and productivity gains.

Despite the recent improvements, the last agricultural census of the IBGE, (2006) presents parameters that shows the reality of the low competitiveness and technology adoption in the dairy production at that time. For instance 'mechanical milking' was present in only 2.4% of farms representing 22% of the milk collected. Artificial insemination was present in 1.4% of farms representing 14% of the milk. Only 0.1% of farms employed embryo transfers, representing 1.2% of the milk production. Finally, only 11% of farms had

[2] In 1996 a new agricultural census was conducted in the country, updating the real number of producing cows in the country, much less than estimated, explaining the sharp increase in the productivities in this specific year.

cooling tanks. Small farms predominate; 84% own less than 50ha corresponding to 60% of the total production quantity and 45% produced less than 10 liters/day.

This low technology adoption rates are also connected to low qualities of dairy outputs. In this regard, Brazil obtained the international sanitary certification to export to China only recently in the year 2015. In 2016 around 30% of the total milk production was self-consumed or traded in informal markets. The remaining 70% was processed by about 1,969 companies (IBGE, 2017).

1.4 Research Objectives and Outline

The objectives of this thesis are manifold. The main objective is to identify the factors refraining the evolution of the dairy supply chain in Southern Brazil, but also the possible levers to its development. The Brazilian market and economy opportunities has been attracting companies, national and multinational, normally specialized in the dairy sector to its production zones. Large multinational dairy processors are installing processing plants in the country, raising a process of pressure for efficiency gains of the local industry that must introduce measures of fast adaptation in order to remain in the market. A structural change is taking place where some companies exit, and others evolve and remain pushing a joint process of "exclusion/inclusion" of farmers. Therefore this thesis also searches for possible solutions to mitigate the exclusion of farmers from the sector via vertical integration measures, but always maintaining a path of inclusion of farmers in the high value markets opened by modern processing companies and retailers. In this regard, a special attention is dedicated to the cooperatives throughout this thesis, which play an important role in the dairy sector worldwide, especially for the inclusion of small farmers.

So the core questions are: Why is the dairy sector, especially in the South of the country, running behind other sectors in the national agriculture in terms of competitiveness and modernization? What measures can be considered in order to upgrade it into a modern supply chain? How to do that while avoiding a high exclusion rate of farmers at the same time? Those are the general questions guiding this research. The current body of literature examining these topics does not provide concrete answers to these issues, thus this thesis contributes to fill such gaps.

Therefore, three essays are developed to investigate such issues where three specific objectives are pursued:

1. The first is to understand and map the organizational structure of the dairy sector in Southern Brazil, the main producing area in the country. For that purpose, the first essay applies a life cycle analysis of the dairy sector to allow a deep perception of its organization and problems in an historical perspective focusing on the development of cooperatives in **chapter 2**.
2. After possessing such information, the second objective is to determine possible factors affecting the inefficiency of the processing companies in the area under analysis. Therefore in **chapter 3** a stochastic frontier analysis permits us to perform such evaluation and bring to the front possible factors influencing the efficiency of companies. It includes an efficiency comparison of cooperatives versus IOFs.
3. The third objective comes to test and possibly confirms the findings of the previous essays, but also to provide knowledge from an internal perspective about the causes of problems affecting competitiveness. It is also the case to identify the strategies activated by the stakeholders to overcome the problems. In this regard **chapter 4** presents a qualitative analysis of competitiveness, where leaders of the sector were asked what they consider relevant problems and possible strategies to enhance the competitiveness in the Brazilian dairy supply chain.

The thesis closes in **chapter 5** with some general conclusions, a summary of findings, policy implications and limitations and suggestions for future research.

Chapter 2: Organizational Structures and the Evolution of Dairy Cooperatives in Southern Brazil: A Life Cycle Analysis[3]

2.1 Introduction

More exigent consumers and more competition lead to changes in agri-food chains. The major change is the shift from production orientation to producers adopting a market focused strategy, driven by an increasing consumer demand for greater quality and a larger variety of products. However, some less efficient traditional cooperatives face difficulties in securing the necessary risk capital to invest in marketing strategies and risk being excluded from the market (Chaddad and Cook 2004). This issue is extremely relevant for dairy cooperatives and the small family farms associated with them in the Mesorregião Grande Fronteira do Mercosul (GFM).

GFM, located in southern Brazil[4], is the largest dairy production area in the country. Its production is based on family farms and cooperatives and, as the dairy sector becomes increasingly competitive, it is growing faster than in all the other regions in the country (Anschau, 2011). This growth is driven by increasing domestic demand for dairy products since, over the last 10 years, middle-class consumers have grown from 38% to 56% of the population and today account for more than 119 million people. Nevertheless, the aggressive process of industrial concentration in the hands of large investor-owned firms (IOFs), both national and multinational, put the fragile organization of regional cooperatives at risk. The possibility of market saturation and difficulties regarding export also threaten both the cooperatives in the GFM and the many small family farms linked to them for which dairy provides the main source of income (Medeiros and Padilha, 2015). The southern region of Brazil had 606,000 farmers actively involved in dairy in 1996; only 412,000 were still active in 2006—a decline of 32% (IBGE, 1996, 2006). However,

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[4] The South of Brazil comprises three states: Paraná, Santa Catarina and Rio Grande do Sul.

production increased by 28% over the same period. In Brazil, there are about 6.8 thousand cooperatives as compared with 6 million IOFs. Only 7% to 8% of Brazil's total national GDP is generated by these cooperatives, of which 90% are agricultural (OCB, 2012).

Despite its present importance, milk has always been a secondary source of income within GFM farms' business models whilst other products, like poultry, pork and cereals, have been the major crops since the mid-1950s (Escher, 2011b). Specialization in the latter sectors has led to investment in specific assets, vertical integration and, in consequence, the exclusion of many small farmers who entered dairy production in order to subsist (Ferrari et al., 2005). As a result, farmers formed dairy cooperatives to counter market failures hence following a defensive strategy against market risks. In this regard, dairy cooperatives in the GFM have played an important role in maintaining the survival of family farms since they, in contrast to other companies, provide an important service for small producers: the purchase and collection of products even in the most remote regions (Souza, 2014). However, since the mid-1990s, the dairy industry has been growing and has followed the same method of specialization and exclusion as other agribusiness sub-sectors. Despite the significant progress made with the organization of dairy cooperatives, less efficient traditional cooperatives face difficulties in obtaining the risk capital necessary to invest (Schubert and Niederle, 2011) and so increase competitiveness. This is due to the fact that some of the traditional policies and practices adopted by Brazilian cooperatives no longer seem to align with market realities (Chaddad, 2007a). Due to the great importance of cooperatives for the dairy sector, especially for small producers, their exit from the market could generate major financial problems for thousands of farmers and their families. However, the evolution of such cooperatives and their failure have never been analyzed historically and especially not by the means of a life cycle analysis, which places special attention on the internal and external issues that, over time, have changed these Brazilian institutions. This study also focuses on the evolution of the politico-economic scenario that has played a major role in the competitiveness, resilience and decline of dairy cooperatives in the GFM.

This study also analyzes in detail the historical development of GFM dairy cooperatives in order to identify the failures responsible for their poor

performance. Using the life cycle approach developed by Cook (1995) as a framework for qualitative analysis, it examines the influences on the cooperatives' competitiveness, of failures in their organizational dynamics and of the institutional, political, and economic environment. Therefore, instead of focusing on one single cooperative as proposed by Cook (1995), this study provides a descriptive application of the life cycle approach for the entire sector of dairy cooperatives in this specific region. The sector as the unit of analysis was tested successfully by Chaddad (2007b). However, in his study the approach was applied at the national level, drawing conclusions on the general future viability of farmer cooperatives in the agricultural sectors of a globalized world. In our case we concentrate on a specific dairy production zone in order to derive concrete management and policy implications for improving future competitiveness. These management implications are of great relevance for such interested parties as cooperatives' boards of directors. This study also contributes to the academic literature by further developing Cook's (1995) approach to cooperatives' life cycle analysis, testing it on a specific case and deriving an extension to the method. Furthermore, an examination of political implications should be of interest to political decision makers in Brazil, who hope to initiate institutional reforms providing special incentives such as support/consulting services and access to specific lines of credit for the dairy cooperatives in order to preserve family farms in the region under analysis.

The remainder of the chapter is organized as follows: Section 2 presents the conceptual framework and Section 3 provides insights into the GFM dairy sector followed by an outline of the methodology in Section 4 also with an overview of the national cooperative system's structure. Section 5 presents the results and in Section 6 we close with a discussion of the results and our conclusions.

2.2 Conceptual Framework

Based on former theories about the dynamics of a cooperative's evolution, Cook (1995) developed a five-step life cycle framework for cooperatives (LCC) (see table 1). His aim was to understand the evolution of U.S. agricultural cooperatives better and within the politico-economic scenario, which had played a major role regarding their competitiveness, resilience or decline. This

approach was further developed by Cook and Burress (2009) and has since been applied to cooperatives from various sectors in developing, transitional and industrialized countries. With regard to industrialized countries, (Whitman, 2011) described the LCC of a workers' cooperative in the United States in order to explore their motivation when starting the cooperative and learn about the stages of the cooperative's life cycle. This study also sought to identify possible problems that can be encountered or avoided at each stage in the cooperative life cycle. Terfloth, (2015) applied the LCC to understand the collapse of one of the largest and most influential consumer cooperatives in North America, the Berkeley Co-op. With regard to developing and transition countries, Chaddad (2007b) applied the LCC in his analysis of the Brazilian dairy industry, using the whole sector as the unit of analysis and not just one cooperative. Conclusions were then drawn on the future role of farmer cooperatives in an agricultural sector under the shadow of globalization. Wouterse and Francesconi, (2016) assessed the organizational health of 253 cooperatives in three African countries, showing that the cooperatives' state evolves according to a life cycle, as Cook (1995) had suggested. In a similar study, Francesconi and Ruben, (2008) assessed the collective marketing engagement of 200 cooperatives in Ethiopia. They compared cooperatives established by farmers as a voluntary initiative and those established by an external initiative (government or NGO). This study identified a different life cycle for each group. Cooperatives that grew from farmers' initiatives, having an economic justification for their establishment, proved to be more sustainable and able to readapt more easily during times of crisis. They followed the five stages of Cook's LCC. In contrast, cooperatives established by external initiatives more often formed, declined, and exited without showing the same LCC trend.

Ben-Ner, (1988) analyzed the life cycle of worker-owned firms in market economies by comparing sectors in different industrialized countries, starting from the premise that such firms are formed during periods of crisis in a countercyclical dynamic. He stated that adverse economic conditions increase the advantages of worker-owned firms by raising the cost of adversarial relations in IOFs. This leads to an increase in the worker-owned firm's formation activity. Governments and other organizations may also encourage and foster the formation of such firms if they realize that they can constitute

a comparatively inexpensive measure to combat unemployment. Changes in the environment, especially the regrowth of the economy and those firms' own growth, may gradually transform them into IOFs as they hire wage laborers and their members aspire to higher personal incomes in a firm reorganized as an IOF. However, this countercyclical pattern could also vary across countries and sectors. Pérotin, (2006) came to the same conclusion in her empirical article examining the determinants of entry and exit among IOFs and worker cooperatives in France, a country with a long tradition in cooperative forms of business. In this case the creation of cooperatives is related to the rise of unemployment, lowering the opportunity cost of creating a firm and raising income risks associated with employment in conventional firms. On the other hand, Staber, (1993) found, when measuring the founding and failure rates of worker cooperatives in Maritime Canada, that such firms enter and exit the market independent of changes in general economic conditions.

Our study builds on these previous studies by using the LCC approach and its five recurring steps as the underlying approach for the qualitative in-depth analysis.

The life cycle approach starts by identifying the economic justification for forming the cooperative. Cooperatives are formed mostly as a defensive strategy against market failure and price slumps induced by oversupply (Cook, 1995), in turn providing economic benefits to members due to their higher efficiency in comparison to IOFs (Hendrikse and Feng, 2013).

Table 2-1: Cook's Life Cycle approach

Stage	**Description**
1. Economic justification	Cooperatives are formed to protect the value of farmers' assets in situations of oversupply and/or market failure.
2. Organizational design	The institutional environment (e.g., incorporation statutes, tax laws) sets rules (and therefore costs) for cooperatives' formation and functioning that must be compensated for by the benefits of collective action to ensure the survival of the cooperatives.
3. Growth and consequences	The growth of cooperatives leads to increasing awareness of internal transaction costs, which include free-rider, portfolio, horizon, control, and influence-cost problems.

4. Crisis and recognition of conflicts	Challenges to management of cooperatives appear as a result of pressures from the competitive environment and internal transaction costs. Cooperative leaders are confronted with three strategic options: exit, minor changes to the traditional structure, and shift to a new model.
5. Restructuring	Cooperative leaders choose between strategic options, and a new life cycle begins.

Adapted from(Chaddad 2007b) and Cook (1995).

In the second stage, principles, rules and policies are developed defining the institutional framework for cooperatives' establishment and day-to-day operation. At this stage sector- and country-specific institutional environments influence the development of cooperatives and should be taken into consideration. This new environment generates costs that need to be compensated by the benefits of collective action through cooperatives in order to survive this stage of development economically (Chaddad 2007a). Cook (1995) argues that cooperatives created due to oversupply do not generally persist beyond this stage.

Cooperatives that survive the second stage enter into a growth phase (third stage). This growth leads to their being perceived as competitors by IOFs, which adapt to the cooperative competition by increasing their payments in order to ensure supply. On the other hand, cooperative members realize that the short-run costs of transacting with a cooperative are high. These transaction costs originate from the ownership structure of traditional cooperatives (Chaddad and Cook 2004). Cook (1995) describes them as the vaguely-defined property rights (VDPR) constraints, which include the free-rider, portfolio, horizon, control, and influence-cost problems.

The fourth stage is crisis and recognition of conflicts. At this point, cooperative leaders face difficulties in managing their cooperatives due to pressures from the competitive environment. As a result, in the fifth stage of the life cycle, managers must decide on one of the following three strategic options (Cook, 1995; Cook & Iliopoulos, 1998; (Iliopoulos and Cook, 2013):

Option 1: **Exit** through either liquidation or conversion into an IOF. Low performance cooperatives tend to liquidate or merge with other cooperatives, whilst high performance cooperatives tend to convert into IOFs. Mergers and acquisitions are included in this strategy.

Option 2: **Continue**. Undercapitalized cooperatives appear to choose one of two options at this stage: the first option is to seek outside equity capital without restructuring as an IOF. This is done through strategic alliances (with publicly held subsidiaries, joint ventures, or limited liability companies). The second option is to pursue a proportionality strategy of internally generated capital. In this case, financial responsibility is shared on a proportional basis (Cook and Iliopoulos, 1998), which results in policies and strategies such as base capital plans, proportional voting, narrowing product scopes, pooling on a business unit basis and capital acquisition on a business unit basis (Cook, 1995).

Option 3: **Shifting** to a New Generation Cooperative. This cooperative structure attempts to ameliorate the five VDPR issues. It is achieved by developing asset appreciation mechanisms, increasing share liquidity by creating delivery rights, base equity capital plans and membership policies to eliminate external free riders aligning residual rights of control with residual claims within the cooperative organization (Cook and Iliopoulos, 1998).

2.3 The Dairy Sector in "Mesorregião Grande Fronteira do Mercosul" (GFM)

In 2007, the Brazilian Ministry of National Integration proposed the establishment of 13 mesoregions based on historical, cultural, social, and political identity. These regions have similar institutions, social problems and economic dynamics, which have been used in the application of various development programs and policies.

One of these is the "Mesorregião Grande Fronteira do Mercosul" (GFM), which comprises 415 municipalities in northwestern Rio Grande do Sul (NW-RS), Western Santa Catarina (W-SC), and southwestern Paraná (SW-PR)—the three states that comprise the southern region of Brazil with 139,200 km² and 3.8 million inhabitants in total (Deves et al., 2008). Figure 1 shows the exact location of GFM in the respective states in southern Brazil.

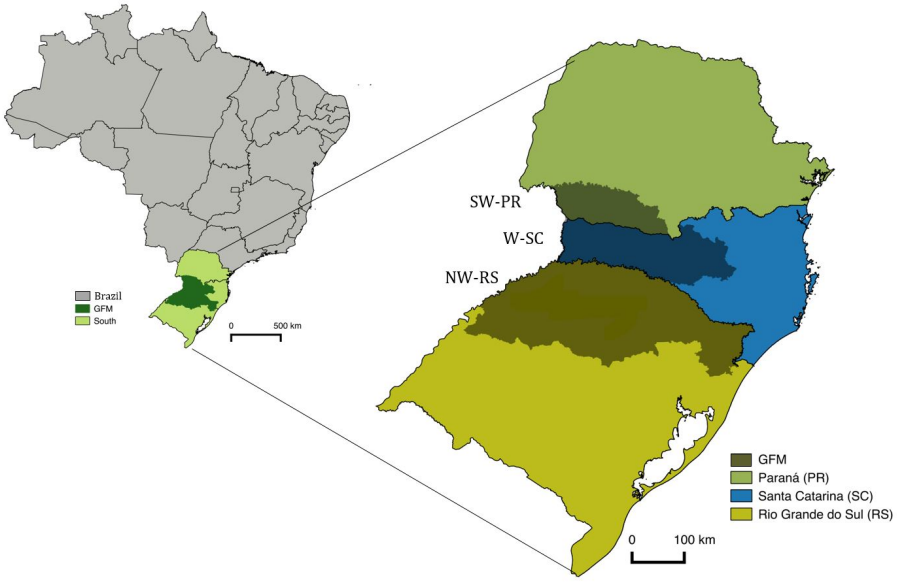

Figure 2-1: Map of Brazil with southern Brazil and GFM highlighted (left). The three states of southern Brazil and GFM shaded (right).

Source: Authors' elaboration based on data from IBGE (2014).

Nowadays, about 35% of the GFM population lives in rural areas, which is far above the countrywide average of 19%. Correspondingly, small-scale farms predominate since 40% of farmers own less than 10 ha. The GFM comprises one quarter of the total area of southern Brazil but accounts for only one tenth of its GDP, mainly through agricultural production and agroindustry. In this respect, the most relevant products are cereals, pork, poultry, beef and dairy cattle, fruit, yerba mate and tobacco. The region has recently experienced a process of economic restructuring in response to the impact of globalization (Mercosul, 2007). Dairy cows are present on nearly all family farms in southern Brazil. Until the 1910s they generally had a subsistence role for the families. Soya beans, pork, poultry and tobacco were traditionally the main sources of farm income. Large agribusiness companies generally dominate these sectors and the historical as well as the economic instabilities in them promoted the exclusion of many family farmers, creating anti-corporate sentiments among them. Cooperatives[5] already installed in the

[5] A cooperative is defined in the Brazilian Federal Law 5764 of 1971 as a society with its own form, legal status, and civil status, which is not subject to bankruptcy, which has been established to provide services to members, and which distinguishes itself from other companies by the following characteristics: (I) voluntary membership, with an unlimited number of members, unless its growth makes it technically impossible to provide services; (II)

region for other activities (soya bean, pork, poultry) adapted their plants to collect milk from farms in order to provide farmers with income and enable their continued existence in rural areas. More recently (since the 1970s) instability and displacement in the pork and poultry industries plus government incentives to reduce tobacco cropping have further enhanced the region's dairy sector (Escher, 2011b). Less concentrated and more competitive, dairy production has become an important business in the region. Many IOFs have been established and many new cooperatives have been created. The supply chain has become more structured and complex as production has increased.

The Brazilian milk production sector has experienced a rapid and significant growth since the 1990s mainly driven by the dairy sector in the GFM (see figure 2). In 1992, for instance, the Brazilian milk production accounted for only 15.8 billion liters. By 2006, production quantities had increased to 25.4 billion liters of which 13.3% was produced in the GFM. In this region 60% of the farms produced milk as their main or secondary product in 2006. That made a total of 182 thousand farms producing milk from 1.95 million cows in 371 municipalities (IBGE, 2017). According to the IBGE this milk generated US $396 million in total in the same year, representing 9.2% of agricultural GDP and 2.7% of the total GDP in the GFM, which corresponds to on average US $ 2000 per farm/year. In 2015, Brazil produced 35 billion liters of milk, of which GFM production alone accounted for roughly 18.5% (6.46 billion liters) collected by 420 companies.

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variability of the capital represented by shares; (III) limiting the number of shares of capital for each member, but allowing the establishment of proportionality criteria if doing so is more suitable for the achievement of social objectives; (IV) inaccessibility of the capital shares to third parties outside the society; (V) uniqueness of vote, while allowing central cooperatives, federations, and confederations of cooperatives, with the exception of those of credit activities, to opt for the principle of proportionality; (VI) quorum for the operation and resolution of the general assembly based on the number of members and not on capital; (VII) return of the net profits of the year in proportion to the operations carried out by the member, unless otherwise decided by the general assembly; (VIII) indivisibility of financial reserve and of technical assistance, educational, and social reserves; (IX) political neutrality and religious, social, and racial nondiscrimination; (X) provision of assistance to members, and, when determined in the statutes, to employees of the cooperative; (XI) associates' admission area limited to facilities for meeting, control, operations, and services.

Marketing companies, generally IOFs, which are experienced competitors on the commercialization side, are operating in the prominent GFM area and competing on the production side as well. Growth in production, movement towards concentration and professionalization along the entire value chain are increasing competitive pressure in the sector. Cooperatives, which are highly dependent on good market prices for spot milk and government support, are having serious problems maintaining sustainable activity. They are also not acting fast enough to adapt to this competitive environment.

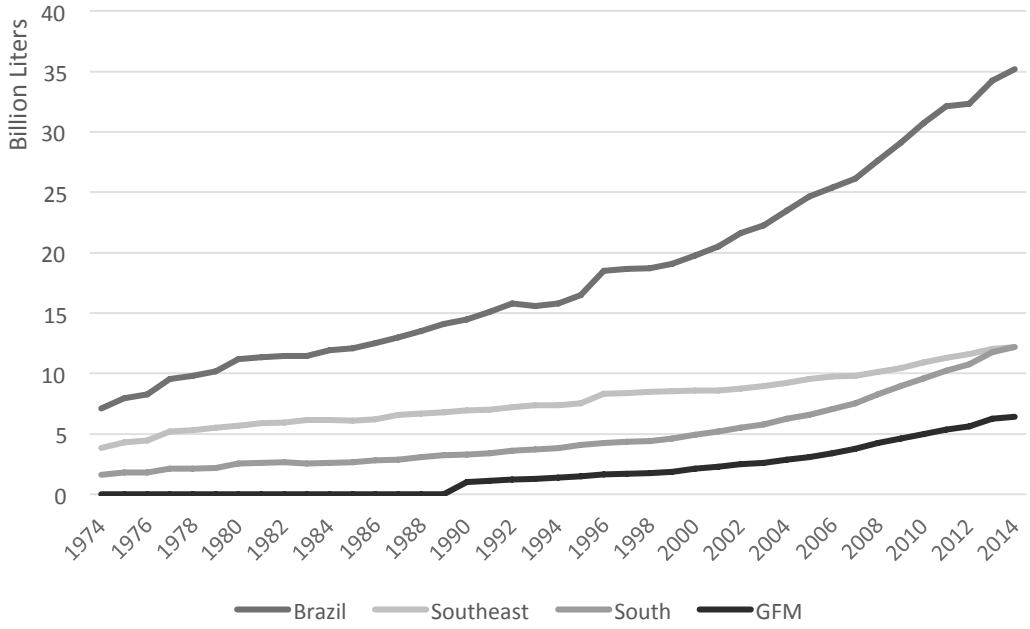


Figure 2-2: Milk production (in billions of liters).
Source: Authors' elaboration based on data from IBGE (2014).

In this article we investigate the historical development of GFM dairy cooperatives and identify the main failures responsible for their current poor performance. We also show how Cook's life cycle approach (1995) lays out the creation and development of the cooperatives and provides a deeper understanding of the dynamics in GFM dairy cooperatives.

2.4 Methodology

2.4.1 Data Sources and Analysis

The five stages explained in Chapter 2 are taken into consideration in the following analysis based on a literature review, the analysis of secondary data

and expert interviews. The secondary data was mainly gathered from three types of sources: firstly from the Brazilian Institute of Geography and Statistics (IBGE) which performed the agricultural census in 2006, secondly from dairy company reports. Finally it was also obtained from the dairy cooperatives' census performed by the "Organization of Brazilian Cooperatives", "Confederation of Dairy Brazilian Cooperatives", "Brazilian Agricultural Research Corporation – Dairy" and "Center for Advanced Studies in Applied Economics – Esalq/USP" in 2002 and reported on by Martins et al. in 2004. The agricultural census is conducted by the IBGE in 10-years cycles, the last two in the years 2006 and 2016. Since the data from the 2016 census is not available yet, data on the dairy sector from the 2006 census is used in this study in addition to data from dairy processors collected on a quarterly base by the same institute. IBGE's secondary data includes total milk production, productivity, number of farmers and processing companies, processing capacity and the geographic area of production and milk collection. The national census of dairy cooperatives completed in 2002 is the first, and up to now the only, national database registering the characteristics of the dairy cooperative system. Data from the follow - up census conducted in 2015 is still only available as a summary of selected parameters (Martins et al. 2004; BRASIL 2015). However, economic performance indicators on the company/cooperative - level are rarely available. A more detailed analysis based on such indicators, as recommended by Aramyan et al., (2006) including indicators of the four categories, "efficiency", "flexibility", "responsiveness" and "food quality", cannot be taken into account in this analysis. Additionally, little data has been found on previous and subsequent years. To close these gaps, 32 additional semi-structured interviews were conducted in 2015/16. These were with managers and directors of dairy cooperatives, with IOFs located in the GFM, also with directors of research and extension institutions, representatives from the Ministry of Agriculture, syndicates/unions and associations Table 2 represents an overview of the companies and organizations interviewed.

Table 2-2: Experts and institutes interviewed

Expert number	**Institute/Company**	**Size**[6]
01	Cooperative	Large
02	Cooperative	Small
03	Cooperative	Large
04	Cooperative	Large
05	Cooperative	Large
06	Cooperative	Medium
07	Cooperative	Large
08	Cooperative	Large
09	IOF	Large
10	IOF	Large
11	IOF	Large
12	IOF	Small
13	IOF	Large
14	IOF	Large
15	IOF	Large
16	Cooperatives Organization	
17	Cooperatives Organization	
18	Cooperatives Organization	
19	Cooperatives Organization	
20	Dairy Alliance	
21	Dairy Alliance	
22	Dairy industry union	
23	Dairy industry union	
24	Development Institute	
25	Farmer	
26	Farmer	
27	Research and Extension Institute	
28	Research and Extension Institute	
29	State Agricultural Secretary	
30	State Agricultural Secretary	
31	State Dairy institute	
32	Technical Assistance Institute	

The questions varied according to the company/organization interviewed. We asked questions in various categories, which included government support

[6] The different sizes are explained in section 4.2

(strategies for dealing with periods of crisis and/or declining government support; barriers to implementation of solutions), the evolution of the sector (difficulties in competing in the sector; expected solutions to sector problems; market trends and frauds) and information about a specific cooperative/IOF (volumes processed; management strategies; general problems faced to compete; competition against IOFs/cooperatives;) as relevant. The analysis of the interviews followed a systematic descriptive approach. The information and data gathered is used below to enhance and complement information from the literature review and secondary data in order to provide details about the above mentioned five stages life cycle analysis. However, a structured content analysis, as proposed by (Mayring, 2014), could not be applied during our analysis due to the heterogeneity of experts and the corresponding variety of interview foci regarding time periods and content aspects.

2.4.2 Description of the Case "Brazilian Dairy Cooperative System"

The information contained in this subsection was obtained from the two national censuses of dairy cooperatives. The first took place in 2002 and was compiled by Martins et al. (2004) and the second was in 2015 for which only a limited subset of data is as yet available in a summary (BRASIL, 2015). In 2002, central and singular[7] cooperatives in Brazil were responsible for 40% (5.3 billion liters) of the total milk collected in whole Brazil , whilst 36% was collected in the country's southern region[8]. This amount had generated total revenue in the whole country of US$ 1.82 billion in 2002 (RS$ 4.91 billion in 2002 or RS$ 0.93 per liter). Across Brazil 4.4% was collected by 97 small scale cooperatives accounting for less than 19.5 thousand l/day each. 11.8% was collected by 93 medium scale cooperatives accounting for 19.5 to 55.5 thousand l/day and 83.8% by 98 large scale cooperatives accounting for more

[7] The major system in Brazil is the central-singular scheme. Singular cooperatives are members of a central cooperative, where the firsts collect the milk from farmers and deliver/sell most of their products to the second (or other IOFs depending on their exclusivity contract with the central cooperative), which are mainly responsible for processing and commercializing. This scheme contrasts to the centralized scheme where farmers deliver directly to the cooperative responsible for processing and commercialization reducing one transaction.

