DIVERSITY OF COORDINATION MECHANISMS TO SUPPORT TRANSACTIONS

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Farmer-buyer relationships and farmer performance in the Brazilian pork chain

FRANCO MÜLLER MARTINS

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Propositions

1. In the Brazilian pork sector, companies use diverse coordination mechanisms to support a non-diverse set of quality requirements.

   (this thesis)

2. Strengthening horizontal relationships enables farmers to improve information exchange and relationship quality with buyers.

   (this thesis)

3. Food companies and supply chains should use communication strategies that make consumers more familiar with agricultural practices.

4. Decision support systems that account for stakeholder values are more likely to lead to sustainable solutions than systems that do not take these into account.

5. Improving our understanding why existing models do not work is more important than building whole new models.

6. PhD students should gain more knowledge about cultural differences when working in international graduate schools.

Propositions belonging to the thesis, entitled

Diversity of coordination mechanisms to support transactions -
Farmer-buyer relationships and farmer performance in the Brazilian pork chain

Franco Müller Martins
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Diversity of coordination mechanisms to support transactions

Farmer-buyer relationships and farmer performance in the Brazilian pork chain

Franco Müller Martins

Thesis committee

Promotors
Prof. Dr S.W.F. Omta
Professor of Management Studies
Wageningen University & Research

Prof. Dr J.H. Trienekens
Personal chair at the Management Studies Group
Wageningen University & Research

Other members
Prof. Dr A.G.J.M. Oude Lansink, Wageningen University & Research
Dr L.K.E. Dries, Wageningen University & Research
Prof. Dr X. Gellynck, Ghent University, Belgium
Prof. Dr L. Sauvée, UniLaSalle Beauvais, France

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Franco Müller Martins

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Dedicated to my wife Rose

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CHAPTER 1

General Introduction

1.1. Introduction

Food chains have been increasingly challenged to deliver products meeting standards on food safety, welfare and sustainable production and trade. Food crises (i.e. in food safety) and changes in consumer preferences have triggered, especially from the early 2000s, changes in regulations and the implementation of various quality standards and certification schemes (Theuvsen et al., 2007; Trienekens and Zuurbier, 2008, Heyder, 2010). New quality demands also imply new coordination arrangements between buyers and suppliers in these chains. To address these developments, food companies use different types of governance structures (GS). Through these GSs companies monitor processes, control inputs used in production and provide farmers with technical support (Raynaud et al., 2005; Swinnen and Maertens, 2007; Gellynck and Molnár 2009; Goodhue, 2011).

However, little attention has been paid to the complexity behind the GSs that chain actors use to support production. First, companies operating in the same sector may use different GSs to support similar transactions. Second, such diversity can also be found within GS used by a single company. Looking at this complexity, there are grounds for interesting insights for scholars, managers and policy makers. First, it allows us to understand which aspects are coordinated by a GS. For example, a contract, a type of GS, may include distinct mechanisms to coordinate prices, quality and resource allocation. Second, it refines insights concerning the reasons why chain actors choose distinct GSs (and underlying coordination mechanisms) to support similar transactions. Strategic issues as well as quality requirements may define these mechanisms. Third, it allows for a more precise evaluation of how GSs influence exchange relationships. For example, information exchange among chain actors and distinct settings of resource allocation and control over processes and inputs may lead to different levels of compliance.

The main goal of this thesis is to analyse the GSs used to support transactions between buyers and pig farmers in the Brazilian pork chain. More specifically, this study investigates the diverse types of GSs that are used, the relationships between GSs and quality requirements and relationships between GSs and farmer performance and investments.

This chapter is arranged as follows. The section 1.2 describes the Brazilian pork sector, which is the research background of this thesis. In section 1.3 the research problem and research questions are stated. Section 1.4 discusses the theoretical framework; section 1.5 describes the research methodology; Finally, Section 1.5 provides an outline of the thesis content.

1.2. Research background

Brazil is the fourth largest global producer and exporter of pork. Between 2011 and 2015, Brazil had an average share of 3.1 % of world production and 8.5% of exports (USDA, 2016). In 2015, Brazil exported 542,000 tons of pork and the main importers were Russia (45%), Hong Kong (23%), Angola (6.5%), Singapore (5.2%) and Uruguay (4.2%) (MAPA, 2017). In

2015, the exports totalled 15.2 % of Brazilian production. In Brazil, the per capita consumption of pork is 15.1 kg per year (ABPA, 2016). The production herd accounts for 1,600,000 sows and 39,000,000 pigs. The main regions of production are the south, the southeast and the mid-west, which maintain, respectively, 61%, 21% and 16.5 % of housed sows. The number of pig farmers in Brazil is estimated to be approximately 42,000 (ABCS, 2016). In terms of quality, the Brazilian Pork Chain (BPC) predominantly complies with public regulations.

The public framework includes requirements for animal health, food safety, animal welfare and the environment. Companies that comply with these regulations are able to supply the internal market and export to countries that demand baseline standards met in international trade and mediated by the World Trade Organization (WTO). In addition, BPC meets specific requirements set by the sanitary authorities of importer countries and specific customers. The main requirements set by countries regard residues of substances used in feed, use of medicines and biosecurity. Regarding the last, countries demand that pigs should be produced in areas that are accredited as free of diseases such as Foot and Mouth Disease and Classical Swine Fever. Customers, in turn, are concerned with issues such as fat content, size of cuts and coloration.

In Brazil, pig production is predominantly arranged in schemes of vertical coordination supported by contracts (Miele and Waquil, 2007). However, these GSs are made up of a diverse set of mechanisms to coordinate prices, resource allocation and quality. Through different types of contracts companies monitor production and provide farmers with technical support. The sector does not use retailing or sector (processors) certification schemes led by third parties to control quality, such as in Europe and the US. There are contracts in which farmers own the critical inputs (i.e. feed and animals) used in production. In others, companies provide farmers with these inputs. In contracts that do not include provision of critical inputs, companies use markets to define base prices. In input-providing contracts companies use internal prices. Contracts differ in terms of the criteria used to define bonuses on the top of base prices. Different criteria based on productivity are used in input-providing contracts. In addition, companies use requirements for the quality of animals and checklists for processes and facilities as price incentives. Moreover, companies use other types of GSs to support a minor part of their production. For instance, in order to handle market fluctuations, some buyers purchase pigs through spot markets. Furthermore, there are buyers that use internal production as a way of developing the knowledge about new practices or technologies to be used throughout contracted production.

Different types of contracts and underlying coordination mechanisms (CMs) are found in distinct transaction contexts. This research identified five environments where transactions between buyers and pig farmers take place: Spot Market, Mini-Integrations, Singular Cooperatives, Central Cooperatives and Investor Owned Companies.

In the BPC, Spot Markets (SM) are the contexts where independent farmers deliver pigs. These farmers retain ownership of all inputs (e.g. sows, feed, veterinary inputs) used in

production. Instead of using pure market-driven transactions, the farmers maintain informal relationships with a selected set of buyers. The prices used in these transactions follow the markets. SM farmers supply local slaughterhouses, other farmers or intermediaries and meet public baseline standards.

Mini Integrations (MIs) are organisations led by big producers that coordinate production by means of contracts or informal relationships with pig farmers. In contracts that support the production of piglets, the suppliers (farmers) retain the ownership of the main inputs. In contracts with finishers, the buyers use input-providing contracts. MIs supply local slaughterhouses or big pork processors in the national market and meet public baseline standards. In the MIs analysed in this study, the number of contracted farmers ranges from 35 to 210. Deliveries vary between 60,000 and 140,000 pigs annually.

Singular Cooperatives (SCs) produce pigs through contracts with their member farmers. Some SCs are specialised in pork, however, many SCs are indeed food companies that deliver other products, such as dairy and/or poultry, besides pork. Individual SCs maintain supply contracts with up to 300 pig farmers. In contracts with piglet farmers, the SCs provide technical support and the farmer uses inputs meeting the recommendations set out by the coop. In the other production stages (i.e. finishing, nursery) the SCs use input-providing contracts. The slaughtering capacity of SCs ranges from approx. 140,000 to 290,000 pigs per year. It is estimated that SCs perform about 7% of slaughters in Brazil (SIPS 2014).

Central Cooperatives (CC) are big organisations that bring together affiliated cooperatives. There are two CCs that produce pork in Brazil. One is based in Santa Catarina and maintains 12 affiliated cooperatives (9 in Santa Catarina, 1 in Rio Grande do Sul, 1 in Paraná and 1 in Mato Grosso do Sul). The affiliated cooperatives maintain approx. 63,000 farmers producing, mainly milk, chicken and pigs. The number of pig farmers totals approx. 3,500. This CC slaughters pigs in four slaughterhouses that process a total of 4,000,000 pigs annually. The CC supplies the national market and stringent importers such as Russia and Japan.

The other CC is located in Paraná. This CC groups six affiliated cooperatives and slaughters in a single plant. In 2013 the affiliated cooperatives had 4,664 members (881 pig farmers). The slaughters totalled approx. 1,540,000 pigs in 2014. The exports predominantly meet baseline standards. In 2014 the two CCs together slaughtered 17% of the pigs produced in Brazil (SIPS, 2014). CCs define the quality requirements to be met and coordinate production by defining production quotas for each cooperative. Moreover, the central cooperative supports the technical assistance the affiliated coops provide to farmers. The affiliated cooperatives organise production through contracts as explained above for SCs.

Investor owned firms (IOFs) are big food companies that lead meat production in Brazil. In 2014, the 4 biggest firms slaughtered 52% of the pig production (SIPS 2014). This research includes the two IOFs that lead pork production in Brazil. The biggest firm maintains contracts with about 3,600 pig farmers and slaughters in nine plants in southern Brazil and the mid-west. This firm slaughtered 9,000,000 pigs in 2014. The second firm, regarding pig

production, maintains contracts with about 2,600 farmers and slaughters in 5 different plants (Rio Grande do Sul (2), Santa Catarina (2) Paraná (1). The firm slaughtered about 4,500,000 pigs in 2014. Both companies export part of their production to more demanding importers. These firms use input-providing contracts as the main GS to support transactions with farmers at the different production stages.

Table 1.1 depicts the main characteristics of the transaction contexts. Information on slaughters in IOFs and cooperatives (SIPS, 2014) allows us to estimate that SMs and MIs produce about 24% of the pigs slaughtered in Brazil.

Table 1.1. Main transaction contexts in the Brazilian Pork Chain

	Spot Market	Mini Integrations	Singular Cooperatives	Central Cooperatives	Investor Owned Firms
Customers	Local slaughterhouses, farmers, middlemen	Local slaughterhouses and national markets	Local and national retailers and international customers	National retailers and international customers	National retailers and international customers
Standards	Public baseline	Public baseline	Public baseline	Public baseline and stricter	Public baseline and stricter
Type of contract	Market and informal contracts	Informal and formal contracts	Formal contracts	Formal contracts	Formal contracts
Annual volume (Pigs x 1,000)	*	60-140	140-290	1,540-4,000	4,500-9,000
Market share	24%**		7%	17%	52%

* Information on individual farms not available
** Includes spot markets and mini integrations

The BPC includes companies that supply feed and/or feedstuff (i.e. premixes), genetics, veterinary inputs, and equipment and information technology, amongst other inputs and services (Figure 1.1). However, to support their vertical coordination schemes, buyers that use contracts integrate upstream steps of the supply chain. For instance, MIs and small cooperatives maintain feed mills. Bigger cooperatives and IOFs maintain feed mills and run their own genetic programmes. Normally, these buyers work with the support of feed and genetic firms to develop their nutritional and breeding policies.

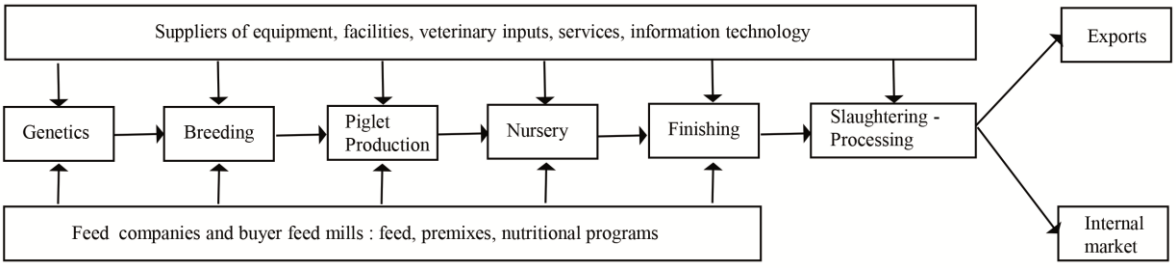

Figure 1.1. The Brazilian Pork Supply Chain

Moreover, the chain actors are supported by sector entities. These entities support their members by defending their interests before the government and other stakeholders. The Brazilian Association of Pig Farmers (ABCS) and the Brazilian Association Animal Protein (ABPA) are the national unions that represent, respectively, slaughterhouses and pig farmers. One important role of these associations, for instance, is to participate in the Swine and Poultry Council maintained by the Agricultural Ministry (MAPA). In this council, the entities discuss commercial issues, food developments, relationships between chain links, regulations and food standards. Furthermore, the council members cooperate to develop new standards (i.e. regulations) and adjustments in other public-sector policies. These organisations support the sector with different actions. The ABCS provides the sector with manuals on good agricultural practices and capacitation programmes. In line with the national association, state pig farmers' associations develop similar actions. The Brazilian and state associations of slaughterhouses not only support the sector with guidelines and capacitation, but also allocate resources such as technicians, vehicles and software to support sector policies on biosecurity.

1.3. Problem Statement and Research Questions

Brazil is an important global player in the pork sector. The country exports about 15 % of its production (ABPA, 2016). BPC meets the most stringent requirements of its current and potential buyers. However, the international market is very competitive and presents few opportunities for expansion. For example, China, the biggest global consumer of pork is, at the same time, the biggest producer. The same holds for European countries. On the other hand, internal consumption is low (15kg per capita) if compared, for instance, to markets such as China and Europe (40 kg per capita). For the BPC, ensuring quality and producing efficiently are of growing relevance in the battle to maintain and improve its competitiveness.

Efficient governance structures (GSs) to support production are of key importance in the BPC. Transaction Cost Economics theory assumes a mode of governance that minimises production and transaction costs taking into account the standards and requirements to be met (Williamson, 2000; Ménard and Valceschini, 2005). For example, studies have demonstrated that in food chains in which public standards prevail, chain actors rely on market-like governance structures and certification by third party bodies to support production. In supply chains driven by private standards, chain actors rely on stricter mechanisms (Raynaud et al., 2005, Schulze et al., 2007, Bahlmann and Spiller, 2009; Wever et al., 2010).

BPC is predominantly driven by public regulations and a few specific customer requirements. Overall, these requirements present low diversity. However, diverse GSs (i.e. types of contracts) are found throughout the sector and within individual supply chains. GSs are supposed to enable chain actors to fulfil compliance and to produce efficiently (Williamson, 2000; 2010; Ménard and Valceschini, 2005). The general goal of this thesis is to analyse the governance structures (GSs) used to support transactions between buyers (e.g. mini integrators, cooperatives, firms) and pig farmers. To address this objective, the following general research question is set:

Which factors explain the diversity of GSs used to support transactions in the BPC and how do these GSs influence farmer performance and investments?

In response to this general research question, the present study examines GSs, CMs included in these GSs and quality requirements met in the BPC. Moreover, the thesis examines how the relationships among chain actors and buyers support influence performance. To address this general research question, four specific research questions were formulated.

In the BPC, although the quality requirements present little diversity, as explained above, the different GSs used to support transactions include diverse types of coordination mechanisms (CMs) on prices, quality, and resource allocation (Raynaud et al., 2005; Wever, 2012, Martins et al., 2017). These characteristics provide an interesting case for investigating the relationships between governance structures and quality requirements.

Therefore, the first specific research question of this thesis is:

RQ1 - What are the main (GSs) CMs used to support quality requirements in transactions between buyers and pig farmers in the Brazilian pork chain?

TCE refers to GSs as discrete and generic solutions (e.g. markets, contracts, cooperatives, vertical coordination) to be compared by their cost efficiency, taking into consideration transaction attributes and the constraints of the institutional environment (Williamson, 1991, 2000; Ménard and Valceschini, 2005; Williamson, 2010).

A GS is, indeed, a combination of coordination mechanisms (Grandori, 1997; Foss, 2002) used to control different aspects of the exchange. GSs differ from one another in aspects such as formality, duration, resource allocation, quality requirements and monitoring. To support compliance with quality requirements, a buyer may implement CMs in contracts with suppliers, such as monitoring schemes, grades of quality and price incentives (Boger, 2001; Martinez and Zering, 2004; Martinez, 2012). Looking at CMs offers more refined insights concerning the aspects of a transaction that are coordinated by a GS.

In the BPC, chain actors use different types of contracts including diverse CMs. A single contract may combine market-like, hybrid, and strict CMs (Wever, 2012). To purchase piglets, for example, some buyers in the BPC use markets (i.e. less strict coordination) to set base prices, monitor processes (i.e. stricter coordination) and provide farmers with technical support (also stricter coordination). Moreover, in line with the literature (Heide, 2003; Parmigiani, 2007; Ménard, 2013; Miranda and Chaddad, 2014) this research found that individual firms and cooperatives in the BPC combine the most efficient type of contract with other GSs (and CMs) to produce or purchase pigs. Therefore, examining CMs included in a GS refines the understanding of how such a GS supports an exchange and helps to distinguish, more clearly, different GSs used to support similar transactions (Grandori, 1997). Moreover, examining the reasons why companies use plural forms of governance provides relevant insights into the constraints that prevent chain actors from using the most efficient

solutions to coordinate production. The above explanation leads, therefore, to the second specific research question:

RQ2- Which factors may explain the diversity of CMs used to support similar transactions in the BPC?

Literature has demonstrated that information exchange (IE) and relationship quality (RQ) are elements of key importance for coordination of vertical (buyer-supplier) relationships. Information Exchange enables chain participants to meet customer satisfaction, and increase supply chain efficiency and competitiveness (Li et al, 2006, Han et al 2009; Coronado et al., 2010; Huo et al., 2014). Relationship quality positively influences information exchange (Sheu et al., 2006; Prajogo and Olhager, 2012; Wu et al., 2014) and performance (Nyaga and Whiple, 2011; Molnár et. al., 2010; Odongo et al., 2016) in supply chains. Moreover, farmers who participate in horizontal (buyer-buyer) forms of collaboration improve their performance (Lu et al., 2008b; Hennessy and Heanue, 2012; Hansen, 2015) and their (vertical) relationship with buyers (Lu et al., 2012; Brito et al., 2015). In the BPC, different schemes of (formal or informal) IE are used in vertical relationships to support pig production. Moreover, farmers establish horizontal relationships with the support of farmers' associations. Therefore, examining the interaction between horizontal and vertical (IE and RQ) relationships in the Brazilian pig production may provide relevant insights for management.

The third specific research question of this thesis is:

RQ3- What are the impacts of vertical (i.e. IE and RQ) and horizontal relationships on farming performance in the Brazilian pork chain?

Contracts used to support production in food chains include coordination mechanisms on prices, volumes, quality and resource allocation (Wever, 2012; Martins et al., 2017). Resource allocation may include provision of inputs and technical support to farmers. These mechanisms are used to ensure that farmers meet compliance with quality requirements and produce efficiently (Key and MacBride, 2003; Raynaud et al., 2005; Dries et al., 2009; Goodhue, 2011). Moreover, this support improves farmers' capacity to invest in transaction-specific facilities and equipment (Davis and Gillespie, 2007; Key, 2013). In the BPC, production contracts normally include the provision of technical support to farmers. However, contracts differ in terms of input (e.g. feed, animals) allocation, depending on the transaction context (e.g. firms, cooperatives) and production stage (e.g. weaning, finishing). Examining how different settings on support influence farmer performance and investments provides relevant insights concerning coordination. This leads to the following research question:

RQ4- What are the impacts of buyer support on farmer investments and farmer performance in the Brazilian pork chain?

1.4. Theoretical Framework

Transaction costs economics (TCE) is the main theoretical framework used in this thesis (Williamson, 1991; 2000; 2010). In a broad sense, this theory was chosen to support the analysis of relationships between governance structures (GSs) and quality standards (QSs). Moreover, this thesis relies on Supply Chain Management (SCM) and network theory to support analyses on interactions between vertical and horizontal relationships among supply chain actors.

TCE has explained, to a large extent, how different types of GSs (e.g. markets, contracts, cooperatives and vertical integration), ranging in the continuum between markets and hierarchies, have been used to support transactions in food chains (Ménard and Valceschini, 2005; Raynaud et al., 2005; Schulze et al., 2007; Wever et al., 2010). This thesis focuses on contracts used by different types of buyers to support their relationships with pig farmers. Studies have demonstrated that even contracts may present different levels of coordination and assume different positions within the hierarchical continuum (Raynaud et al., 2005; Schulze et al., 2007; Gellynck and Molnár, 2009). Overall, these differences concern the different levels of control on inputs, processes and resource allocation. An analysis of such differences is especially interesting in this thesis because diverse settings regarding the above-mentioned aspects are used in contracts found in the BPC. However, the literature has focused on identifying specific (single/discrete) solutions (GSs) that best fit the generic characteristics of standards (e.g. ownership, scope). Therefore, the first contribution of this thesis goes a step further in this theory. Chapter 2 examines the relationships between coordination mechanisms (underlying governance structures) and quality requirements (underlying quality standards). This approach allows us to demonstrate, first, that similar quality requirements (i.e. the Brazilian pork chain case) may well be supported by different coordination mechanisms. This is especially useful when analysing the organisation of supply chains where quality is coordinated by buyers instead of third parties.

The traditional view of the TCE aims to point out the GS that best fits the transaction attributes (Williamson, 1991; 2010). However, this thesis relies on extended approaches that focus on CMs underneath a governance structure. First, a single GS might be made up of a bundle of CMs (Grandori, 1997, Foss, 2002, Wever, 2012). Second, individual chain actors may use more than one GS to support similar transactions (Bradach and Eccles, 1989; Heide, 2003; Parmigiani, 2007; Mols et al., 2011; Ménard, 2013). With regard to the first, Wever (2012) proposed a framework revealing that different CMs (i.e. price, quality, volume and investments) underlying a single GS, may assume different positions within the market-hierarchy continuum. Next, studies on plural forms of governance have explained that chain actors rely on more than one GS to support supply or distribution for different reasons. One of the streams of this literature has demonstrated that chain actors combine, for instance, internal production and contracts, to develop, along with suppliers, knowledge and capabilities to be applied and consolidated throughout contractual relationships (Heide, 2003; Parmigiani, 2007; Mols et al., 2011, Miranda and Chaddad, 2014). Other studies have shown that actors use plural governance to handle market fluctuations, difficulties in monitoring suppliers and

strategic issues (Parmigiani, 2007; Ménard, 2013). The third chapter of this thesis develops on CMs underlying GSs (Wever, 2012) and plural forms of GSs (Bradach and Eccles, 1989; Heide, 2003; Parmigiani, 2007; Mols et al., 2011; Ménard, 2013) to analyse the diversity of CMs used in contracts that support the production of piglets in the BPC. This chapter brings two contributions concerning theory. First, this study proposes refinements in the framework of CMs (Wever, 2012) with variables and values more aligned with the characteristics of production contracts used in food chains. The second contribution is to expand on explanations as to why different coordination mechanisms (and GSs) are used to support a homogeneous set of requirements. In the BPC, diverse CMs are used to define prices, resource allocation, and quality control in pig production. Analysing this diversity enabled us to expand on the subject with explanations grounded in the strategic view (Ménard, 2013) and buyer-supplier collaboration (Parmigiani, 2007; Heide, 2003; Parmigiani 2007; Mols et al., 2011). Analyses in different contexts (i.e. firms and cooperatives) help to refine insights concerning the diversity of arrangements.

Regardless of the type of GS used to support production, the performance of a supply chain depends on how chain actors coordinate processes and the quality of products. It implies establishing exchange of information, inputs and knowledge between chain links (Poppo and Zenger, 2002, Li et al, 2006; Huo et al. 2014). Moreover, the literature has demonstrated that the quality of vertical relationships influences the quality of the outputs, production costs and margins (Nyaga and Whiple, 2011; Molnár et. al., 2010; Odongo et al., 2016) and influences information exchange (Sheu et al., 2006; Prajogo and Olhager, 2012; Wu et al., 2014). Therefore, using elements of the Supply Chain Management (SCM) theory becomes important when it comes to analysing how vertical (i.e. buyer-supplier) relationships influence performance. Moreover, studies grounded on network theory have demonstrated that horizontal relationships (HR) (i.e. networks, discussion groups, farmers' associations) help farmers to improve quality of deliveries and profits (Lu et al., 2008b; Hennessy and Heanue, 2012; Hansen, 2015). Other studies, demonstrate that participation in HRs leads to improvements in vertical (i.e. farmer-buyer) relationships (Lu et al., 2012; Brito et al., 2015). Therefore, the fourth chapter of the present thesis combines elements of TCE, SCM and network theories to analyse how interactions between VRs and HRs influence performance in the Brazilian pig production. Previous studies have analysed, separately, the effects of VRs on performance (Li et al., 2006; Nyaga and Whipple, 2011; Wu et al., 2014) and HRs on performance (Hennessy and Heanue, 2012; Hansen, 2015). Moreover, HRs have been analysed for their influence on VRs (Lu et al., 2012; Brito et al., 2015). This research investigated, through a single structural model, how VRs and HRs interact and influence performance of pig farmers in the BPC. The analysis includes transactions conducted through contracts and spot markets.

TCE has provided diverse analyses on how production contracts have influenced farmers' performance and investments. More specifically, these studies have examined how the support included in contracts (e.g. technical assistance, provision of inputs) has helped farmers to improve the quality of deliveries, their profitability (Swinnen and Maertens, 2007; Key and Mac Bride, 2003; Dries et al. 2009, 2015; Goodhue, 2011; Martinez, 2012) and to

access resources that enable them to invest in facilities, equipment and technologies meeting the requirements of their buyers (Key and McBride, 2003; Davis and Gillespie, 2007; Falkowski, 2012; Key, 2013). Based on this literature, the fifth chapter of the present thesis analyses how buyer support influences farmer performance (i.e. quality, margins) and investment capacity, and how farmer performance influences the investment requirements set by buyers. Moreover, these effects are examined in two distinct types of transactions: contracts between buyers and piglet farmers and contracts with finishers. In the first, the buyer support is predominantly provided through technical assistance. In the second, the support incudes technical assistance and provision of inputs. This chapter expands on TCE by distinguishing the role of different coordination mechanisms in contracts used to support (similar) transactions in a single food sector. This study demonstrates that different settings of support mechanisms included in contracts imply different influences on performance and investments.

Figure 1.2 depicts the theoretical framework of this thesis.

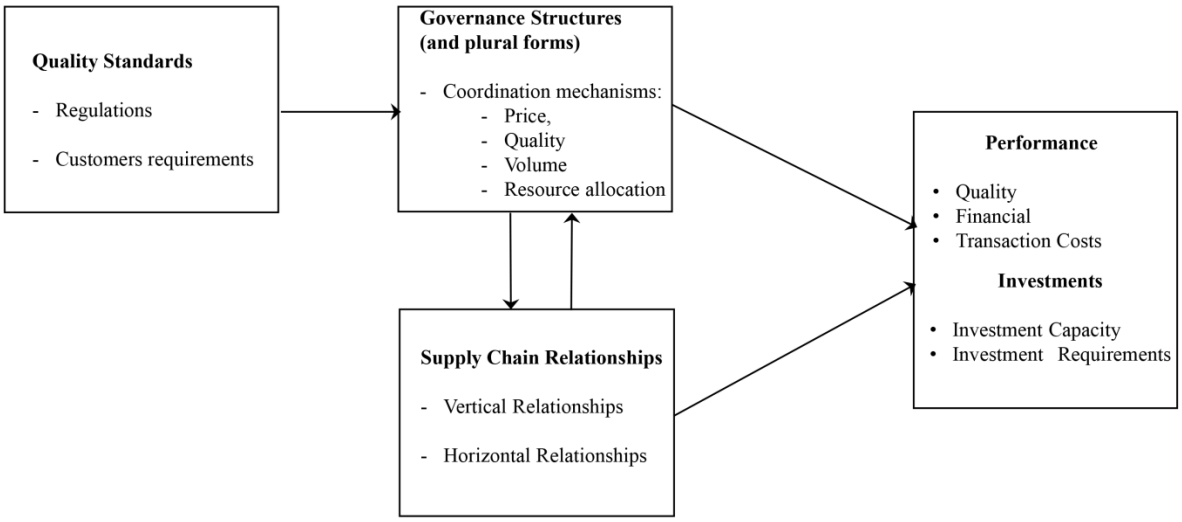

Figure 1.2. The theoretical framework

1.5. Research Methodology

This research covers the whole Brazilian pork sector and its institutional environment. Overall, the study includes all regions where pigs and pork are produced in Brazil. The empirical study was performed in two steps: qualitative and quantitative analyses. The qualitative research was important for identifying the main GSs, CMs and quality requirements used in the BPC and the main transaction contexts where pig production takes place (i.e. markets, mini integrations, cooperatives, and firms). Overall, findings obtained in this step were used to support the analysis on the relationship between governance and quality (Chapter 2), explore the complexity of CMs underlying a GS and discover the reasons why individual buyers use plural forms of governance (Chapter 3).

The qualitative analyses were supported by interviews (n = 41) with representatives of the sector and the institutional environment (Table 1.2), between September 2014 and April 2015. The set of buyers includes small, medium and big firms and cooperatives that together account for the lion's share of the domestic markets as well as the exports. The retailer and the information technology company are leaders in their respective sectors. Moreover, the two feed companies supply important firms and cooperatives in the BPC.

Table 1.2. Interviews settings

Type of interviewees, organisations and number of interviews(n)	n	Interview duration		Interviewee function	States where interviews took place
		Min	Max		
Buyers: IOFs, Coops, MIs	21	48	130	Directors and managers in production, quality, exports; owners.	Rio Grande do Sul, Santa Catarina, Paraná, Goiás, Brasília, Mato Grosso.
Famers' Associations (6 state and 1 local and the national association)	7	74	118	Presidents, Executive Directors, Consultant	Rio Grande do Sul, Santa Catarina, Paraná, Goiás, Minas Gerais and Brasília
Slaughterhouses Associations (2 state and the national association)	3	104	240	Vice-President, Executive Directors	Rio Grande do Sul and Santa Catarina
Information Technology	1	71		Santa Catarina	Owner (Director)
Retailer	1	72		São Paulo	Development of Meat Supply
Feed/Feedstuff Companies	2	88	91	Owner, Technical Adviser	Rio Grande Do Sul and Santa Catarina.
Government: Agricultural Ministry and Brazilian Agricultural Research Corporation. (EMBRAPA)	6	38	83	Staff of the Ministry areas: Animal Health, Livestock Production, Foreign Affairs, Inspection Service; Researcher on Animal Health	Santa Catarina and Brasília.