[8] The remaining shares were collected by the IOFs.

than 55.5 thousand l/day (see Table 3). This distribution demonstrates the large variety of cooperatives with different scales of industrial processing, making it difficult to establish and promote brands as well as to compete in markets outside their region of origin. Their unit costs for milk collection, processing and commercialization also vary greatly due to differing economies of scale depending on company size (Becker et al., 2007; Belloin, 1988; Dalton et al., 2002).

When looking closer at the major relational scheme of the cooperatives in the data from 2002, especially at the main role of singular cooperatives in collecting without processing, we observe that singular cooperatives collected 53.8% of the milk across the country, compared to only 44.6% in the South. In Brazil around 41% of the milk collected by the singular cooperatives was sold / transferred to central ones. Additional quantities are sold to, for example, IOFs. The share of milk resold unprocessed is much higher for smaller singular cooperatives than for the larger ones. Among singular cooperatives collecting less than 19.5 thousand l/day, 91% was sold/transferred to central cooperatives indicating their reduced capacity for marketing and commercialization. Cooperatives collecting more than 55.5 thousand l/day transfer only 35% to central cooperatives, representing deeper participation in the market via commercialization.

The Brazilian raw-milk market in 2002 was largely controlled by cooperatives, given that there were no or only very few IOFs collecting milk and reselling it without processing. In this regard, 41% of the milk collected by the cooperative system is sold to other cooperatives or other companies, defining the scope of the raw-milk market in Brazil. From the total milk collected by the cooperatives only 44.2% is industrialized, thereof 49.4% by larger cooperatives. Cooperatives that industrialize less than 1/3 of their milk earned a gross revenue of about US$ 0.17 per liter while those industrializing more than 2/3 of their supplies received about US$ 0.34 per liter. Unfortunately processing costs are not available. They would otherwise allow for a better overview and comparison. Nevertheless, these numbers may represent higher revenue generated through value adding, allied with improved milk industrialization combined with better commercialization of processed products by larger cooperatives. It also highlights the importance of economies

of scale in the dairy sector (Boysen and Schröder, 2005; Mosheim and Lovell, 2009).

The summary from the second national census of dairy cooperatives shows that the shares of total milk collected by Brazilian central and singular cooperatives have shifted in favor of the southern region (46.5%) in relation to Brazil as a whole (35.5%) despite an increase in total volumes (8.54 billion liters) (BRASIL 2017). However, these procurement and capacity shifts were accompanied by very low capacity utilization rates in the cooperatives in 2015. Their installed processing capacity was reported as a total of 28 million liters/day with 47% idle capacity for whole Brazil. In the southern region the capacity represents 14.1 million liters/day with 41% of idle capacity. The total revenue of dairy cooperatives in Brazil is listed as around US$ 2.3 billion (RS$ 7.4 billion in 2015 or RS$ 0.87 per liter), 38% from UHT milk, 15% from powder-milk and 12% from pasteurized milk. Less value was added per liter of milk compared to 2002. Cheeses and dairy drinks account for less than 16% of the total revenue, evidence of a low share of value-added products in their product – portfolios (BRASIL 2017).

Table 2-3: Characteristics of the dairy cooperatives

	Characteristics	**Small (less than 19.500 l/day)**	**Medium (between 19.500 and 55.500 l/day)**	**Large (more than 55.500 l/day)**	**Total**
Brazil	Quantity of cooperatives	97 (33,7%)	93 (32,2%)	98 (34%)	288
	Milk collected in Million l/day	231 (4,4%)	620 (11,8%)	4.403 (83,8%)	5.254
	Members	14.682 (9,7%)	34.374 (22,8%)	101.855 (67,5%)	150.912
	Average milk collected by each member in l/day	43	49	118	95
	Milk industrialized	17,7%	26,0%	49,4%	
South	Members	4.518 (5,7%)	13.748 (17,2%)	61.623 (77,1%)	79.891
	Milk collected in Million l/day	63,1 (3,3%)	170,1 (8,9%)	1679,8 (89,9%)	1.911

Source: (Martins et al., 2004).

The Brazilian dairy cooperative system accounted for 151 thousand members in 2002. Of those 9.7% belonged to cooperatives collecting less than 19.5 thousand l/day, 22.8% were associated to cooperatives collecting between 19.5 and 55.5 thousand l/day, while 67.5% were members of cooperatives collecting more than 55,5 thousand l/day. The average milk quantity collected per farmer was 43 l/day, 49 l/day and 108 l/day respectively. The average over the whole cooperative system was 95 l/day, which is a very small number when compared to other countries like Argentina, Uruguay, Germany, USA and France(OECD, 2015). It also indicates the level of professionalization of farms and farmers, given that such a small production makes investment in high-tech inputs unaffordable. This also leads to low adoption rates of new technologies due to limited capacity of investment. The southern region of Brazil concentrates more than half of the national cooperative members (52.9%), but 78% of those are associated with cooperatives collecting more than 55.5 thousand l/day. This picture highlights the importance of the cooperative system in the dairy sector for the country and especially for the southern region.

Producers delivering less than 100 l/day represent 60.5% of all cooperative members in the country (but only 16.9% of the milk produced). 16.8% deliver between 100 and 200 l/day (representing 14.5% of the milk), 10.9% deliver 200 to 500 l/day (representing 18.7% of the milk) and only 5% deliver 500 to 1000 l/day (representing 13.4% of the milk). More than 1000 l/day were delivered by 6.8% of the farms but they account for 36.5% of the total milk produced. These percentages show the typical characteristics of small farms in the Brazilian dairy sector and represent the cooperatives' social role as sole operators in the sector collecting the milk of those farmers even when long distances make it unprofitable.

2.5 Results: The Life Cycle of GFM's Cooperatives

Dairy production in southern Brazil emerged with European colonization in the 19th century. This cultural aspect played a major role for the development of the dairy sector since the immigrants preferred to produce their own fresh milk rather than consume powder milk from the large dairy

industries already existing in the southeast of Brazil (Minas Gerais and Sao Paulo). This production was initially organized as vacarias[9] around a huge number of small cities spread throughout the territory and became a distinctive characteristic of southern Brazil. This greatly influenced the regional character of the dairy industry with its purpose of supplying the growing local market. The growth of urban areas in the first half of the 20th century and developments in milk-processing techniques allowed the displacement of milk production zones. Consequently, after the 1910s, IOFs as well as singular dairy cooperatives were formed in these emerging milk zones in southern Brazil (Souza, 2014). However, in the GFM, a traditional rural area, the focus remained on other products, such as cereals, pork, and poultry, which were also organized in cooperatives; these businesses remained more important and developed at that time. Dairy production did not play an important economic role until the 1960s even though it was always present among small family farms, which may be viewed as the incipiency of dairy cooperatives in the GFM (Escher, 2011a). The five stages of their life cycles, which partially overlap on a historical timeline (due to the entire sector consisting of numerous cooperatives with different timings as the unit of analysis) are described in detail below.

2.5.1 First Stage: Economic Justification

Dairy production in southern Brazil has always been linked to land dynamics and arose in the GFM as an alternative source of income adopted by small farmers who were excluded from other sectors. To better understand those dynamics, we developed a timeline of expansion of the dairy production that started in NW-RS and moved northward to W-SC and then SW-PR (see map in figure 1).

In the NW-RS region during the 1940s and 1950s, wheat and soya beans were the main crops and economic priorities for farmers. Infrastructure development in transport intensified the production of these products and changed farmers' focus towards export orientation. These changes demanded increases in scale and, thus, a concentration on large farms and an exclusion

[9] The *vacarias* were establishments (farms) specialized in production, purchase and sales of milk, located around the villages. They were the first commercial form of milk supply to urban centers in Southern Brazil.

of many small farms, which then had to find alternatives for their milk production. These excluded farmers started to form cooperatives and to reorganize the GFM dairy supply chain structure based on their experiences in the grain sector. They formed dairy cooperatives to supply inputs at affordable prices, provided services lacking at the time (such as credit and technical assistance) and countervail the market power of buyers or facilitate access to urban markets. In other words, these singular local cooperatives were formed for defensive purposes as they attempted to protect margins and wealth at the farm level (Magalhães, 2007).

The government made an important contribution to the development of the cooperatives at that time by implementing a plan of modernization and industrialization of agriculture throughout the country. The promotion of cooperatives was the main instrument deployed by the government to achieve its goals. Government institutions were established to support dairy farmers' cooperation and subsidized loans were offered to dairy cooperatives. In this top-down plan, cooperatives became highly dependent on state programs and national policies (Medeiros and Padilha, 2015). In consequence, a significant number of small singular dairy cooperatives were founded in the NW-RS region of the GFM. Additionally and promoted by farmers, cooperatives specializing in other agricultural products adapted their plants or even converted completely to dairy in order to collect milk from small farms and increase their incomes. A similar dynamic happened a few years later in the W-SC and SW-PR regions among farmers excluded from pork and poultry sectors (institutional historic it's possible to find the foundation dates).

2.5.2 Second Stage: Organizational Design

From the mid-1960s to the late 1980s, the development of dairy cooperatives was significantly affected by interference from the federal government, which monitored and controlled cooperative arrangements through direct intervention and by regulating the dairy market. In 1971[10], Law 5764 was enacted, which established the institutional framework that still regulates the Brazilian cooperative system today. This law defined the legal status of

[10] The Brazilian government first recognized and allowed the organization of agricultural cooperatives in 1903; however, rules concerning the organizational characteristics of cooperatives were established in 1932 with the Rochdale principles of cooperation.

cooperatives, rules for their formation and function, their representation system and support agencies.

Quality and sanitary standards for milk and dairy products were introduced in the mid-1960s. The Federal Inspection System (SIF) stamp, a sanitary surveillance compliance stamp, became mandatory in 1976. Compliance with the sanitary requirements in order to acquire this stamp was too expensive for many cooperatives, especially small ones. Consequently, "…this system promoted the foundation of large central cooperatives…[11]" (Expert 18) and "…at the same time it forced many small dairies to exit the market" (Expert 17). These facts are also similarly expressed by Expert 23.

Additionally, from 1945 to 1991, the government set guaranteed minimum prices for milk producers and maximum consumer prices for liquid milk (Carvalho 2008) as well as commercialization and processing margins. Furthermore, milk producers and dairy cooperatives received large volumes of subsidized short and long-term loans from federal rural credit systems (Chaddad and Jank 2006).

2.5.3 Third Stage: Growth and Consequences

During the 1970s, the Brazilian Government introduced measures to foster the adoption of new processing technologies and the professionalization of cooperatives. Thus, in the late 1970s, central cooperatives were formed to reorganize the singular cooperatives, increase their bargaining power and add value to the raw milk produced by small farms in rural areas in order to compete with IOFs in the large urban centers. However, these central cooperatives remained dependent on government programs supporting them with subsidized loans and fixed prices (Chaddad and Jank 2006).

In 1976, farmers pressured the Rio Grande do Sul Federation of Wheat and Soybean (FECOTRIGO) to create the central Cooperativa Central Gaúcha de Leite (CCGL) in the NW-RS region (Carvalho 2012) (see Figure 3 for timeline details). In 1970, the Companhia Riograndense de Laticínios e Correlatos (CORLAC) was founded in Rio Grande do Sul. Extremely important to small farmers, CORLAC was owned by the state and counted on 6,000 farmers and

[11] The authors translated the sentences under quotations from the interviews.

22 processing plants. Two decades later, in 1993, it was transformed into the central cooperative COORLAC (de Souza and Waquil 2008).

Many families that could not remain in the NW-RS region migrated to W-SC or to SW-PR, where pork and poultry production was growing and consolidated as farmers' main economic activities during the 1960s and 1970s. However, from the early 1980s the rapid growth of these industries led to the formal integration, exclusion and concentration of family pork and poultry producers who could not afford the high investments required. As a consequence, more than 52,000 farms were excluded from pork activities (Ferrari et al., 2005). These farms then also entered dairy production and a second generation of singular cooperatives was founded. The central cooperative AURORA[12], a large marketing cooperative of the meat industry in W-SC, adapted to collecting milk from these singular cooperatives. The Cooperativa Central Catarinense de Laticínios (CCCL) also experienced rapid growth based on the littoral of Santa Catarina, where dairy production was concentrated at that time. A little later it expanded its coverage area to W-SC by acquiring a processing plant in 1991 and consolidated as the main dairy industry in Santa Catarina (Souza, 2009).

In SW-PR the Cooperativa Central Agropecuária Sudoeste Ltda. (SUDCOOP), established in 1977 for processing pork, began processing milk in the early 1980s after acquiring three dairy processing plants in the region (Escher, 2011b) and commercialized through its brand Frimesa. Just after that, it transferred its company headquarters to the West of PR, where its activities were concentrated. The Cooperativa Agropecuaria Guarany Ltda. (CAPEG) was the second dairy cooperative created in the SW-PR region. The central AURORA also collected milk from singular cooperatives present in this area (Escher, 2011a). Both SUDCOOP and AURORA had their main businesses in the pork and poultry sectors. They invested in the dairy sector after pressure generated by the concentration of poultry and pork activities.

Between the late 1970s and the early 1980s, the entire dairy industry experienced a boom in the GFM. The conversion of farms to dairy production, a positive institutional environment for cooperatives, growth in the number of

[12] AURORA is a large marketing cooperative in the meat industry, with strong brands, lengthy experience in the market, and large distribution channels.

consumers in urban centers, the creation of cooling stations to collect the milk and improvements in road infrastructure boosted the sector in this region. Leading companies invested in the expansion of the collection network and the construction of cooling stations, going beyond the industry's initial area of operation and, in several cases, beyond state borders. Many small cooperatives were formed or adapted to collecting milk in the most remote areas, creating a large collection and distribution network. They benefited from output growth due to their proximity to members and the capillarity of their milk collection systems (Jank, Farina, & Bertini Galan, 1999) and had an important role in ensuring market access for farm production. Central cooperatives were also successful. At that time, CCGL with its brand ELEGÊ, formed by 35 singular cooperatives was responsible for 60% of milk procurement in Rio Grande do Sul. Over the same period, CCCL procured about 50% of the milk in Santa Catarina under the brand DO VALE. In the SW-PR region, SUDCOOP and CAPEG were also responsible for the majority of milk procurement.

Since that time, dairy production has become the main economic activity sustaining local family farms in GFM, involving almost all the farms in the territory. The entire supply chain has been organized and sustained by cooperatives (Ferrari et al., 2005). This growth is also linked to crises in other sectors that excluded many farmers. As a result, the growth of the dairy sector as a whole and of the cooperatives in particular has been faced with increasing difficulties with regard to performance.

2.5.4 Fourth Stage: Crisis and Recognition of Conflicts

Despite their rapid growth during the 3rd stage, GFM dairy cooperatives remained highly dependent on governmental paternalism. They were not exposed to market prices and competition, which undermined the natural development of their capacity and stimulus to compete. Additionally, "…huge unplanned investments were also made with subsidized loans creating idle capacities in cooperatives" (Expert 16). In the 1980s, after a national debt crisis and political change in Brazil, liberalization and market-oriented policies started being implemented. The Brazilian government reduced credit and subsidies for farmers and cooperatives until the dairy market was completely deregulated in 1991. The constitution of 1988 abolished the government's rights to interfere in cooperatives' arrangements. Thus, from late 1980s and

early 1990s, the politico-economic environment became more and more challenging for cooperatives (Chaddad and Jank 2006).

Furthermore, external economic influences at that time negatively affected all Brazilian industries. The petrol crisis forced the United States to change its monetary policy and increase interest rates. Countries dependent (in debt) on the U.S. dollar, such as Brazil, suffered from these new rates. Dairy cooperatives that traditionally acquired capital from external sources (loans) were badly affected, exposing their structural fragility as well as their lacking economies of scale and competitiveness (Escher, 2011a).

In addition to external pressure from the financial markets, there was also external pressure through competition from increasing imports of dairy products. This was a result of globalization but amplified in the early 1990s, when the Brazilian government reduced trade barriers. Urbanization and income increases among the Brazilian population made the country's dairy market more and more attractive for multinational agrifood processors and retailers, which increased their investments. In 1995, Mercosur countries established a common tariff replacing import barriers. Uruguay and Argentina, with their solid and advanced dairy industry, dumped high quality and cheaper products in Brazil. Less efficient and less agile enterprises were rapidly excluded from the market. National competitors were not able to adapt to the new market conditions and were displaced due to the resulting industry concentration and elimination of many medium-sized and small companies, especially cooperatives (Azevedo et al., 2004). This trend has been further reinforced by new technological advances such as UHT (ultra-high temperature) and air-tight carton packaging. This technological progress allows milk to be conserved for longer periods and its transport over greater distances. Milk became a commodity and the sector grew even more concentrated in industrial zones, undermining the main advantage of cooperatives—the local character of their collection and distribution networks, where especially in the dairy sector transport costs are high (Frenken, 2014).

A third kind of pressure on GFM dairy cooperatives appeared due to changes in the organizational structure of the Brazilian dairy supply chain, in particular an increase in the concentration of companies downstream. In this regard, the emergence of supermarkets led to increasing competition on national dairy markets and an attendant decrease in prices. UHT milk in

particular, an important staple food, was used by supermarkets to attract consumers; they offered it at very low prices as part of their competitive strategy, which in some cases even led to negative margins – a typical example of a "lost leader" (Chaddad 2007b).

IOFs and cooperatives represent the main point of competition in the procurement of milk. In order to deal with such issues "…a contract system was established between collectors and processors in order to ensure quantity and quality in supply" (Expert 09). However "…with such a degree of competition, leading companies failed to set standards of price and quality…" (Expert 14), enabling new agents to be created and to expand their market positions. This feature created a power struggle in the chain among retailers, the processing industry and the cooperatives' collection system (Experts 04, 08, 09, 14).

The sector was growing fast but the frequency of transactions in this sector is high and uncertainty of supply in the spot market is also high (Experts 01, 03, 04, 07, 08, 09, 11, 14, 15). Investments to increase production were necessary, consequently increasing the specificity of assets. The traditional cooperative ownership structure made it difficult for cooperatives to raise the necessary capital to invest. The absence of managerial skills and difficulties in raising equity capital from members generated important managerial and financial constraints for the cooperatives. Consequently, changes were necessary and the cooperatives had to restructure (Experts 01, 02, 04, 07) as described below.

2.5.5 Fifth Stage: Restructuring

As a consequence of these crisis and conflicts, after the mid-1990s cooperatives and IOFs with low or no power of investment ended up being acquired by large IOF groups with national or international capital. Many supply/input (and/or cooperatives that only collected milk), especially singular cooperatives but also some central cooperatives left the market. Only "…those with better elaborated marketing strategies were able to persist even though facing financial constraints" (Expert 32). This development is also confirmed through similar statements by Experts 17 and 19.

The industrial concentration process that started in the 1990s in the GFM dairy sector had distinct moments. As a result, during the first phase in the early 1990s, large foreign capital agribusiness groups entered the sector,

attracted by market liberalization and tax incentives in Brazil. "…The strong competition generated by these companies characterized this period" (Expert 20).

For instance, the IOF Parmalat[13] (Table 4), pursuing an aggressive growth strategy and global corporate marketing policies, entered the GFM in 1993 (Carvalho 2008). A significant consequence of its entry was the displacement of the main dairy region from the eastern-center to the NW-RS, competing directly with the central cooperative CCGL in sales and in milk procurement.

After the deregulation of the dairy sector, Parmalat introduced the first movement of professionalization and strong competition in the dairy industry in GFM. The company forced farmers, cooperatives and IOFs to become more efficient, change their strategies and organizational structures, or exit. Singular cooperatives either exited or invested in equipment for bottling UHT milk, which was generally financed by Parmalat. This process created an industry with little bargaining power from the production side and tightly dependent on large processing companies (Experts 24 and 28).

The central cooperative CCGL could not resist the strong competition from Parmalat and exited in 1996. By this time Parmalat and AVIPAL, who had bought CCGL, controlled 70% of the market in RS, characterizing an oligopsony. The greater concentration in the processing stage of the supply chain, referring to Expert 23 "…directly affected the prices paid to singular cooperatives and producers", a price-effect that is also described by Expert 16. Also in 1996, the central CCCL lost its main singular supplier cooperatives in western SC. These cooperatives formed the Cooperativa Central Agromilk, a society made up of 11 singular dairy cooperatives headquartered in W-SC. Agromilk delivered its milk to another central cooperative acquired by Parmalat two years later.

The second period of industrial concentration in the mid-2000s was characterized not only by the entry into the sector of large national IOF agribusiness conglomerates but also the restructuring and new growth of singular and central cooperatives (explained in the subsection "New Life Cycle" below) "…supported by government incentives and increased credit

[13] Parmalat is an Italian food product company founded in 1961 in Parma. The company arrived in Brazil in 1974.

access" (Expert 16). Different reasons were fundamental for the expansion of national companies (IOFs and cooperatives).

First, in the late 1990s, Parmalat was involved in a fatal corruption scandal and consequently a major crisis. "The closure of the company's activities offered a huge opportunity for national companies to enter the dairy sector…" (Expert 2). Second, in the early 2000s, large pork and poultry industries reduced their activities in the GFM. They moved from the GFM to the center-west of the country, attracted by tax incentives and the proximity of the corn and soya bean production zones. These companies reduced procurement contracts and excluded less efficient farms from the pork and poultry sector once again. Third, the Brazilian government gave national IOFs and cooperatives increased access to credit. However, cooperatives needed a longer time to recover from the 1990s crisis in comparison to IOFs, which already had access to the financial market and other sources of capital in addition to having more qualified managers (Experts 01, 02, 03, 06, 18, 19, 22, 29, 30).

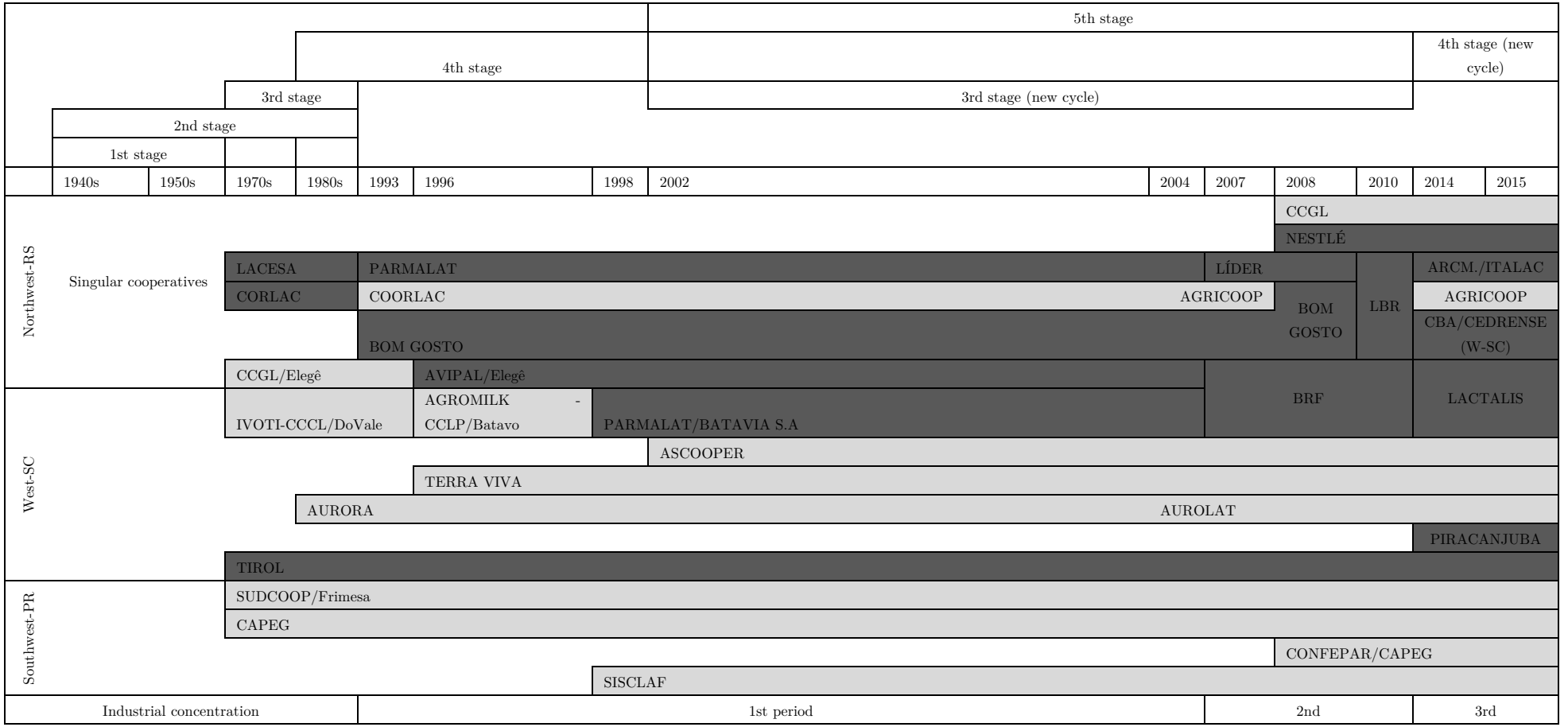
At this time, the quality and sanitary requirements became more restrictive with the "Normative Instruction 51" (IN-51) in 2002. New technical standards required farmers to invest in refrigerated tanks. It also became mandatory for dairy processors to collect milk from producers in refrigerated trucks. These developments induced scale effects and led to the closure of cooling stations due to the tankers' ability to collect milk over longer distances, which again undermined singular local cooperatives' competitive advantage and their traditional procurement systems (Chaddad 2007b).

Enterprises with capital to invest used the opportunity to expand their activities into the dairy sector. The most important example is the IOF BRF-Brazil Foods[14] Group (Table 4), which started operating in the dairy segment in 2000. In early 2008, it was the second largest dairy company in Brazil and the main competitor for cooperatives and other IOFs in the zone (de Souza 2014). Figure 3 shows the differences between cooperatives and IOFs according to their collection capacity.

[14] This company acted primarily in the poultry and pork sector, where its main business activities are focused. Its headquarters are in W-SC.

The increased industrial concentration generated by national capital groups in the 2000s helped to improve national industry competitiveness in face of foreign companies in the sector, forming an oligopolistic structure. The procurement of raw milk is the main point of competition between companies, generating significant impacts on producers (Experts 02, 04, 05, 10, 12, 13, 16, 31). The dairy industry started to undergo a process of transition, with a view not only toward the regional market, as had been the case until the early 1990s in Brazil, but also toward greater competitiveness in the international market. To survive, producers and the industry as a whole had to increase their scale as mentioned by Experts 21, 25, 26, 27 and 28.

Table 2-4: Chronology of the dairy companies evolution in the GFM



Source: Authors' illustration based on companies' reports available online on companies' homepages and direct personal interviews; IOFs highlighted in dark grey and cooperatives in light grey.

2.5.6 New Life Cycle (3rd stage)

According to Cook (1995), after restructuring a new life cycle begins and that was the case for GFM dairy cooperatives. Restructuring trends increased in the mid-2000s: after the crisis in the early 1990s, cooperatives with huge debts and farmers pressured the government to create measures for mitigating their difficult situation. As a result, policies for restructuring and capitalizing agricultural cooperatives were created in 1998 but especially in 2003, which was characterized by the new political environment that developed when the Workers Party assumed leadership of the central government (Alves, 2003). Credit was released for investments in the modernization of plants and the professionalization of managers. Then a period of rapprochement between cooperatives and the government began. Farmers responded by creating new singular cooperatives, associations of cooperatives and central cooperatives for joint commercialization and processing in a strategy to add value to their production (Schubert and Niederle, 2011).

As predicted in Cook's framework, a new life cycle had begun. With the 1st and 2nd stages already established in the first cycle, a second phase of growth (3rd stage – new cycle) took place. This growth occurred in parallel with the 5th stage of the first cycle, when other cooperatives were restructuring.

At this time, dairy cooperatives developed following two different organizational models in the GFM: first a productionist model predicting the concentration and specialization of production and the high intake of external inputs with no space for many small producers. Second, a model favoring balanced production systems, diversification of production and sanitary hygienic standards appropriate to the reality of family production units—the cooperative networks (Ferrari et al., 2005).

The productionist model resulted from important investments by large central cooperatives in the dairy sector. Cooperatives from the poultry and pork sector but also traditional dairy cooperatives invested in processing plants and in marketing strategies.

Since the late 1980s the central cooperative AURORA had only collected milk from their farmers through its singular cooperatives, processed the basic steps (homogenization and pasteurization) and sold it on the market. However, in 2004 AURORA decided to process the production of milk (products ready for consumption) only through the brand AUROLAT, adding more value to the 7,200 associated cooperative members' production. It began processing milk mostly after pressure from member associates. This diversification was also a result of farm

diversification and the evolution of agricultural production dynamics in the GFM. SUDCOOP also collects 36% of its processed volume in the SW-PR region. Market- and consumer-oriented cooperatives such as AURORA and SUDCOOP are competitive and successful.

Implementing another marketing strategy, after 12 years out of the market, the central cooperative CCGL restarted its activities in the GFM dairy sector in 2008 with new processing plants (CCGL, 2015). Also in 2008, CONFEPAR, a cooperative from the north of PR, installed a processing plant in the SW-PR region (CONFEPAR, 2015).

Concentration and exclusion also led to the formation and organization of socio-economic actors into a new profile, called cooperative networks, the second organizational model of the cooperatives. For the purpose of analysis, these networks can be considered cooperative associations. These cooperative networks were founded by an initiative of social organizations to mitigate concentration and ensure market access for excluded farmers. The reorganization was a reaction to the policies adopted by large agribusiness firms in the region favoring large-scale production (Anschau, 2011).

The networks achieved a reasonable level of competitiveness with regard to access to raw milk, especially from a production perspective. Their main advantages were a widespread system of milk collection and their proximity to members in most remote regions, as confirmed through the interviews. Cooperatives and networks primarily supported farms in the organization of production, improvement of milk quality and working conditions, reduction of production costs, technological adaptation, the use of credit and joint commercialization of production (Escher, 2011b). These networks included COORLAC[15] in NW-RS, ASCOOPER and TERRA VIVA in W-SC, and SISCLAF in SW-PR.

COORLAC (Cooperativa Riograndense de Laticínios e Correlatos) was formed in 1993, when the former CORLAC came under the management of cooperatives (see 3rd stage in the first cycle). COORLAC comprised a central cooperative, 4 regional centers, and 22 singular cooperatives. According to the 2002 Brazilian Association of Milk Producers, it occupied the seventeenth position in the national ranking of companies in volume production, with an average of 20 million liters per month and

[15] COORLAC acquired cooperative status only in 1993. Before that, it was owned by the state and had different names, such as SABEL (1936), ELSA (1946), DEAL (1948), and CORLAC (1970).

seventh place among producers with 6,000 members. The central cooperative commercialized through the brand CORLAC (Souza, 2007).

Since 2001 in the W-SC region, this dynamic has led the formation of singular dairy cooperatives of family farming, with the support of family farming unions, associations of family farms, and institutes. From this first organization, seven cooperatives associated and created the ASCOOPER (Associação das Cooperativas Produtoras de Leite do Oeste Catarinense) in 2002. Some years later it grew to twenty singular cooperatives and brought together 43 municipalities covering 3,370 small farmers, who were undercapitalized and normally excluded from other production systems due to low production scales. In 2011, it produced a volume of 55 million liters of milk. It arose from the organizational needs of small local cooperatives that aggregate family dairy producers in the municipalities of the W-SC region. Even today, ASCOOPER does not have processing plants or joint commercialization. It acts exclusively through the organization and representation of cooperatives. Thirty percent of its production is sold to other cooperatives, while 70% is sold to IOFs (Magalhães, 2007).

Another important cooperative network in W-SC was the Rede Cooperativa Intermediária, which was coordinated by workers of the Landless Movement (MST). During the 1990s, the number of farmers who involved in dairy production increased. Simultaneously, during harvest seasons with surpluses, producers received only 30% of the market price for milk. In response, the MST felt the necessity to add value to the farmers' products as an alternative to a rural exodus, leading the MST leadership to process the milk (ready for consumption) produced in the settlements. Consequently, investments were made creating COOPEROESTE, which processed the milk through the brand TERRA VIVA. The first processing unit of milk and cheese was established in 1996. In 2015, it processed 700,000 liters per day from 6,000 families. Their processing operations are concentrated in one plant (Terra Viva, 2015). Today, COOPEROESTE is considered a successful, market-oriented network.

In the SW-PR region, SISCLAF (Sistema de Cooperativas de Leite da Agricultura Familiar com Interação Solidária) system had the same purpose as COOPEROESTE in the W-SC region. In 2015, it consisted of 16 singular cooperatives and one central cooperative. Its earliest singular cooperatives were formed in 1998, and the central cooperative in 2004. Singular cooperatives have municipal scope and serve to organize groups of producers. They are integrated in regional centers, negotiate with

regional partners, coordinate technical assistance and control the collection and the quality of milk. The central cooperative's role is to establish strategies and projects for the whole network system, to represent it and to provide support services for other member cooperatives. The system had 5,000 associates, who produced on average about 6 million liters of milk per year in 2009 (Escher, 2011b). SISCLAF invested in small processing plants, created joint ventures with other cooperatives and bought services from other companies with idle industrial plants to process their products (de David and Garcia, 2009). This network also acquired a processing plant from one of its debtors. Additionally, SISCLAF frequently invests in marketing (Escher, 2011b).

2.5.7 New Life Cycle (4th stage)

This second phase of the "growth" stage in a second life cycle, during which cooperatives which were formed in the GFM, expanded without taking into account long-term survival strategies and so was again followed by crisis and recognition of conflicts (4th stage new cycle). Thus, despite the rapprochement of GFM cooperatives with the Brazilian government in the mid-2000s (through governmental support actions), cooperatives are again facing difficulties in developing marketing strategies to increase their market share and power in the face of large, often global IOFs. Since most cooperatives do not have the marketing know-how and industrialization structure to ensure the commercialization of products they tend to exit because they act exclusively to collect and negotiate the total volume of production. Cook (1995) argues that these cooperatives generally do not survive the second stage. Furthermore the social connotation of cooperatives mentioned in subchapter 4.2 implies additional high collection and transaction costs and consequent degradation of the cooperatives' competitiveness (Rangasamy and Dhaka 2007). The whole process of strategic management, such as development and implementation of efficient collection processes and provision of technical assistance is therefore more complex for the cooperatives due to their spread and fragmented structure. This scenario can be made worse by the poor professional qualification of managers and directors in a large number of cooperatives (Ortmann and King, 2007). Their initial advantage of scale economies has rapidly been offset by management and organizational issues plus decreasing profit margins. Allied to this deficiency, Expert 07 mentions that "…there is a dispute in the political field as well as in the direction of cooperatives". This statement is also confirmed by Experts 08, 16 and 17.

These aspects lead to problems in the allocation of formal control rights (Chaddad and Iliopoulos 2013). As a consequence, trust and cooperation ties, which supported those cooperatives and networks, have been damaged. Deng and Hendrikse, (2014) argue that the social capital of cooperatives decreases over their life cycle and cooperatives' comparative advantages may disappear. Ben-Ner, (1988) made a similar statement concluding that growth encourages members to pursue higher personal incomes. In order to avoid this problem, the income rights structure must change appropriately and leaders should maintain and develop social capital over time.

After the crisis of 2008, the central cooperative COORLAC dropped out of the Brazilian dairy sector and sold the brand CORLAC and its industrial operations. It was renamed AGRICOOP (Central Cooperative Agrofamiliar) and in 2015 only 10 singular cooperatives were part of its system. Its main function was the organization of producers and the collection of milk. In 2014, AGRICOOP acquired a processing plant and began developing new business models (Agricoop, 2015).

ASCOOPER lost famers and cooperatives to other companies. Today, this network includes only 14 cooperatives, totaling 2,572 associated farmers and a milk production of 38 million liters/year.

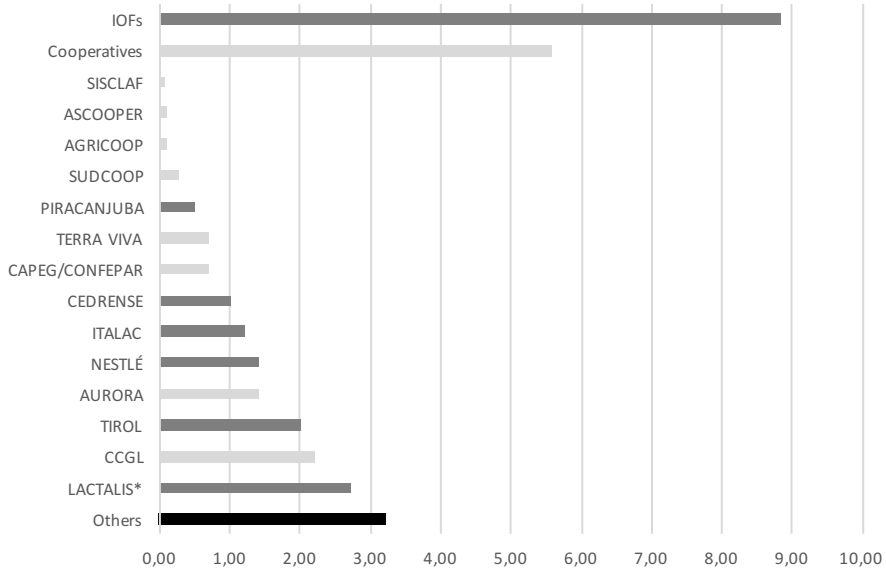
Recently the Ministry of Agriculture, Livestock, and Supply (MAPA) decided to unify the national sanitary inspection systems. They are currently separated into federal (SIF), state (SIE), and municipal (SIM) bodies and only allow commercialization within their individual territories. SIF has more restrictions and also allows export. Additionally, the ministry intends to create the Brazilian System of Animal Products Inspection (SISBI-POA) (MAPA, 2016). As in 1976, when SIF became mandatory, this initiative might increase export opportunities for all companies and, at the same time, exclude those who are unable to afford the necessary improvements.

A third period of industrial concentration started in 2013/2014. New multinational IOFs specialized in dairy processing settled in GFM, having been attracted there by promising market opportunities in this region and its solid dairy supply chain. Large mergers and acquisitions characterize this most recent period (Schubert and Niederle, 2011). Internally, the financial crisis of 2008 depreciated the Brazilian currency (Reais R$) so multinationals invested in Brazil in order to produce with lower costs. Externally, the EU extended its policy of outsourcing production of low-value-added products, this measure affected the dairy sector in 2015. Anticipating the fall of the

dairy quota system in the EU, some companies invested in emerging countries and GFM was considered an attractive zone for those multinationals.

The French group LACTALIS, owner of Parmalat International, acquired all the dairy activities in the group BRF-Brazil Foods. That started a strong movement of international expansion. In 2015, it became the largest group in the dairy sector in GFM (figure 3) and the second largest in all of Brazil. Expert 29 states that "the arrival of the group LACTALIS in the GFM in 2014 supported the process of professionalization in the dairy supply chain and pushed cooperatives and IOFs to increase efficiency or exit the market". This development is also described by the Experts 16, 20, 21, 23 and 30.

This new industry structure resulted in a spatial reorganization of the sector. The structural pattern of production units changed from small factories and dairy plants to production concentrated in industrial plants with higher production capacities. These new structures benefit from economies of scale and break with the former regional character of the industries located in southern Brazil. These changes have increased competitive pressure in the dairy sector, which forces all companies, IOFs and cooperatives who intend to remain active, to search constantly for innovation along the entire supply chain (de Souza 2014).



*Volume calculated based on acquisitions

Source: Companies reports available online in companies' homepages and direct personal interviews.

Figure 2-3: Major players in the GFM dairy industry (capacity of collection in million liters/day)

Table 2-5: Summary of life cycle stages.

Stages	**Main Findings**
1st - Economic justification (1940s - 50s)	Exclusion of farmers from various sectors prompted the creation of singular cooperatives supported by government incentives.
2nd - Organizational design (1960s - 80s)	Establishment of the cooperatives law and quality and sanitary standards for dairy products. The government intervened directly in market prices.
3rd - Growth and consequences (1970s - early 90s)	Implementation of government measures to foster technology adoption and professionalization. Creation of large central cooperatives. Migration of farmers towards the North. Expansion of the dairy sector in GFM region. Formation of a large connection and distribution network.
4th - Crisis and recognition of conflicts (1990s)	Liberalization and market-oriented policies implemented in the country. Reduction of government support and trade barriers. Less efficient companies exit the market, especially cooperatives.
5th - Restructuring (mid 1990s - mid 2000s)	Exiting cooperatives are acquired by large national and international IOFs. Industrial concentration and competition increased. Large central cooperatives exit. There was an increase again in national companies after new government supports. The national industry became more competitive, but cooperatives took longer to regrow.
3rd *New life cycle* - Growth and consequences (mid 2000s)	More supporting measures from the government. Cooperatives again grow, modernize and professionalize. Development of the productionist model and the cooperative networks.
4th *New life cycle* - Crisis and recognition of conflicts (early 2010s)	Cooperatives formed and expanded without taking into account long-term survival strategies. Crisis of 2008. Difficulties in developing marketing strategies to increase their market shares and market power in the face of large, often global IOFs. Rise of political problems in the direction of cooperatives. Most cooperative networks decline. Multinational IOFs install processing plants in the region. Large mergers and acquisitions.

2.6 Discussion and Conclusions

By analyzing the overall evolution of cooperatives in the GFM region in southern Brazil historically combined with the role of institutional, political and economic environment in their competitiveness, it becomes evident that close links exist between the failure of cooperatives and government interventions. This became evident through the application of the life cycle of cooperatives approach developed by Cook (1995), a valuable tool for analyzing the entire process—from creation to exit—of cooperatives in the dairy sector of southern Brazil. Using the region as a

unit of analysis is also appropriate for understanding these dynamics at a regional level, which confirms and extends the earlier study by Chaddad (2007b). When doing so, it becomes obvious that the fundamental assumption in strategic management literature that firms' strategies reflect external conditions as well as internal resources and capabilities (e.g., (Johnson et al., 2014), is also true for the cooperative sector. Furthermore, the findings support the contingency theory view that external contingencies have a strong influence on firm performance (Donaldson, 2001). Our findings are also in line with Francesconi and Ruben, (2008), who argued that agri-cooperative business in developing countries is likely to be less adaptive and may face limited sustainability for external reasons (missing markets and invasive governance) as well as managerial procrastination. In this study, the authors showed that public intervention to promote the formation of rural cooperatives is often too invasive (as has been the case in Ethiopia), triggering collective dependency rather than entrepreneurship.

Our analysis identified three relevant phases: an initial period of growth and expansion in the 1960s and 1970s, followed by huge crises in the 1980s and 1990s and then a period of recovery and growth beginning in 2000s. These phases are linked to differing public policies, especially with regard to credit access, the internal and external economic environment and the foundation of new institutions. Our findings run counter to those of Ben-Ner, (1988) and Pérotin, (2006), who concluded that cooperatives grow counter-cyclically, that is, they are born during crisis. However, in a developing country as per our study, this premise does not apply. During a crisis, the government tends to abandon incentive programs for cooperatives, leading them to fail. The political environment has more influence than the economic one. Cooperatives that are formed as a result of political incentives are therefore more likely to fail when those incentives no longer exist. It is important to emphasize that the Brazilian economy grew faster and unemployment declined quicker when not only cooperatives but also medium and small IOFs were supported. The main problem is that there were no concurrent measures to make them independent of government support so they could survive alone when the government removed the incentives. Apart from the observation on non-counter-cyclicality, the results of this study clearly show that after the first completed life cycle, there is neither a continuing phase of sector stabilization nor a restart from new as conceptualized by Cook (1995). Instead, concurrent with the 5th stage of the first life cycle, a number of cooperatives in Brazil entered the 3rd stage of a second life cycle much earlier

than others. These findings on the one hand provide proof of overlapping life cycles and on the other hand the restart of further life cycles at more advanced stages, depending on the external contingencies and internal characteristics of companies in any given sector and country. Since such developments have never been conceptualized and observed before, this study adds further theoretical advances to the existing academic literature on Cook's (1995) life cycle approach.

Currently, dairy cooperatives in GFM are again under huge economic pressure due to a spatial reorganization of dairy production and changes in the structural pattern of production units. New business models and strategies aimed at disconnecting them from government aid plus new approaches to market competition are necessary to promote competitiveness in this growing sector and maintain the viability of family farms. Hoff and Stiglitz, (1990) suggested that cooperatives in developing countries formed from external capital (government or aid projects) are generally passive. Similarly, Wouterse and Francesconi, (2016) found that cooperatives are healthier if they do not receive external support for their establishment, most likely because this reduces the need to provide an economic justification for that establishment.

According to our results, historical dynamics in the GFM dairy sector show that supply and/or input cooperatives tend to leave the market, whereas marketing cooperatives remain. Directors of cooperatives are aware that cooperatives and associations that continue only collecting and selling milk will disappear. They understand the weakness of this role (de David and Garcia, 2009). This finding parallels earlier research on strategic management in cooperatives, which revealed that strategic positioning is a decisive determinant for a cooperative's success (Theuvsen and Franz, 2007).

Our findings have manifold managerial implications. First, economies of scale, optimization of organizational and governance structures, increase of capital, correct and efficient investments in marketing and commercialization are potential solutions for cooperatives seeking to avoid market exit. Managers should therefore have a plan of action geared towards merging small cooperatives in order to achieve gains in scale and a market/consumer-oriented focus. The creation of centralized structures instead of a singular-central system is one possible solution that should be analyzed in greater detail.

Furthermore, improvement of milk quality through enhanced quality controls in rural areas and productivity through industrialization of production are considered of special importance. In this regard, a higher degree of professionalization within

boards of directors among GFM cooperatives and farms is needed to introduce these changes, which in turn are necessary for survival in this fast changing environment. This professionalization could be achieved by the following 5 recommendations drawn on Chaddad's (2007) and Cook and Iliopoulos, (2016) suggestions and adapted to our case:

1. **Focus** on a single economic activity or create independent business units to provide services to specific groups of producers. In this regard, the central cooperatives must separate the dairy business in order to establish an independent administration and improve and professionalize the management of the dairy production process. A second option would be to create separate capital and service pools (Iliopoulos and Cook, 2013).
2. Control the quantity and quality of **supply** through defined member frameworks and marketing contracts. This could be a challenge since many farms are very small and have low technology adoption. The establishment of contracts without any support could exclude many families from the sector. To overcome this problem and implement such contracts, cooperatives must invest in programs of extension and quality training for farmers as well as investment capital financing. Farmers who want to deliver to the cooperatives should be required to participate in specific training to professionalize their activity. Cooperative networks should adopt the same mechanisms. Communication with members must also be further developed together with contracts.
3. Redefine contractual relationships with members to offer them **incentives** to invest risk capital, or seek new sources of capital in the market. Here, the cooperatives law has to be revisited. The Brazilian cooperatives law (Law Nº 5.764, 16/12/1971) does not allow the formation of New Generation Cooperatives (NGC) to overcome the five problems of vaguely defined property rights (VDPR) (Cook and Iliopoulos, 1998). Therefore, as yet, none of the dairy cooperatives have shifted to NGCs in the Brazilian dairy sector. Updates to this old law of cooperatives are needed to provide some flexibility and allow the creation of mechanisms to avoid VDPR issues (Cook, 1995) by such means as developing asset appreciation mechanisms and equity capital plans, increasing share liquidity by creating delivery rights and introducing new membership policies. A variety of different governance structures with different allocations of decision and residual rights are required in order to overcome the aforementioned problems (Chaddad and Cook 2004). To allow for those structures, cooperatives must adjust and

remake their bylaws (Hendrikse and Feng, 2013). This conclusion is also valid for other cases and (developed) countries: Rebelo and Caldas, (2015) derived the same conclusions in their analysis of the role of agricultural cooperatives in Portugal, showing the need for cooperatives to be more flexible in their organizational structure to solve a wide range of their current problems.

4. **Proportional** investment capital, division of profits and voting rights in accordance with the cooperative use (milk production) in order to control the opportunism of "free riders". The actual law does permit proportionality according to use. However political issues, especially the abuse of power (control and influence-cost problems) in the administration of cooperatives results in very few co-ops adopting proportionality systems. Such a system must be extensively adapted with specific rules for avoiding power abuses in order to pursue an optimal allocation of ownership.
5. **Market orientation**. Focus on customer satisfaction. Here the main challenges are the size of cooperatives and level of management skills. We recommend the fusion of cooperatives to increase size and bargaining power so creating a competitive yardstick. The marketing cooperatives (CCGL, Aurora and Sudcoop) should lead this strategy. The first movement would be to separate their dairy activity into an independent structure. The next would be to merge with other cooperatives: Capeg/Confepar, Terra Viva, etc. This process will lead to a transformation from the central/singular scheme into a centralized structure with many organizational advantages, beginning with processing in the high-value-added food industry. Our recommendation for the cooperative networks is similar. It is necessary to make investments in processing plants and marketing actions and to merge with other marketing cooperatives or create strategic alliances or joint ventures with them.

We also strongly recommend collecting additional information through new censuses of dairy cooperatives and combine them in a database whereby experts could perform a more detailed follow-up. Furthermore, our findings have a variety of implications for political decision-makers, for example with regard to how politics addresses the competitiveness of cooperatives in the GFM dairy sector.

The same industry that produces an income of about US$25 billion annually expels, on average, one producer every 11 minutes. The general head of EMBRAPA Dairy argues that cooperatives are the best way to deal with such problems since they work on reducing social problems caused by economic conditions. Thus, today's

cooperatives still very much reflect the mission that once inspired the rise of the cooperative movement (Grosskopf et al., 2010).

This study is limited by its qualitative descriptive nature. Further quantitative analyses are needed in order to confirm its results. In this regard, a spatial analysis of performance in the Brazilian dairy sector is being developed in order to identify spatial influences on the efficiency and productivity of the various production zones in Brazil. Furthermore, the determinants of the performance of dairy cooperatives in the state of Paraná, in the southern region of the country, are also being quantified.

Chapter 3: Technical Efficiency and Organizational Forms: the Case of Dairy Processing Industry in Southern Brazil[16]

3.1 Introduction

The dairy industry is a key agribusiness sector for rural value creation and important for food security in remote rural areas. In Brazil the dairy industry corresponds to 5,8% of the total value share in national agricultural GDP and 15% of animal production (IBGE, 2017). It also generates around 4.7 million employments. In 2014 1.3 million farms produced 35.17 billion litters of milk making it the fourth largest producer in the world. The dairy is a peculiar sector in agriculture, where labor intensity is particularly high even in highly capitalized countries. Furthermore, the perishability of the product, which needs to be quickly processed, increases the amount of transactions between the farmers and the processors, if compared to other sectors (Frenken, 2014). This characteristic raises the dependency of the farmers and the possibilities for an opportunistic behavior of processors, which despite the positive aspects generated in the supply chain and for farmers, may take advantage of their monopsonistic position and pay low prices to farmers.

As a solution to overcome the power of buyers, traditionally the farmers have formed cooperatives for milk collection and processing, to control the processing chain link and the prices at this step (Chaddad, 2007a). In countries such as the United States, the Netherlands, New Zealand, Australia, Denmark, Sweden, Germany, India and Uruguay for example, cooperatives have a wide dominance over the processing steps in modern dairy supply chains. In Brazil it was not different, producers facing market failures in input and output markets formed dairy cooperatives to supply inputs at affordable prices, provide missing services (such as credit and technical assistance) and to countervail market power of buyers or to facilitate access to urban markets. In other words, local cooperatives were formed with defensive purposes as they attempted to protect margins and wealth at the farm level (Chaddad, 2007b).

[16] A shorter version of this chapter was submitted to 'Agribusiness' as: Beber, C.L., Lakner, S., Skevas, I. "Determinants of Technical Efficiency of Dairy Processing Firms in Southern Brazil".

However, despite it is relatively easy to cooperatives enter in modern agrifood chains, it is difficult for them to sustain their participation by evolving with the markets requirements, especially for the traditional cooperatives (Berdegué, 2001). Cook, (1995) shows that the organizational structure of the traditional cooperatives has inherently 'five vaguely defined property rights' that impact negatively their organization and performance.

Furthermore a part of the literature also argues that internal transaction costs might decrease the efficiency of cooperatives, since their objectives and decision making structures are not exclusively focused on profits and returns on assets, but rather on the interests of the members (Beckmann, 2000; Hirsch and Hartmann, 2014). The Beckmann's study (2000) suggested that dairy cooperatives perform less efficiently than Investor Owned Firms (IOFs) due to their social functions in rural areas. Other authors in the literature argue that cooperatives may be more efficient by having a more conservative financial structure, important for dealing with crisis and changes of policies and paying higher prices to farmers (Soboh et al., 2014), or by alleviating market imperfections and reducing transaction costs for farmers for example (von Braun et al., 1989).

So the literature is controversial in what concerns the efficiency of cooperatives. One important and established method to analyze the impacts and implications of a firm's management decision is the productivity and efficiency analysis (Coelli et al., 2005). In this regard, the main objective of this study is to contribute to such literature by using the stochastic frontier analysis and by estimating the technical efficiency (TE) levels of dairy processing companies in Southern Brazil. Consequently, we analyze both types of organizations, the cooperatives and the IOFs, using the parametric technique of stochastic frontier analysis (SFA) introduced by Aigner, Lovell and Schmidt (1977) and Meeusen and van Den Broeck (1977). We also examine the determinants of their efficiency levels, so that we can provide the leaders of the chain and political decision makers with important policy and managerial recommendations which can then be considered as initiatives to improve companies' efficiency and mitigate their tendency to go bankrupt.

By looking at the characteristics of the Brazilian dairy sector we can highlight some aspects that might be central to improve the processing companies' efficiency. Among them stands out the highly dependency on domestic market demand. The sector shows historical insignificant exports (US$ 82mi in 2015 or US$ 32mi in 2013 for example), and consequently no market alternative for dairy products in moments

of national decreasing consumption, as happened after the 2008 crisis. Even with a decreasing consumption the national industry suffers from pressure of imports from neighbouring countries such as Uruguay and Argentina for example. Those imports arrive in the country with a lower price, even with import tariffs, evidencing the low competitiveness of the national processing industry.

The way this low marketing capacity affects the companies' efficiency is also evidenced by the trade destination in the dairy supply chains. For instance there is a clear distinction between mass production companies or companies integrating globalized markets (Dries et al., 2009) and niche companies focusing on local markets or targeted consumer groups (McKenna, 1988; Shani and Chalasani, 1992).

But certainly the degree of **technology adoption** is a factor having proven direct impact in productivity and efficiency with important consequences especially to developing and emerging economies (Nishimizu and Page, 1982; Solow, 2001) where any small improvement might have high effects. This can also be directly related to the size structure of the processing companies and their capacity or resistance to invest (Lundvall and Battese, 2000). For example the analysis of Lakner et al., (2017) on the Chilean milk processing industry shows small firms to have a higher technological change than the large global player. This suggests both, a dynamic sector of small firms and some large, quasi-monopolistic actors, which are reluctant towards technological change.

Finally the efficiency of processing companies might also be **influenced by policy** interventions aiming to support the sector as illustrated by several cases around the world. For example in Canada there are milk quotas; in the USA the "Milk marketing orders", "MPP-Dairy" and "DPDP"; and in the European Union (EU), there were several subsidies and the milk quota system in the past. And today the EU still has decoupled payments to farmers and import tariffs on dairy products. In Brazil, more specifically in the state of Paraná where we conduct this study, the governmental programs for institutional purchase like the "Programa Leite das Crianças" ("Children's Milk" Program) or the "Programa Leite do Paraná" (Paraná's Milk Program) are also policies implemented in order to bring benefits to the sector.

Considering these aspects, this study proposes the assessment of dairy processing companies in Paraná, Southern Brazil, one of the most promising and dynamic dairy production areas in the world. It adds to the literature that assesses technical efficiency in supply chains, or more precisely, in supply chains in developing and

emerging countries. We contribute to the literature in three ways; first, we investigate the TE in an intermediate step in the agri-food supply chain, while the vast majority of the literature focuses on farm-level analysis.

Despite the importance of agribusiness in general and more specifically, the milk processing sector, there not much research has been carried out with regards to productivity and efficiency. In most cases, agribusiness is part of the "manufacturing industry" (Lundvall and Battese, 2000; Pavcnik, 2002; Roudaut, 2006). There is a limited literature on dairy processing sectors, and even less investigating the technical efficiency of dairies (Baran, 2013; Doucouliagos and Hone, 2000; Ferrier and Porter, 1991; Kanter et al., 2013; Lakner et al., 2017, 2013; Porter and Scully, 1987; Singh et al., 2001; Soboh et al., 2012, 2014; Soboh, 2009). Second, we use a unique own dataset of 243 companies with data collected at plant level. The few studies assessing TE at the same processing-level use general data from national statistics databases, where little or no information on management practices is available. Third, while most of the available studies on TE in the processing stage refer to developed countries, where data is more easily accessed, we conducted this analysis in an emerging economy. Statistical data is often not available in developing and emerging countries because of the high participation share of the informal sector (Wilkinson and Rocha, 2006) and the high costs of data collection.

The remainder of the chapter is organized as follows; in the next section we present the Background of the study. In sequence the methodological framework employed and the Bayesian techniques used to estimate the model, followed by a description of the data and the empirical model. The major results are then presented in sequence. The chapter ends with a discussion and some concluding remarks.