The main topics of the interviews were quality and coordination. Regarding quality, interviewees were asked about aspects such as their view on quality standards (e.g. buyers' requirements, regulations) developments, virtues and bottlenecks. Questions on coordination included the characteristics of CMs used to support production. They also included interviewees opinions on the strengths and bottlenecks of the relationships in the chain. The field research also relied on sectorial documents, buyers annual reports and manuals (good practices) and regulatory information.

Furthermore, insights obtained in the interviews were used to support the definition of constructs and measurement items to be used in the quantitative analyses. Data for quantitative analyses were obtained through a survey questionnaire applied to pig farmers in the Southern Brazil. This approach was chosen to test the hypotheses grounded in literature with empirical evidence based on data obtained from a representative sample. This region is pioneer in pork production and is also the place where firms and cooperatives that lead processing and exports in Brazil are based. The region represents about 70% of slaughters and 80% of exports of Brazilian pork (ABPA, 2016). The sample (Table 1.3) includes pig farmers from the three states located in the South: Rio Grande do Sul, Santa Catarina and Paraná. Farmers in Spot Markets were selected from lists provided by state farmer associations and

indicated by other farmers. Farmers involved in contractual arrangements (i.e. mini integrations, cooperatives and IOFs) were selected from lists provided by the companies. The survey was performed between March and May 2014.

Table 1.3. Sample design

	Transaction Contexts				
		Contracted Production			
	Spot Market	Mini Integrations	Cooperatives	Investor Owned Firms	Total
Total (Farmers)	45	43	111	70	269

The farmers responded to the questionnaire in the presence of the interviewer. The interviewers provided farmers with general explanations on the research and how to fill in the questionnaire beforehand.

The questions addressed background information (e.g. age, gender, farm profile) and farmers' perceptions on the aspects that involve their relationships with buyers. These questions on perceptions relied on a seven-point Likert scale ranging from strongly disagree (value = 1) to strongly agree (value= 7).

Respondents assigned a value equal to zero to questions that were not applicable to their reality. After the data collection, a principal component analysis was carried out to select the measurement items and constructs to be used in chapter 4 and in chapter 5 of this thesis. Afterwards, the reliability of the constructs was checked (Field, 2013). The hypotheses were tested by means of structural equation modelling (SEM) using STATA IC 14. In Chapter 4, the model analyses relationships between one construct on HRs, two constructs on VRs (i.e. Information Exchange and Relationship Quality) and three constructs addressing performance: Financial Performance, Quality and Transaction Costs. In Chapter 5, the SEM model is to analyse interactions among five constructs: Buyers Support, Investment Capacity, Financial Performance, Production and Quality (performance) and Investment Requirements.

1.6. Thesis outline

Chapter 2

Chapter 2 analyses the relationships between coordination mechanisms and quality requirements used to support transactions in the Brazilian pork chain. The results were obtained by means of interviews with public and private actors, including the main companies and other stakeholders in the Brazilian pork sector. The research addresses regulations, requirements of customers and supporting coordination mechanisms used in the different transaction contexts identified in this research - spot markets, mini-integrations, singular cooperatives, central cooperatives and investor-owned firms. Transaction Cost Economics theory focuses on the alignment between governance structures and quality standards. This

paper goes a step further by analysing the relationships between coordination mechanisms (underlying governance structures) and quality requirements (underlying quality standards). The findings show that similar quality requirements may well be supported by different coordination mechanisms. It further gives indications on why different coordination mechanisms are used to support a homogeneous set of requirements. The main differences in the coordination mechanisms used concern resource allocation and price incentives.

Chapter 3

Chapter 3 depicts the main coordination mechanisms (CMs) included in governance structures used to support the supply of piglets in the Brazilian Pork Chain (BPC). Furthermore, it analyses how and why actors use plural forms of coordination to support similar transactions. Based on the literature and an exploratory study carried out in the BPC, the chapter proposes a framework to analyse how price, volume, quality and resource allocation are coordinated in transactions. This paper builds on transaction cost economics (TCE) in two ways. First, it shows that to arrange a transaction, a buyer may set CMs in distinct positions within the market-hierarchy continuum. It also shows that actors use plural CMs with different counterparties in similar transactions. We found four explanations for the use of plural forms of governance: market fluctuations, bargaining power of suppliers, stricter coordination and quality, and the exchange context. We conclude that explanations for plural governance are provided by TCE in combination with organisational and neoclassical theories.

Chapter 4

Chapter 4 analyses the influence of Vertical (VRs) and Horizontal Relationships (HRs) on the performance of pig farmers in the Brazilian pork chain. Data were obtained from 269 farmers delivering pigs through contracts and spot markets in southern Brazil. Six hypotheses were examined using structural equations modelling (SEM). The results demonstrate that vertical relationships as well as horizontal relationships may improve farmer performance. Moreover, horizontal relationships positively affect vertical relationships by improving exchange of information between farmers and buyers. In addition, the findings suggest that these relationships are sensitive to the context (spot market or contracting) in which the transactions are executed. Although the study focuses on farmer buyer relationships and farmer performance, it brings relevant implications for management of other chain actors such as farmer associations and buyers.

Chapter 5

The aim of chapter 5 is to analyse how buyers support included in contracts, impacts on farmers performance, farmers investment capacity and farmers investment requirements. Data were obtained from 199 farmers supplying piglets and finished pigs through contracts in Southern Brazil. The paper expands on the literature by integrating in a single structural model (SEM) different relationships regarding the effects of buyers' support in transactions.

Moreover, the paper analyses these relationships in two production stages (i.e. piglet production and finishing), which are distinct in terms of buyers resource (i.e. input) allocation in the transaction. In the full sample, the study demonstrates the positive effects of support services on farmers performance and investment capacity and a negative relationship between performance and investment requirements. However, the findings in the distinct production stages suggest that the provision of inputs affects the effectiveness of the support. Theoretical and managerial implications are provided.

Chapter 6

Chapter 6 presents the general findings obtained in this thesis and discusses the limitations and implications for further research, management and policy-making.

CHAPTER 2

Differences in Quality Governance: The Case of the Brazilian Pork Chain[1]

[1] This chapter is based on:

Martins, F.M., Trienekens, J.H., Omta, S.W.F., 2017. Differences in Quality Governance: The Case of the Brazilian Pork Chain, Accepted for publication in the British Food Journal.

2. Differences in Quality Governance: The Case of the Brazilian Pork Chain

2.1. Introduction

Literature on food chains has shown how developments such as food crises (i.e. in food safety) and changes in consumer preferences have affected a fast development of regulations, quality standards and certification schemes These have increasingly challenged food chains to implement quality management systems in order to deliver high quality food and comply with new information requirements on their production processes (Theuvsen et al., 2007; Heyder et al., 2010; Trienekens et al., 2012). Especially from the early 2000s, a rapid growth of food quality standards and changes in food regulations has occurred. New quality demands also imply new coordination arrangements between buyers and suppliers in these chains. Food companies (slaughterhouses, processors) in the Brazilian pork chain have developed a wide range of coordination mechanisms with their suppliers in order to comply with the quality requirements set by public and private parties.

Different types of quality standards are used in food chains. Public standards normally address international agreements such as the Sanitary and Phitosanitary Measures (SPS) and Technical Barriers to Trade (TBT) mediated by the World Trade Organization (WTO) (Henson and Reardon, 2005; Henson and Humphrey, 2010). Retailing schemes, such as Global Gap and BRC set requirements on good agricultural practices to be met by suppliers worldwide (Theuvsen et al., 2007; Trienekens and Zuurbier, 2008; Heyder et al.,2010). Moreover, industries develop schemes that are sector specific. For example, IKB, Certus, and QS are schemes used in meat production respectively in the Netherlands, Belgium and Germany (Trienekens and Zuurbier, 2008; Bahlmann and Spiller, 2009). Moreover, there are differentiated standards, such as those on sustainable production, fair trade and business-to-business schemes that are used in narrower scopes (Theuvsen et al., 2007). Retailing, industry and special certification schemes are not used in the Brazilian pork chain. The main quality drivers in the sector are public regulations. Besides, sometimes companies must meet stricter quality requirements (e.g. residues, meat quality, biosecurity) demanded by importer countries and specific customers. To address these demands, companies set specific requirements in their contracts with pig farmers.

Food processors and retailers use different types of governance structures to support quality addressing food regulations and consumer preferences. Market, contracts, alliances, cooperatives, and vertical integration are examples of GSs actors use to support transactions (Ménard, 2004; Raynaud et al., 2005). According to the Transaction Costs Economics theory (TCE), each GS has inherent costs – e.g. selecting and monitoring partners - which are affected by the transaction attributes – i.e. uncertainty, measurement difficulties and assets specificity – and the institutional environment where transactions are embedded. Therefore, this theory assumes that, to support a transaction, an actor selects the GS that most efficiently match these aspects (Williamson, 2000; 2010). In this regard, food quality plays a central role by affecting the attributes of the exchange and demanding institutional mechanisms (e.g. private standards, regulations, contracts) to support its enforcement (Ménard and Valceschini,

2005; Raynaud et al., 2005, Schulze et al., 2007). In this paper we will analyse how coordination mechanisms underlying GSs (e.g. pricing, resource allocation) support quality requirements of buyers in the BPC.

Brazil is the fourth largest global producer and exporter of pork. Between 2011 and 2015, Brazil had an average share of 3.1 % of world production and 8.5% of the exports (USDA, 2016). In 2015, Brazil exported 542,000 tons of pork and the main importers were Russia (45%), Hong Kong (23%), Angola (6.5%), Singapore (5.2%) and Uruguay (4.2%) (MAPA, 2017). The production herd accounts 1,600,000 sows and 39,000,000 pigs. The main regions of production are the south, the southeast and the middle west, which maintain, respectively, 61%, 21% and 16.5 % of housed sows. The number of pig farmers in Brazil are estimated at about 42.000 (ABCS, 2016). The per capita consumption is 15.1 kg per year. In 2015, processed pork accounted for 89% of production (ABPA, 2016).

The Brazilian Pork Chain (BPC) presents little diversity of quality standards and meets, predominantly, public regulations, which are sufficient to supply the internal market and to export. Companies use mostly contracts to support transactions (Miele and Waquil, 2007). However, the contracts used in the sector differ in terms of coordination mechanisms used to support similar transactions in distinct transaction contexts. Previous literature has demonstrated how characteristics of standards (e.g. ownership, scope) affect the choice of GSs (Raynaud et al., 2005; Wever et al., 2010; Schulze et al., 2007). This study goes a step further by analysing how specific quality requirements (underlying quality standards) affect coordination mechanisms making up contracts.

Therefore, this paper aims to analyse the relationship between quality requirements and coordination mechanisms (CMs) embedded in contracts between buyers and pig farmers in the BPC. The next section presents a theoretical discussion on quality standards and governance. In Section 3, the research methods are described. Section 4 depicts main setters and quality requirements used in the BPC. In Section 5, interactions between coordination mechanisms and quality requirements are analysed. Section 6 presents the results. Discussions and conclusions are drawn in Section 7.

2.2. Theoretical Framework

2.2.1. Governance and Quality

Transaction Cost Economics theory predicts that the most efficient GSs are those that minimize production and transaction costs taking into account the institutional environment (Williamson, 2000, Ménard and Valceschini, 2005). The institutional environment is where formal and informal rules are set in order to reduce uncertainties and transaction costs. When it comes to food quality, regulations, public and private certification schemes (i.e. standards) and buyers' specific requirements are examples of institutional rules affecting chain organisation (i.e. GSs).

In his pioneer paper, Coase (1937) compared markets and hierarchies as alternative GSs and explained that hierarchy (i.e. internal organisation) is a response to the limitation of the price mechanism (i.e. market) in coordinating adaptations in transactions. Accordingly, a firm would only exist if it was able to produce at costs lower than market prices. Overtime, scholars demonstrated that intermediary GSs such as contracts, franchising, cooperatives and alliances, in which parties are mutually dependent, exist between the polar GSs market and hierarchy. These GSs are called hybrids (Williamson, 1991; Ménard, 2004). Contracts, a type of hybrid GS used to support production of pigs in the BPC, are of special interest in this paper.

According to the TCE's efficient alignment principle, the choice of a GS depends on the magnitude of transaction attributes - asset specificity, uncertainty, and measurement difficulties (Ghosh and John, 1999; Williamson, 2010). In market-like relationships, these attributes present low intensity. Therefore, these exchanges do not demand much control on quality and market prices are seen as a suitable coordination mechanism. In transactions with increased uncertainty or asset specificity, for instance, more hierarchical GSs are applicable. In such GSs, stricter coordination mechanisms, such as control on processes and inputs used by suppliers and prices associated with quality compliance prevail (Hobbs and Young, 2000; Martinez and Zering, 2004; Wever et al., 2010).

Aligning Governance and Quality

The increasing diversity of quality standards used in food chains has triggered interest on how efficiently GSs support quality. Examining food chains in Europe, Raynaud et al., (2005) found that more hierarchical GSs are used to support strict standards enforced by private actors. Inversely, market like GSs apply to little differentiated standards supported by public certification. Sector certification, certification supported by a sector organisation, also minimizes uncertainties regarding quality and, like with public certification, pushes governance towards market like arrangements (Bahlmann and Spiller, 2009; Schulze et al., 2007). In line with these contributions, Wever et al., (2010) examined how scope, ownership and scale of quality management systems (QMS) affect governance choices. Scope regards the number of chain stages a QMS covers. Ownership distinguishes the setters of standards – e.g. public, private actor or a third party. Finally, scale regards the number of suppliers (e.g. farmers) in the QMS. In this study, the authors found that, hierarchical GSs apply to QMS used in narrow scopes (e.g. business to business), small scale and set by private actors. Market-like GSs, in turn, are more suitable to chain wide QMS, set by public actors and used on large scale. Overall, this literature has provided interesting insights into how governance structures align with quality assurance standards.

In the Brazilian pork chain, however, chain actors do not use industry or retailing certification schemes led by third parties. In this sector the main quality drivers are public regulations - addressing issues on animal health, food safety, animal welfare and environment – and some stricter and specific requirements of importer countries and customers, for example, on meat quality, residues and biosecurity. Nevertheless, there is a wide range of coordination

mechanisms supporting these quality requirements. Therefore, rather than analysing how types of standards affect chain organisation (GSs), this paper goes one step deeper to examine the relationship between quality requirements and coordination mechanisms.

2.3. Methodology

This research is exploratory. Open interviews (n=41), were carried out between September 2014 and April 2015, with public and private actors, in the main regions that produce pork in Brazil (see Table 2.1). The sample includes small companies as well as cooperatives and investor owned firms which maintain about 75% of the Brazilian production. The set of interviewees also includes a retailer and an information technology company, which are leaders in their respective sectors, and feed companies with important participation in the BPC.

Table 2.1. Interviewees

Type of organisations	**n**	**Interviewees' functions**	**States**
Buyers: Investor Owned Firms, Cooperatives and Mini Integrators	21	Owners (5), Directors (4), managers on production (10) , quality (1), and exports(1);	Rio Grande do Sul, Santa Catarina, Paraná, Goiás, Brasília, Mato Grosso.
Famers Associations: (1 national, 5 state, 1 local)	7	Presidents (5), Directors (1), and Technical Manager (1)	Rio Grande do Sul, Santa Catarina, Paraná, Goiás, Minas Gerais and Brasília.
Slaughterhouses Associations (1 National 2 state)	3	Vice-President (1) and Directors (2)	Rio Grande do Sul, Santa Catarina and São Paulo
Information Technology	1	Director	Santa Catarina
Retailer	1	Staff member of Development of Meat Supply department.	São Paulo
Feed suppliers	2	Owner, Technical Adviser	Rio Grande do Sul, Santa Catarina.
Government	6	Agricultural Ministry areas: Animal Health (1), Livestock Production (2), Foreign Affairs (1), Inspection Service (1). Brazilian Agricultural Research Corporation (EMBRAPA): Researcher on animal health (1).	Santa Catarina, Brasília

Questions addressed issues on quality and coordination. Regarding quality, the main topics were current and upcoming requirements, strengths and bottlenecks regarding public and private enforcement. In coordination, the main topics were types of mechanisms such as resource allocation (e.g. technical support, inputs) and price incentives used in transactions Companies' annual reports, legislation and sector data were used as complementary sources of information. The average time of the interviews was 86 minutes. The interviews were recorded and transcribed. When it was necessary to validate interpretations, additional meetings, by telephone or Skype TM were arranged.

2.4. Results

2.4.1 Transaction Contexts

This research identified five different transaction contexts in which pigs are delivered: Spot Market, Mini-Integrations, Singular Cooperatives, Central Cooperatives and Investor Owned Companies. This study focuses on transactions between buyers and pig farmers within these contexts.

In the BPC, production stages are normally assigned to specialized farmers. The predominant scheme used in contractual relationships sets, in sequence, weaning – nursery – and finishing farms. In weaning farms, piglets are born and raised until they reach a weight between 7 and 8 kg. These piglets are transferred to nurseries where they reach a weight between 22-25 kg. From nurseries or farrowing farms, piglets go to fattening farms where they reach the slaughtering weight (100-125 kg). In some cases, piglets are born and raised until they are 22-25 kg before being transferred to finishing farms. Some companies use the wean to finish model to cover part of their production. In these farms, piglets enter at 7-8 kg and are raised until the slaughter weight. The farrowing to finish system gathers the three stages in one farm. Although the use of this system is decreasing it is still adopted by independent farmers and some cooperatives. In what follows, the contexts wherein transactions between buyers and pig farmers take place are described.

Transactions driven purely by markets are not often used in BPC. Thus, in this research, we include in Spot Market (SM) arrangements in which a farmer maintains informal long-term relationships with a selected number of buyers. In Brazil, these farmers are known as independent producers. SM farmers supply local slaughterhouses, other farmers or middlemen and meet public baseline standards. In this research, owners of two local slaughterhouses purchasing pigs exclusively from independent farmers were interviewed.

Mini Integrations (MI) are organisations led by big pig producers that coordinate production by means of contracts or informal relationships. MIs supply local slaughterhouses or big pork processors in the national market and meeting public baseline standards. In this study 3 MI's were interviewed – 2 in Santa Catarina and 1 in Rio Grande do Sul. The number of farmers that supply each of these MIs ranges between 35 and 210. Deliveries of these MIs vary between 60,000 and 140,000 pigs annually.

Singular Cooperatives (SC) normally arrange production by means of contracts with member farmers. Some SCs are specialized in pork and others diversify their activities (e.g. poultry, dairy). In this research, 5 SCs were interviewed: 2 in Rio Grande do Sul, 2 in Paraná and 1 in Mato Grosso. The annual slaughters of these SCs range between 140,000 and 290,000 pigs. the number of farmers varies between 46 and 290. Smaller SC's meet predominantly public baseline standards and supply local, regional or national markets. There are SCs that arrange part of their supply to meet strict requirements of importers (e.g. substances used in the feed).

Data on slaughters of individual processors allows estimating that SC's perform about 7% of slaughters in Brazil (SIPS 2014).

Central Cooperatives (CC) are big organisations that hold affiliated cooperatives. In this research, the two CCs that produce pork in Brazil were interviewed. One is based in Santa Catarina and maintains 12 affiliated cooperatives (9 in Santa Catarina, 1 in Rio Grande do Sul, 1 in Mato Grosso do Sul and 1 in Paraná). In total these cooperatives maintain about 63,000 farmers involved, mainly, in dairy, poultry and pig production (3,500 pig farmers). The CC slaughters about 4,000,000 pigs annually in 4 slaughterhouses. The other CC produces in Paraná, gathers 6 affiliated cooperatives and maintains a single slaughterhouse. Although the affiliated cooperatives diversify production, the CC processes only dairy and pork products. In 2013, the affiliated cooperatives accounted 4,664 members (881 pig farmers). The slaughters totalized at about 1,540,000 pigs in 2014. Both CCs supply the domestic market and export. The one in Santa Catarina supplies the more demanding importers such as Russia and Japan. Together, these CCs perform 17% of slaughters in Brazil (SIPS, 2014)

Investor owned firms (IOFs) use contracts with farmers to organize production. IOF's lead production of pork in Brazil. The 4 biggest firms perform about 52% of slaughters (SIPS 2014). We conducted interviews with the two biggest IOFs which, together, maintain 42%. The biggest firm maintains contracts with about 3,600 pig farmers and slaughters in 9 plants in Rio Grande do Sul (2), Santa Catarina (3), Paraná (1), Minas Gerais (1), Goiás (1) and Mato Grosso (1). The slaughters reached about 9,000,000 pigs in 2014. The other firm is supplied by about 2,600 farmers and slaughters in 5 different plants (Rio Grande do Sul (2), Santa Catarina (2) Paraná (1). The firm slaughtered about 4,500,000 pigs in 2014. Both companies export part of their production to more demanding importers (e.g. Russia).

Table 2.2 depicts the main characteristics of the transaction contexts. Information on slaughters in IOFs and cooperatives (SIPS, 2014), allows to estimate that SMs and MIs produce about 24% of the pigs slaughtered in Brazil.

Table 2.2. Main transaction contexts in the Brazilian Pork Chain

	Spot Market	Mini Integrations	Singular Cooperatives	Central Cooperatives	Investor Owned Firms
Customers	Local slaughterhouses, farmers, middlemen	Local slaughterhouses and national markets	Local and national retailers and importers	National retailers and importers	National retailers and importers
Standards	Public baseline	Public baseline	Public baseline	Public baseline and stricter	Public baseline and stricter
Type of contract	Market and informal contracts	Informal and formal contracts	Formal contracts	Formal contracts	Formal contracts
Annual volume (Pigs x 1,000)	*	60-140	140-290	1,540-4,000	4,500-9,000
Market share	24%**		7%	17%	52%

* Information on individual farms not available; ** Includes spot markets and mini integrations

2.4.2. Quality Requirements

Setters

The Ministry of Agriculture, Livestock and Food Supply (MAPA) is the main setter of requirements in the BPC. However, to continuously address food developments and to update requirements, MAPA maintains close interaction with the pork sector. For instance, MAPA maintains the Swine and Poultry Council that brings together organisations which represent farmers (e.g. Brazilian Association of Pig Farmers- ABCS) processors (e.g. Brazilian Association of Animal Protein-ABPA), feedstuff sector, retailers and other stakeholders. Sector institutions also perform actions to support compliance in the supply chain. This includes elaboration of manuals on good agricultural practices and allocation of resources such as technicians, vehicles, software and capacitation to implement biosecurity measures (ABCS, 2011, FUNDESA, ICASA). Next, as described before, companies adopt specific requirements to address additional demands of customers, emerging issues and gaps in public regulations. This will be further explained in the next sections.

Public Regulations

The Federal Inspection System (S.I.F) is the MAPA's scheme which accredits processors to supply the national market and to export meeting international standards. At farming stages, MAPA sets regulations on animal health, food safety and animal welfare. The Environment Ministry sets general policies for the management of water and soil resources. Table 2.3 depicts the main regulations used in the BPC.

Table 2.3. Public regulations on pork production in Brazil

Quality Issue	Regulations	Main topics
Animal Health	Decrees 30.691/1952 and 8681/2016	Industrial and sanitary inspection of animal products
	Normative Instruction 26/2009	Production, quality, commerce and use of medicines
	Normative Instruction 19/2002	Certification of breeding pig farms.
	Normative Instruction 44/2007	Prevention and eradication of Foot and Mouth Disease.
	Normative Instructions 25/2016	Prevention and eradication of Classical Swine Fever.
	Normative Instruction 08/2007	Prevention and eradication of Aujeszky Disease.
Food Safety	Normative Instruction 65/2006	Manufacturing and use of feed, supplements and premixes
	Normative Instruction 14/2009	Control on residues and contaminants in meat
	Normative Instruction 04/2007	Hygienic-sanitary standards in production of animal feed.
	Normative Instruction 27/2008	Accreditation of slaughterhouses to export.
Animal Welfare	Normative Instruction 56/2008	Handling, transportation and nutrition at farming
	Ordinance 711/1995	Handling and facilities at pre-slaughtering
Environment	Law 12. 305/2010; Resolution 430/2011	Use of water and soil resources
	Normative Instruction 11/2014	Use of water, storage and disposal of manure.

Source: MAPA 2016, FATMA, MMA

Regulations on animal health address issues on the use of medicines and control of diseases. Requirements on the use of medicines include issues such as banning, withdrawing periods, quality control and marketing. To control diseases (e.g. Classical Swine Fever) MAPA maintains programs to monitor risks, to provide chain actors with capacitation and to establish actions to handle outbreaks. The main instrument used to support the sanitary control throughout the supply chain is the Animal Transportation Guide (GTA). The GTA is a mandatory document used by owners of pigs and transporters including data on the origin and destination, finality (e.g. farming, slaughter) and sanitary information (e.g. use of vaccines). At slaughterhouses, for instance, officials perform systematic control on GTAs accompanying batches of pigs to be slaughtered.

Regulations in food safety include good practices in production of feed, control of residues and banning of certain substances. With respect to animal welfare, MAPA establishes general recommendations on handling, facilities and equipment used in transportation and production. Based on environment national policies, state agencies set requirements on the licensing of pig farms addressing issues such the use of water, storage and disposal of manure.

Specific Requirements

In The BPC, companies may comply with specific requirements, which are stricter than those set in public regulations, for different reasons. For example, sanitary authorities of countries that import pork are normally concerned with residues and sanitary status of regions wherein pigs are produced. Moreover, some customers (e.g. processors, restaurants) look at specific aspects regarding meat quality. Finally, companies set requirements to fill gaps in regulations or to address emerging issues such as EU standards on animal welfare. All of these examples, affect, somehow, the requirements companies set in their contracts with pig farmers.

Regarding residues, Russia and China, for example, require evidences that pigs are fed with feed that is ractopamine free [1]. Japan, which is still an emerging market for Brazil, is concerned with residues of medicines. To address issues on residues, companies select specific farms wherein strict requirements on nutrition management, control on the use of medicines and traceability are required. With respect to sanitary status, some countries only accept pork from pigs produced in areas free of herd diseases. For example, Japan only accepts pork produced in areas that are free of Foot and Mouth Disease (FMD) without vaccination. Santa Catarina is the only state that meets this condition in Brazil. Until 2016, fifteen Brazilian states were accredited by OIE as areas free of Classical Swine Fever (CSF). It makes BPC a potential supplier of markets such as USA, Mexico and South Korea.

With respect to biosecurity, MAPA sets requirements on practices and facilities for breeding farms but does not set measures for production farms. Therefore, companies (e.g. IOFs; cooperatives) define their own requirements farmers need to comply with. MAPA's requirements on animal welfare are currently accepted in the international markets. However, recent efforts led by MAPA, NGOs and the pork sector, have raised awareness on this issue. As a consequence, the two biggest companies in the pork sector are committed to have their

whole supply meeting European standards until 2026. These firms are setting specific requirements on facilities and equipment (e.g. collective housing) to be met by piglet farmers.

Different types of customers demand specific issues regarding meat quality. For example, Japanese packers are strict with size of cuts, coloration, fat thickness and marbling. Fast food networks demand specific characteristics in the pork fat used in their products. To address these issues, companies set, to farmers, specific requirements on genetics and nutrition. Table 2.4 presents an overview of enforcers and drivers of quality requirements in the BPC.

Table 2.4. Enforcers and drivers of quality requirements in the Brazilian Pork Chain

Enforcers	Drivers	Requirements
Government	-International agreements and food developments	Baseline regulations on Animal Health, Food Safety, Animal Welfare and Environment
Government and companies	-Specific requirements of countries	Stricter control on residues (nutritional management; traceability) and diseases
Companies	-Emerging issues -Regulatory gaps -Specific customer's requirements	Stricter standards on biosecurity, genetics, animal welfare

2.4.3. Different Coordination Mechanisms to Support Quality

As explained above, the BPC is basically driven by public standards and some stricter requirements set by countries and customers. However, our research shows that chain actors use a diverse set of CMs (GSs) to handle this quite homogeneous set of standards. In the following the main settings of these mechanisms, used in the different transaction contexts, are presented (Table 2.5).

Coordination Mechanisms

Independent farmers use their own animals and feed to produce pigs. These farmers purchase premixes from feed companies. Feed companies support farmers in nutritional management aiming to increase feed conversion. Normally, this support is extended to issues such as sanity and handling. Farmers meet public baseline quality standards. There are buyers that maintain exchange relationships with a selected set of independent farmers. Some of these buyers specify genetics, provide vaccines and occasional technical support. However, all transactions are driven by market prices.

In Mini Integrations, buyers use different contractual settings with farmers producing in different stages. The ownership of the critical inputs differs across the different chain stages. Farmers use their own feed and sows to produce piglets. At nurseries and finishing farms the integrator provides farmers with feed and piglets. The integrator provides technical support, which is also used to monitor quality, with focus on sanitary issues. This support is performed in on demand basis at the piglet production and is more systematic at the nursery and finishing stages. The prices used in the payment of piglets follow regional markets. For

piglets raised in nurseries and pigs grown in finishing farmers MI's use internal prices and criteria based on productivity of inputs provided to farmers (e.g. mortality, feed conversion). Normally, MI's use formal contracts with piglet farmers and finishers. However, in many cases, the relationship with piglet farmers is informal. The contracts with piglet farmers are known as *Buying and Selling.* With nursery and finishing farmers, MI's use input providing contracts known as *Partnership Contracts*.

To arrange their supply and control quality, Singular Cooperatives (SCs) use formal contracts. However, these contracts are arranged with farmers that are also members of the cooperative. Piglet farmers normally use their own sows and feed meeting, for both inputs, standards recommended by the cooperative. Many cooperatives recommend that farmers purchase the feed produced by the cooperative. However, the ownership of the critical inputs is always exerted by the piglet farmers. SCs provide piglets farmers with technical support in production. In many cases, weaning farmers use software to monitor the productivity within a supply chain information exchange scheme with the SC. The SCs use this information to give farmers feedback to improve efficiency (e.g. feed conversion, number of weaned piglets per sow) and quality (e.g. uniformity, welfare, sanity). At the fattening stage, SCs provide farmers with feed, piglets and veterinary inputs and technical support. To support the provision of piglets, SCs maintain contracts with farmers (also cooperative members) who raise weaned piglets in nurseries, as explained before. SCs provide systematic technical support and perform monitoring in production in all production stages. The price mechanisms used to pay piglets include a base price following regional markets and bonus/penalty based on the fit/deviation from a defined weight. For finished pigs, SCs use internal prices, criteria based on productivity (e.g. mortality, feed conversion) and a bonus based on a checklist on maintenance (e.g. cleanness, status of equipment and facilities) and administration (e.g. documentation) of the farm. Some cooperatives set specific models of facilities addressing biosecurity measures and include compliance with these measures in their checklists. Similar mechanisms are used to establish the payment for piglets raised in nurseries.

In Central cooperatives (CCs) the supply is arranged by the affiliated cooperatives. The affiliated cooperatives use, in their relationship with farmers, the same coordination mechanism used by SCs, as above explained. Because CCs centralize the slaughtering, processing and delivering of pork products, these organisations set the standards to be met by their affiliated coops. Therefore, the technical support provided to pig farmers is carried out by the affiliated cooperatives with supervision and support of the CC.