3.2 Background

In the Southern region of Brazil, the main dairy production area in the country, about 300,000 small-scale family farms produce milk and deliver their production to a formal processing company (IBGE, 2017, 2006). Promoting competitiveness of processing companies and consequently ensuring market access for small-scale family farms is vital for the economy and society in the context of a rural development setting. Besides guaranteeing market access, the processing companies are the main diffusors of information and technology. Consequently they are also the drivers of inefficiency reduction in their coverage areas, as well as fundamental sources of various positive competitive spillovers (Tybout, 2000). This diffusion of information

about markets and the availability of new technologies and techniques may ensure that farms remain productive and competitive in a dynamic sector (Rao, Brümmer and Qaim 2012). Furthermore, competitive processors may offer stable market access and less volatile prices, which can reduce the risk that farmers face, increase their willingness to invest in new technologies and increase their specialization in dairy activity (Michelson et al., 2012). This is mainly observed in sectors where exports, multinational companies, large retailers and Foreign Direct Investment (FDI) are present (Farina and Viegas 2003). Such companies can require relatively high standards on health, quality and environmental care, when sourcing the raw materials they buy from farmers and other intermediary suppliers (Farina, 2002). These standards are achieved through the diffusion of new technologies, generally in a top-down flow from processors to producers in the form of technical assistance and then enforced through "obligational contracts" or "certifications" (Masakure and Henson 2005; Schipmann and Qaim 2010). It is therefore fundamental to enhance strong institutions in order to guarantee that this situation will not generate abuses from power imbalances in that processors gain in bargaining power towards small family owned suppliers (Rozanski and Thompson, 2011).

However, Brazilian dairy processing companies have been struggling since the 1990s, when a late process of supply chain modernization started, in which institutional changes were implemented such as trade liberalization, deregulation of prices, imposition of public and private standards and the creation of the sub-regional trade bloc Mercosur[17]. This created a new environment where efficiency and innovation became the most important instruments of competition for retailers, processors, and farmers (Chaddad, 2007b; Farina, 2002). Also, the substitution of pasteurized milk for Ultra high Temperature (UHT) with a much longer shelf-life, changed the distribution of fluid milk from small shops and bakeries to large supermarket retailers, whose relentless quest for cost-cutting was passed on to the dairy processors. Intense competition then started leading processing companies to adapt or to exit the market. Such adaptation was based on the adoption of new supply chain management strategies. They implemented private standards to reduce costs, raise efficiency and provide incentives for farmers to invest.

[17] The South American trade bloc was established by the Treaty of Asunción in 1991 and Protocol of Ouro Preto in 1994. Its full members are Argentina, Brazil, Paraguay and Uruguay.

On the other hand, inefficient processors who were not updating with new technologies and information, mainly for poor management reasons, were in turn not able to properly diffuse innovations to farmers on their coverage area. The result was maintaining low productivity in the sector and consequently low competitiveness, which in some cases led to exiting the market. The indirect consequences of those companies' exit was the exclusion of thousands of small-scale farmers from the market (Medeiros and Padilha, 2015), who depended on that market access. That alone indicates the importance of measuring companies' efficiency levels as well as identifying their determinants in order to promote policy and managerial upgrades.

Therefore, in this study we assess a set of determinants that according to the literature may have a significant impact on the (in)efficiency of processing companies. First we included "cooperatives" as a determinant of efficiency, since they have an important role in technological diffusion, good managerial practices and contribute to rural development in the study area (de Lima and Alves, 2011). They play a major role in Parana's agriculture. It is the only state in the country where the cooperatives represent the majority of agricultural GDP (56%), generating a net income of US$ 7 bn in 2009. The largest cooperative of Latin America, the agricultural cooperative COAMO, is also from Paraná. On the other hand, 70% of all cooperative members in this state are small-farmers with less than 50ha. They are also facing a mix of difficult challenges; to reorganize the supply chain in their coverage area, to collect milk over long distances, to transfer technological and managerial improvements for farmers and to have qualified human resources (Beber et al., 2018). Therefore we want to investigate if this organizational form is more or less (or equally) efficient than their IOFs counterparts.

The literature is controversial about this subject. Among the few empirical studies comparing the technical efficiency of dairy cooperatives and Investor Owned Firms (IOFs), we found different results showing that both cooperatives and IOFs can be more efficient depending on the context, the data used and the objective of the performance measured. For example, the study by Porter and Scully (1987) and Ferrier and Porter (1991) using 1972 data from US dairies showed IOFs more efficient. However, Singh et al. (2001) compared 23 processing plants in India over four years, from 1992/93 to 1996/97 with both SFA and Data Envelopment Analysis (DEA) and found cooperatives to be more efficient. The same outcome was found by Soboh et al. (2014) using a SFA comparing the efficiency of European dairy processing firms from 1995 to 2005 that found cooperatives to be slightly less

efficient, but having a more productive technology. Finally Soboh et al. (2012) using a DEA with 2004 data from European dairy processing firms showed that cooperatives could either outperform their IOF counterparts or be outperformed by them, depending on the approach used to account for the cooperatives' differential objectives. Cooperatives may have different objectives than simply maximizing profits (Hirsch and Hartmann, 2014; Soboh et al., 2014), such as maximizing the aggregate members' profit and maximizing the aggregate cooperative and members profit. Since we assume the cooperatives' only objective is simply to maximize company's profits (for a data availability purpose) we expect them to be less efficient than IOFs.

In the set of determinants of (in)efficiencies assessed we also included the type of inspection service adopted by the companies. In Brazil the inspection service for animal products is separated into Federal (SIF), State (SIE), and Municipal (SIM) inspectorates [18], which only allow commercialization within the scope of their territories. The SIF has more sanitary and quality restrictions and also allows exports and the SIM has the less, allowing only commercialization in the level of municipalities. So firms adopting the SIF standards are expected to be more efficient than firms working to SIE or SIM standards because higher quality products will probably have more added value, generating higher outputs. However the side effect regarding the commercialization scope of such inspection services must not be neglected.

In the same line of the sanitary aspects, the quality aspects of the milk processed by the dairies are also included. For doing so, we use an indirect approach, controlling for the companies that have a program of payment based on quality premiums/penalties (and not just quantity). Botaro, Gameiro and Santos (2013) have shown a direct association with a payment program based on milk quality and the reduction of both somatic cell count (SCC) and total bacterial count (TBC) in Southern Brazil. Monetary incentives offered to dairy producers can encourage them to improve overall milk quality parameters. Similar results were found by Nightingale et al. (2008) in the USA. So firms adopting different criteria for their milk payments are expected to process better quality milk and consequently to be

[18] The Brazilian quality and sanitary inspection systems are: ***SIF*** - *Sistema de Inspeção Federal;* ***SIE*** - *Sistema de Inspeção Estadual;* ***SIM*** - *Sistema de Inspeção Municipal.*

more efficient. Once again, higher quality products achieve more added value, so generate more output per input used, when inputs are similar.

Finally we also investigate whether the idle capacities determine the inefficiencies or not. We expect, for example, that companies with larger ratios of used capacity, defined as the percentage of the used capacity/total capacity, to be more efficient, since they use more total capacity (a proxy for capital) to produce less output.

3.3 Methods and Data

3.3.1 Theoretical Model

3.3.1.1 Exponential stochastic frontier model

A stochastic production frontier is used to estimate firms' technical efficiency. In particular, we assume that N firms can produce output y by using a vector of inputs $\mathbf{x} \in R_{+}^{M}$. The production frontier model (in logarithmic terms) can be written in the following way:

$$y_i = x_i'\boldsymbol{\beta} + v_i - u_i, \tag{1}$$

where y is the logarithm of the output of production, $\mathbf{x}$ is a vector of the logarithm of inputs, $\boldsymbol{\beta}$ is a vector of parameters to be estimated, v_i is a two-sided symmetric error term that accounts for white noise, and u_i is a non-negative one-sided error component that measures inefficiency. The output is specified as the an output index, the vector of inputs $\mathbf{x}$ consists of transport distance, labor in number of employees and total production capacity. While the two-sided error term v_i is assumed to follow a Normal distribution with zero mean and variance σ_v^2, we assume an exponential distribution for the inefficiency component u_i with the rate parameter λ_i:

$$u_i \sim Exp(\lambda_i) \tag{2}$$

Technical efficiency (TE) estimates, which are bounded on the unit interval, can be obtained by taking the expectation of e^{-u_i}. However, since the objective of this study is not only to examine the efficiency levels of dairy processing firms but also the determinants of their inefficiency, the rate parameter λ_i can be expressed as a function of firm-management characteristics as follows:

$$\lambda_i = e^{\mathbf{z}_i'\boldsymbol{\delta}} \tag{3}$$

where $\mathbf{z}$ is a vector of potential determinants of technical inefficiency, and $\boldsymbol{\delta}$ is the $L \times 1$ vector of parameters to be estimated.

3.3.1.2 Bayesian inference

We use Bayesian techniques to estimate the model in equations (1-3) (van den Broeck et al., 1994). Bayesian methods are particularly useful in stochastic frontier analysis since latent variables, like the inefficiency component, can be integrated out from the likelihood simply by using the powerful simulation-based method of data augmentation (instead of numerical integration that frequentist methods use). All parameters to be estimated are collected in a vector $\boldsymbol{\theta} = [\boldsymbol{\beta}', \sigma_v^2, \boldsymbol{\delta}']'$. Then, the posterior distribution of the model is written as:

$$\pi(\boldsymbol{\theta}, \{\boldsymbol{u_i}\}|\boldsymbol{y}, \mathbf{X}, \mathbf{Z}) \propto p(\boldsymbol{y}, \{\boldsymbol{u_i}\}|\boldsymbol{\theta}, \mathbf{X}, \mathbf{Z}) \times p(\boldsymbol{\theta}) \quad (4)$$

where $\mathbf{p(y, \{u_i\}|\theta, X, Z)}$ is the complete data likelihood of the model, $\mathbf{Z}$ is the matrix of covariates in equation (3), and $\mathbf{p(\boldsymbol{\theta})}$ is the prior density of the parameters to be estimated. The complete data likelihood consists of two terms: (i) the probability density function (pdf) of the Normal distribution, which is due to the normality assumption of the error term v_i and (ii) the pdf of the exponential distribution that is assumed for the inefficiency component u_i. The prior density includes three terms: two multivariate Normal densities for the vectors of parameters $\boldsymbol{\beta}$ and $\boldsymbol{\delta}$, where prior means are set equal to zero and the covariance matrices are specified as diagonal with a value of 1000 on the diagonal entries, and the inverse-Gamma density for the variance parameter σ_v^2 with the shape and scale hyper-parameters being set equal to 0.001. The model's parameters are estimated using Markov Chain Monte Carlo (MCMC) simulation, with the latent variable u_i being integrated out from the posterior using data augmentation. Gibbs sampling is used to sample from the full conditionals of $\boldsymbol{\beta}$ and $\boldsymbol{\delta}$ since their priors are conjugate, while Metropolis-Hastings updates are used for $\boldsymbol{\delta}$, since its complete conditional does not belong to any known distributional family.

3.3.2 Data and Variable Construction

Southern Brazil is today the largest dairy producing zone in the country and Paraná is the third largest dairy state in Brazil, producing 4.7bn liters, or 14% of the national production of 33.6 bn. liters in 2016. In 2009 “Paraná Economic and Social Development Institute – IPARDES” conducted a census to gather information from the states’ dairy processing companies which included 301 units, then corresponding to 96% of the companies (total population) and 83% of the processed volume in the state. The questionnaires contained information on the characteristics of companies, the origin and quality control of raw milk, the technological structure, management practices, institutional choice, policy support, etc. For the purpose of this analysis we

retained only 243 companies including 35 cooperatives and 208 investor owned firms (IOFs). The remaining 58 companies were excluded from the sample because of excessive missing values on the variables of interest, or because of unreasonable/abnormal values caused likely by typos during data entry. In the production frontier model we specify one output (output index) and three inputs (total capacity of processing, labor and transport).

With regard to the output index specified in equation (1), its estimation was based on other known variables. We therefore used the monthly mean volume collected over the last 12 months, the rate of the specific products produced by the company as available in the dataset, the volume of milk necessary to produce each specific product and their respective prices in that year. This output index is represented in Brazilian currency (1,000 R$ Reais). Since we used the raw milk volumes to calculate the output index, we didn't include this variable as an input to avoid endogeneity. The inputs that are specified in the **X** vector in equation (1) are the following: (i) "Total capacity of processing" represents the full capacity in liters per month of the processing plants. It can also be viewed as a proxy for capital, (ii) "Labor" represents the total number of employees in the company, which can be very intense in some sectors of developing countries, which have a high number of small enterprises (Tybout, 2000). (iii) "Transport" represents the maximum distance (in km) that each company has to travel in order to collect the milk from the farthest farmer. This variable is included because the dairy sector is very demanding in terms of transport since milk, as a perishable product, has to be collected frequently (Frenken, 2014), which means every two days in most cases. Companies processing milk exclusively from their own herd have a value of 0.01. In the dataset those inputs were the best inputs representing the production function. Table 3-1 provides the description of the output and input variables. It shows that cooperatives have, on average, higher values for the output and the three input variables.

Table 3-1: Descriptive Statistics of the Output and Inputs

Variable		**Full sample (n=243)**	**Cooperatives (n=35)**	**IOFs (n=208)**
Frontier	**Unit**	**Mean (Std. Dev.)**	**Mean (Std. Dev.)**	**Mean (Std. Dev.)**
Output	1000 R$	684.628,50 (2.268.836,00)	1.685.719 (5.255.695)	516.175,70 (1.132.705,00)
Transport	Km	67,78 (99,58)	82,09 (184,71)	65,37 (77,13)
Labor	Persons	24,96 (51,76)	38,77 (99,1)	22,63 (38,48)
Total capacity	1000 liters	1.018.322 (2.454.208)	1.754.338 (4.623.248)	894.473 (1.850.341)

Technical efficiency model				
Used capacity	%	0,5 (0,23)	0,48 (0,25)	0,5 (0,23)
Cooperatives	Dummy	0,14 (0,35)		
Different payment criteria	Dummy	0,83 (0,38)	0,6 (0,5)	0,87 (0,34)
Type of inspection service	Categorical	2,06 (0,76)	1,8 (0,8)	2,11 (0,74)

Source: Own Calculations.

Finally the **z** vector in equation (3) includes four variables: (i) "used capacity of the plant", defined as the percentage of the used capacity/total capacity; (ii) A categorical variable is used for the "type of inspection service" adopted (SIM, SIE or SIF), where the SIF is the most restrictive and rigorous with 77 companies in the sample and the SIM the least with 62 companies in the sample, the SIE is the mid-term and 104 are subscribe under this category; (iii) a dummy representing any "different criteria of payment" different from volume of milk; finally we included a (iv) dummy for "cooperatives". Other potentially relevant drivers of efficiency like firm age, provenances of capital, among others were tested, but no interesting results were found, thus not reported.

Regarding the size, during the application of the questionnaires the companies were asked to declare their yearly turnover size category. The frequency of the companies in the six size categories is shown in Table 2.

Table 3-2: Size categories of companies in the sample

Category size	**Frequency**	**Percent**
Below R$ 360.000	104	42.8
From R$ 360.001 to R$ 1.200.000	60	24.7
From R$ 1.200.001 to R$ 2.400.000	25	10.3
From R$ 2.400.001 to R$ 10.500.000	33	13.6
From R$ 10.500.001 to R$ 60.000.000	11	4.53
Above R$ 60.000.001	6	2.47

Source: Own Calculations.

There has been an effect on the producer cooperatives. As noted above, the central cooperatives used to dominate the pasteurized milk segment, and they have been the most affected by these changes. All cooperatives currently produce UHT, even very small ones with scale disadvantages. However, the pasteurized milk was mainly sold by co-ops that were protected from competition because, with

pasteurized milk being more perishable and requiring cooling storage and transportation, they were able to dominate their local catchment area. Nestlé and Danone have never sold pasteurized milk.

From the 243 companies in the sample, four didn't want to declare their sizes. As expected, a large share, more than 65% of the companies are classified as small companies in the two first categories.

In this study the production function is specified in a Cobb-Douglas[19] functional form.

3.4 Results

Table 3 reports the results of the posterior means, standard deviations and 95% credible intervals with respect to inputs and the variance parameters.

Table 3-3: Posterior means, standard deviations and 95% intervals with respect to inputs and the variance parameters

Variable	**Mean**	**Std. dev.**	**95% Credible Interval**
Constant	0.303***	0.049	[0.220, 0.382]
Transport costs	0.003$^{n.s.}$	0.013	[-0.018, 0.025]
Labor	0.324***	0.048	[0.246, 0.403]
Production capacity	0.795***	0.037	[0.733, 0.856]
Constant	2.416***	0.545	[1.563, 3.352]
Used capacity	1.741***	0.229	[1.389, 2.138]
Dummy for cooperatives	0.913*	0.509	[0.175, 1.824]
Dummy for different payment criteria	- 0.146$^{n.s.}$	0.356	[- 0.741, 0.425]
Type of inspection service	- 0.346**	0.186	[- 0.649, - 0.038]
σ_u	8.215	1.220	[6.353, 10.349]
σ_v	0.352	0.026	[0.311, 0.397]

Source: own calculations.

Significance levels: ***/**/* denote significance-level of alpha at 1, 5 and 10 per cent levels, respectively.

[19] The translog would be preferred since it is a flexible functional form that does not impose any restrictions on substitution possibilities between inputs and outputs. However, the formal model comparisons based on Bayes factors suggest that the data favor the Cobb-Douglas specification against the translog. The test results can be provided upon request.

The elasticities of labor and total capacity are significant as their respective credible intervals do not contain zero, and positive fulfilling the monotonicity condition. The positive output elasticities in respect of these inputs indicate that if labor and total capacity increase by 1%, output grows by 0.32% and 0.79% respectively. The result on the scale elasticity of 1.12 corroborates, revealing that companies operate under increasing returns of scale.

The mean value of technical efficiency of all firms is 77%, meaning that firms can, on average, increase their production by 23% using the same amount of inputs. This percentage represents the relative measure of TE in comparison to the most efficient companies in the respective sample. Figure 1 presents the histogram of distribution of the companies' TE scores.

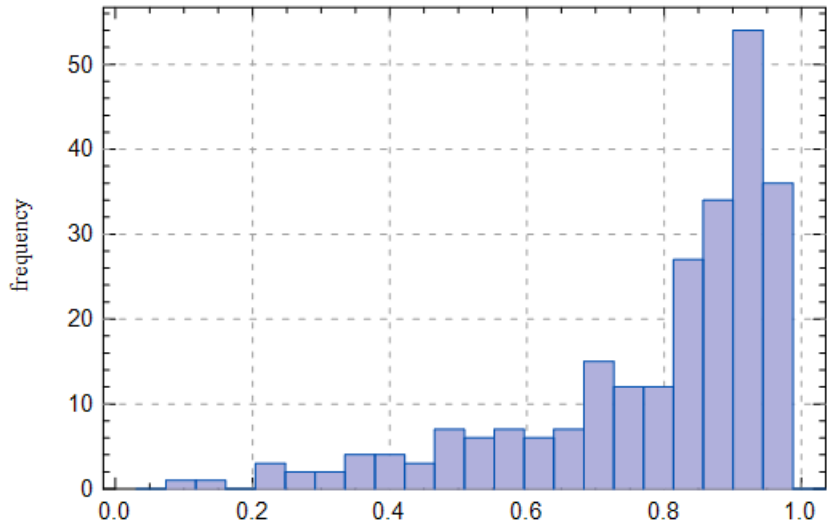


Figure 3-1: Histogram of Technical Efficiency scores

Source: own calculations.

As expected, most of the companies are concentrated in the upper levels of efficiency, so likely to be the more competitive ones in the sector. However, a significant number of companies are also seen at the very low levels, 45 companies are below 0.6, indicating passiveness amongst the less competitive companies in the sector.

Since one of the main contributions of this study lies on the explanation of TE heterogeneity due to firm-specific characteristics, we derived the marginal effects of the variables in z on TE. These marginal effects were calculated at the mean values of the variables in z and are presented in Table 4.

Table 3-4: Marginal effects of the variables in Z (inefficiency determinants) on technical efficiency

Variable	Mean	Std. dev.	95% Credible Interval
Used capacity	0.224***	0.032	[0.172, 0.277]
Dummy for cooperatives	0.086*	0.037	[0.022, 0.145]
Dummy for different payment criteria	- 0.015 n.s.	0.043	[- 0.082, 0.056]
Type of inspection service	- 0.045**	0.025	[- 0.086, - 0.005]

Source: own calculations.

Significance levels: ***/**/* denote significance-level of alpha at 1, 5 and 10 per cent levels, respectively.

Three out of four marginal effects are statistically significant. As expected, higher used capacity in processing plants increase the efficiency of the firms. In this regard, an increase in used capacity of 1%, leads an efficiency increase of 0.22%. It is also very likely to affect the efficient use of the input total capacity. Figure 2 shows the strong relation between technical efficiency and the used capacities.

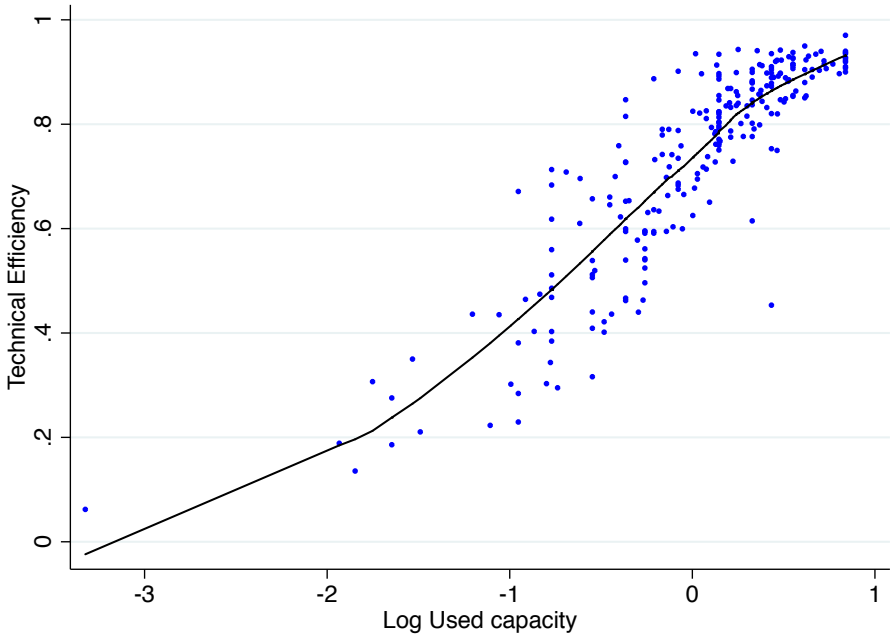


Figure 3-2: Scatter plot of technical efficiency and (log) used capacity of processing companies

Source: own calculations.

The dummy for cooperatives highlights the point that cooperatives are in general more efficient than their IOF counterparts. We assume the objectives of cooperatives are simply to maximize company profit. Cooperatives are in general 0.08% more

efficient than IOFs. The average efficiency of cooperatives is 83,4, while the IOFs is 76,4.

The payment criteria for different volumes of milk is not significant, so firms are not more or less efficient in paying prices to producers based on quality or other characteristics of the milk.

Differently from expected, the companies linked to the inspection services that are more restrictive on sanitary and quality parameters for dairy products are shown to be less efficient. The most restrictive is the Federal (SIF), then the States (SIE) and then Municipals (SIM) respectively. Companies moving from the SIM to SIE or from SIE to SIF, decrease their efficiency in 0.04%.

3.5 Discussion

1. The results on scale elasticity show that companies operate under increasing returns to scale, which suggests, that there is some potential for firm growth or structural change. Indeed the sector includes a large number of small, very labor intensive processors but also some few large processors. Tybout (2000) argues that in many industries within developing countries, large numbers of microenterprises and a handful of modern, large-scale factories produce similar products side by side. The small producers frequently operate partly or wholly outside the realm of government regulation and rely heavily on informal credit markets and internal funds for finance. They are relatively labor intensive, so they account for a larger share of employment than for output. Unskilled labor and the lack of long-term finance create incentives to economize on fixed capital items. Since most machinery and equipment must be imported, the trade regime and lack of local technical support may further compromise the competitiveness of small processing companies in underdeveloped markets (Tybout, 2000).

The results reflect the ongoing structural change in the milk processing industry in Brazil. The dairy sector in this region, as in the entire country, is undergoing a process of restructuring. Since the early 1990s to the present, Brazilian dairy processing has been consolidating and undergoing a process of rapid multi-nationalization but has yet to achieve its most efficient size. The rise of supermarkets and the deregulation of the dairy market, that occurred from 1989 to 1993, freed retail and farm prices which brought a sharp increase in competition as firms began competing vigorously on price and cost cutting. That led to the entrance of large multinational processors in the sector (Carvalho, 2008; Chaddad and Jank, 2006).

National companies were slow to respond to this path of consolidation. Political and management problems typical of such companies retarded the consolidation process. Our result suggests a margin for growth through expansion and/or mergers, keep the process of consolidation of the dairy sector in Brazil moving (Chaddad, 2007a). Examples of successful fusions of dairy processing companies are present all over the world. We could mention Fonterra, Arla Foods, Dairy Farmers of America (DFA), Friesland-Campina, DMK, Lactalis/Parmalat, amongst others.

The drivers of such fusions were the structural changes in the food industry, consolidation of the productive sector, high price volatility in the 1990's and little growth in consumption. These drivers increased competitiveness and forced firms, mostly cooperatives, to gain scale and improve their operational efficiency in order to compete with private companies (Chaddad 2007a). Similar developments have been observed in Brazil over the past several years. Nevertheless, the proportion of organizations using this strategy remains low, either because of disorganization in the sector or internal conflicts. This point is also reinforced by companies' total capacity not being adjusted over the long-run and idle capacities existing likely because of management problems, not because of any external shocks as seen above.

The size distribution of companies in the country may be explained by different factors such as the **degree of enforcement of regulations and taxes**. Rauch (1991) shows that when larger firms face higher unit input costs, the entrepreneurs exploit big firms' productivity advantages, so the extra profits they earn from being big more than cover the higher input costs they must pay. Other entrepreneurs prefer stay small and informal, dodging taxes and regulations to reduce costs. The size distribution exhibits a "missing middle" because it never pays to be just large enough to attract enforcement.

That remains true for the country's dairy sector, but it has been changing over the past several years. In Paraná for example, 79.4% of the processing companies are micro and small companies, which are responsible for 15.8% of processed volume, while the 9.7% large companies are responsible for processing 65.9% of the volume. The development of institutions in the country, de-bureaucratization, improvement of educational levels (professionalization) as well as government incentives to companies are changing this figure and, in Paraná for instance, 11% of processing companies are medium size and process 18.3% of the volume.

However heavy regulation does not explain the size distribution of companies in Brazil entirely; less urbanization and under-developed

transportation networks in some areas create high demand spots leading to small-scale, localized production. Another factor is the dynamic formation and exiting of microenterprises in the processing segment (93% have existed for less than 20 years). In Brazil the dairy sector is seen not only as a shelter for farmers excluded from other sectors, but also for workers unable to find employment in the formal sector. These create their own microenterprises to survive, but with little or no managerial experience. To provide a picture, in Paraná family-based management occurs in more than 70% of companies, predominating among micro-enterprises (96% of cases). This is likely to explain the dynamic of microenterprises constantly entering and exiting and, in turn, the size distribution.

2. The heterogenous results on technical efficiency suggest the coexistence of "dual structure" in the milk processing industry in Paraná. There are zones where milk production and processing are concentrated with a high level of technology adoption, marketing campaigns and professionalism. In parallel, there are zones where small family-farms and producers' cooperatives for milk collection predominate. In fact some of the sharpest deviations of actual from potential output occur in primary producing countries, and in many cases have a demand-side source (Solow, 2001). In developing and emerging countries dairy consumption is not only very sensitive to incomes, but in addition to any decline in consumption, the milk sector is also very sensitive to any production surplus, increases in input prices or decrease in output.

The companies with efficiencies below 0.6 are most likely those in the verge of exiting the market (which unfortunately cannot be captured by this cross-sectional data.) However, if that's not the case, these companies remain active for any reason that may guarantee them a market for their products. It could be the remoteness and the anti-competitive effects in some areas ensured by a monopolistic/monopsonistic position with a niche market. These firms are offering the sole choice of dairy products to some costumers and in some cases acting as the only buyers of milk from the farmers.

Adding to this, some companies were recently created with the sole purpose of taking advantage of governmental programs for institutional purchase like the "Programa Leite das Crianças" ("Children's Milk" Program) or the "Programa Leite do Paraná" (Paraná's Milk Program). Generally, such companies are new to the market, and have government purchases as their core business, which generates strong

dependence. In these cases, there are fewer incentives to professionalize the management or design marketing strategies or become more efficient.

Strong criticism on the effectiveness of such government incentives in the agricultural sector is attributed to Schultz (1964). In his "poor, but efficient"-hypothesis he states that the provision of agricultural incentives will be ineffective in improving productivity and incomes when investment opportunities are limited. For instance, in developing and emerging countries such opportunities could be limited due to technological access and good managerial practices or even credit access. Therefore, the end of governmental incentives generally determines the end of such firms.