IOFs also use contracts to support production and quality. However, these firms focus on maintaining the ownership of critical inputs and providing all types of farmers with feed and animals. IOFs provide technical support and monitor production, systematically, in all production stages. At the weaning stage, it normally includes use of software to support information exchange on productivity. The mechanisms used in the payment for piglets include an internal base price, bonus based on productivity (e.g. feed conversion, mortality, number of piglets weaned per sow) and bonuses based on checklists on maintenance, administration of the farm and facilities meeting the firms' standards on biosecurity. More

recently, IOFs have also centred efforts in the implementation of weaning farms meeting EU standards on animal welfare. The firms are implementing price incentives to ensure that farmers have margins which overweight the interest rate of the loans the farmer needs to make to invest in facilities that meet the required standards. At the finishing stage, IOFs use internal base prices, bonus based on productivity and checklists. In addition, firms establish grids assigning farmers to groups of performance associated with differentiated price levels.

Table 2.5. Main coordination mechanisms addressing quality requirements in the Brazilian Pork Chain.

Coordination Mechanisms	**Production Stages**	**Transaction Contexts**			
		Spot Market	**Mini Integration**	**Cooperatives**	**Investor Owned Firms**
Provision of feed	Piglet production	The farmer provides the feed to be used in all production stages	The farmer provides the feed	Farmer provides (meeting coops' standards) or purchases from the coop.	The firm provides the feed in all production stages
	Nursery and fattening		The integrator (buyer) provides the feed	The coop provides the feed	
Provision of animals	Piglet production	The farmer provides the animals in all production stages	The farmer provides the sows	The farmer provides the sows (meeting coop's standards in genetics)	The firm provides the animals in all production stages
	Nursery and fattening		The integrator provides the piglets	The coop provides the feed	
Technical Support (and monitoring)	Piglet production	Farmers account with support from their feedstuff suppliers	The integrator provides technical support in an *on demand* basis.	The cooperative provides systematic technical support.	The firm provides systematic technical support.
	Nursery and fattening		The integrator provides technical support	The cooperative provides technical and managerial support using software to exchange information.	The firm provides technical and managerial support using software to exchange information.
Pricing (criteria)	Piglet production	Market	Market	Market and weight of the piglets	Internal price and productivity
	Nursery and fattening		Internal price and productivity	Internal price, productivity and checklist on organisation and maintenance of the farm.	Internal price, productivity, performance comparison (grids), and checklist on organisation, maintenance and facilities.

Coordination Mechanisms and Quality Requirements

The previous sections identified for the BPC, the main quality requirements and coordination mechanisms chain actors use to support the supply of pigs. The results show that baseline public regulations are dominant in this supply chain. However, companies also comply with stricter requirements to address demands of specific countries and customers.

On the level of the governance structure (GS) overall, the results demonstrate alignment between transaction attributes and governance modes, as expected in TCE theory (Williamson, 1991; 2010; Hobbs and Yang, 2000), where transaction attributes are to a large extend dependent on quality requirements constrained by institutional developments (regulations, international markets) (Williamson, 2000; Ménard and Valceschini, 2005; Raynaud et al., 2005; Gellynck and Mólnar, 2009). For instance, market prices prevail in all spot market transactions and in the supply of piglets in MI's. In these cases, the quality requirements present a low influence on transaction attributes: delivery of standard quality products, which need little company-to-company monitoring and low specific investments. However, in transaction contexts wherein concerns with quality increase, like in companies delivering to higher demanding customers, it was found that buyers increase control on farming processes and inputs used by farmers. These buyers (i.e. coops, IOFs), use routines of technical support and specific incentive mechanisms, associated with checklists, to decrease uncertainty in quality and protect investments in genetic and nutrition programs and in feed mills which are made to provide farmers with the right inputs.

However, looking at the CMs included in contracts used in different transaction contexts, our study finds that there are more differences in coordination than in quality requirements. In other words, chain actors use a diverse set of CMs to coordinate a non-diverse set of quality requirements. Chain actors use different types of contracts – i.e. partnership, buying and selling - (Miele and Waquil, 2007), in different contexts (MIs, Coops, IOFs) to produce piglets complying with public baseline regulations. These contracts present differences in CMs such as resource allocation (e.g. ownership of inputs, technical support) and price incentives (checklists, e.g. productivity). Furthermore, the study demonstrated that individual buyers (e.g. MIs and Coops) maintain different types of contracts to support production at different stages (i.e. buying and selling contract to purchase piglets; partnership contract at finishing farms). IOFs, in turn, focus on using partnership contracts in all stages. However, even contracts that fit a general type of GS (i.e. partnership) might present company specific differences in underlying CMs. For example, at the fattening stage, IOFs normally use grids comparing performance of farmers to differentiate payment prices. This device is not used in cooperatives.

2.5. Conclusion, policy implications and further research

Literature on the alignment between governance structures and generic types of standards or quality management systems (Raynaud et al.,2005; Schulze et al., 2007, Gellynck and Molnár 2009; Wever et al., 2010) has helped to identify general types of solutions (e.g. markets, contracts, vertical integration) that most efficiently support transactions. However, rather than looking at generic types of standards and GSs, the present study focused on quality requirements and CMs embedded in contracts. This approach helped to explain why in BPC, where public standards prevail, chain actors apply a diverse set of coordination mechanisms to support transactions. The study also showed that specific quality requirements must be taken into account to understand modes of organisation that prevail in a food sector.

The above explained diverse CMs used to handle a homogeneous set of quality requirements indicate that quality is not the only driver that explains the forms of coordination used to support transactions of pig farmers in the BPC. First, at the processing stage, the BPC is highly concentrated. We recall that, at the time of this research the 4 main firms and 2 central cooperatives that deliver pork maintain, respectively 52% and 17% of the slaughters (SIPS, 2014). On one hand, it gives buyers (bargain) power to enforce their coordination mechanisms. On the other hand, processors pursue, constantly, cost advantages in the obtainment of inputs (i.e. live pigs) to maintain their competitive position. This enables them to use input providing contracts in all production stages (i.e. weaning, nursery, finishing). Therefore, considerations regarding the power of the buyer and its specific competitive strategy should be taken into account in analysing the relationships between quality and governance (Zylbersztajn and Farina, 1999; Silva and Saes, 2007; Ménard and Valceschini, 2005).

Second, findings regarding the cooperatives suggest that the context in which the buyer-supplier relationship is embedded matters for governance choices. Cooperatives face specific constraints to align quality and governance. First, besides the supply relationships, relationships between cooperatives and farmers regard membership and control (Cechin et al., 2013). Although supplying contracts of cooperatives specify sanctions in cases of non-compliance, their enforcement is also affected by these relationships. For example, cooperatives provide technical support to piglet farmers preserving farmer autonomy (i.e. ownership of inputs). Moreover, cooperatives use the contractual relationship with pig farmers as a means to commercialize feed (i.e. grains). Because the relationship with farmer present these specific characteristics, it is not surprising that (more often than IOFs) cooperatives use devices which go beyond contractual mechanisms such as technical support and price incentives. Many cooperatives use manuals, quality programs, technical meetings and capacitation directed at farmers to improve smooth communication with farmers regarding requirements and production practices.

Policy implications

In addition, this research provides insights in public and sector policies. The current model of organisation is, in part, a response to institutional gaps. The public framework lacks specific standards on various aspects of quality management, such as biosecurity and systematic monitoring for farming. Thus, companies use their own mechanisms, technical support and monitoring schemes. Therefore, it can be of interest to analyse whether the further setting of public regulations on quality management, including facilities, would reduce, through more standardization of processes, the necessity for private coordination. Apart from the impact this would have on IOF and cooperative arrangements, such support could be of special interest for farmers that currently do not receive support (e.g. in practices, provisioning of inputs) from companies. Regarding this, the interviews identified opinions in favor of the use of sector certification to support quality at farming stages (Bahlmann and Spiller 2009; Trienekens and Zuurbier, 2008). Looking at the GSs described in this paper, it can be assumed that this innovation would challenge the current pattern of organisation and competition within the sector. Research into consequences of sector certification could be of great interest from both academic as well as practical perspectives.

Further research

The different GSs identified in this study present differences in costs (e.g. of technical support, monitoring, documentation). Comparing these costs can provide interesting insights in the organisation of the chain. Moreover, analysing the effectiveness of the GSs in ensuring quality compliance will enhance our knowledge on the alignment between GSs and quality standards. These analyses could be refined with other aspects that affect the choice of CMs, such as organisational complexity (e.g. central cooperatives), power relationships and competition.

In CCs, the constraints above explained sum up with the challenge to align standards throughout affiliated cooperatives. This is not without frictions regarding, for example, power relationships among these cooperatives and differences in internal organization. Therefore, analysing in more detail how (whether) coordination mechanisms differ throughout affiliated cooperatives supplying a CC and how these CMs support performance (i.e. in quality and costs) would be an interesting topic for further research.

This paper focused on the main coordination mechanisms used to support quality (and production) in different contexts of exchange. However, it is known that chain actors combine different CMs to support similar transactions (Heide, 2003; Ménard, 2013). On one hand, a processor may use markets to purchase part of the supply in order to handle fluctuations in demand. On the other hand, a buyer may deploy stricter mechanisms to address competition with other buyers or to develop knowledge (e.g. practices, technology) to be applied throughout the whole supply chain (Martins et al., 2017; Parmigiani, 2007). Examining the reasons why chain actors combine different CMs to support similar exchange relationships is also an interesting field for further research.

[1] Ractopamine is and additive that improves the feed conversion, reduces fat content, and increases the daily weight gain of a pig. World pork producers and exporters as USA and Canada use ractopamine in pig production. In Brazil, its effects in terms of cost-efficiency is estimated at about 12-15%. Although there are no evidences of risks of this substance to human health, Russia and China, following EU, banned its use.

CHAPTER 3

Governance Structures and Coordination Mechanisms in the Brazilian Pork Chain - Diversity of Arrangements to Support the Supply of Piglets[2]

[2] This chapter is based on:

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3. Governance Structures and Coordination Mechanisms in the Brazilian Pork Chain - Diversity of Arrangements to Support the Supply of Piglets

3.1. Introduction

The literature on transaction cost economics theory (TCE) has paid little attention to the complexity of coordination mechanisms (CMs) that underlie governance structures (GSs) (Wever, 2012). Researchers have used different GSs, ranging within a continuum from market ("buy") to integration ("make") to explain coordination in food chains (Raynaud et al., 2005; Schulze et al., 2007; Gellynck and Molnár 2009; Wever et al., 2010). However, a GS (e.g. contract) may incorporate CMs - such as quality, price, investments and volume – that may be located at different points in this continuum (Wever, 2012). Examining these CMs in an integrated way, supports more refined insights into how a GS coordinates different aspects of the exchange.

Next, the use of plural GSs (Bradach and Eccles, 1989; Ménard, 2013), to support transactions with different counterparties within a same supplying context, has attracted the interest of scholars. This organisational diversity, which in part contradicts the principle of the efficient alignment (Williamson, 1991), is largely present in different sectors. Technological uncertainty, development of mutual (supplier-buyer) skills, monitoring difficulties and strategies to handle problems in coordination are examples of explanations for this development (Heide, 2003; Parmigiani, 2007; Mols et al., 2011; Ménard 2013; Miranda and Chaddad; 2014).

Brazil is the fourth largest global producer and exporter of pork. In terms of quality, the Brazilian Pork Chain (BPC) meets, predominantly, public regulations, which are sufficient to supply the internal market and the majority of importer countries. In addition, BPC meets specific requirements set by domestic buyers and importers. Although BPC shows little diversity in quality standards, chain actors use many types of GSs, combining different CMs, to support pig production. These characteristics fit an interesting object of research in TCE.

The goal of this paper is to analyse the heterogeneity of CMs and GSs used to support transactions between farmers and buyers in BPC. It includes analysing how and why chain actors use plural forms of combined CMs in similar exchange relationships. The next section presents a theoretical discussion and the research questions. Section 3 describes the research methods. Section 4 describes the elaboration of a modified framework of CMs and the main characteristics of coordination in the BPC. Section 5 presents case studies on the complexity of CMs and use of plural forms of governance. Section 6 discusses the results reflecting on the literature. Finally, section 7 presents the conclusions.

3.2. Theoretical framework

3.2.1. Governance in Food Chains

Transaction Cost Economics theory poses three different attributes to which the problem of selecting a matching governance structure is paramount: asset specificity, uncertainty and measurement difficulties (Rindfleisch and Heide, 1997; Ghosh and John, 1999).

Asset specificity regards investments made to fit the requirements of a particular agreement, which lose their value if used in another relationship. For instance, a processor concerned with a strict quality requirement, may set, in contracts, price incentives for suppliers to invest in specific resources (e.g. facilities, computer controlled feeding). However, if one of these suppliers uses these resources in transactions not driven by the same standards, the returns decrease. Therefore, a GS (e.g. a contract) may include a safeguard to protect the investments against opportunistic behaviour (Klein, 1996).

Uncertainty stems from the environment and behaviour of transaction parties. Environmental uncertainty raises the transaction costs of adaptation and coordination (Rindfleisch and Heide, 1997; Ghosh and John, 1999; Williamson, 2008). Examples of uncertainty are changing customer requirements and information on quality (Martinez, 2012), market conditions (Heyder et al., 2010), public regulations and their enforcement (Williamson, 2008; Ménard and Valceschini 2005; Zylbersztajn and Farina, 1999). To handle uncertainty a processor may use a governance structure specifying, for instance, standards and mechanisms of control on processes and inputs used by suppliers.

Measurement difficulties regard the complexity inherent in monitoring a transaction according to a desired performance. Ghosh and John (1999) define it as the degree to which the value of an actor's contribution is not verifiable by ex post inspection of an output. This complexity poses difficulties in aligning incentives and may cause loss of value in the transaction. For example, to facilitate control on a credence attribute, which is not possible to verify in visual inspections (i.e. food safety), a buyer of livestock may provide a farmer with specific inputs (e.g. GMO free feed). On the one hand it facilitates control of farming processes. On the other hand, it increases the costs incurred by the buyer to produce and deliver these inputs (i.e. selecting feedstuff supplier, logistics).

Governance Choices

Coase (1937) launched the discussion on forms to support transactions by pointing out markets and internal organisation (hierarchies) as alternative arrangements used to produce a good at comparable (transaction) costs. With this rationale, decision makers would use a firm only if it produced at lower costs than market prices. Over time, hybrid GSs that range between market and hierarchy began to be analysed by TCE scholars (Williamson, 1991; Ménard, 2004; Sauveé, 2013). Parties to a transaction rely on hybrids to cope with the risks

that accrue from the market on the one hand, and to reduce the costs of internal organisation on the other. For Williamson (1991), hybrids are intermediary forms of control where parties remain autonomous but become mutually dependent to some extent. Ménard (2004) adds that in hybrids, parties to a transaction rely on a "little help" from the price system to make an exchange but do not unify ownership of resources. As examples of hybrids, the author describes *franchising, collective trademarks, partnership, cooperatives, networks, alliances and contracts*.

TCE literature has presented different typologies of GSs, used to support transactions in food chains. Gellynck and Molnár (2009), depicted product, chain level and country-specific characteristics of GSs used in European food chains. Raynaud et al., (2005) use six types of GSs following a hierarchical sequence - *Spot Market*, *Relational Contract*, *Relational Contract with Approved Partner*, *Formal Written Contract*, *Equity Based Contract* and *Vertical Integration* - to analyse the alignment between quality and GSs. Schulze et al., (2007) present a typology of GSs used in pork chains: *Spot Market*, *Long-Term, Relationships*, *Marketing Contracts*, *Production Contracts*, *Farming Contracts* and *Vertical Integration.*

3.2.2. Coordination Mechanisms

GSs differ from one another in aspects such as formality, duration, resource allocation, quality requirements and monitoring. Therefore, comparing GSs for their cost efficiency (Williamson, 1991) has not been sufficient to depict more clearly which aspects each alternative (GS) coordinates. A GS is, indeed, a combination of coordination mechanisms (Grandori, 1997; Foss, 2002) used to control different aspects of the exchange. For example, to support transactions with suppliers, buyers may use contracts (i.e. a GS) including standards for inputs and processes. To support compliance with such standards, the buyer may implement CMS such as monitoring schemes, grades of quality and price incentives (Boger, 2001; Martinez and Zering, 2004; Martinez, 2012). Examining CMs included in a GS refines the understanding of how such GS supports an exchange and helps to distinguish, more clearly, different GSs used to support similar transactions (Grandori, 1997). However, the literature lacks integrated analyses on how these mechanisms jointly make up GSs. First, some studies focus on only one mechanism. Second, little attention is given to the fact that different aspects underlying a GS may be coordinated differently (i.e. by more hierarchical or market-like settings). Third, there is no exploration of how interactions between CMs affect coordination (Wever, 2012).

To fill these gaps, Wever (2012) proposed a framework that includes four CMs - *Price*, *Volume*, *Quality* and *Investments*. These CMs may assume different positions within the market-hierarchy continuum (Table 3.1).

To illustrate this, let us take an example of a transaction between a farmer and a processor. The farmer delivers the input with amounts defined in each transaction and prices set in a

reference market. In addition, the processor adds a bonus based on a specific standard. The buyer monitors farming processes to check compliance. In the end, no investments are required. This simple example shows that a GS may be a more complex arrangement than is assumed in the discretionary perspective (Williamson, 1991, Raynaud et al., 2005; Schulze et al.,2007).

Table 3.1. Typology of Contractual Coordination Mechanisms (Adapted from Wever, 2012)

Coordination Mechanisms	Variables	Values			
		Market <----------->Hierarchy			
Price	- Setter - Duration - Criteria	Spot price with/without fixed bonus	**Reference market price with/without variable bonus**	Fixed forward price with/without variable bonus	Internal Price with/without variable bonus
Volume	-Duration -Amount -Specification	**Spot volume**	Fixed volume with min/max deviations	Fixed volume	Internal volume
Quality	-Setter -Monitor	Spot market specifications/ Public framework	Third party quality coordination	**Counterparty quality coordination**	Internal quality coordination
Investments	-Types -Sources	**No (external) investments used**	Debt security	Convertible debt security	Equity security

Analyses of GSs may involve even more complexity. Firms may apply plural forms of governance (settings of CMs) to support similar transactions. This topic is discussed in the following section.

3.2.3. Plural Forms

As long as TCE has centred attention on identifying the most cost-efficient mode of organisation solution (Williamson, 1991), empirical evidence and literature have demonstrated that companies use more than one GS to support similar exchange relationships (Bradach and Eccles, 1989; Heide, 2003; Parmigiani, 2007; Mols et al., 2011; Ménard, 2013). Bradach and Eccles (1989) consider plural forms as *"*arrangements where distinct organisational control mechanisms are operated simultaneously for the same function by the same firm*"*. Ménard (2013) explains that actors rely on plural forms: *"*for a class of transactions dealing with the same activity and within the same institutional and competitive environment, a party uses simultaneously different modes of governance or relies simultaneously on substantially different types of contracts". Plural governance takes place in supply (Heide, 2003; Parmigiani, 2007) and distribution (Bradach, 1997; Hendrikse and Jiang, 2011) relationships. This paper focuses on the first.

Studies have indicated that the combination of internal production and outsourcing can function as a source of knowledge and may increase the performance of buyers and suppliers. For Heide (2003), this combination serves as a selective strategy used when quality is

difficult to assess and customised products are at stake. In addition, internal production helps a buyer to develop the skills to monitor suppliers. On the other hand, it "enables suppliers to self-select into a buyer relationship" because they learn how to signal information to buyers. Miranda and Chaddad (2014), in line with the view on mutual learning, argue that a firm depends on its capabilities and resources to be effective in measuring the quality attributes of an input and to define the GSs used to support the procurement. For Mols et al., (2011) internal production, combined with outsourcing, enables buyers to assess the skills, facilities and quality control systems that suppliers use. In addition, combining internal and external supply moderates uncertainties in volumes, technology and specificity of assets and works as a safeguard for the termination of the relationship. Parmigiani (2007) also found that the use of plural GS can be beneficial for buyers and suppliers. For the author, the factors that drive the adoption of plural GSs are technological and performance uncertainty, scope economies and expertise of buyers and suppliers.

Ménard (2013) explained that the principle of efficient alignment (Williamson, 1991) does not explain why actors set plural GSs to support an exchange. The author discussed drivers for plural governance found in literature (e.g. innovation, benchmarking, and credibility for the termination of a relationship) and proposed an integrated framework with three groups of explanations: *ambiguity* with respect to asset specificity, monitoring *complexity* and *strategising. Ambiguity* relates to difficulties an actor faces to, *ex-ante,* evaluate the benefits that can be seized from transactions supported by distinct GSs. Therefore, an actor may use plural GSs to compare their respective advantages. *Monitoring complexity* relates to uncertainties an actor has in identifying an adequate way to monitor the transaction. It occurs, for instance, when a buyer deals with suppliers who use different technologies to produce the same input and each technology demands a distinct monitoring mechanism. Finally, *strategising* develops when a party faces difficulties in implementing the form of coordination that best fits his/her business view (i.e. cost advantages, reputation for quality) and is forced to implement another type of GS to support a part of the supply or distribution. For instance, suppliers may use bargain power to prevent buyers from controlling processes and/or inputs used in production.

3.2.4. Research questions

This paper aims to depict and analyse the heterogeneity of GSs and underlying CMs used to support the supply of piglets in the BPC. It includes analysing how and why actors use different CMs and apply these in differentiated ways (plural forms) in similar transactions. The literature discussed above and an exploratory study conducted in the BPC enabled us to propose a modified framework to analyse different CMs and GSs used by chain actors. To achieve the goals of this study the following research questions were set:

RQ_1- Which GSs and CMs are predominantly used to support the supply of piglets in the BPC?

RQ_2- How do distinct CMs differentiate in their position within the market-hierarchy continuum in GSs used to support the supply of piglets in the BPC?

RQ_3-Why do actors rely on distinct CMs (plural forms) to support similar exchange relationships in the supply of piglets in the BPC?

3.3. Methodology

Data were collected by means of semi-structured interviews (n=41) with representatives of the sector and the institutional environment (Table 3.2), between September 2014 and April 2015. The set of buyers include small, medium and big firms and cooperatives that together maintain the lion's share of the domestic markets as well as the exports.

Table 3.2. Interviews settings

Type of interviewees, organisations and number of interviews(n)	n	Interview duration		Interviewee function	States where interviews took place
		Min	Max		
Buyers: IOFs, Coops, MIs	21	48	130	Directors and managers in production, quality, exports; owners.	Rio Grande do Sul, Santa Catarina, Paraná, Goiás, Brasília, Mato Grosso.
Famers Associations (6 state and 1 local and the national association)	7	74	118	Presidents, Executive Directors, Consultant	Rio Grande do Sul, Santa Catarina, Paraná, Goiás, Minas Gerais and Brasília
Slaughterhouses Associations (2 state and the national association)	3	104	240	Vice-President, Executive Directors	Rio Grande do Sul and Santa Catarina
Information Technology	1	71		Santa Catarina	Owner (Director)
Retailer	1	72		São Paulo	Development of Meat Supply
Feed/Feedstuff Companies	2	88	91	Owner, Technical Adviser	Rio Grande Do Sul and Santa Catarina.
Government: Agricultural Ministry and Brazilian Agricultural Research Corporation. (EMBRAPA)	6	38	83	Staff of the Ministry areas: Animal Health, Livestock Production, Foreign Affairs, Inspection Service; Researcher on Animal Health	Santa Catarina and Brasília.

For example, in 2014, the IOFs and cooperatives included in the sample together slaughtered, respectively, 45% and 19% of Brazilian production. The retailer and the information technology company are leaders in their respective sectors. Moreover, the two feed companies supply important firms and cooperatives in the BPC. The average interview duration was 86 minutes. The main topics of the interviews were quality and coordination. Regarding quality, interviewees were asked about aspects such as their view on quality standards (e.g. buyers requirements, regulations) developments, virtues and bottlenecks. Questions on coordination included the characteristics of CMs used to support production. They also included interviewees' opinions on the strengths and bottlenecks of these relationships. The contents of the interviews were arranged in reports. The field research also

relied on sectorial documents, buyers' annual reports and manuals (good practices) and regulatory information.

3.4. Results

3.4.1. The Brazilian Pork Chain

Between 2011 and 2015, Brazil had a share of 3 % (3.3 million tons) of global pork production and 8.4% (590 kilo tons) of the exports (USDA, 2016). The commercial herd accounts for 1,600,000 sows and 39,000,000 pigs in the rearing stages (ABCS, 2016). The main importers of Brazilian pork are Russia, which constitutes 45% of the imported volume, Hong Kong (23%), Angola (6.5%), Singapore (5.2%) and Uruguay (4.2%) (MAPA, 2017). Brazil's most important regions of production are the south, the south-east and the mid-west. These regions comprise respectively 61%, 21% and 16.5 % of the Brazilian herd in terms of housed sows (ABCS, 2016).

Overall, BPC meets public standards and specific customer requirements. The Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA, 2016) sets the public regulations on animal health, food safety, and animal welfare. State level (environment) agencies set specific rules for the licensing of pig production. These standards are sufficient to meet international standards mediated by the World Trade Organization. In addition, some importers require standards on substances used in the feed (e.g. Russia; China) and sanitary status of regions of production (e.g. Japan). Furthermore, to address their policies on quality, buyers set their own standards (e.g. biosecurity, genetics, welfare) to be met by farmers.

There are retailers that set requirements and carry out inspections over chain stages to accredit suppliers. Overall, actors do not use specialised quality management systems (Wever et al., 2010) such as Protected Designation of Origin (PDOs), Protected Geographical Indication (PGIs), Traditional Speciality Guarantee (TSG), organic production, differentiated retail schemes and regional production adopted in Europe (Trienekens et al., 2009; Becker and Staus, 2009; Bonneau et al., 2011; Grunert *et al.*, 2011; Verbeke et al., 2010). Indeed, actors use an array of GSs and underlying CMs to handle a *non-diverse* set of standards. This research identified five general types of supplier arrangements in the BPC: Spot Market, Mini-Integrations, Singular Cooperatives, Central Cooperatives and Investor Owned Companies.

Spot market (SM) arrangements support informal agreements with a low level of coordination. Transactions based purely on market mechanisms are rarely used in BPC. In this research, SM represents the exchanges in which the farmer has supplier agreements with different buyers. In these arrangements, farmers meet baseline public regulations and supply, mainly, local butcheries and slaughterhouses and other farmers.

Mini Integrations (MI) are arrangements coordinated by big producers or middlemen by means of formal or informal agreements with pig famers. In these transactions, the integrators may allocate feed and technical support in production, depending on the farming stage and type of agreement. MIs meet public standards and supply local and national slaughterhouses. MIs deliver pigs to different buyers by means of spot markets and/or contracts.

Singular Cooperatives (SC) produce by means of contracts with farmers that are also cooperative members. In these agreements, the cooperative provides technical support, monitors production and set prices based on quality. Piglet farmers normally use resources sold or approved by the SC. These main customers of SCs are regional and national retailers. Some SCs export with baseline or stricter standards.

Central Cooperatives (CC) are big organisations (i.e. food companies) that hold affiliated cooperatives. To arrange the supply of pigs, the affiliated cooperatives use contracts. However, these contracts are established with farmers that are member of these cooperatives. The CCs set the quality standards member cooperatives use to produce pigs. Furthermore, CCs slaughter all production from their affiliates and deliver the pork products. National retailers and exports (with baseline and stricter standards) are the main channels to which CCs deliver pork.

Investor Owned Firms (IOF) arrange their supply by means of contracts with farmers. However, these companies use more hierarchical mechanisms in these contracts. For instance, firms focus on allocating feed and animals in all production stages. IOFs deliver pork to the national market and export with baseline and stricter standards.

In summary, these five arrangements use the same baseline requirements of quality. However, the major part of production (estimates based on SIPS, 2014) meets stricter requirements and is reliant on coordination supported by contracts (Table 3.3). The following sections explain and illustrate coordination mechanisms buyers use to support the supply of piglets in the BPC.

Table 3.3. Supplying arrangements in BPC

Characteristics	Spot Market	Mini Integrations	Singular Cooperatives	Central Cooperatives	Investor Owned Firms
Main types of agreements	Spot market and informal agreements	Informal agreements and contracts	Contracts	Contracts	Contracts
Predominant Standards	Public	Public	Public Export	Public Export - strict	Public Export - strict
Production share	24%		7%	17%	52%

Chain actors normally arrange production in a “three site” system, with the rearing stages in different locations. Weaning and farrowing are the main systems chain actors use to raise piglets. In the first, the piglets are born and raised until they reach a weight between 7 and 8

kg. Then the piglets are transferred to nurseries where they reach a weight between 22-25 kg. In the farrowing system, piglets are born and raised until they are 22-25 kg. Finally, piglets are delivered to fattening farms where they are raised until the slaughter (100-125 kg). In the *wean to finish* model, pigs enter the farm at 7-8 kg and are raised until slaughter. The *farrowing to finish* system includes three stages in a farm. This system is little used but is still adopted to supply spot markets or even cooperatives.

3.4.2. A modified framework of Coordination Mechanisms (based on BPC)

Wever's (2012) framework comprises CMs on Price, Volume, Quality and Investments and respective variables (Table 3.1). In this research, interviews with managers of different types of organisations in BPC and literature on GSs used in the pork sector (Boger, 2001; Martinez and Zering, 2004; Martinez, 2012; Schulze et al., 2007; Miele and Waquil, 2007), enabled us to refine set of variables and values underlying CMs.

Price Mechanisms

As mentioned in section 2, Wever (2012) uses the variables Price Setter, Price Term and Price Criteria to explain coordination on prices. Price Setter refers to the actors that set the prices – *Centralised Markets, Reference Markets, Parties to a Transaction* and *Internal Prices.* Findings in BPC fit these values. For example, actors normally use reference markets (e.g. prices set by a slaughterhouses association within a region) or parties to a transaction (i.e. buyers) to set prices. To distinguish this CM from the criteria that affect bonus or penalties we changed its name to *Base Price Reference.*

To specify values for the variable Price Term Wever (2012) uses *Short Term* (i.e. until 10 days), *Medium/Long term* (i.e. longer than 10 days) and *Indefinitely* (i.e. no termination date is fixed). Findings in the BPC fit these values. Actors normally set prices for the *Short Term* or *Indefinitely*. As some buyers review the prices paid to farmers periodically (e.g. twice a year), this variable can be refined with an upper limit of six months for the value *Middle Long Term.* To explain Price Criteria Wever (2012) uses the values *No Bonus Component, Variable Bonus and Fixed Bonus.* These values look limited if compared to the array of mechanisms actors may combine to define a bonus. In the BPC actors use different aspects of productivity and quality to reward compliance. Therefore, the following criteria are included in the framework: *Fixed Bonus, Bonus on Productivity, Bonus on Checklist, Production Costs Sheet, Performance Comparison and Penalty for Weight Deviation and Bonus on Carcass Quality.*

The *Fixed Bonus* is a pre-agreed premium that a farmer receives for commitment to the agreement, regardless of his performance**.** The *Bonus on Productivity* rewards aspects such as rates of mortality and feed conversion in exchanges in which farmers use animals and feed allocated by the buyer. *Performance comparison* is a mechanism that compares the productivity of a farmer with a threshold defined in the agreement. This threshold may be, for instance, the performance of other buyers classified in categories (e.g. *top, average and tail*).