3. The results show that the installed and used processing capacity in a firm is closely linked to its technical efficiency in milk processing. The results show, that technical efficiency is higher in firms with large used capacity. On the other hand, it is important to highlight that we assumed that production technology operates at static cost-minimizing input levels, where all inputs are fully adjusted to their long-run equilibrium levels within one period. However, 'total capacity' could be assumed instead as a quasi-fixed input, i.e. not completely, instantaneously adjusted in response to changes in factor prices and at no cost. This would imply that companies presenting idleness in the short-term, may not present it over the long-term, as their total capacities are adjusted over time. A formal test of such long-term adjustment to this quasi-fixed factor (total capacity) would confirm if those companies are indeed over-capitalized and operating with inefficient idle capacities or instead, achieve long-term equilibrium with total capacity optimally adjusted (Kulatilaka, 1985; Morrison, 1985). In the latter case, companies may still have idle capacity due other management shortcomings, but its dimension would be rather smaller. In fact, a previous study on the same area ((Beber et al., n.d.), *in preparation*) provided us a strong indication that idle capacities are mostly due to management and therefore we decided to include this variable in the efficiency model. In this parallel study we conducted semi-structured interviews with managers and directors of processing companies in this region asking directly about the existence and the sources of 'idle capacities'. Most of the interviewees confirmed the existence of long-term idle capacities (even in high season periods) due to disputes in supply control, a lack of loyalty amongst suppliers and poor management planning of processing among others ((Beber et al., n.d.), *in preparation*), reinforcing our decision. It therefore could not be considered a short-term effect of cyclical

fluctuation. It is also not possible to attribute these 'idle capacities' to an inflationary pressure on costs of changes in aggregate demand. Since 2009 inflation has been under control and demand for dairy products has been increasing in Brazil. Companies therefore had margin to expand.

This indication of 'over-capitalization' may also have an historical explanation. During the 1980's and 1990's, investment credits were given to cooperatives and other agricultural processing companies without technical and managerial support. So huge unplanned investments were made with these subsidized loans, with the building of large processing plants without any strategic plan for their supply or commercializing their production. Idle capacities were therefore created (Escher, 2011a) which may persist over time.

4. The technical efficiency is strongly influenced by the organizational form, showing, that cooperatives are more efficient than their private counterparts. This result corroborates the findings of other studies Singh et al. (2001) and Soboh et al. (2014), which found cooperatives to be more efficient. It is however different from studies that found IOFs to be more efficient such as Porter and Scully (1987) and Ferrier and Porter (1991). As previously mentioned, technical efficiency measures could vary highly depending on the performance objectives of the cooperatives, i.e. what the cooperatives intended to focus on.

Chaddad (2007a) showed that cooperatives usually add value only in the initial stages of the industrial process. Furthermore, and with few exceptions, agricultural cooperatives in developing countries are generally not well prepared to develop a competitive and efficient commercialization model (Ruiz-Guerra and Molina-Moreno, 2014), which increases dependency on other companies to marketing the farmers' production. Scarce capital for investments and their organizational characteristics in general, usually slows down the development of such projects (Cook, 1995). However when accounting for the specific objective of the cooperatives, they may outperform the IOFs (Soboh et al., 2012). Bontems and Fulton (2005) show that the alignment of the objectives of the cooperative and its members provides advantage over the IOFs. Soboh et al. (2014) using data of European dairies show that cooperatives have higher physical productivity but are also more marketing efficient. The descriptive statistics in 'table 1' shows that cooperatives have 3.3 times higher outputs than IOF, but both have similar used capacities around 50%. At the same time cooperatives have only 1.26 times higher the maximum distance of transport, and 1.72 times higher the labor. That means that cooperatives are indeed using their

inputs more efficiently than IOFs contradicting Hind (1999), who argues that cooperatives are less efficient in input use.

In Brazil the cooperatives used to dominate the pasteurized milk segment. They were protected from competition because, with pasteurized milk being more perishable and requiring both cooling storage and transportation, they were able to dominate their local catchment area (Farina, 2002). Technological progress (UHT and air-tight carton packaging) allowed milk to be conserved for a longer period and its transport over greater distances. Milk then became a commodity and the sector grew even more concentrated in industrial zones. This development undermined the main advantage of cooperatives; their local collection and distribution, where (especially in the dairy sector) transport costs are high (Frenken, 2014). Thus, cooperatives had to adapt to this new market context in order to remain competitive along the years. In fact, the more conservative financial structure of the cooperatives may bring advantages for dealing with such changes of context and policies. Using financial indicators, Soboh, Oude Lansink and van Dijk (2011) demonstrate that cooperatives have a stronger financial position than the IOFs and are well equipped for making investments necessary for such adaptation. They are on average less profitable, but pay higher prices to farmers being more attractive, operating more efficiently.

5. Surprisingly, the quality payment top-up does not influence technical efficiency of the processing firms. This measure alone is perhaps not sufficient to encourage farmers to increase milk quality by improving management techniques or investing in new technologies. Consequently, companies do not have access to better quality milk and it is not making them more efficient. One third of them declared to have different payment criteria, for almost all the large companies, but less than 25% among the small ones.

6. Inspection service shows a direct effect on the firm's efficiency. This result shows that companies facing more strict sanitary conditions are less efficient. However, the sanitary controls may be not the reason for the decrease in efficiency, but the market region. The average score of companies adopting SIE and SIF is similar of 77.2, however those adopting SIM have a higher score of 78.1.

Companies adopting the SIM are only allowed to sell their products inside the municipality and generally such companies are specialized in more specific added-value products. They generally don't compete for the low-added value products such as drinking milk, butter or powder-milk for example for obvious reasons such as scale of production. This result is probably explained by the scope of products produced to

attend such markets. Products having higher added value like special cheese, yogurts, *dulce de leche*, among others. For that reason, they may be competing in niches or local markets with products permitting them to be more efficient in the processing and commercialization of raw milk (Shani and Chalasani, 1992).

It is important to mention that more restrictive inspection services also allow companies to sell their products over a larger area of the country and also to export, in the case of SIF. This larger market access should induce higher efficiency since more exigent consumers demand higher quality and improved sanitary standards but can also provide a more stable demand. However, this objective can only be achieved through better management and marketing strategies in a competitive sector (Porter 1980).

Our results show that companies acting in smaller, niche markets, normally those acting in the municipality level have a higher technical efficiency. The Ministry of Agriculture, Livestock and Supply (MAPA) in Brazil, intends to consolidate the national sanitary inspection systems and create the Brazilian System of Animal Products Inspection (SISBI-POA). This consolidation would have the effect of leveling sanitary parameters in accordance to the current SIF. This measure would demand better sanitary conditions of the whole sector, but also provide increased market access for companies and producers. The drawback would be that companies not able to afford the necessary improvements would exit the market. A time for adaptation and a follow-up, transition process must therefore be carefully considered in order to avoid unnecessary prejudices.

3.5.1 Conclusions and Recommendations

This article specifies a stochastic production frontier and estimates the technical efficiency and its determinants for processing companies in the State of Paraná in Southern Brazil. The dynamic scenario for the rural dairy sector combined with industry concentration is making the abilities of companies to compete more effectively a vital feature for their survival and progress. By identifying the determinants of the TE we have provided policy-makers and managers with a useful tool, with which to design measures that can increase firms' performance. Ensuring good performance in such firms is not only very important for economic growth but also for rural development. In most cases, they are the main source of information and consequently the drivers of efficiency improvements in the rural areas, especially in sectors based mainly on small farmers. In developing countries the flow of

information and consequent efficiency in such sectors is top-down, cascading from retailers and processing companies to the farms. Those firms may therefore be the providers of credit and missing technologies to promote efficiency gains in a specific industry. This assertion is further reinforced because of the remoteness of some regions and their monopsonistic structures, which are very common in the agricultural sectors of developing countries. Assuming that the more efficient those companies are, the better technical assistance they are able to provide to their farmers, if predatory behavior are non-existent.

Descriptive results show that cooperatives have higher outputs, and the determinants of efficiency also show cooperatives being more efficient. They possibly operate at a more efficient scale than the IOFs, but also adding more value to the final products. Despite being more efficient, this organizational form provides several benefits to the farmers besides the monetary, and therefore should be supported by specific public policies.

The determinants of inefficiency captured in this study of Southern Brazilian companies relate to reducing their idle capacities and management shortcomings in order to improve efficiency considerably. Since companies operate under increasing returns to scale, increasing the size of companies through mergers and/or acquisitions or organic growth would lead operations at a more efficient scale, specifically for the IOFs, which are smaller than the cooperatives. Fusions should be carefully managed and organized, otherwise they could enhance the monopsonies in some areas, generating anti-competitive effects, lowering returns to farmers, increasing the risk in farming activities and cutting-off more farmers and small companies; especially cooperatives (Rozanski and Thompson, 2011). Outsourcing production and the development of strategic alliances may also reduce idle capacity in dairy firms, particularly when combined with technical assistance measures to reduce production seasonality among farmers. Strategic alliances and outsourcing are indeed powerful management tools, not only to mitigate the consequences of bad infrastructure in the chain but also in any process in which the company is not able to perform efficiently. It is vital to improve the costs structure, global efficiency, reduce idle capacities and, most important, react rapidly to market changes (Winkleman, Dick and Lee 1993; Duque-Ceballos, González-Campo and García-Solarte 2014, Lakner et al. 2017). Other advantages of externalizing are lower competitive pressure, reduced investments in infrastructure, improved quality and efficiency plus fewer administrative and operational problems (Fill and Visser, 2000).

Another important result regards the adoption of the different inspection services. More restrictive ones regarding the sanitary characteristics of products decrease the efficiency of companies. However despite companies adopting SIM show more efficiency, that doesn't mean that less care about the sanitary measures is the reason of such higher efficiency. The literature shows evidence that higher sanitary measures may lead the stakeholders to access further markets in modern supply chains (Dries et al., 2009), but the necessary investments to meet such requirements may lead companies to exit as well (Noev et al., 2009). Some firms access more markets by achieving higher standards, but small companies go bankrupt when such standards are simply imposed. Therefore support for the transition period must be provided in order to avoid such exclusion and further studies must bring more insights into this paradox caused by the higher quality and sanitary standards.

This study provide an insightful contribution to the literature on technical efficiency in the agribusiness sector with the assessment of an important primary database on dairy processing companies in southern Brazil. A limit of this study lies in the estimation of the output index variable, since companies were not willing to disclose their total revenue. Our estimation may be missing information on products' value added, innovations, regional dominance and other factors influencing prices and hence revenues, whether up or down. Changes may occur for the most technically advanced companies but we do not expect many of them. Overall our results suggest a set of determinants that should be targeted at actions aiming to improve the technical efficiency of dairy processing companies in Southern Brazil, a prominent strong competitor in the global dairy chain.

Chapter 4: Dairy Supply Chain in Southern Brazil: Barriers to Competitiveness[20]

4.1 Introduction

The Brazilian dairy industry has experienced a rapid and significant growth since the 1990s, mainly driven by the production in the mesoregion "Grande Fronteira do Mercosul (GFM)", located in Southern Brazil[21]. Its production is mostly based on family farms and cooperatives and, as the dairy sector becomes increasingly competitive, is growing faster than in all the other regions in the country (Anschau, 2011). For instance, in 1992 the Brazilian milk production accounted for only 15.8 billion liters. In 2006, production quantities had increased to 25.4 billion liters of which 13.3% was produced in the GFM. By 2015 it was already the largest dairy production area in the country, accounting for roughly 18.5% (6.46 billion liters) of the national production of 35 billion liters. 420 companies were responsible for the collection and processing the raw milk of 288 thousand farms in the Southern region (IBGE, 2017). The dairy production has a high socioeconomic importance[22] in this region, generating incomes and jobs.

However the dairy sector in the whole country, including the GFM, does not show the high competitiveness traditionally present in many Brazilian agricultural sectors such as soybean, maize, pork, poultry, sugarcane and beef (Helfand et al., 2015; Mueller and Mueller, 2014). The domestic dairy production has not been able to supply the internal market with products of higher quality and quantity, even less to the export market that is more stringent in terms of quality and regular demand. Given this context and the pressure of the economic environment, which is increasingly competitive, cooperatives and some national private companies have

[20] A shorter version of this chapter is under review at 'IFAMR - International Food and Agribusiness Management Review' as Beber, C.L., Ruales, A., Almadani, M.I., Theuvsen, L. "Dairy Supply Chain in Southern Brazil: Barriers to Competitiveness".

[21] The South of Brazil comprises three states: Paraná, Santa Catarina and Rio Grande do Sul.

[22] In GFM 60% of the farms produced milk as their main or secondary product in 2006. That makes a total of 182 thousand farms producing milk. According to the IBGE (2006), this milk generated US $396 million in total in the same year, representing 9.2% of agricultural GDP and 2.7% of the total GDP in the GFM – which, in turn, corresponds to an average of US$ 2000 per farm/year.

been facing hard challenges to compete and persist in the market, especially in GFM. Their collapse would see the exclusion of small producers from the market, and the reduction of a source of income and employment for those families. Therefore improving the competitiveness of producers and processing companies in this supply chain may generate important socioeconomic gains in this area.

Competitiveness has different origins depending on the sector assessed (Kennedy et al., 1997). What is known is that those factors are framed by the external conditions: the politico-economic situation, technological conditions, and market characteristics (Porter 1980), among others. But given that external conditions are the same or similar across a country, in our case Brazil, why does the dairy sector present such a competitiveness gap when compared to other agricultural sectors? It is a controversial issue that must be addressed by this emerging economy from a rural development and economic growth perspective.

It is important to note that as an emerging economy, some sectors will be more developed than others indeed, in some cases serving as an economical subterfuge to encompass the less favored population still existing in those countries. Therefore the next step in the national development plan must be to prioritize the inclusion of the work force in those areas in a more professional, competitive and global modern supply chain. To this end, we conducted this study to investigate what were the main problems faced in the dairy sector, what the possible drivers of competitiveness and why it is less developed compared to other agricultural sectors in Brazil.

The analysis of competitiveness requires the examination of the underlying factors that influences the individual firms and industries (Batalha and Souza Filho, 2009; Kennedy et al., 1998; Martin et al., 1991), but there is little consensus in the literature on how to measure it. In our analysis, we adopted the framework proposed by Harrison and Kennedy, (1997). They suggest five primary sources of competitiveness that might affect the firms' profits and market shares (Porter, 1985). These sources are: technology, attributes of purchased inputs, product differentiation, production economies and external factors, which can provide superior levels of competition to firms, when improved.

Different factors have been identified in the literature that might influence those sources, serving as possible drivers of companies' competitiveness (or its lack). Technology diffusion and adoption is considered to be one of the most important (Solow, 2001). It would drive competition by originating structural changes, contributing to efficiency and productivity gains, improvements of working

conditions, and cost reduction and provides high responsiveness in a constantly changing environment (Schwab et al., 2015). This feature becomes especially evident in emerging economies where increases to the middle-class population are shifting consumer preferences from the massive consumption of bulk products to quality consumption of more differentiated food products. Other factors identified in the literature include professionalization of human resources; availability of technical assistance; well-planned investments; adequate infrastructure and policies; productivity; access to external markets and the quality of management among others (Carraresi and Banterle, 2015; Chaddad, 2007a; Ndiaye et al., 2015; Nivievskyi, 2012). Market actors and their linkages (vertical and horizontal coordination), collective actions and supporting industries, for instance service providers, also have a particular importance in the dairy supply chains and might affect the competitiveness (Albu and Griffith, 2006; de Brito et al., 2015; Farina, 2003; Hudson, 1990).

However there are only few studies which attempt to provide an analysis of competitiveness through looking at the processing stage of a supply chain in an emerging economy context, where some areas and sectors show indices of developed countries, alongside to others with indices of developing countries. That is one of the interests in GFM, in Southern Brazil, which has a large amount of family farms present in the zone, and the dairy sector has a high potential in contributing towards the livelihoods of these families. In this light, the GFM case might be seen as a blueprint for similar sector conditions in many emerging and developing economies. This study gives a global perspective on the supply chain, drawing management and policy recommendations derived from information provided by industry leaders. To our knowledge this is the first study using this approach for the GFM dairy supply chain.

The remainder of the chapter is organized as follows: in the opening section, we present a background on competitiveness for the GFM. In sequence we describe the methods employed followed by a description of the data. Next, the major results are presented and discussed. Lastly, the article ends with the conclusions and policy implications.

4.2 Competitiveness of GFM Dairy Supply Chain

Several definitions of competitiveness are found in the literature, which might focus on the different sources and indicators of competitiveness depending on the research

objectives of each study (ex.: Cook and Bredahl, 1991; Feurer and Chaharbaghi, 1994; Kennedy et al., 1997); but little consensus exists. Porter provides a well-accepted and largely adopted definition of competitiveness: 'the ability to profitably create and deliver value through cost leadership or product differentiation (customer value)' (Porter, 1980). It was further extended to include indicators of competitiveness: 'the sustained ability to profitably gain and maintain market share (Porter, 1985).

In a dairy supply chain perspective, both cost leadership and the customer benefit approach are applicable. Downstream, product differentiation is essential for companies to achieve a competitive advantage, but since a large number of close substitutes exist in the markets where they operate, prices and costs must not be neglected. Companies' costs might also highly vary because of management shortcomings and inefficiencies on the processing plants. In GFM dairy supply chain, companies face a high competition for both resources (milk purchase) and for sales of dairy products. Therefore the definition of competitiveness provided by Cook and Bredahl, (1991) seems more appropriate and it is adopted in this paper. It is itself a further extension of Sharples and Milham's (1990), and Porter's (1985) definitions. Cook and Bredahl, (1991, p. 1472) define competition as the "ability to deliver goods and services at the time, place, and form sought by buyers at prices as good or better than other suppliers while earning at least the opportunity costs on resources employed" in a specific market. Therefore according to this definition, in order to understand more specifically the mechanisms refraining or boosting the competitiveness capacity of dairy supply chain in GFM, in the next paragraphs we will situate it in an agribusiness context.

Despite the large potential, significant investments and the fast development of the agricultural sector in Brazil, the dairy supply chain is suffering a much slower process of improvements with regard to productivity and modernization. Today the dairy sector runs far behind, in terms of competitiveness, compared to other sectors in the country's agriculture such as soybean, maize, pork, poultry, sugarcane and beef where the modernization started earlier and received many incentives (Helfand et al., 2015; Mueller and Mueller, 2014). This also holds true in comparison to the dairy sector of neighboring countries, such as Argentina and Uruguay, and other countries with similar production systems and environmental conditions. The Brazilian dairy sector has not exploited its full potential. To illustrate, take a closer look at a few indicators and characteristics of this supply chain.

Although ranking fourth in the world production of milk and showing a constant growth, Brazil presents an extremely low productivity in dairy farming, with less than 1600 kg/animal/year (97th position in productivity ranking of FAO), while New Zealand for example, with a similar pasture-based system and pedo-climatic conditions like Brazil, produces approximately 4500 kg/animal/year. The neighboring countries Argentina and Uruguay also show higher productivities, 5646 and 2890 kg/animal/year respectively in 2014 (FAO, 2014). This is also indicated by sector statistics of the three states in GFM (Rio Grande do Sul, Santa Catarina and Paraná). Thereby, the productivity average of these regions together in 2014 was 2790 liters/cow/year (see figure 1) (IBGE, 2016).

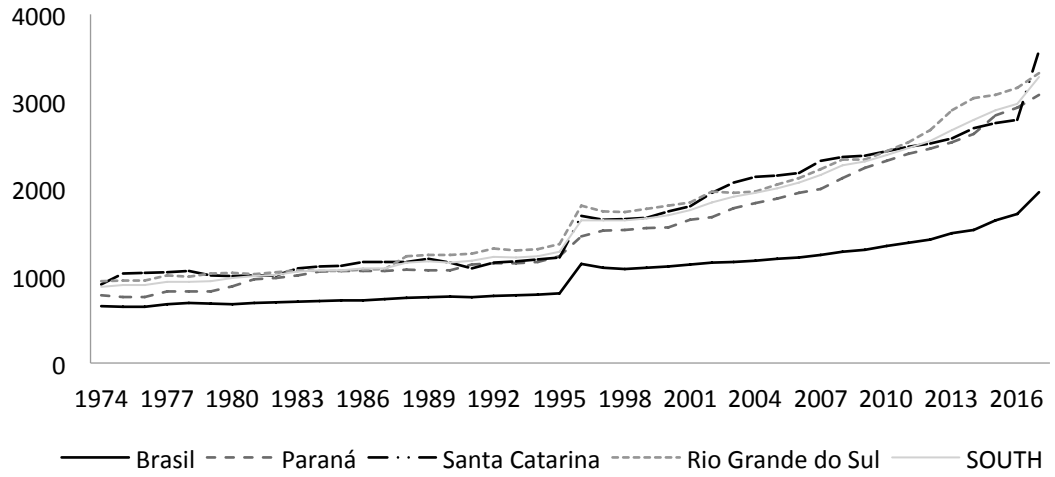


Figure 4-1: Productivity in liters/cow/year.
Source: Own calculation based on data from IBGE (2017)[23].

Only the state of Rio Grande do Sul reached the level of 3000 liters/cow/year in 2014 (IBGE, 2014), which was still very low in the international context.
The country's herd decreased to 17.1 million milk cows in 2017, while the productivity per cow increased by 29% (IBGE, 2017) led by Mina Gerais (62%) and Santa Catarina (33%), the most productive state in the country with 3,580 liters/cow/year. These recent developments highlight the structural changes taking place in Brazil and a higher technification of the production systems reflecting the efforts for efficiency and productivity gains.

[23] In 1996 a new agricultural census was conducted in the country, updating the real number of producing cows in the country, much less than estimated, explaining the sharp increase in the productivities in this specific year.

Despite recent improvements, the last agricultural census of the IBGE, (2006) presents parameters that show the reality of the low technology adoption in the dairy production at that time. For instance 'mechanical milking' was present in only 2.4% of farms representing 22% of the milk collected. Artificial insemination was present in 1.4% of farms representing 14% of the milk. Finally, only 11% of farms had cooling tanks.

This low technology adoption rates are also connected to low qualities of dairy outputs. A large part, 34% of the milk is still not complying with the quality and sanitary Federal Inspection System (SIF). In this regard, Brazil obtained the international sanitary certification to export to China only recently in the year 2015. In 2016 around 30% of the total milk production was self-consumed or traded in informal markets. About 1,969 companies processed the remaining 70%. Small farms predominate; 84% own less than 50ha corresponding to 60% of the total production quantity and 45% produced less than 10 liters/day (IBGE, 2017).

The country became self-sufficient in dairy production only in 2003. Thus, as the production increases, raising 315% from 1980 to 2014, reaching 35bn liters, some of the sector's stress has been shifted to processors, who are now adjusting to a new reality by increasing their scale and professionalizing in order to become more competitive. The national dairy processing companies have been struggling since the 1990s, when a late process of supply chain modernization started, in which institutional changes were implemented such as trade liberalization, deregulation of prices, imposition of public and private quality and safety standards and the creation of the sub-regional trade bloc *Mercosur* (Chaddad and Jank, 2006). But even today, these processing companies are not able to supply the domestic demand with products of higher quality and quantity, even less to export. This is reflected in the trade balance, which is historically negative (figure 2).

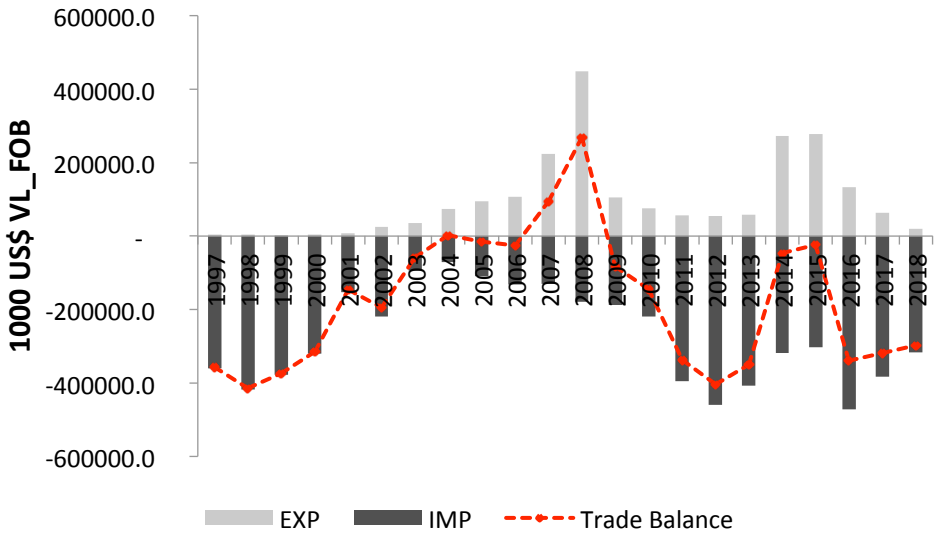


Figure 4-2: Trade balance historic of Brazilian dairy production
Source: Own calculation based on data from MDIC (2019).

In 2016 the trade balance of added value dairy products such as cheese, yogurt and derivates summed up to US$ -141 million FOB, while the country's exports from the whole agriculture and agro-food industries totaled over US$ 71 billion in 2016 (US$ 60 billion positive balance), accounting for more than 40% of total national exports (FAO and OECD, 2015; IBGE, 2017). This represents the gap that exists between the dairy and the other agricultural sectors in the country. Another unfavorable indicator is the decreasing share of processed products in these exports, declining from 69% in 2007 to 56% in 2016 (MDIC, 2016), representing a lower industrial intensification of added value products. In this regard low added value products such as basic cheese, powder milk, fluid milk and butter represented together 93.3% of the milk used in the industry in 2006 (Carvalho et al., 2007). Brazilian dairy exports account for less than 1% of the total world exports (FAOSTAT, 2019), being 2008 the best year, where it achieved 1.3%, representing a low market share in the international market.

Previous experiences in the restructuring of modern globalized supply chains of other Brazilian agricultural sectors, such as pork and poultry in Southern Brazil for instance, revealed an intense exclusion of farmers initially and a subsequent inclusion of the remaining farmers on higher value markets (Escher, 2011a; Ferrari et al., 2005). Most of those excluded farmers migrated to the dairy production and decided then to integrate and formed traditional cooperatives for milk collection and processing to overcome the power of buyers, controlling the processing chain link and

the prices at this step (Chaddad, 2007a). However the low productivity of small producers and the poor infrastructure of rural areas in Brazil increases a lot the costs per unit of output, especially for those cooperatives which collect the milk of smaller producers in remote areas (Carvalho, 2008) and thus, have an important social role. And today, after a late initiative started only in the 1990s, these companies are also facing a process of modernization with the consequent restructuration of the supply chain.

For instance, there is a path of consolidation amongst dairy processors in Brazil, a trend that has been active in the country's dairy industry over the last few years, and continues to intensify, accelerated by various economic challenges. For example, in 2007 the fifteen largest dairies processed 30.7% of the national production, yet until 2016 this number raised to 41.7%, with the two largest processing companies (foreign multinationals) processing together 14.3% of the total milk produced in the country (Milk Brazil, 2017). This means the exit of less efficient processors, not only cooperatives, but also private companies, and the exclusion of farmers.

For what concerns the government and professional institutions, in GFM they act by creating and proposing policies to promote the progress of the chain through studies and projects. But since this sector displays a huge competitive gap when compared to other agricultural sectors in Brazil, it leads us to believe that such actions are not sufficient or not efficient enough. Furthermore the government is not looking at the dairy sector as it did decades ago with other sectors, on which Brazil is among the most competitive suppliers on the planet. Producers of soybeans, corn, poultry, pork, sugar cane and beef receive(d) high-level technology funded by the government via EMBRAPA[24] and other institutes and credits with very low interest rates. They also had or still have access to the CONAB[25] for production stock among other support programs and good technical assistance. The dairy sector is still perceived as a "social shelter sector" to protect small and less professional farmers, preventing rural exodus and ensuring employment. However, this perception is changing and companies are pushing to enter the competitive market. So measures to enhance the competitiveness and support small producers and processors are fundamental, as they are in place in many countries. The executive-chief of EMBRAPA said that

[24] Brazilian Agricultural Research Corporation.

[25] Brazilian National Supply Company.

milk should be treated as a state matter: “It's like this everywhere in the world. There is no country that works with free trade regarding milk”.
This scenario illustrates the competitive position of the dairy sector in GFM and Southern Brazil, and the difficulties it is facing in order to improve it. In the next section, we go deep into the sector by interviewing different actors and asking about the barriers the sector faces and the strategies (factors) in place to overcoming them. We situate each of these factors in the framework of competitiveness sources of Harrison and Kennedy, (1997).

4.3 Methods and Data

The research was conducted in the Southern Region of Brazil, in three states that form the mesoregion Grande Fronteira do Mercosul (GFM) according to the national standard coding system. The mesoregion comprises the Southwest zone of Parana, the West of Santa Catarina, and the Northwest of Rio Grande do Sul (Figure 3). Qualitative primary data was collected between November 2016 and January 2017.

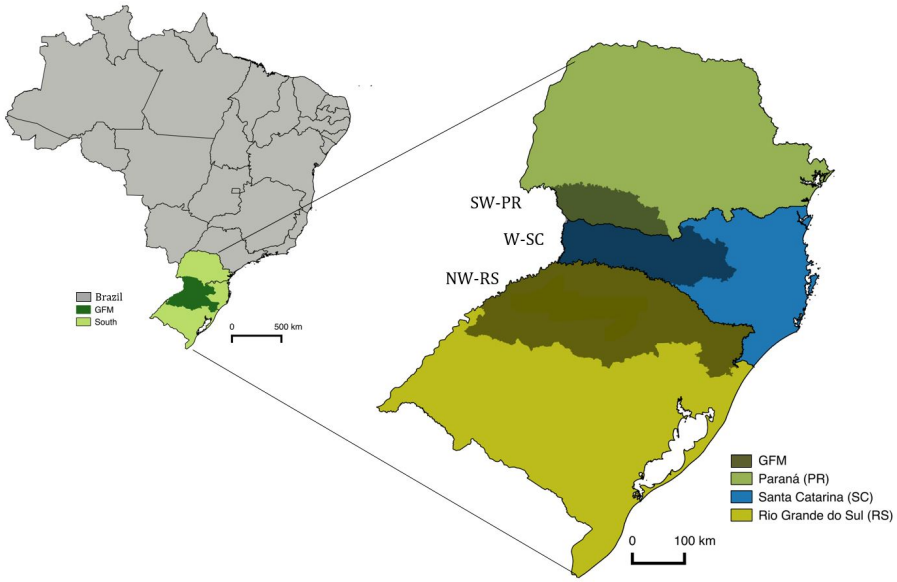


Figure 4-3: Map of Brazil with Southern Brazil and GFM highlighted (left). The three states of Southern Brazil and GFM shaded (right).
Source: Authors' elaboration based on data from IBGE (2014.).

For this study the sample size of twenty-six interviewees was set, across a spectrum of leadership roles in the dairy industry. We interviewed managers, directors and presidents of almost all the main dairy processing cooperatives and private

companies (all large and medium enterprises) in the region, in addition to the leadership of institutes, associations and unions involved in the dairy sector in the zone, to collect opinions from different perspectives in this economic activity. Out of the twenty-six persons interviewed, eight represented central cooperatives, four private companies, four non-governmental institutes, five unions, four governmental institutes, and one an association. By institutes here we refer to research and development and extension services institutes, unions and syndicates and governmental bodies, that is, all those not directly involved in processing (cooperatives or private companies). We chose the main companies with operations in the region and the main institutes carrying out important actions to promote the supply chain. Some of the companies or cooperatives interviewed are the largest in the zone, representing in some cases more than 6,000 producers and covering areas in more than one state. When considering the subsidiaries, associations and alliances, they are on a larger scale and these organizations are usually dispersed all over the country. Together, the milk processed by the private companies and cooperatives of the whole sample represents 55% of the total milk production of the GFM, so more than half of the chain volume (3.55 billion liters/year) passes through these processing companies. For confidentiality purposes the interviewees are identified in the text with numbers, ranging from *ID001* to *ID026*.

Data was collected using semi-structured interviews, which were individually prepared and guided to avoid missing important aspects of each respondent. Questions varied according to the target participants. They cover aspects of the background information of the interviewed and their relation/influence on the supply chain from an historical perspective; structural and organizational aspects; management aspects; governance environment; market dynamics and external factors; technology adoption and diffusion; attributes of purchased raw milk; product differentiation and commercialization channels; future expectations and actions. They intended to capture the main problems and strategies factors that might have any effect on the five primary sources of competitiveness proposed in the framework developed by Harrison and Kennedy, (1997) and the coordination between actors in the supply chain. Ten interviews were conducted in *Rio Grande do Sul*, eight in *Santa Catarina* and eight in the state of *Paraná*, showing a uniform spatial distribution in the zone. Each interview lasted around one and a half hour on average. In few cases more than one person from the same institute or enterprise were interviewed.

After collection, the information was transcribed and a discourse/content analysis of the qualitative data was performed including codification, first round of analysis and recodification. We identified how the elements are related between each other and how they affect the five primary sources of competitiveness. From this process, and from the fundamental topics investigated in this study, the 'problems' and 'strategies' emerged (according to the interviewees' perceptions). As a result ten factors were identified as the main restrictions and levers to the competitiveness of firms in this supply chain that directly or indirectly affect one or more of the primary sources of competitiveness defined by Harrison and Kennedy, (1997). The factors are: human resources; diffusion of technologies and techniques; quality and sanitary aspects; contracts; communication and loyalty; idle capacities; investments; transport costs; entry of large companies; and frauds.

4.4 Results and Discussion

In general, all interviewees agreed that it is necessary to have some changes and investments in the corporations and at farm levels in order to increase the competitiveness and improve the efficiency in the chain.

- *"Efficiency arises from increases in technical assistance, reduction of idle capacities, industrial management, cost management in the industry and farms, better inspection services, and the loyalty of farmers" (ID005)*
- *"Marketing, communication, management and invest more in RTDI (Research, Technology, Development and Innovation)" (ID023).*
- Leaders are aware that *"the main problems of efficiency and productivity are the lack of professionalization of the producers; immediacy of producers and industrials; lack of a deeper analysis and planning …" (ID024).*

Next, we are going to analyze the main results of the interviews and discuss them. They are subdivided in those ten subcategories mentioned in section 3, according to their relevance as a problem and/or a lever of competitiveness to this supply chain.

4.4.1 Human resources

The problem

One of the main findings of our research is that the **low professionalization of the human resources** on the production and processing levels of the dairy chain may be the principal cause of several other problems. Lack of skilled labor at the processing plants and management teams are perceived as huge problems. At farm

level, the problems are even more marked. Fifteen interviewees agreed that one of "the weakest point in the chain is the professionalization of the farmer management" (ID013) and that this significant problem needs to be fixed.

The strategies

To mitigate such problems, several companies offer different forms of training for their employees in order to *"promote the internal growth, giving scholarships up to 40% to the employees, internal training in leadership, regulation, results, quality …" (ID019).* Furthermore a *"…central [cooperative] offers training in management to the singulars [cooperatives]" (ID015)* as well as *"training to the technicians of the singular coops, and then those transfer the technologies to the farmers" (ID008).* Not only companies, but also governmental and non-governmental institutes offer different kinds of training, acting *"…mostly in the articulation and enabling of events such as training and talks" (ID005).* In total fifteen interviewees stated that they offer at least one or more types of training for the employees as well as to producers in many areas, including internal training, preparation for extension agents, field days, and others. The most frequently cited area of training was in management (mentioned eight times), followed by training in quality and hygiene (mentioned five times), and training for transporters (mentioned four times).

This problem is generally found in cooperatives where it is common that directors are in charge (elected) because of their political power inside the cooperative and not due to their technical or managerial specialization – a situation which often results in inefficiencies and high costs (Benson, 2014). A study conducted by the 'Brazilian Micro and Small Business Support Service' SEBRAE found that leaders and directors of cooperatives are not well prepared to confront the changes and transitions in the sector, since investments are made without any market evaluation or viability study, milk collection is deficient, and there are many conflicts between singular and central cooperatives, and predatory behavior exists between cooperatives (Jank et al., 1999). On the other hand Lopes et al., (2002) show that cooperatives which considered the professionalization in their management important, and made adjustments accordingly, had higher performance in comparison with those that considered the professionalization not so central. Theuvsen and Ebneth, (2005) also show that in order to adapt to new challenges in globalized agri-food markets, many cooperatives underwent a process of professionalizing their management and the cooperative sector as a whole reveals a wide spectrum of professionalism and consequently very diverse financial

performances. More educated managers may be able to use more diverse approaches for problem solving and decision making, which facilitates the adoption of innovations (Young et al., 2001).

It is not only the professionalization of private companies and cooperatives which are important for the development of the sector, but also the support of **Institutes**. They act mainly to propose policies, develop studies and projects to standardize and inspect the quality and sanitary aspects, or to promote the consumption of dairy products as well as training programs, among other initiatives.

The costs, quality and coordination of the human resources affect directly the competitiveness in the chain. Thus, in the framework of Harrison and Kennedy, (1997), the human resources may be viewed as an **Input** source of competitiveness. However the decision taken by people in all levels of the supply chain, including external factors may have an impact on other sources of competitiveness mentioned in the framework. Thus this factor must be foremost in all strategies aiming to improve the competitiveness of a supply chain.

4.4.2 Diffusion of technology and techniques

The transmission of technology and good practices for farmers is also affected by the low professionalization at the processing level. Companies' managers must be highly qualified themselves in order to provide such assistance. At the production level, Lacki, (1998) suggests that agricultural professionals should include in their objectives the transmission of knowledge to farmers in order to transform them into efficient and self-sufficient entrepreneurs. In this regard the World Bank is currently developing an exemplary project of how training and technical assistance can help to improve the competitiveness of farmers, private agro-firms, and development of rural communities in Uzbekistan. This results in the creation of new jobs along the entire value chain, increasing incomes, higher profits, and higher productivity (Khidirov, 2017). This factor also seems to be hindering the competitiveness in GFM.

The problem

The quality and productivity at farm level depends upon frequent and good technical assistance and the diffusion of technologies from processing companies. The current poor quality of assistance and its infrequent offering slows modernization of the chain. Interviewees recognized that *"the only way to improve [competitiveness] is by increasing productivity and making farms viable to produce (ID019) through good farming techniques and animal genetics" (ID007).* And this would only be possible through the diffusion of technology and techniques to producers. However only a

small proportion of farmers are highly specialized in dairy production, in some cases making the necessary investments not affordable.

On the other hand, training organizers also complain about the negligence of some farmers saying that *"producers are not bad because of missing information, all have access if they want, … but few producers participate" (ID017).*

The strategies

Some companies claim to offer a technical assistance, having *"…a department for the promotion of quality, nutrition, silage, hygiene" (ID019)* or even a *"a program of technical assistance to reduce the problem of seasonality. They work in the pasture, nutrition, pregnancy rate in the summer to search for stability in the production" (ID013).* In total thirteen interviewees stated that the sector offers technical assistance – though it is precarious and lackadaisical - and the most frequently mentioned fields are quality and hygiene, and animal nutrition. In addition, most of the entities, which offer this service, are cooperatives, hence underlining the importance of these organizations in technology diffusion and farm management, which is also in line with the study conducted by de Brito et al., (2015) in the dairy chain of Paraná.

Although we found signs that there are programs for **technical assistance and training** in GFM, companies and institutes should offer more programs, with more frequency, and more excellence; covering themes of production, management, as well as sanitary practice and quality. This is in line with the thoughts of some interviewees from the institutes who said that producers needed to increase quality because it will be a cutoff requirement, and payments for quality are inevitable in the near future, especially with the entry of large companies. But first it is necessary to work with and offer more training to producers to increase their milk quality in order to avoid further exclusions.

The diffusion of technology and techniques affect directly the **Technology** access as a source of competitiveness, by influencing the productivity enhancing and quality enhancing in the chain.

4.4.3 Quality and sanitary aspects

Ten interviewees agree that an improvement of these parameters is essential, the implementation of inspection and quality control systems will be especially important if the industry aims to reach international markets. *"In order to export, the country has to develop a program of quality improvements to reach the international standards" (ID004).*

The problem

"Quality and sanitary aspects are issues that must be improved in the supply chain" (ID012). The indices are too *"…variable and difficult for industry standardization" (ID015).* Five interviewees said that is difficult to establish payments per quality or solids content because the market itself (consumers) does not pay differentiated prices, in some cases also because cooperatives have internal disputes. Producers' disloyalty is problematic because *"…they migrate to other companies when they receive payments below the market value as a punishment for low quality. Some don't want to improve"(ID025).*

The strategies

It is possible that one of the first measures to enhance such quality, besides technical assistance, would be the payment for quality and solids. Indeed *"there is a tendency for payments per quality and solids because that's only what interests in milk production" (ID016).* In this case payments are made by protein content and fat content because these two components are crucial to manufacture products with high added value; there are, therefore, bonuses or discounts over the base price because of these nutrients. In addition to the composition (solids), the quality is also determined by sanitary factors: the somatic cells count SCC and the total bacteria count TBC, for instance. These, in turn, influence the price to be paid. The requirements are based on regulatory standards to protect the human health. The Normative Instructions 51 and 62 of the Federal Government regulate such standards in Brazil.

Andri and Shiratake, (2005) recommend that farms should work to **increase quality** and cooperatives should offer the proper price and strive for it. In large-producer countries, differentiated payments have been used for decades under the logic that paying for quality increases the benefits for producers and provides incentives to them to improve, consequently increasing benefits for the company (Madalena et al., 2001). Jank and Galan, (1998) consider that this problem is generalized in Brazil and the low quality of the milk that arrives at the processing stages discourages firms from differentiating prices.

Indeed, prices alone may not be efficient enough to transfer complex and rapidly changing information, especially regarding technological diffusion. Missing markets for information can slow adjustments on the part of producers and result in costly supply and quality shortfalls for firms that rely on spot markets for their product supply. Therefore, firms can solve the problem of missing markets for information by

internalizing the production process, or by employing production-management contracts (Key and Runsten, 1999). Production-management contracts are a good strategy to transfer specialized technology to producers. This is often the case in developing countries where firms want to locate a processing plant in a particular region but, at the same time, markets for inputs or services needed in the production are missing (Austin, 1981) – such as the case in GFM.

Quality and sanitary aspects affect directly the purchased **Inputs** from processing companies. The **Technology** and information access, and specific **External Factors** like governmental regulations supporting the inspection and extension services might improve them.

4.4.4 Contracts

The problem

One of the most frequently mentioned problems in the sector is the establishment and enforcement of contracts between producers and processors. Most transactions are done on the spot. At the processing level, the disincentive to use contracts with small producers and the high transaction costs involved - associated with providing inputs, credit, extension services and product collection and grading (Key and Runsten, 1999), including the time and costs involved in the enforcement of such contracts – are, again, major discouragements. Almost all the interviewed processors stated that they currently work without contracts with producers; some of them used contracts in the past, but not anymore. At the production level, many farmers do not want or do not like to work under formal contracts, this is for a number of reasons: the lack of information and communication between buyers and producers; they do not take the dairy production seriously, seeing it as a second source of income and do not specialize and professionalize on its production; the judicial system is not effective enough or because it is a consequence of the poor management skills at farm level. In the analysis we found three main reasons why contracts do not work properly: judicial processes; seasonality of production; disloyalty.

The general opinion is that *"…contracts don't work because there is no judicial safety to enforce them" (ID018), "…the judicial costs are too high" (ID021) and they "… could be very slow" (ID010).* Legal systems and crime prevention are poor in developing countries, especially in rural zones, and corruption represents a serious problem, so the protection of property rights and the contract enforcement can be problematic and costly (Brunetti et al., 1999; Tybout, 2000).

"There is also a problem with the seasonality of production, which makes it still harder to sign contracts" (ID012) where *"…production and prices are instable along the year." (ID004).* In GFM the months with highest production are August and September, and the months with lowest are April and May, which represents a difference of about 46 million liters in 2016 (IBGE, 2017). Managers find it difficult to comply with contracts in terms of volume. Even though they are aware that *"contracts would be interesting for warranties in volumes and prices, but seasonality is a huge problem to implement those." (ID015).*

Another major problem in implementing contracts is disloyalty and the free riders. *"Very infrequently contracts will be established for the sake of loyalty and selfish" reasons (ID005).* Companies "*…understand the importance of making contracts, but the producer does not" (ID014),* in many cases they often seek the highest prices regardless of who pays due to the lack of future vision and communication.

The strategies

No practical actions were identified among the interviewers for the establishment of contracts. To overcome missing contracts, other strategies to ensure the milk supply are used by the processing companies. The producers have created horizontal arrangements to reduce this problem. Cooperatives and associations were then formed, with higher volumes and lower frequency being transacted, thus, reducing its costs for the farmers. In this case the cooperatives incur these high costs, facing several difficulties as well, with the consequent abandon by its farmers.

Therefore a **good contracting system** should be enhanced and its benefits communicated to farmers ensuring their loyalty. It gives farmers the opportunity to improve and can reduce the price variations, increase incomes for poor farmers, and promote rural development (Alemu and Adesina, 2015; Andri and Shiratake, 2005; Key and Runsten, 1999). It must be associated with an efficient program of technical assistance for quality improvements. Moreover, improvements in the judicial system (easier access and the lessening of bureaucracy) to enforce and make cheaper the enforcement of contracts may also help to solve the problem.

Contracts depend on the level of **Coordination** among the actors involved in the chain, but also from **External Factors**, such as established institutes that guarantee their correct functioning.

4.4.5 Communication and loyalty

The problem

Disloyalty not only affects contract implementation, it also affects the producer-to-industry or member-to-cooperative relations, where "*…any minor pressure under the producer, prompts a move to another company" (ID020).* Nine interviewees mentioned that they are aware of this problem and would work to solve it because it increases logistic costs, the transparency, prevents supply and processing planning on industrial plants and quality standardization, and affects the offer of technical assistance. Among the main causes of missing loyalty mentioned, we found that poor communication and information about benefits of loyalty from companies, cultural disloyal profile of the producer and the unfair competition in milk procurement, were all mentioned as factors.

The strategies

Ten interviewees declared to have loyalty policies or incentives to retain producers. They work on strengthening loyalty with simple actions, which give some advantage and stability in production and transactions. The main action mentioned comprises of economic incentives, followed by actions involving the community and family, as well as offering support and technical assistance to producers. We found a very large scope of actions, varying from "*…extra payments for the milk and encouraging farms to get the certificate [of brucellosis]" (ID019)* to social actions like *"talks with experts about social aspects, drugs, violations … and the offer of health insurance … and funeral insurance" (ID013)* for the families of producers, especially cooperative members. But apparently such actions do not have the desired effects on farmers' loyalty, since disloyalty persists and generates further problems.

Communication and loyalty also depends on the **Coordination** mechanisms, but also on the culture and behavior of actors in the chain. They have an impact on other sources of competitiveness consequently.

4.4.6 Idle capacities

The problem

Processing companies also face high idle capacities' rates in their plants, which are also costly and generate inefficiencies. During the 1980s and 1990s, investment credits were given to cooperatives and other agricultural processing companies without technical and managerial support. So huge unplanned investments were made with these subsidized loans, with the building of large processing plants

without any strategic plan for their supply or commercializing their production (Escher, 2011a). Idle capacities affect processing plants that do not rely on sufficient milk suppliers because they cannot offer better prices to producers, cannot manage the seasonality, or simply because of an excess of infrastructure or poor management and planning. Seven persons interviewed noted this problem. *"Many industries are still working with idle capacity, which 'weighs' the production system" (ID026).* They mention that *"this idle capacity is very costly" (ID014)* generating losses and inefficiency. It is also linked to seasonality, disloyalty and control of supply, and poor management planning. *"In Santa Catarina the idle capacity was 40%, which made it difficult to get financing from government credits" (ID017)* for example.

The strategies

This problem may be addressed through the offer of technical assistance to control for low production effects of seasonality at farm level and establish contracts for supply control. Furthermore, companies must establish strategic alliances or outsource activities, which will allow the reduction of idleness and costs and even gains in economies of scale. It would also allow companies to differentiate the portfolio of products, allowing access to other markets and increase sales, merge with other companies and reinvigorate the processing plants. In fact mergers and acquisitions, strategic alliances and outsourcing are considered as important strategies to increase competitiveness in the literature.

According to our results seven companies are adopting strategic alliances or outsourcing. Managers, especially from cooperatives, are using this tool to seek to reduce their large idle capacities and increase the portfolio of products with low investments. We found cooperatives having*"… many strategic alliances and also studying make new alliances to process products with other companies" (ID013).* Outsourcing is also used in order to add value to the milk production or to participate in different channels of commercialization, like, for example, the cooperative that *"…outsourced the powder milk production to participate in institutional programs from the government" (ID011).* It is also very commonly found (seven companies) in transportation and logistics, which is a notable problem in the chain. Managers agree, *"… it is much more organized now after outsourcing the logistics" (ID018),* especially in controlling fraud in the chain. Outsourcing is a powerful strategic management tool as part of the global process to solve problems (Schneider, 2004). It could be used not only to mitigate the consequences of bad infrastructure in the chain, but also in any process in which the company is not able

to perform with efficiency. It is useful to improve the costs structure, the global efficiency, reduce the idle capacities and most importantly, provide a rapid reaction capacity to market changes (Duque-Ceballos et al., 2014; Winkleman et al., 1993). Other advantages of externalizing activities are the reduced investments in infrastructure, improved quality and efficiency and the fewer administrative and operational problems (Fill and Visser, 2000).

Interviewees also mentioned that *"… there is a tendency for merger between cooperatives to compete in scale" (ID008)* against large private companies, but also to improve their costs structure and reduce idleness in processing plants through more efficient planning. Despite interviewees' awareness, we did not see much evidence for these mergers; thus they should occur faster and involve more cooperatives. Various successful examples of mergers and acquisitions all over the world reinforce this strategy, such as Fonterra, DFA, FrieslandCampina, Arla and others. For example, in USA the drivers of mergers and acquisitions were the structural changes in the food industry, the consolidation of the productive sector, the high price volatility of the 1990s and little consumption growth which, in turn, increased the intensity of competition and forced firms, mostly cooperatives, to gain in scale and improve their operational efficiency to successfully compete with private companies (Chaddad, 2007a). Similar events have been observed in Brazil in the last years. Nevertheless, the proportion of organizations adopting such strategies in GFM is still quite low, because of disorganization in the sector or internal conflicts.

Idle capacities are mostly affected by the **Production Economies** of size and scope. **Coordination**, **Differentiation** and management capacities may also influence the idleness' levels in a company.

4.4.7 Investments

The problem

In terms of investments, five interviewees, representing large cooperatives and private companies, argued that there is low level of **investment** in the sector, especially in **marketing and RTDI**. They say that in general, managers still consider marketing an expense rather than an investment, arguing that *"there is a very poor culture of investment in RTDI and marketing" (ID023)* as consequence of non-professionalization of the chain. Only six participants mentioned marketing as an important investment. Among cooperatives, only a few are *"… investing in marketing and branding" (ID008).* They focus more to *"invest in social programs, community programs, and quality…, to maintain the producer [loyalty] and avoid*

losses to privates [companies]" (ID015). Furthermore specific internal conflicts inside cooperatives interfere when investment decisions have to be taken "*…for financial reasons and weak professionalism of directors" (ID011).* In this regard directors and managers are aware that *"… the cost for the company to do the marketing directly with the consumer is very expensive; but the return pays off." (ID026).*

Seven participants affirm that they **invest in RTDI** to improve competitiveness, however *"there is still a huge gap to improve and create more products, companies should also diversify the presentation of the products, the types and sizes of packages" (ID004).* In terms of differentiation only two interviewees confirm that their companies have implemented product differentiation as a strategy; and four believe that companies have difficulties in differentiating products, but should do it to increase their profits, especially the *"micro and small companies should differentiate products in order to have gains in the niche markets" (ID007).*

The strategies

It is possible, however, to find a few positive examples. Some companies *"release new products every year. Have a department of innovation and RTDI for innovation" (ID012)* or even run *"[on the cooperative] an experimental center (RTDI) to develop technologies of pasture-based milk production. Also some have an experimental dairy farm" (ID008)* or *"[on the cooperative] a team working on products development and quality" (ID014).* RTDI are fundamental to developing products, processes, and technology in order to be more competitive. Moreover, the enrichment of the technological patrimony contributes towards the capacity for constant market adaptation and competition changes. In terms of the governmental investment programs, the state of *"Santa Catarina has invested a lot in technology and genetics. It is also the only state free of foot-and-mouth disease without vaccination" (ID023).* The capital for investment comes mainly from governmental development banks, or in some cases, the capital is a mixture of both credits and own capital.

Investments are mostly affected by the capacity and intention of managers (**Inputs**), but also by different **External Factors** such as governmental policies and macroeconomic variables influencing the availability of credits for a specific sector. The level of investments may be determinant for other sources of competitiveness, for instance Technology, other Inputs, Production Economies and the **Differentiation** of products through innovation, quality and advertising for example.

4.4.7.1 Investments and Cooperatives

Cooperatives additionally face higher restrictions and challenges in GFM regarding investments **in RTDI**. There are common problems implicit in traditional cooperatives' [26] organizational characteristics affecting investments decisions and increasing competitiveness constraints. These problems are related to the vaguely defined property rights in these cooperatives, which result in the so-called 'free-rider', 'investment horizon', 'portfolio', 'influence costs' and 'control' problems (Cook, 1995). The 'free-rider' problem arises when a non-member producer receives benefits (such as higher prices) without bearing the associated costs of membership, or when new members of a cooperative have the same residual rights and the same payment per unit of patronage as existing members. The dilution of the return to existing members creates a disincentive, discouraging investments by patron-members. This type of problem is seen in GFM where cooperatives buy milk from non-members and with members selling to other cooperatives that pay higher prices. The 'investment horizon' problem happens because there can be a disincentive for members to contribute to growth opportunities when a member's residual claim on the net income generated by an asset is shorter than the productive life of an asset, due, for instance, the higher age of a member or because members have stopped milk production (Porter and Scully, 1987). Restrictions on transferability and liquidity of such rights generate this problem. It becomes worse when considering investments in intangible assets, RTDI or branding for instance. Members pressure to increase the proportion of the cooperative's cash flow devoted to payments and not investments (Cook, 1995). This issue is common in GFM in view of the low investments of cooperatives in RTDI and in the pressure of members to receive payments instead of investing. The third problem affecting investments in cooperatives is related to the 'portfolio' of investments. Due to the lack of transferability, liquidity and appreciation mechanisms of the residual rights, members are not able to adjust the cooperative asset portfolio to their personal risk preferences. In this case some members are forced to accept higher risks than they are willing to accept and pressure to reduce the cooperative's portfolio of investments even if that means lower expected returns (Cook and Iliopoulos, 1998). This can also be observed in GFM where cooperatives have a reduced portfolio of investments, especially in regards to technology, research, marketing and brands.

[26] All cooperatives in GFM are "traditional cooperatives".

The 'influence costs' problem is also commonly noticed in GFM. It is a collective decision making problem. It happens mostly in multi-purpose marketing cooperatives where product portfolio is diverse and complex, where members have different objectives and attempt to influence the decisions to their benefit. This raises transaction costs leading to wrong decisions and affecting the distribution of wealth and other benefits among the different groups of members (Cook, 1995). This problem is very common in GFM where most cooperatives are multi-purpose and different groups can pressure to invest according to their preferences in specific activities.

Together with the 'control' problem - the divergence of interest between the members of the cooperative and its managers (less noticed in GFM) - "these five property rights constraints are increasingly recognized as major inhibitors of growth activities for cooperatives, especially in the capital intensive, value-added downstream levels of the agri-food chain" (Cook and Iliopoulos, 1998) as is the case of the dairy sector assessed by this study.

Cook and Iliopoulos, (1998) & Iliopoulos and Cook, (2013) propose a set of actions and measures to overcome the aforementioned property right problems in cooperatives. They involve a relaxation in the organizational characteristics of "traditional cooperatives" with the definition of individual delivery rights (defined volumes) and mechanisms to allow the transferability, liquidity and appreciation of membership rights. Among these actions are: the creation of incentives for risk capital investment with a base capital plan for investments with up-front equity; closed membership and singleness of purpose to control quality and quantity of supply; constant communication and a contractual agreement with members to create a sense of belonging and commitment, among others. The latter has also been referred to as supplier relationship management (Gyau et al., 2011). The implementation of such measures in GFM could help cooperatives to avoid several problems and increase their competitiveness. To achieve this, the government must update the outdated and inflexible Brazilian cooperatives law (Law Nº 5.764, 16/12/1971).

4.4.8 Transport costs

The problem

The region also faces problems with high costs related to the transport of milk from the farms to the plants. The main reasons are the poor **infrastructure** related to *"…the bad situation of the roads" (ID002)* in addition to the large distances to collect

low volumes from small producers, which *"make higher the cost of milk procurement" (ID003).* For example, in the SW-PR the average of distance to collect the milk is around 149 km for the large companies, with the extreme of 617 km in one of the cases, and the volumes to collect are on average 55 liter/day/producer (IPARDES, 2010). This situation significantly raises costs, especially for the cooperatives having a social role in rural areas. Moreover, during the rainy season, access becomes even more difficult and expensive. The consequence is that *"volumes are taken into account to exclude some farms because of logistics … the transport costs are too expensive" (ID019).* The problems not only lie in collecting the milk, but also to transporting inputs to the farm as well as provide technical assistance to remote farmers.

The strategies

Ten interviewees, including institutions, cooperatives and private companies, conclude that this problem could be improved by developing the supply chain. "*Increasing volumes per farm, and maintaining good routes to access the farms can solve those problems" (ID010).* This issue involves the provision and maintenance of the public works service by the local/state governments, in which the producer has low or no direct control. A reliable and stable provision of electricity on the farms is also a fundamental infrastructural ambition since dairy farms have to keep the milk cooled for at least two days before collection (Escher, 2011a).