Actors use the *Production Costs Sheet* as a reference with which to negotiate. To set the costs and prices for pigs, parties define an expected productivity based on the technology (e.g. equipment, practices) and price of inputs farmers use (e.g. feed, electricity). Buyers use the *Bonus on Checklist* to reward compliance with specific requirements. These items may include issues on animal health (e.g. biosecurity facilities), food safety (e.g. silo, pipes), animal welfare (e.g. equipment, handling), environment (e.g. water treatment) and documentation. *Penalty for Weight Deviation* is a mechanism buyers use to incentivise farmers to deliver pigs within a weight range. *Carcass Quality* is a mechanism based on fat/meat percentage and the presence of injuries in the pigs.

The aforementioned mechanisms were used to refine the values of Price Criteria in the framework (Figure 3.1). First, Bonus Criteria is more appropriate because these mechanisms relate to incentives. To define the values, it was necessary to combine mechanisms in distinct groups. A criterion called Productivity includes *Bonus on Productivity, Performance Comparison* and *Production Costs Sheet*. It implies that a transaction in which one or more of these mechanisms is used meets the criterion Productivity. The criterion Pig Quality includes *Bonus on Carcass Quality* and *Penalty for Weight Deviation.* Finally, the criterion Process Quality includes items used in *Bonus on Checklist.* Afterwards the values were set in sequence within the market-hierarchy continuum. The first value does not include bonus or penalty. The second includes only the pre-agreed fixed bonus. In the third, *Pig Quality* or *Productivity* works as an incentive. The other values combine aspects of quality and productivity.

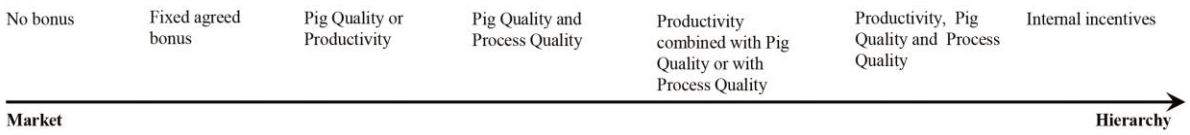

Figure 3.1. Bonus criteria values

Volume

Wever (2012) uses the variables Volume Term and Amount Specification to explain coordination on Volume. The values for Volume Term are *Short Term, Medium/Long Term, and Indefinitely.* These values fit periods used in BPC. For instance, to handle market fluctuations, some buyers use spot markets with deliveries valid for the *Short Term*. Buyers that use contracts normally set terms for *Indefinitely*. For *Amount Specification* Wever uses the values *No Amount Specified, Base Volume with Allowed Deviations* and *Fixed Amount.* Usually, transactions in BPC fit the last two values. However, regardless of the type of transaction, the amount needs to be specified. Thus, this value is changed to *Specified per Order.*

Quality

Wever (2012) uses the values *Public Actor, Third Party, Party to a Transaction, Intra Company* to explain both variables of Quality Setter and Quality Monitor. However, more than one actor may set or monitor the standards. In BPC, public standards cover all transactions. Nevertheless, there are buyers that add requirements to address the demands of customers. Furthermore, a third party could add and monitor its own standards regardless of the existence of other requirements. Therefore, following the logic developed to set the values on Bonus Criteria the variables Quality Setter and Quality Monitor are refined with six distinct values: *1-Public Actor; 2- Public Actor and Third Party; 3-Public Actor, Third Party and Party to the Transaction; 4- Public Actor and Party to the Transaction; 5-Public Actor, Third Party and Internal Setting;* and *6 -Public Actor and Internal Setting.*

Resources Allocation

Wever (2012) uses the variables Monetary Benefits/Risks, Non-Monetary Benefits/Risks and Source of the Investment to explain coordination on Investments. These variables are related to allocation of financial capital. However, transactions within the pork sector are reliant on allocation of resources actors use in production to meet contractual clauses (Schulze et al., 2007). In addition, understanding the allocation of resources used in production facilitates the interpretation of values of other CMs. For instance, a buyer that provides a critical resource (e.g. feed) to be used by his suppliers, may set a bonus for those suppliers that use this resource more efficiently. Therefore, the name Resources Allocation is more appropriate when designating this CM. Two variables explain Resources Allocation: Critical Resources and Buyer's Support Resources. Examples of Critical Resources are the feed and the animals farmers use. These resources can be allocated by the buyer or by the farmer. If the farmer allocates the resource, the buyer may require the farmer to use resources that meet specific standards. For example, to increase control of quality and productivity a buyer may allocate or recommend the standards of the feed and or genetics. Therefore, the values proposed for Critical Resources are*: 1-Resources are Not Allocated Nor Approved by the Buyer; 2-Farmer uses Feed or Animals Approved by the Buyer*; *3-Farmer uses Feed and Animals Approved by the Buyer; 4-Resources are Partially Allocated by The Buyer* (feed or animals); *5-Resources are Totally Allocated by the Buyer*; and *6- Resources are Used Internally*.

Buyer's Support Resources include technical support in production, implementation of projects and the use of information technology to support farming management. Technical Support in Production is the technical advice buyers give on production. Support in Projects is the support buyers give when a farmer sets up a new farm, makes renovations, up-scales or acquires equipment. By doing this, buyers help farmers to get credit to invest and exert more control over the standards used in projects. Support with Information technology (IT) consists of schemes in which farmers use software for farming management and exchange information with the buyer. Buyers use this information to guide farmers on how to improve their processes. The proposed values for Buyer's Support Resources are: *1-No Buyers Resources are Allocated, 2-Buyer Gives Technical Support in Production According to*

Suppliers Request, 3-Buyer Gives Regular Technical Support in Production, 4-Buyer Gives Regular Technical Support in Production and in Projects, 5-Buyer Gives Regular Technical Support in Production, in Projects and Information Exchange, and *6- Support is Used Internally.*

Bonus Criteria (BC), Critical Resources (CR) and Buyer's Support Resources (SR) illustrate differences in how the arrangements found in the research coordinate transactions (Table 3.4). Singular and Central Cooperatives do not differentiate for characteristics of the relationship between the farmer and the buyer and are therefore in the same group. IOFs use CMs close to the hierarchy. IOFs normally allocate feed, animals and support in production, projects and information exchange. Thus, the bonus is reliant on the productivity and quality of processes. Cooperatives do not allocate feed and animals but give support in production and projects. Normally, quality (i.e. weight) of pigs affects the bonus. MIs and SMs use more market-like CMs. MIs provide technical support but it is normally less regular than in cooperatives and IOFs. SM farmers hire technical support or rely on advice given by feed companies.

Table 3.4. CMs used in the supply of piglets

Arrangements	**Variables**	**Market <----------->Hierarchy**
Investor Owned Firms (IOFs)	BC	X
	CR	X
	SR	X
Cooperatives (Coops)	BC	X
	CR	X
	SR	X
Mini Integrations (MIs)	BC	X
	CR	X
	SR	X
Spot Markets (SM)	BC	X
	CR	X
	SR	X

BC= Bonus Criteria; CR = Critical Resources; SR = Support Resources

3.4.3. Coordination Mechanisms Underlying a Governance Structure - a Case Study

In this section we present case studies to analyse the complexity of CMs included in GSs used to support the supply of piglets in the BPC. First, CMs underlying a GS used by a cooperative is analysed. Afterwards, we present three different cases and analyse how and why different types of buyers use plural CMs (and GSs) in the same supply context. Information on production organisation and respective explanations were collected in the interviews with the managers of the firms and cooperatives.

A Case Study on the Complexity of CMs – Singular Cooperative (SC)

This section presents a case study to explore the complexity of CMs included in GSs used to support the supply of piglets in the BPC. Case A is an SC, located in Rio Grande do Sul

State, in the south of Brazil. The cooperative produces pork, dairy and poultry products. The slaughters were estimated at about 290,000 heads in 2014 (SIPS, 2014). The cooperative delivers pork products to national markets and exports that meet baseline public standards. To set base prices of piglets Case A uses weekly quotations arranged by the National Supply Company (CONAB) in the region. Furthermore, Case A sets a targeted weight for piglets (i.e. 8 kg) and establishes a penalty if the weight deviates from this value. Price mechanisms assume the values *Reference Market for* Base Price Reference, *Short Term* for Price Term, and *Pig Quality* for Bonus Criteria.

The contracts specify the number of sows (i.e. volume) of a farm for *Indefinitely*. The amount may vary due to occasional problems (e.g. mortality) or when the farm size changes, in accordance with Case A's demands. Thus, it fits the value *Fixed Amount*. As Case A meets only public regulations, the Quality Setter value is a *Public Actor*. Case A's technicians monitor production regularly. Thus, the variable Quality Monitor assumes the value *Party to the Transaction*. Farmers buy the feed produced by Case A and acquire sows with genetics that meet the standards the cooperative recommends. Therefore, the variable Critical Resources assumes the value *Farmer Uses Feed and Animals Approved by the Buyer*.

Technicians give technical support in production and the cooperative supports farmers in procedures to get credit for new projects. In addition, farmers use software to exchange information on production with Case A. Thus, the variable Support Resources assumes the value *Regular Technical Support on Production, in Projects and IT Based Management*. The CMs assume different positions within the market-hierarchy continuum. These values are highlighted in bold in Table 3.5.

Settings of Base Price Reference, Price Term and Quality Setter assume market-like values. However, by setting a defined weight for piglets as a bonus and monitoring the processes, Case A refines the coordination of the costs of the supply of piglets and quality. Coordination on Volume is extremely hierarchical. The use of approved feed and genetics makes the allocation of Critical Resources assume an intermediary level. However, the complete set of Support Resources offered by the cooperative makes the transaction more hierarchical.

Case A is only an illustration of the complexity of CMs underlying a GS. Other combinations of values can be identified in other contexts. For example, a buyer that allocates feed and animals in the exchange may set incentives based on productivity and quality. It means that Bonus Criteria and Resources Allocation assume more hierarchical values. A *Public Actor* and a *Party* (buyer) may set the standards and a *Third Party* could be the monitor. Others buyers could set volumes in market-like arrangements and require farmers to use approved critical resources.

Table 3.5. Coordination mechanisms in Case A.

Coordination Mechanisms	Variables	Market <---------- Values ----------> Hierarchy						
Price	Base Price Reference	Centralizsed Market		**Reference Market**		Party to the transaction		Internal price
	Term	**Short Term**			Medium-Long Term		Indefinitely	
	Bonus Criteria	No Bonus	Fixed agreed bonus	**Pig Quality** or Productivity	Pig Quality and Process Quality	Productivity combined with Pig Quality or Process Quality	Productivity, Pig Quality and Process Quality	Internal incentives
Volume	Term	Short Term			Medium-Long Term		**Indefinitely**	
	Amount	Specified per order			Base volume with allowable deviations		**Fixed Amount (Based on Internal Demand)**	
Quality	Setter	**Public Actor**	Public Actor and Third Party	Public Actor, Third Party and Party to the transaction		Public Actor and Party to the transaction	Public Actor, Third Party and Internal setting	Public Actor, and Internal setting
	Monitor	Public Actor	Third Party	Third Party and Party to the transaction		**Party to the transaction**	Third Party and Internal monitoring	Internal monitoring
Resources Allocation	Critical Resources	Resources Are not Allocated Nor Approved by the Buyer	Farmer uses Feed or Animals Approved by the Buyer	**Farmer Uses Feed and Animals Approved by the Buyer**		Resources are Partially Allocated by the Buyer (Feed or Animals)	Resources are Totally Allocated by the Buyer (Feed and Animals)	Feed and Animals are used Internally
	Buyer's Support Resources	No Buyers's Resources are allocated	Technical Support in Production According to Suppliers Request	Regular Technical Support in Production		Regular Technical Support in Production and in Projects	**Regular Technical Support in Production, in Projects and Information Exchange**	Support is used Internally

Combinations of CMs may fit types of GSs known in literature and used in pork chains. In the BPC, the most known types of GSs used to purchase pigs and piglets are *Partnership* and *Buying and Selling contracts* (Miele and Waquil, 2007). In what follows, we present cases on plural governance.

3.4.4. Cases on Plural Forms

This section presents three cases to explain the use, by one buyer, of different CMs to support similar transactions (Table 3.6).

Table 3.6. Plural governance structures used in the case studies

Case	Type of Arrangement	Type of transaction	Volume	Types of governance structures and participation (%)		
B	Investor Owned Firm	Farrowed piglets	235,000 sows	Partnership 68%	Lending 24%	Buying and Selling 8%
C	Cooperative	Farrowed piglets	23,000 sows	Centralised production 78%	Buying and Selling 22%	-
D	Cooperative	Weaned piglets	41,000 sows	Buying and Selling 28%	Buying and Selling with stricter CMs 55%	Lending 17%

Case B – Investor Owned Firm

In the BPC, driven by cost efficiency and strict quality, IOFs rely on *quasi-integration* GSs to support production (Figure2). However, some firms combine these GSs with less strict mechanisms. Case B is an IOF that leads production, slaughtering, processing and exports of pork in Brazil. The firm owns branches in the main regions of production in Brazil. The slaughters range from 8 to 9 million pigs a year. To produce piglets, the firm uses about 345,000 sows in the weaning (26%) and farrowing system (74%). This case study focuses on the CMs included in contracts with farrowing farmers (Table 3.7).

In the *partnership contract,* the firm sets base prices based on expected productivity and costs associated with the technology used in production. This fits the value *Party to the Transaction* for the variable *Base Price Reference.* The firm reviews the base price twice a year depending on prices of inputs farmers use to produce. It implies the value *"Medium/Long Term"* for *Price Term*. The firm sets a bonus based on the number of weaned piglets per sow; feed conversion and mortality, weight of the piglets and a checklist based on biosecurity, practices and documentation. These settings fit the value *Productivity*, *Pig Quality and Process Quality* for the variable *Bonus Criteria.*

In *loan contracts,* the firm uses base prices based on the criteria used in the *partnership contract.* However, famers produce or buy the feed used in production. Thus, fluctuations in grain prices (e.g. maize) affect base prices in the *Short Term* (i.e. weekly). The *Bonus Criteria* are reliant on the productivity of sows, penalties for weight deviation and performance comparison. This fits the value *Productivity Combined with Pig Quality or Process Quality.*

Buying and selling contracts set base prices based on *Reference Market* (e.g. in Santa Catarina, the association of slaughterhouses surveys prices used by pork processors). These prices are subject to variations within the *Short Term* and the bonus is based on *Pig Quality* (i.e. weight at 22-24 kg).

The terms for the arrangement on volumes are *Indefinitely* in the *partnership* and *lending contracts*. Farmers follow Case B's production plan in both agreements. Volumes in *buying and selling contracts* are subject to changes in the *Short Term*. Plurality does not hold in coordination of quality. The whole production meets baseline standards set by the MAPA, a *Public Actor,* and by Case B - *Party to The Transaction.* The firm monitors suppliers in the three contracts. These GSs differentiate in allocation of Critical Resources. In the *partnership contract,* Case B allocates feed and sows. It fits the value *Resources Are Totally Provided by The Buyer.* In the *lending contract, Resources Are Partially Provided by The Buyer* because the firm allocates only the sows. In the *Buying and Selling* contracts, Case B does not allocate feed and sows but recommends standards on these resources. The firm provides *Regular support in production, projects and IT based information exchange* in the *Partnership* and *Lending* contracts. In the *Buying and Selling* contract, Case B provides technical support to farmers.