A study conducted by the World Bank, investigating the influence of remoteness on price volatility in Burkina Faso, indicated that market access and distance influence prices and costs; the greater the distance and the worse market access, the higher the price volatility. Consequently, infrastructure and integration are key factors to commercialize agricultural products in remote areas (Ndiaye et al., 2015). Another study conducted in Vietnam also reflected that after rehabilitating roads linking rural areas, the market developed and the variety of goods sold by households increased (Mu and van de Walle, 2007). Moreover, the World Bank, (1994) report stated that roads, ports, airports, communication facilities, power, and safe water access tend to be quite limited in developing countries. In instances where infrastructure services are missing or unreliable, production techniques and costs are affected, as firms must produce their own power, transport, and/or communication services. Thus, better infrastructure will increase sales, decrease costs, and enhance the rural development.

Volumes of milk (**Inputs**) affect the transport costs, but also the situation of the roads and accesses to farms that depend on governmental interventions (**External Factors**). **Coordination** mechanisms might also alleviate or increase the transport costs.

4.4.9 Entry of large companies

GFM is a very dynamic and fast growing region in dairy production. Large companies have been installing plants in the region [27] and competing for the procurement of milk, provoking controversy among interviewees. Some believe that these companies will develop the dairy sector by stimulating the improvement in techniques to achieve greater competitiveness. Others think that these companies harm the smallest ones, and bring negative consequences establishing a monopsonistic position in the milk procurement of some areas with an anticompetitive effect.

The problem

There are those, especially some institutes that *"…see future conflicts in the chain because companies are expanding and arriving in the production zone to procure the milk, but there is not enough milk for everybody" (ID002). "Large companies are creating more refrigeration stations to collect milk in remote areas and they are competing against the small [companies] in the procurement of milk" (ID003). "It will be hard for cooperatives to compete. Companies will compete in the milk procurement and […] will probably 'steal' producers from others" (ID001).*

Some large companies have a high level of professionalization on their teams, with a good education and training level for employees and skilled managers; a scenario which is widely different from the smaller ones, especially singular cooperatives that *"…are managed by producers in most cases. And they don't have many managerial skills…" (ID018).* In this regard an important aspect recognized by the interviewees that must be prioritized is the **social role of cooperatives** who are perceived to be *"…different from other private firms because [we] work in the development of the region with actions to improve the farmers' wellbeing, socially and economically" (ID008).* Small cooperatives *"are closer to the producer and have an important social service in the communities … they have a function of income distribution in*

[27]Nestlé installed two plants in 2008 and 2010. Lactalis arrived in 2014 and is already the largest group in GFM. Other large companies include Tirol, Italac, Piracanjuba, etc. The largest cooperatives are CCGL installed in 2008 and Aurora, which started processing milk only in 2004.

rural areas" (ID003); "…investing in social programs, technical assistance, culture, community programs, quality, pasture" (ID015) to *"…maintain the young in the farms and also a program for the women" (ID013).* Excluding such organizations may generate a social problem in some rural areas. For instance, it is difficult to exclude inefficient producers, and at the same time consider that the situation of the members depends on the economic success of the cooperative; and they compete against for-profits corporations that have a clear market orientation (Carvalho, 2008).

Another view of the "problem"

On the other hand there are those who affirm that *"the entry and expansion of **large companies** increases the competitiveness of the sector" (ID003)* and it *"brings improvements in the competitiveness, boosting production and innovation" (ID012)* so that the sector is *"…becoming competitive, professional instead of familiar and that raises the prices [for producers]" (ID009).*

Actually the dairy chain has experienced significant concentration at all levels in most OECD countries (Hewitt, 2001). In the Southern region of Brazil, from the 469 processing companies existing in 2012, only 383 (-18%) still remained in 2017, while the volumes collected are stable at around 8.6 billion liters per year. Efficiency gains and countervailing market power arguments have been offered as explanations for increases in concentration at various stages of the dairy supply chain.

Furthermore, as profit margins decline, increasing concentration is inevitable, in order to spread fixed costs and remain competitive (Sutton, 2003). Porter (1990) considers that rivalry generates pressure on competitors and stimulates sustainable and continuous growth to maintain competitive advantages. The process of concentration and internationalization is inevitable in the modernization of a supply chain, but these processes should happen in a fair way, especially to the small producers who are the most affected. In this regard the mergers and acquisitions of small companies (cooperatives) would be an important strategy to realize gains in scale and bargaining power. The professionalization of the management of such companies is also fundamental, though. Otherwise the consequences of monopolies would be lower returns to farmers, increased risk in farming activities and the cut-off of more farmers and small companies, especially cooperatives.

External Factors such as governmental incentives may be one of the reasons why companies move to a region, but also because of the macroeconomic stability and

institutional security in the country. Supply competition, logistics and coordination mechanisms are also generally involved in such decisions.

4.4.10 Frauds

The problem

Several interviewees complained about frauds in the chain, identifying two common types of fraud. The first type of fraud was *"the huge problems with payment defaults… This discouraged production because everybody is afraid" (ID019).* At least four interviewees said they had been victims of this type of cheat. *"Frauds and payment defaults are factors that break producers" (ID015).* The second type of fraud is adulteration of the milk: when the sector faces low prices, low production and payments per volume, farmers and transporters, but also people responsible for cooling stations, add water and other substances to the milk in order to increase the volume for delivery. Since 2013, the MAPA has developed tests and penalties to combat these fraudulent actions. Through the '*Operação Leite Compensado*' they discovered adulterations in the milk and some representatives of cooperatives and private companies who were aware of the fraud. Thus, the image of the whole chain and the products of the companies involved was tarnished.

The strategies

Companies defend themselves against the second type of fraud by constantly taking samples of the milk, doing *"…frequent and rigorous tests of the milk, …" (ID010)* and punishing the persons responsible when fraud is detected. This type of scam had directly or indirectly affected ten interviewees.

Fraud in dairy chain occurs often, especially in countries where regulations and inspections are deficient. Our study shows that frauds in GFM are mainly a result of altering volumes. The impacts of adulterating milk go further than just fooling buyers though: they imply serious consequences to consumers' health, since in general non-potable water, detergents, urea, hydrogen peroxide, caustic soda, and other toxics are added. Handford et al., (2016) present a broad review of the literature on milk fraud in developing countries outlining the impact on nutrition, food safety and consumer confidence. They illustrated that milk is adulterated in high percentages, reaching more than 70% in some cases, with the aim to obtain financial gains. They also mention that these practices represent a common problem in developing countries where there are unregulated practices, inefficient inspection systems and low food safety standards. Scott and Costello, (1985) mentioned the existence of these frauds to increase volumes by adding water, emphasized in the

informal distribution channels in Latin American countries. In Brazil, Souza et al. (2011) conducted an analysis for adulterants in 100 samples of UHT milk and found nonconformities of up to 55% of them. This discourages potential national and international consumers, and downgrades the image of the product and the chain. In order to guarantee that such problems would not be repeated, the government and sector authorities should review the actions conducted by other countries – like in some European countries and the US where this problem is much more thoroughly controlled. The actions of these countries are focused on organizing an efficient inspection system, with updated detection methods and the conduction of regular audits on suppliers, as well as training of the personnel involved in the operations and a good education for farmers to avoid malpractice (Handford et al., 2016). The government must act severely regarding the enforcement of measures to prevent fraud. **External Factors** influenced by governmental regulations and its capacity of enforcement are behind such frauds. Cultural behavior and Coordination mechanisms may also influence the existence of frauds.

Figure 4 illustrates the primary findings.

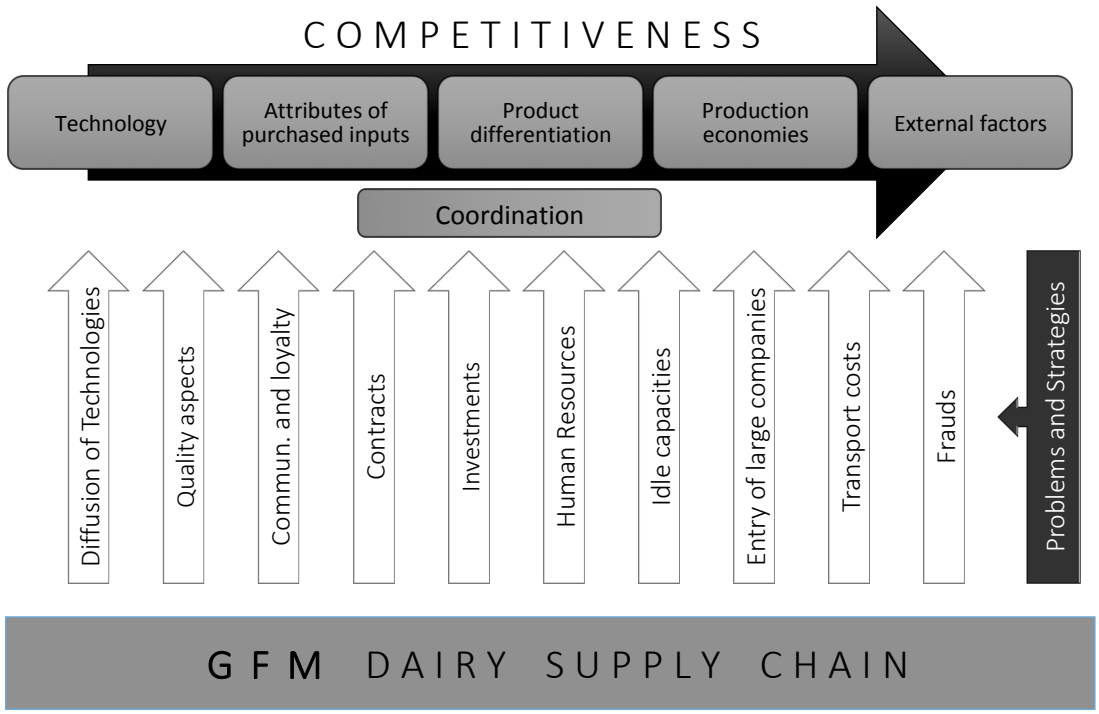


Figure 4-4: Problems and strategies influencing the competitiveness of GFM dairy supply chain

The problems and strategies identified can directly or indirectly affect on one or more sources of competitiveness of the Harrison and Kennedy, (1997) framework.

4.5 Conclusions and Policy Implications

This research shows that the dairy sector in GFM region is still far from being competitive at the international level, since the productive chain still has several factors to improve. Therefore, this scenario urges urgent measures to promote and guide the necessary structural changes, increase competitiveness and contributing to future growth on firms that seek and compete for positioning in the market. Such changes involve not only technological improvements in machinery, equipment, and materials, but also processes and methods of organization and coordination (Dries et al., 2009); all with the common objective of increasing efficiency in production and contributing to a an environment conductive for innovation.

Productivity is one of the fundamental pillars to increase competitiveness through the adoption of technology, an adequate scale of production, and increases in efficiency. To raise the productivity level of the dairy sector of Southern Brazil, it is necessary to improve the level of professionalism in the whole chain. This includes professionalization at production level with farmers more attentive to the farms' productive, environmental and economic performances, but also at the processing level with more skilled workers and managers to achieve higher quality, innovation and technological levels and further market access, both national and international. Moreover, **product quality** is a key factor in developing the chain. It requires better managerial practices and the implementation of higher quality standards that allow the development of high quality products with the potential to access international markets. In developing and transition economies, efficiency tends to spread in a top-down flow. Thus, it is necessary to improve the provision of training and technical assistance to farmers in order to spread the new technologies and techniques already available. Since companies are mainly responsible for such technical assistance, more professional and competitive companies are able to spread them more efficiently to their farmers. Therefore, management professionalization at processing level is one of the first steps to improve the competitiveness of the whole supply chain.

In the management of agrifood enterprises there still often exists a culture of low innovation and resistance to changes, especially in concerning entrepreneurship. To overcome this, the strategy and vision of the corporation must be clear, planned and

well defined, with a professional and specialized profile understanding the market dynamics; making correct decisions, in correct moments, with the correct resources, boosting the evolution of the corporation to compete.

In Brazil, the problems could be much more alleviated if the government improved the infrastructure, the judicial security, the inspection and control system and promoted the diffusion of technologies already available for the dairy production and management. The government must also anticipate, encourage and/or pressure the companies and farmers to raise their aspirations and their competitive performance by creating an environment that facilitates the development of competitive advantages. But, at the same time, the government has to improve institutional procurements, microfinance, rural extension, education, professionalization and entrepreneurship at the rural level, so that small producers are not excluded but have awareness of how to progress and adapt to the competitive market.

This research has limitations. First, it is limited by the scope of the interviewees. Future research should include the farmers' point of view into the analysis of competitiveness of the general sector. That would make it possible to see the context from another angle, which sometimes could be contrasted to those of other stakeholders in the chain. Small processing companies should also be included. Second, this research is limited by the case study area, where only the Southern Brazil is represented. However, there are similarities with other dairy production zones, especially in neighboring states and countries, which could be also analyzed in future studies.

Chapter 5: Summary of Findings and General Conclusions

5.1 Summary of Findings

The dairy supply chain in Southern Brazil offers an important opportunity for the economic, and therefore rural development of the country. The many advantages offered by this region are considered as valuable assets for the establishment of a competitive dairy production zone. Among them we can highlight the eco-pedoclimatic conditions, the historical savoir-faire of producers and the provision of technical services and inputs in the long-time established supply chain, the relatively cheap labor and land prices, but also the relative institutional stability of the country. These assets may offer an important competitive advantage over other production zones across the globe if well exploited.

Attentive, national and international processing companies are further developing their business, closely followed by public agents that see also an important opportunity for a rural development strategic plan, since thousands of small household families are the main production force. These interests are pushing the supply chain through a phase of restructuring and modernization in an effort by both internal stakeholders and public actors in an attempt to catch up with other sectors of the national agriculture and the dairy sector of other countries in terms of competitiveness.

In this attempt, some of the sector's stress have been posed on to the processing companies, which are facing different challenges. They involve the exclusion of producers by vertical integration, the consolidation and market competition, and the access to qualified managers and workers, among others.

Therefore the intention of this thesis is to provide inputs by both processing companies and public agents to make sure their interests would not be contrasting, so the business and the rural can develop side by side. With this purpose, three essays were developed having the main common objective of identifying the factors refraining the evolution of the dairy supply chain in Southern Brazil, but also the possible levers to its development, combined with measures to avoid exclusion of farmers during the process.

In the first essay in chapter 2 we conduct a study on the evolution of the dairy cooperatives and their organizational structure from a historical perspective in the

Mesorregião Grande Fronteira do Mercosul (GFM) in southern Brazil, the country's largest dairy production area. Cooperatives have been the base of the dairy sector since it became a formal sector in Brazil, similar to most other major producing countries, and today they still represent the main connection to the market for the majority of producers in GFM. Therefore, their importance in the supply chain and for rural development is high. In this essay the life-cycle of cooperatives developed by Cook (1995) is extended to the assessment of a sector. The study identified three relevant phases during the cooperatives' evolution: an initial period of growth and expansion in the 1960s and 1970s, followed by huge crises in the 1980s and 1990s and then a period of recovery and growth beginning in the 2000s. These phases are linked to differing public policies, especially with regard to credit access, the internal and external economic environment and the foundation of new institutions. One of the main findings of this study is that the dairy cooperatives in this zone have been dependent on the government incentives for their foundation and permanence in the sector, and this dependency is counterproductive. In times of crisis the incentives are reduced, and the cooperatives have severe difficulties to survive only with their own resources. The main reason is that those incentives were not accompanied by measures to promote their future independency.

In the second essay in chapter 3, we specified a stochastic production frontier and estimated the technical efficiency and its determinants for a set of 243 processing companies in the State of Paraná in Southern Brazil. We used a set of factors identified in the previous study and in the literature as determinants of efficiency. We found an average efficiency of 77%, which indicates a margin for a 23% increase in output using the same level of inputs and technology. Companies operate under increasing returns to scale, therefore increasing their sizes would lead to operations at a more efficient scale, specifically for the IOFs, which are smaller than the cooperatives. This study also shows that cooperatives are more efficient than the IOFs. Reduction of idle capacities would considerably increase the efficiency of companies whereas more restrictive inspection services would decrease their efficiency.

In the third essay we conducted an in-depth case study to better understand the results from the previous essays. We collected and analyzed information of some of the main stakeholders involved in the Southern Brazil dairy supply chain. By interviewing the main supply-chain leaders we gathered information about the difficulties that the companies face to be more competitive and the successful

strategies already implemented to countervail them. Thus we identified the main factors affecting the often low competitiveness and slowing the modernization of the supply chain. Several issues contribute to slow down or accelerate this process, but one of the main findings of the study is that most of determinants of competitiveness are related to the level of professionalism of the human resources in the whole chain. Management professionalization at the processing level is one of the first steps to improve the competitiveness of the whole supply chain. Processing companies' managers can introduce actions favoring also the technical/managerial improvement of producers. The latter can offer a product with higher quality and quantity, improving the performance of processing companies in a back-and-forth process of modernization. This conclusion is supported by Dries et al. (2009), who show that investments by modern processing companies and vertical coordination with suppliers can play a significant role in improving the global competitiveness of supply chain. Moreover, private supplier assistance schemes seem to reach many small farms, which are left out of government programs and thus, contribute to the inclusion of small farms into modern food supply chains. However these schemes do not exclude the importance of public support, which must be effectively applied, in order to boost the whole competitiveness. "It is important for policy to focus on the most effective and appropriate methods for developing ''win–win" solutions for companies and farmers". This finding from Dries et al. (2009, p. 1756) holds true for the Brazilian dairy sector.

5.2 Policy Implications

The results from Chapter 2 point out that public incentives for the formation of cooperatives alone create a certain passiveness and are generally not effective for the firms' long-term sustainability. External and internal factors contribute to this passiveness, thus missing markets and invasive governance, but also managerial procrastination may lead cooperatives to fail (Francesconi and Ruben, 2008). Other studies including Hoff and Stiglitz (1990) and Wouterse and Francesconi, (2016) present conclusions in the same direction. By the other side, the Brazilian economy has historically enjoyed a fast growth and unemployment decline when not only cooperatives, but also medium and small IOFs received public incentives. Therefore these results inform policy-makers that incentives might be given, but they are not effective if not embedded into a broader spectrum of policy measures. Further measures must be coupled to them in order to avoid such passiveness and

progressively generate independency of firms from government incentives by favoring the cooperatives' competitiveness. The results of this chapter also demonstrate that the problems resulting from vaguely defined property rights inherent of the traditional cooperative system (Cook, 1995) are harmful for cooperatives' competitiveness in liberalized markets. In this regard the government should revise the law of cooperatives in order to allow more flexibility in the cooperative system. That would permit more professional governance structures, but also mitigate the property rights problems.

Chapter 3 provides further evidence that subsidized loans without any technical or managerial support creates huge unplanned investments. Large processing plants were built during the 1980s and 1990s without any strategic plan for their supply or commercialization of their production. Idle capacities were therefore created and are an important determinant of inefficiencies. This result is supported by the findings of Steitieh (1971, p. 96) who concluded from a study of crop production in Southern Brazil that "increased investment in inputs (capital formation), such as mechanized equipment and fertilizer, alone is not the answer to increasing production. Better management, information, and utilization of resources are as important and should be equally emphasized if any benefit is to be expected from increasing expenditure on these inputs". These earlier findings and our study imply that any policy encouraging a better management where professionals are able to apply measures reducing idle capacities should positively contribute to the technical efficiency of processing companies. Results of Chapter 3 also indicate that in the supply chain under analysis, cooperatives are more efficient than IOFs. This is consistent with empirical findings of Singh et al. (2001) and Soboh et al. (2014). In this regard measures promoting the development of cooperatives by facilitating improvements in their organizational structures, governance and management as seen above, may increase the technical efficiency of the whole processing stage in the dairy sector of Paraná. Results also show that the companies adopting the SIM inspection system are more efficient. Further studies would help to demonstrate the reasons behind this higher efficiency, since this is an unexpected result and we can only provide suggestions and derive further assumptions to explain it. The Ministry of Agriculture, Livestock and Supply (MAPA) in Brazil already started the process of consolidation of the currently fragmented national sanitary inspection systems. This measure requires better sanitary conditions of the whole sector, with the intention of modernization and increasing market access to companies and producers in high-value chains. The

drawback would be that companies that are not able to afford the necessary improvements would have to exit the market. A time for adaptation and a follow-up and assisted transition process must therefore be carefully considered in order to avoid unnecessary prejudices.

Finally, Chapter 4 provides a full picture of the sector in GFM where several stakeholders were asked about the perceived barriers to higher competitiveness. Not surprisingly, the results indicate that professionalization at all levels in the supply chain would bring benefits in terms of technology adoption, quality and general performance. In this regard training and technical assistance programs must be promoted, both public and private incentives to processing companies to offer such programs to their managers, employees and suppliers are needed.

The FAO and OECD, (2015) on their 'Agricultural Outlook' of Brazil reinforce this aspect. They suggest that to enhance the economic growth it is necessary to invest more in education, training and extension services in order to spread technologies, which leads to rising incomes and reduced poverty. Castellanos, (2013, p. 33) is pragmatic in this matter when he says, "the education and knowledge generated by a country is a factor that directly affects the competitiveness of agribusiness, for better or for worse". In this regard well-prepared and updated producers, managers and personnel are required.

Technology and information are better transferred via vertical and horizontal integration, so again the promotion and development of the cooperative system is a strategic action to enhance rural development. In the same line, production-management contracts facilitate such transfer of know-how. Policy-makers should act in establishing and enforcing fair rules, via the reinforcement of institutions, specially the juridical system in rural areas for the easiness of contract enforcement and prevention of frauds.

In Brazil, the problems could also be alleviated if the government improved infrastructure of roads and electricity, important for the transport and cooling of milk. The promotion and the diffusion of context-adapted technologies already available for the dairy production (production techniques, breeding, pastures, etc.) and farm management techniques are essential to raise the competitive performance. Credits for investments in new technologies, research, marketing and brands for example would be important improvements as well. Furthermore public investments in technological development via EMBRAPA and other research institutes have proven to be a promoter of efficiency and productivity gains in other agricultural

sectors in Brazil. That should also be the case for the dairy sector.

Another important result of this chapter regards the social functionality of the dairy sector in Brazil. It is mostly comprised of small and less professional farmers excluded from other sectors, therefore improving their performances and avoiding their exclusion seems a difficult task envisaged by policy-makers. It is however essential to prevent rural exodus and ensure employment. In past years this perception has been changing and companies are pushing to enter the competitive market. So measures to enhance the competitiveness and at the same time maintain the viability of family farms and processors, with a special attention to cooperatives, are fundamental. These measures could include institutional procurements, microfinance, rural extension, education, professionalization and entrepreneurship at the rural, so that small producers are not excluded but have awareness of how to progress and adapt to the competitive market.

5.3 Limitations and Suggestions for Future Research

The Chapter 2 has focused on the application of the life-cycle concept of cooperatives developed by Cook, (1995) at a sector level, an extension of the original approach that was first applied at company level. Further theoretical development of this tool for its application at the sector level in other industries would be helpful. Furthermore, from a practical perspective, an application of this tool at company level in the main dairy cooperatives on the GFM region would help managers and members to deeply understand their cooperatives' competitive weaknesses and strengths from an evolutionary approach. Also taking into account the firms' internal resources and capabilities and external conditions in the environment. It would help them to design adequate strategies to improve their short and long-term sustainability. This study is limited by its descriptive nature.

In Chapter 3 an impressive database of processing companies was used for the application of a Stochastic Frontier Analysis including the determinants of efficiency. Research and extension personnel from the state of Paraná collected such data. The gathered information offers several possibilities to deeply understand the potentialities of a sector and target specific strategies and policies. The database is limited by missing the information on the total revenues of processing companies, which could provide a more accurate output measure, and for being a database of 2009, already nine years old. Thus, we strongly advice the Paraná policy-makers and researchers to collect the data on dairy processing companies on a regular basis. In

this case a dynamic framework methodology could be applied to understand the persistence of technical inefficiency over time and the effect of investments and adoption of new technologies. Thus overcoming another limit of this study, which is the cross-sectional analysis. The real objective of maximization of cooperatives could also offer a better estimation of the real output, since the theory and practice show that cooperatives may have different maximization objectives. In the same line environmental indicators could be included in a multiple output framework offering the possibility to measure the environmental efficiency of those companies. We make the same advice to all state policy-makers and researchers. Possessing such valuable data open possibilities to extend the research to other areas and sectors and reduce uncertainties for the decision-making process.

An interesting exercise for the last study in Chapter 4 would be to include the farmers' point of view to contrast their opinions and perspectives about the competitiveness on the region, which is a limit of this study. Further understand their wishes and needs would result in a more accurate study and recommendations. Furthermore, also the micro and small processing companies' point of view should be included, another limit of this study. As highlighted in chapter 3, those companies may act on niche markets, may be more technical efficient and likely to have another perspective and strategies for competitiveness. Different concepts of competitiveness can also be further explored and applied, in order to capture the competitive position and strategies at the international markets. Studies focusing on companies' competition at the international markets should be further developed. Thus, future research concerning processing companies should focus on exports and internationalization process, in order to understand the constraints and propose facilitative measures.

Besides the shortcomings of this thesis that could be further developed, future research could tackle the issue of the production systems existing in the Brazilian dairy farming. Today in Brazil there is a large debate regarding which production system is more profitable and adapted to the country's conditions: pasture based, free-stall or compost barn. A technical efficiency analysis of the different production systems at farm level would shed light into the better production system to be supported by public policies. Another interesting study would be the assessment spatial effects on technical efficiency in the five larger producer states in the country. To do so, methodological advances on the SFA and spatial econometrics models have to be developed.

Bibliography

Aigner, D., Lovell, C.A.K., Schmidt, P., 1977. Formulation and estimation of stochastic frontier production function models. J. Econom. 6, 21–37. https://doi.org/10.1016/0304-4076(77)90052-5

Albu, M., Griffith, A., 2006. Mapping the market: participatory market-chain development in practice. Small Enterp. Dev. 17, 12–22. https://doi.org/10.3362/0957-1329.2006.016

Alemu, A.E., Adesina, J., 2015. Effects of co-operatives and contracts on rural income and production in the dairy supply chains: Evidence from Northern Ethiopia. Afr. J. Agric. Resour. Econ. Vol. 10, 312–327.

Alves, A.G. de M.P., 2003. As cooperativas agropecuárias e o BRDE – Histórico, Situação Atual e Perspectivas. Dir. Planej. BRDE.

Andri, K.B., Shiratake, Y., 2005. Empirical study of contract farming system conducted by dairy cooperatives in east java, indonesia.

Anschau, C.T., 2011. Redes Cooperativas da Bovinocultura de Leite e o Desenvolvimento do Oeste Catarinense.

Aramyan, L., Ondersteijn, C., Kooten, O. van, Lansink, A.O., 2006. Performance indicators in agri-food production chains, in: Quantifying the Agri-Food Supply Chain. Netherlands, pp. 49–66.

Austin, J.E., 1981. Agroindustrial project analysis, EDI series in economic development. Published for the Economic Development Institute of the World Bank [by] Johns Hopkins University Press, Baltimore.

Azevedo, P.F., Chaddad, F.R., Farina, E., 2004. The Free Trade Area of the Americas and the Food Industry in Brazil and the United States. Agric. Trade Lib. Policy Implic. Lat. Am. 295–331.

Baran, J., 2013. Efficiency of the production scale of Polish dairy companies based on Data Envelopment Analysis. Acta Sci. Pol. Oeconomia 12.

Batalha, M.O., Souza Filho, H.M., 2009. Analisando a Competitividade de Cadeias Agroindustriais: uma proposição metodológica. Agronegócio No MERCOSUL Uma Agenda Para O Desenvolv. São Paulo Atlas 1–22.

Beber, C.L., Ruales, A., Almadani, M.I., Theuvsen, L., n.d. Dairy Supply Chain in Southern Brazil: Barriers to Competitiveness. Prep.

Beber, C.L., Theuvsen, L., Otter, V., 2018. Organizational structures and the evolution of dairy cooperatives in Southern Brazil: A life cycle analysis. J. Co-op. Organ. Manag. https://doi.org/10.1016/j.jcom.2018.06.003

Becker, K.M., Parsons, R.L., Kolodinsky, J., Matiru, G.N., 2007. A Cost and Returns Evaluation of Alternative Dairy Products to Determine Capital Investment and Operational Feasibility of a Small-Scale Dairy Processing Facility1. J. Dairy Sci. 90, 2506–2516. https://doi.org/10.3168/jds.2006-433

Beckmann, V., 2000. Transaction costs and institutional choice in agriculture – between market, hierarchy and cooperation (in German), Berliner Schriften zur Kooperationsforschung. Ed. Sigma, Humboldt-University Berlin.

Belloin, J.C., 1988. Milk and dairy products: production and processing costs, FAO animal production and health paper. Food and Agriculture Organization of the United Nations, Rome.

Ben-Ner, A., 1988. The life cycle of worker-owned firms in market economies. J. Econ. Behav. Organ. 10, 287–313. https://doi.org/10.1016/0167-2681(88)90052-2

Benson, T., 2014. Building good management practices in Ethiopian agricultural cooperatives through regular financial audits. J. Co-op. Organ. Manag. 2, 72–82. https://doi.org/10.1016/j.jcom.2014.10.001

Berdegué, J., 2001. Cooperating to compete: associative peasant business firms in Chile. s.n, [Wageningen.

Bontems, P., Fulton, M., 2005. Organizational structure and the endogeneity of cost: Cooperatives, For-Pro…t Firms and the cost of procurement 37.

Botaro, B.G., Gameiro, A.H., Santos, M.V. dos, 2013. Quality based payment program and milk quality in dairy cooperatives of Southern Brazil: an econometric analysis. Sci. Agric. 70, 21–26.

Boysen, O., Schröder, C., 2005. Economies of Scale in der Produktion versus Diseconomies im Transport: zum Strukturwandel in der Milchindustrie, Diskussionsbeiträge des Fachbereichs Wirtschaftswissenschaft der Freien Universität Berlin Volkswirtschaftliche Reihe. Freie Univ, Berlin.

Bragagnolo, C., Spolador, H.F., Barros, G.S.C., 2010. Regional brazilian agriculture TFP analysis: A stochastic frontier analysis approach. Rev. Econ. 11, 217–242.

BRASIL, 2015. Censo das Cooperativas do Leite, 2015 – síntese dos resultados.

Brunetti, A., Kisunko, G.B., Aymo Weder, Beatrice, Weder, B., 1999. Institutional Obstacles to Doing Business: Region-by-Region Results from a Worldwide Survey of the Private Sector, Policy Research Working Papers. The World Bank. https://doi.org/10.1596/1813-9450-1759

Carraresi, L., Banterle, A., 2015. Agri-food Competitive Performance in EU Countries: A Fifteen-Year Retrospective 18, 26.

Carvalho, M.P. de, Martins, P. do C., Wright, J.T.C., Spers, R.G., 2007. Cenários para o leite no Brasil em 2020. Embrapa Gado de Leite, Juiz de Fora.

Carvalho, V.R.F., 2012. Indústria de laticínios no Rio Grande do Sul: um panorama após o movimento de fusões e aquisições.

Carvalho, V.R.F., 2008. Tese - Reestruturação do Sistema Lácteo Mundial: Uma Análise da Inserção Brasileira. Universidade Estadual de Campinas - Instituto de Economia.

Castellanos, E.R., 2013. La competitividad de los agronegocios en Colombia: una reflexión académica. Magazín Empres. 9, 29–34.

Chaddad, 2007a. Cooperativas no agronegócio do leite: mudanças organizacionais e estratégicas em resposta à globalização. Organ. Rurais Agroindustriais 9, 69–78.

Chaddad, 2007b. The evolution of Brazilian dairy cooperatives: A life cycle approach, in: XLV Congresso Da Sober," Conhecimentos Para Agricultura Do Futuro", Londrina. pp. 22–25.

Chaddad, F., Iliopoulos, C., 2013. Control Rights, Governance, and the Costs of Ownership in Agricultural Cooperatives: Control Rights, Governance, and the Costs of Ownership. Agribusiness 29, 3–22. https://doi.org/10.1002/agr.21328

Chaddad, F.R., Cook, M.L., 2004. Understanding New Cooperative Models: An Ownership–Control Rights Typology. Appl. Econ. Perspect. Policy 26, 348–360. https://doi.org/10.1111/j.1467-9353.2004.00184.x

Chaddad, F.R., Jank, M.S., 2006. The evolution of agricultural policies and agribusiness development in Brazil. Choices 21, 85–90.

Coelli, T.J., Rao, D.S.P., O'Donnell, C.J., Battese, G.E., 2005. An introduction to efficiency and productivity analysis. Springer Science & Business Media.

Cook, M.L., 1995. The Future of U.S. Agricultural Cooperatives: A Neo-Institutional Approach. Am. J. Agric. Econ. 77, 1153–1159. https://doi.org/10.2307/1243338

Cook, M.L., Bredahl, M.E., 1991. Agribusiness Competitiveness in the 1990s: Discussion. Am. J. Agric. Econ. 73, 1472. https://doi.org/10.2307/1242404

Cook, M.L., Burress, M.J., 2009. A cooperative life cycle framework. Unpubl. Manuscr. Columbia Mo Univ. Mo. Dept Agric. Econ.

Cook, M.L., Iliopoulos, C., 2016. Generic solutions to coordination and organizational costs: informing cooperative longevity. J. Chain Netw. Sci. 16, 19–27. https://doi.org/10.3920/JCNS2016.x001

Cook, M.L., Iliopoulos, C., 1998. Solutions to Property Rights Constraints in Producer-Owned and Controlled Organizations: Prerequisite for Agri-Chain Leadership? Presented at the Third International Conference on Chain Management in Agri Business and Food Industry, G. W. Ziggers, J. H. Trienekens, and P. J. P. Zuurbier (eds.), Wageningen, the Netherlands: Wageningen Agricultural University., pp. 541–553.

Dalton, T.J., Criner, G.K., Halloran, J., 2002. Fluid Milk Processing Costs: Current State and Comparisons1. J. Dairy Sci. 85, 984–991. https://doi.org/10.3168/jds.S0022-0302(02)74158-1

de Brito, M.M., Bánkuti, F.I., Bánkuti, S.M.S., 2015. Horizontal Arrangements and Competitiveness of Small-Scale Dairy Farmers in Paraná, Brazil 18.

de David, A., Garcia, L.A.F., 2009. Competitividade das cooperativas do Sistema de Cooperativas de Leite da Agricultura Familiar-SISCLAF. INFOCOS-Inst. Form. Do 397.

de Lima, J.F., Alves, L.R., 2011. Cooperativismo e desenvolvimento rural no Paraná do agronegócio.

Deng, W., Hendrikse, G., 2014. Cooperative social capital-towards a lifecycle perspective, in: 2014 International Congress, August 26-29, 2014, Ljubljana, Slovenia. European Association of Agricultural Economists.

Deves, O.D., Rambo, A.G., Miguel, L. de A., 2008. A mesorregião Grande Fronteira do Mercosul: Uma Análise dos Sistemas Agrários e das Políticas de Desenvolvimento neste "Território," in: Anais Do Evento. Presented at the Encontro de Economia Gaúcha, EDIPUCRS, Porto Alegre, RS.

Donaldson, L., 2001. The Contingency Theory of Organizations, Foundations for Organizational Science. SAGE Publications.

Doucouliagos, H., Hone, P., 2000. The efficiency of the Australian dairy processing industry. Aust. J. Agric. Resour. Econ. 44, 423–438.

Dries, L., Germenji, E., Noev, N., Swinnen, J.F.M., 2009. Farmers, Vertical Coordination, and the Restructuring of Dairy Supply Chains in Central and Eastern Europe. World Dev. 37, 1742–1758. https://doi.org/10.1016/j.worlddev.2008.08.029

Duque-Ceballos, J.L., González-Campo, C.H., García-Solarte, M., 2014. Outsourcing y Business Process Outsourcing desde la Teoría Económica de la Agencia. Entramado 10, 12–29.

Escher, F., 2011a. Os Assaltos do Moinho Satânico nos Campos e os Contramovimentos da Agricultura Familiar (Master in Rural Development). Universidade Federal do Rio Grande do Sul, Porto Alegre, RS.

Escher, F., 2011b. A evolução institucional do sistema de cooperativas de leite da agricultura familiar com interação solidária-SISCLAF: atores sociais, mercados e ação coletiva no sudoeste do Paraná.

FAO, OECD, 2015. OECD-FAO Agricultural Outlook 2015, OECD-FAO Agricultural Outlook. OECD Publishing.

FAOSTAT, 2019. Food and Agriculture Organization of the United Nations. FAOSTAT Statistics Database. [WWW Document]. URL http://www.fao.org/faostat/en/#home (accessed 3.18.19).

Farina, E., 2003. The Latin American perspective on the impacts of the global food economy: the case of Brazil. Presented at the Conference on Changing Dimensions of the Food Economy: Exploring the Policy Issues, The Hague, Netherlands.

Farina, E., Viegas, C.D.S., 2003. Foreign direct investment and the brazilian food industry in the 90s. Int. Food Agribus. Manag. Rev. 5.

Farina, E.M., 2002. Consolidation, multinationalisation, and competition in Brazil: impacts on horticulture and dairy products systems. Dev. Policy Rev. 20, 441–457.

Farina, E.M.M.Q., Nunes, R., 2002. A Evolução do Sistema Agroalimentar e a Redução de Preços para o Consumidor: O Efeito de Atuação dos Grandes Compradores, Programa De Estudos Dos Negócios Do Sistema Agroindustrial PENSA. São Paulo: PENSA/FIA/FEA/USP.

Ferrari, D.L., MELLO, M.A., Testa, V.M., Silvestro, M.L., 2005. Agricultores familiares, exclusão e desafios para inserção econômica na produção de leite em Santa Catarina. Informações Econômicas São Paulo 35, 22–36.

Ferrier, G.D., Porter, P.K., 1991. The Productive Efficiency of US Milk Processing Co-Operatives. J. Agric. Econ. 42, 161–173.

Feurer, R., Chaharbaghi, K., 1994. Defining Competitiveness: A Holistic Approach. Manag. Decis. 32, 49–58. https://doi.org/10.1108/00251749410054819

Fill, C., Visser, E., 2000. The outsourcing dilemma: a composite approach to the make or buy decision. Manag. Decis. 38, 43–50. https://doi.org/10.1108/EUM0000000005315

Francesconi, G.N., Ruben, R., 2008. The life cycle of agricultural co-operatives: implications for management and governance in Ethiopia. J. Rural Coop. 36, 115–130.

Frenken, K., 2014. The evolution of the Dutch dairy industry and the rise of cooperatives: a research note. J. Institutional Econ. 10, 163–174.

Gasques, J.G., Bastos, E.T., Bacchi, M.R.P., 2008. Produtividade e fontes de crescimento da agricultura brasileira. Políticas Incent. À Inov. Tecnológica.

Gereffi, G., Humphrey, J., Sturgeon, T., 2005. The governance of global value chains. Rev. Int. Polit. Econ. 12, 78–104. https://doi.org/10.1080/09692290500049805

Grant, R.M., 1991. The resource-based theory of competitive advantage: implications for strategy formulation. Calif. Manage. Rev. 33, 114–135.

Grosskopf, W., Münkner, H.-H., Ringle, G., 2010. Our co-op: idea - mission - achievements. DG-Verl, Neu-Ulm.

Gyau, A., Spiller, A., Wocken, C., 2011. Price or relational behaviours?: Supplier relationship management in the German dairy industry. Br. Food J. 113, 838–852. https://doi.org/10.1108/00070701111148388

Handford, C.E., Campbell, K., Elliott, C.T., 2016. Impacts of Milk Fraud on Food Safety and Nutrition with Special Emphasis on Developing Countries: Health impacts of milk fraud . . . Compr. Rev. Food Sci. Food Saf. 15, 130–142. https://doi.org/10.1111/1541-4337.12181

Harrison, W.R., Kennedy, P.L., 1997. A Neoclassical Economic and Strategic Management Approach to Evaluating Global Agribusiness Competitiveness. Compet. Rev. 7, 14–25. https://doi.org/10.1108/eb046342

Helfand, S., Moreira, A.R., Bresnyan Jr, E.W., 2015. Agricultural Productivity and Family Farms in Brazil: Creating Opportunities and Closing Gaps. Wash. DC World Bank.

Hendrikse, G., Feng, L., 2013. Interfirm cooperatives. Chapters.

Hewitt, G., 2001. Competition Issues in Joint Venture.

Hind, A., 1999. Cooperative performance–is there a dilemma. J. Coop. 14, 30–43.

Hirsch, S., Hartmann, M., 2014. Persistence of firm-level profitability in the European dairy processing industry. Agric. Econ. 45, 53–63. https://doi.org/10.1111/agec.12129

Hoff, K., Stiglitz, J.E., 1990. Introduction: Imperfect information and rural credit markets: Puzzles and policy perspectives. World Bank Econ. Rev. 4, 235–250.

Hudson, M.A., 1990. Toward a Framework for Examining Agribusiness Competitiveness. Agribus. 1986-1998 N. Y. 6, 181.

IBGE, 2017. IBGE :: Instituto Brasileiro de Geografia e Estatística [WWW Document]. URL http://www.ibge.gov.br/home/ (accessed 10.26.15).

IBGE, 2006. IBGE :: Instituto Brasileiro de Geografia e Estatística. Censo Agropecuário 2006. [WWW Document]. URL http://www.ibge.gov.br/home/ (accessed 10.26.15).

Iliopoulos, C., Cook, M.L., 2013. Property Rights Constraints in Producer-Owned Firms: Solutions as Prerequisites for Successful Collective Entrepreneurship.

IPARDES, 2010. Caracterização da Indústria de Processamento e Transformação do Leite no Paraná. Instituto Paranaense de Desenvolvimento Econômico e Social - IPARDES, Curitiba, PR.

Jank, M.S., Farina, E., Bertini Galan, V., 1999. O agribusiness do leite no Brasil. Milkbizz/PENSA.

Jank, M.S., Galan, V.B., 1998. Competitividade do sistema agroindustrial do leite. IPEA/PENSA/USP.

Johnson, G., Whittington, R., Angwin, D., Regner, P., Scholes, K., 2014. Exploring strategy: text and cases (10th edition). Pearson Education Limited, Harlow, England.

Kanter, C.A., Hueth, B., Gould, B.W., others, 2013. A Comparative Efficiency Analysis of Cooperative and Non-cooperative Dairy Manufacturing Firms, in: 2013 Annual Meeting, August 4-6, 2013, Washington, DC. Agricultural and Applied Economics Association.

Kennedy, P.L., Harrison, R.W., Piedra, M.A., 1998. Analyzing agribusiness competitiveness: The case of the United States sugar industry. Int. Food Agribus. Manag. Rev. 1, 245–257.

Kennedy, P.L., Harrison, W., Kalaitzandonakes, N.G., H, C.P., Rindfuss, R.P., 1997. Perspectives on Evaluating Competitiveness in Agribusiness Industries. Agribus. 1986-1998 N. Y. 13, 385.

Key, N., Runsten, D., 1999. Contract farming, smallholders, and rural development in Latin America: the organization of agroprocessing firms and the scale of outgrower production. World Dev. 27, 381–401.

Khidirov, D., 2017. Disclosable Version of the ISR - Horticulture Development Project - P133703 - Sequence No : 07 (Implementation Status and Results Report No. 1). Washington, D.C. : World Bank Group.

Kulatilaka, N., 1985. Tests on the validity of static equilibrium models. J. Econom. 28, 253–268.

Lacki, P., 1998. La formación de profesionales para profesionalizar a los agricultores. Rev. CEIBA 39, 25–37.

Lakner, S., Brenes-Muñoz, T., Brümmer, B., 2017. Technical Efficiency in Chilean Agribusiness Industry: A Metafrontier Approach. Agribusiness. https://doi.org/10.1002/agr.21493

Lakner, S., Muñoz, T.B., Aedo, E.R., Brümmer, B., others, 2013. Technical Efficiency in the Chilean Agribusiness Sector–a Stochastic Meta-Frontier Approach. Int. Agric. Trade Res. Consort. Proc. Issues Product. Its Impacts Glob. Trade Seville Spain.

Latruffe, L., 2010. Competitiveness, Productivity and Efficiency in the Agricultural and Agri-Food Sectors (OECD Food, Agriculture and Fisheries Papers No. 30). https://doi.org/10.1787/5km91nkdt6d6-en

Lopes, M.R., Souza, G. da S., Lopes, I., Honczar, G., 2002. Gestão estratégica e reformas nas cooperativas agropecuárias brasileiras, in: Agronegócio Cooperativo: Reestruturação e Estratégias. Viçosa: Suprema. pp. 1–54.

Lundvall, K., Battese, G.E., 2000. Firm size, age and efficiency: Evidence from Kenyan manufacturing firms. J. Dev. Stud. 36, 146–163. https://doi.org/10.1080/00220380008422632

Madalena, F.E., Matos, L.L. de, Holanda Júnior, E.V., 2001. Produção de leite e sociedade: uma análise crítica da cadeia do leite no Brasil. FEPMVZ, Belo Horizonte.

Magalhães, R.S., 2007. Habilidades sociais no mercado de leite. RAE-Rev. Adm. Empres. 47, 15–25.

Martin, L., Westgren, R., van Duren, E., 1991. Agribusiness Competitiveness across National Boundaries. Am. J. Agric. Econ. 73, 1456–1464. https://doi.org/10.2307/1242402

Martins, P. do C., Álvares, J.G., Barros, G. de C., Nogueira Netto, V., Barroso, M., 2004. O futuro do cooperativismo de leite. Embrapa Gado de Leite.

Masakure, O., Henson, S., 2005. Why do small-scale producers choose to produce under contract? Lessons from nontraditional vegetable exports from Zimbabwe. World Dev. 33, 1721–1733. https://doi.org/10.1016/j.worlddev.2005.04.016

Mayring, P., 2014. Qualitative Content Analysis. Theoretical Foundation, Basic Procedures and Software Solution. Klagenfurt.

McKenna, R., 1988. Marketing in an Age of Diversity. Harv. Bus. Rev. 88–95.

MDIC, 2019. Comex Vis: Visualizações de Comércio Exterior [WWW Document]. Minist. Desenvolv. Indústria E Comércio MDIC. URL http://www.mdic.gov.br/comercio-exterior/estatisticas-de-comercio-exterior/comex-vis (accessed 3.17.19).

Medeiros, M.C., Padilha, W., 2015. Os ciclos de desenvolvimento do cooperativismo agropecuário e o crédito rural no Sudoeste do Paraná. Geosul 29, 185–205.

Meeusen, W., van Den Broeck, J., 1977. Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error. Int. Econ. Rev. 18, 435. https://doi.org/10.2307/2525757

Mercosul, 2007. MESOMERCOSUL [WWW Document]. URL http://www.mesomercosul.org.br/ (accessed 10.26.15).

Michelson, H., Reardon, T., Perez, F., 2012. Small Farmers and Big Retail: Trade-offs of Supplying Supermarkets in Nicaragua. World Dev. 40, 342–354. https://doi.org/10.1016/j.worlddev.2011.07.013

Morrison, C.J., 1985. Primal and Dual Capacity Utilization: An Application to Productivity Measurement in the U.S. Automobile Industry. J. Bus. Econ. Stat. 3, 312. https://doi.org/10.2307/1391716

Mosheim, R., Lovell, C.K., 2009. Scale economies and inefficiency of US dairy farms. Am. J. Agric. Econ. 91, 777–794.

Mu, R., van de Walle, D.P., 2007. Rural roads and poor area development in Vietnam.

Mueller, B., Mueller, C., 2014. The economics of the Brazilian model of agricultural development.

Ndiaye, M., Maître d'Hôtel, E., Le Cotty, T., 2015. Maize price volatility: does market remoteness matter?

Nightingale, C., Dhuyvetter, K., Mitchell, R., Schukken, Y., 2008. Influence of Variable Milk Quality Premiums on Observed Milk Quality. J. Dairy Sci. 91, 1236–1244. https://doi.org/10.3168/jds.2007-0609

Nishimizu, M., Page, J.M., 1982. Total Factor Productivity Growth, Technological Progress and Technical Efficiency Change: Dimensions of Productivity Change in Yugoslavia, 1965-78. Econ. J. 92, 920. https://doi.org/10.2307/2232675

Nivievskyi, O., 2012. Increasing the Competitiveness of the Dairy Supply Chain in Ukraine: Role of the Gov-ernment.

Nivievskyi, O., 2009. The essays on competitiveness, efficiency, and productivity: methodological issues and applications. Göttingen, Univ., Diss., 2010.

Noev, N., Dries, L., Swinnen, J.F.M., 2009. Institutional Change, Contracts, and Quality in Transition Agriculture: Evidence from the Bulgarian Dairy Sector. East. Eur. Econ. 47, 62–85. https://doi.org/10.2753/EEE0012-8775470404

OECD, 2015. Dairy, in: OECD-FAO Agricultural Outlook 2015. OECD Publishing. https://doi.org/10.1787/agr_outlook-2015-11-en

Ortmann, G.F., King, R.P., 2007. Agricultural cooperatives I: history, theory and problems. Agrekon 46, 18–46.

Pavcnik, N., 2002. Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants. Rev. Econ. Stud. 32.

Pérotin, V., 2006. Entry, exit, and the business cycle: Are cooperatives different? Ukr. Labor Mark. Transit. 34, 295–316. https://doi.org/10.1016/j.jce.2006.03.002

Porter, M.E., 1990. The competitive advantage of nations. Harv. Bus. Rev. 68, 73–93.

Porter, M.E., 1985. Competitive advantage: creating and sustaining superior performance. Free Press ; Collier Macmillan, New York : London.

Porter, M.E., 1980. Competitive strategy: techniques for analyzing industries and competitors: with a new introduction, 1st Free Press ed. ed. Free Press, New York.

Porter, P.K., Scully, G.W., 1987. Economic efficiency in cooperatives. J. Law Econ. 489–512.

Rangasamy, N., Dhaka, J.P., 2007. Milk Procurement Cost for Co-operative and Private Dairy Plants in Tamil Nadu–A Comparison. Indian J. Agric. Econ. 62, 679.

Rao, E.J.O., Brümmer, B., Qaim, M., 2012. Farmer Participation in Supermarket Channels, Production Technology, and Efficiency: The Case of Vegetables in Kenya. Am. J. Agric. Econ. 94, 891–912. https://doi.org/10.1093/ajae/aas024

Rauch, J.E., 1991. Modelling the informal sector formally. J. Dev. Econ. 35, 33–47.

Reardon, T., Barrett, C.B., Berdegué, J.A., Swinnen, J.F.M., 2009. Agrifood Industry Transformation and Small Farmers in Developing Countries. World Dev. 37, 1717–1727. https://doi.org/10.1016/j.worlddev.2008.08.023

Rebelo, J., Caldas, J., 2015. The Economic Role of the Portuguese Agricultural Cooperatives. Rev. Econ. E Sociol. Rural 53, 91–102. https://doi.org/10.1590/1234-56781806-94790053s01007

Roudaut, N., 2006. Influences of the Business Environment on Manufacturing Firms Technical Efficiencies: The Côte d'Ivoire Case. J. Product. Anal. 25, 93–109. https://doi.org/10.1007/s11123-006-7133-y

Rozanski, G.A., Thompson, T.S., 2011. Issues in the analysis of buyer power in agricultural markets. working paper, Bates White.

Ruiz-Guerra, I., Molina-Moreno, V., 2014. La intangibilidad de las cooperativas como ventaja competitiva. Coop. Desarro. 22.

Schipmann, C., Qaim, M., 2010. Spillovers from modern supply chains to traditional markets: product innovation and adoption by smallholders. Agric. Econ. 41, 361–371. https://doi.org/10.1111/j.1574-0862.2010.00438.x

Schneider, B., 2004. Outsourcing: La herramienta de gestión que revoluciona el mundo de los negocios. Grupo Editorial Norma.

Schubert, M.N., Niederle, P.A., 2011. A competitividade do cooperativismo de pequeno porte no sistema agroindustrial do leite no oeste catarinense. Rev. IDeAS 5, 188–216.

Schultz, T.W., 1964. Transforming Traditional Agriculture, Science & Its Conceptual Foundations. University of Chicago Press.

Schwab, K., Sala-i-Martin, X., Brende, B., 2015. The Global Competitiveness Report 2015-2016 (Vol. 5).

Scott, G.J., Costello, M.G. (Eds.), 1985. Comercialización interna de los alimentos en América Latina: problemas, productos y políticas: selección de las ponencias presentadas en un seminario internacional celebrado en el Centro Internacional de Agricultura Tropical en Cali, Colombia, 11-13 julio 1984, IDRC. International Development Research Centre, Ottawa, Canada.

Shani, D., Chalasani, S., 1992. Exploiting niches using relationship marketing. J. Consum. Mark. 9, 33–42.

Sharples, J., Milham, N., 1990. Longrun Competitiveness of Australian Agriculture (No. 243), United States Department of Agriculture, Economic Research Service, Foreign Agricultural Economics.

Singh, S., Coelli, T., Fleming, E., 2001. Performance of dairy plants in the cooperative and private sectors in India. Ann. Public Coop. Econ. 72, 453–479.

Soboh, R., Lansink, A.O., Dijk, G.V., 2012. Efficiency of Cooperatives and Investor Owned Firms Revisited: Efficiency of Cooperatives and IOF. J. Agric. Econ. 63, 142–157. https://doi.org/10.1111/j.1477-9552.2011.00324.x

Soboh, R.A.M.., 2009. Econometric analysis of the performance of cooperatives and investor owned firms in the European dairy industry. Wageningen University, Wageningen.

Soboh, R.A.M.E., Lansink, A.O., Van Dijk, G., 2014. Efficiency of European Dairy Processing Firms. NJAS - Wagening. J. Life Sci. 70–71, 53–59. https://doi.org/10.1016/j.njas.2014.05.003

Soboh, R.A.M.E.R., Oude Lansink, A., van Dijk, G., 2011. Distinguishing dairy cooperatives from investor-owned firms in Europe using financial indicators. Agribusiness 27, 34–46. https://doi.org/10.1002/agr.20246

Solow, R.M., 2001. Applying growth theory across countries.

Souza, J.J. de, 2014. O complexo agroindustrial de laticínios no Brasil (Thesis). Universidade Federal de Santa Catarina, Florianópolis/SC.

Souza, J.J. de, 2009. Gênese e evolução da indústria de laticínios do oeste de Santa Catarina.

Souza, R.P. de, 2007. As Transformações na Cadeia Produtiva do Leite e a Viabilidade da Agricultura Familiar: o Caso do Sistema COORLAC (RS) (Master Thesis). Universidade Federal do Rio Grande do Sul, Porto Alegre.

Souza, R.P. de, Waquil, P.D., 2008. A viabilidade da agricultura familiar produtora de leite: o caso do sistema COORLAC (RS), in: Sociedade Brasileira de Economia, Administração e Sociologia Rural. Congresso (46.: 2008, 20-23 Jul.: Rio Branco).[Anais Do Congresso Da] SOBER [Recurso Eletrônico]. Rio Branco: Sober, 2008.

Souza, S.S., Cruz, A.G., Walter, E.H.M., Faria, J.A.F., Celeghini, R.M.S., Ferreira, M.M.C., Granato, D., Sant'Ana, A. de S., 2011. Monitoring the authenticity of Brazilian UHT milk: A chemometric approach. Food Chem. 124, 692–695. https://doi.org/10.1016/j.foodchem.2010.06.074

Spers, R.G., Wright, J.T.C., Amedomar, A. de A., 2013. Scenarios for the milk production chain in Brazil in 2020. Rev. Adm. 254–267. https://doi.org/10.5700/rausp1086

Staber, U., 1993. Worker cooperatives and the business cycle: Are cooperatives the answer to unemployment? Am. J. Econ. Sociol. 52, 129–143.

Steitieh, A.M., 1971. Input productivity and productivity change of the crop enterprise in southern Brazil. The Ohio State University.

Sutton, J., 2003. Understanding the rise in global concentration in the agri-food sector: a background paper, in: OECD Conference on Changing Dimensions of the Food Economy. pp. 6–7.

Terfloth, K., 2015. Co-operative Life Cycle Theory. Consumers' Cooperative of Berkeley, CA.

Theuvsen, L., Ebneth, O., 2005. Internationalization of Cooperatives in the Agribusiness - Concepts of Measurement and their Application -, in: Strategies for Cooperation, Ed. by T. Theurl and E. Christian Meyer. Aachen, pp. 395–419.

Theuvsen, L., Franz, A., 2007. The Role and Success Factors of Livestock Trading Cooperatives: Lessons from German Pork Production. Int. Food Agribus. Manag. Rev. 10, 90–112.

Tybout, J.R., 2000. Manufacturing firms in developing countries: How well do they do, and why? J. Econ. Lit. 38, 11–44.

van den Broeck, J., Koop, G., Osiewalski, J., Steel, M.F.., 1994. Stochastic frontier models: A Bayesian perspective. J. Econom. 61, 273–303. https://doi.org/10.1016/0304-4076(94)90087-6

von Braun, J., Hotchkiss, D., Immink, M. (Eds.), 1989. Nontraditional Export Crops in Guatemala: Effects on Production, Income, and Nutrition, Research Report.

Whitman, J., 2011. The Worker Cooperative Life Cycle, Prepared for the Babson-Equal Exchange Cooperative Curriculum.

Wilkinson, J., Rocha, R., 2006. Agri-processing and developing countries.

Winkleman, M., Dick, P., Lee, M., 1993. The outsourcing source book. J. Bus. Strategy 14, 52.

World Bank (Ed.), 1994. Infrastructure for development, 1. pr. ed, World development indicators. Oxford Univ. Press, Oxford.

Wouterse, F., Francesconi, G.N., 2016. Organisational health and performance: an empirical assessment of smallholder producer organisations in Africa. J. Chain Netw. Sci. 16, 29–40. https://doi.org/10.3920/JCNS2016.x002

Young, G.J., Charns, M.P., Shortell, S.M., 2001. Top manager and network effects on the adoption of innovative management practices: a study of TQM in a public hospital system. Strateg. Manag. J. 22, 935–951. https://doi.org/10.1002/smj.194