Table 3.7. Plural forms of coordination mechanisms used to support the supply of piglets in an IOF (Partnership – "P"; Lending "L"; Buying and Selling – BS)

Coordination Mechanisms	Variables	Market <---------- Values----------> Hierarchy							
Price	Base Price Reference	Centralised Market		**Reference Market (BS 8%)**		**Party to the transaction (P 68%; L 24%)**		Internal price	
	Term	**Short Term (BS 8%; L 24%)**			**Medium-Long Term (P 68%)**			Indefinitely	
	Bonus Criteria	No Bonus	Fixed agreed bonus	**Pig Quality** or Productivity **(BS 8%)**	Pig Quality and Process Quality	**Productivity combined with Pig Quality or Process Quality**	**Productivity, Pig Quality and Process Quality (P 68%)**	Internal incentives	
Volume	Term	Short Term			Medium-Long Term		Indefinitely **(P 68%; L 24%; BS 8%)**		
	Amount	**Specified per order (BS 8%)**			Base volume with allowable deviations		**Fixed Amount (Based on Internal Demand) (P 68%; L 24%)**		
Quality	Setter	**Public actor**	Public Actor and Third Party		Public Actor, Third Party and Party to the transaction	**Public Actor and Party to the transaction (P 68%; L 24%; BS 8%)**	Public Actor, Third Party and Internal setting	Public Actor, and Internal setting	
	Monitor	Public actor	Third Party		Third Party and Party to the transaction	**Party to the transaction (P 68%; L 24%; BS 8%)**	Third Party and internal monitoring	Internal monitoring	
Resources Allocation	Critical Resources	Resources Are not Allocated Nor Approved by the Buyer	Farmer uses Feed or Animals Approved by the Buyer		**Farmer Uses Feed and Animals Approved by the Buyer (BS 8%)**	**Resources are Partially Allocated by the Buyer (Feed or Animals) (L 24%)**	**Resources are Totally Allocated by the Buyer (Feed and Animals) (P 68%)**	Feed and Animals are used internally	
	Buyer's Support Resources	No Buyer's Resources are allocated	Technical Support in Production According to Supplier's Request		**Regular Technical Support in Production (BS 8%)**	Regular Technical Support in Production and in Projects	**Regular Technical Support in Production, in Projects and Information Exchange (P 68%; L 24%)**	Support is Used Internally	

In summary, this case illustrates how a buyer combines different values of CMs to support the supply of the same input in relationships with different suppliers. The reasons why the buyer uses plural CMs and GSs piglets are now presented.

The first reason revealed by the manager was the need to handle market fluctuations. In *Partnership contracts*, coordination in volume is not flexible enough to respond to fluctuations in the short term. Furthermore, a notice period of 6 months is required if a party wants to terminate the agreement. Thus, to have this flexibility, the firm uses less strict contracts to support a part of the supply. However, these agreements support a volume that exceeds the level aimed at by the firm.

One of Case B's branches situated in Goiás, in the mid-west of Brazil, absorbs the whole production of farrowed piglets supported by loan contracts within the firm. In the late 1990s the main players in the pork (and poultry) sectors decided to expand their activities in that region. One important driver for this expansion was to reduce production costs. Unlike in the south, maize is produced in large-scale proprieties in the mid-west. As pig production was non-existent, the firm had to use incentives for farmers to produce in that area. Farmers were required to install large-scale farms with up-to-date technology and produce their own feed.

Moreover, the company supported farmers to obtain credit for the large investments that were made. At the time of this research, driven by its policy on food safety, traceability and efficiency, Case B was aiming to shift these contracts to the partnership model. However, to implement this change, the company faced resistance from farmers. Because farmers produced their own feed and obtained cost advantages with this, there were not willing to lose this autonomy. Furthermore, these farmers concentrate the supply in the region and maintain an association from which they receive constant technical assistance and managerial advice to support their decision making. In addition, many of these farmers run other businesses. Therefore, these conditions give farmers the bargaining power that Case A faces to negotiate contractual changes.

In another branch, located in the state of Paraná, Case B faces similar problems. Case B purchases about 30% of the volume of piglets by means of *Buying and Selling* contracts and aims to change these contracts to the partnership model. These farmers also perceive cost advantages in producing their own feed. However, in this region, the farmers are surrounded by potential buyers, who make it known they are available to set contracts fitting the current *Buying and Selling* model.

Another development, not depicted in Table 3.5, is the implementation of farms that meet EU regulations on animal welfare. The firm uses *Partnership Contracts* to support production that meets this standard. As these projects demand high investments, the price is set to cover the production costs, investments and ensure an interest rate. Currently, this CM covers about 15% of piglet production within the company. The firm aims to cover the whole supply with the EU standard until 2026.

Case C - Singular Cooperative

Case C is a singular cooperative located in Paraná State, in the south of Brazil. This cooperative delivers grain, pork and dairy products. Along with two other cooperatives, Case C recently made an investment in a new slaughterhouse. This plant absorbs the production of the three cooperatives and delivers pork with a common brand. Case C delivers 8,400 pigs per month (31% of the slaughtered volume).

The cooperative produces piglets in three central farms and by means of contracts with farmers (Table 3.6). These farmers also conduct the fattening stage and are cooperative members. Recently, Case C increased investments in the central farms to respond to the demand from the new slaughterhouse. One of the central farms (5,000 sows) is a new investment focused on the reduction of sanitary risks and EU standards on animal welfare (e.g. housed in collective crates and fed by computer-controlled systems). The cooperative aims to extend the use of these standards in the contracted production in the future. In the framework, the central production fits the value *Feed and animals are used internally*. The contracted production fits the value *Farmers use feed and animals approved by the buyer*. Furthermore, Case C provides r*egular support in production,* supports *implementation of projects and IT based information exchange.* The manager pointed out two reasons for

keeping these two GSs. The first is using central production to respond to the growth strategy driven by the new slaughterhouse and meeting the required quality. The second is to use the new farm, and its very process of adaptation, as a source of knowledge to facilitate the adoption of the same standards by the (contracted) farmers.

Case D – Affiliated cooperative

Case D is a cooperative affiliated to a central one, located in Santa Catarina State, in the south of Brazil. Case D delivers 3,753 fattened pigs per day. This volume represents 21% of slaughters of the central cooperative. In 2014, the slaughters of the central cooperative were estimated at about 4,000,000 of pigs, representing 12.4% of Brazilian production (SIPS, 2014). The central delivers pork that meets public regulations and stricter requirements of importers. Case D concentrates production in the mid-west of Santa Catarina. However, there are production areas in the south-east of the state and in Rio Grande do Sul. Case D arranges the supply of piglets by means of contracts with 160 farmers. Two developments illustrate the use of plural coordination mechanisms in this case (Table 3.6).

The conventional agreement used to support the supply piglets fits the characteristics of *Buying and Selling* contracts discussed in the IOF case. This type of GS addresses the cooperative's view, which is not to allocate Critical Resources to the production of piglets and incentivise farmers to produce. However, Case D carries out, in cooperation with an IT company, a programme designed to increase farming productivity. To access this programme, which is voluntary, farmers need to accept special conditions that, in comparison with the conventional contract, imply stricter coordination. In the framework, the allocation of Critical Resources fits the values met in the conventional contract - *Farmers Use Feed and Animals Approved by the Buyer*. Regardless of their participation in the programme, all farmers need to, at least, acquire premixes from the cooperative. However, within the programme, farmers need to use only feed produced by the cooperative. In addition, farmers need to use software to exchange information with Case D. Furthermore, the frequency of visits to support and monitor production is higher in this programme. Participation in regular technical meetings with other farmers and the board is also mandatory. The framework does not address variations in the frequency of regular support and monitoring and participation in technical meetings. However, it detects the difference in the use of IT-based information support. With respect to Support Resources, the program fits the value *Buyer gives regular technical support on production, projects and information exchange.* Case D does not use price incentives in this programme yet, but plans to apply these in the future. Increasing productivity is the benefit at stake. For instance, in 2014 the number of piglets weaned per sow has increased by 1.14. The production manager explained that this programme is designed to make farmers more competitive. It also works as a channel to increase the sales of feed (maize) that the cooperative produces.

The second development that accounts for plurality, within the *Buying and Selling* agreements, is the use of a *checklist*. Unlike in the conventional contracts, the cooperative applies a bonus based on *Process Quality* in contracts with 26 farmers (9,000 sows) that

produce in the south-east of Santa Catarina. The manager explained that other companies in that region use this incentive in contracts with their piglet suppliers. It forces Case D to adopt the same incentive.

3.5. Discussion

Based on TCE theory, this exploratory research identified the main CMs used in different types of supplying arrangements in the BPC. A modified framework was elaborated to illustrate and explain, first, the complexity of CMs included in a single GSs and, second, the reasons why buyers use plural GSs and underlying CMs to support the supply.

Complex Coordination

The results show that chain actors may combine CMs that assume different positions within the market-hierarchy continuum. Case A, for instance, provided a detailed illustration of this complexity. The cooperative combines market-like and hybrid values for CMs of Price, Quality and Resources Allocation. Coordination on Volume, however, is subject to hierarchical coordination. These results and those found in three other cases, corroborate with Wever's (2012) assumption on the use of CMs with different levels of control in one GS.

The modified framework of CMs refines the model suggested by Wever in different aspects. With respect to *Price* mechanisms, it includes values that explain why a bonus is used. In terms of *Quality*, the framework addresses the fact that more than one actor may set standards. The same holds for monitoring. Finally, mechanisms on *Resources Allocation* include values that are related to resources applied in production. It brings the focus of analysis to what is involved in the exchange and produces interesting insights about the interaction between the CMs. For instance, the framework may show that a buyer that allocates critical resources may set price incentives so that the supplier uses these resources efficiently. Alternatively, if a buyer does not allocate critical resources, he/she may set incentives based on quality compliance. Overall, these findings are in line with TCE, meaning that actors aim to set coordination in the most efficient way (Williamson, 1991). However, the results demonstrate that each GS is made up of CMs which assume different positions in the market-hierarchy continuum. This refines the perspective that sees GSs as discretionary solutions (Williamson, 1991; Raynaud, et al., 2005, Schulze *et al.,* 2007).

The framework can be used to analyse different combinations of CMs. However, it presents some limitations. For example, to make the framework flexible we grouped different elements in the value *Productivity.* It includes mechanisms such as performance comparison, mortality and feed conversion and number of piglets per sow. It implies that a GS which includes at least one of these mechanisms fits a value where *Productivity* has an effect in the framework. The values Pig Quality and Process Quality have similar characteristics. In addition, Case D showed that a buyer may refine the coordination of a transaction by increasing the frequency of inspections or asking suppliers to attend technical meetings.

These are examples of elements that can be refined or included in the framework according to the interest of managers or scholars. Furthermore, the framework, along with the literature, supported the analyses of plural forms of governance.

Plural Forms

Literature has explored the phenomenon of plurality by analysing dual *internal-contracted* production (Heide, 2003; Parmigiani, 2007). This paper shows that in BPC, overall, actors allocate resources (e.g. technical advice, feed, animals) to support hybrids GSs. With respect to the explanations proposed by Ménard (2013), the results do not correspond to *monitoring difficulties*. All cases show that buyers hold the expertise that is necessary to support and monitor suppliers in terms of efficiency and quality (Miranda and Chaddad, 2014). Case D implemented a productivity programme that illustrates the allocation of internal resources (expertise) to improve the performance of suppliers and explains the coexistence of different CMs. In Case C, one of the reasons for the implementation of a central farm, meeting EU standards, is to produce knowledge for both the cooperative board and farmers. The results obtained in these cases (Table 3.8), corroborates the perspective that internal and contracted production improve their capabilities and performance (Heide, 2003; Parmigiani, 2007; Mols et al., 2011).

Table 3.8. Drivers of plural forms of governance in the case studies

Explanations	**Cases**	**Governance structures used to complement the supply**
Market fluctuations	B	-The buyer uses a contract with coordination mechanisms that are less strict than usual
Absence of alternative suppliers	B	
Incentives offered by competitors (other buyers)	B, D	-The firm (B) uses a contract with coordination mechanisms that are less strict than usual -The cooperative (D) uses a contract with coordination mechanisms that are stricter than usual
Investments to meet stricter quality requirements	B, D, C	-The firm (B) and cooperative (D) use contracts with stricter control and incentives. -The cooperative (C) produces in a central farm
Context of exchange	D	-Cooperative (D) sets quality programme with stricter coordination mechanisms with voluntary adherence

Another finding that fits the perspective of increased coordination as a driver of plural governance is the use of incentives for investments that meet specific quality standards in Case B (EU standards). We lack clear definitions as to the extent to which a quality requirement shifts the type of transaction at stake. However, if we maintain that plurality holds in the perspective of *similar* transactions, this incentive corroborates the view on the improvement of processes (Parmigiani, 2007). This mechanism itself fits the principle of the alignment with transaction attributes (Williamson, 1991).

The results obtained in this paper do not show *ambiguity* regarding returns on specific assets as Ménard (2013) explains. All buyers were shown to have clear views on the forms of coordination that best fit their demands. Furthermore, these actors hold the necessary expertise to produce efficiently and to meet the desired quality**.** The IOFs, for instance, focus

on strict mechanisms, by allocating critical and support resources and setting incentive mechanisms to ensure the supply driven by cost efficiency and quality. Cooperatives, however, pursue performance by handling organisational constraints. For example, as farmers are also *owners of the business*, cooperatives find it more difficult to enforce contractual sanctions. Thus, compared to IOFs, the settlement of strict coordination in cooperatives demands more dialogue and complex decision-making.

The cases C and D demonstrated how characteristics found in specific transaction contexts (i.e. cooperatives) explain plural governance. First, the productivity programme (case D) is also a channel to which the coop markets the feed. Second, the cooperative has a clear view in not allocating critical resources in the transactions but aims to incentivise farmers to produce more efficiently. Third, the voluntary nature of the productivity programme addresses the fact that the board cannot oblige farmers to undergo strict coordination. Therefore, the need to conduct the changes in a gradual fashion illustrates how the exchange context may trigger plural governance. Case C also supports this view. The project of a central farm, working as a source of knowledge that farmers will use in their farms, is a joint decision between the board and the farmers.

Findings in Cases B and D corroborate the *strategising* view of Ménard (2013). These cases illustrate the difficulties of a buyer to coordinate a transaction as desired, which pushes coordination towards plural forms. In Case B, the firm has a clear view on using less strict arrangements (i.e. buying and selling contract) to support some of the supply with more flexibility to handle market fluctuations. However, the volume of production that is supported by these (looser) mechanisms exceeds the level targeted by the company. In contrast, Case D needs to use, with a group of suppliers, a strict incentive mechanism that is not usual in its coordination policy. In both cases, farmers perceive sustained advantages in keeping the CMs in the current fashion. First, other buyers are available to keep the mechanisms that are currently used by some of the suppliers of Case B and Case D. Second, farmers (Case B) are organised in an association, have other businesses and hold the whole volume the firm purchases. It gives them bargaining power to negotiate contractual changes with the buyer.

In summary, this research identified four groups of explanations for the use of plural forms: the need to handle market fluctuations, bargaining power of suppliers, the organisational context of exchange, and the need to implement stricter quality standard**s**. Regarding Ménard's (2013) assumptions, the results fit only the strategising view. Handling market fluctuations is seen by the IOF as a reason to support some of the supply using less strict coordination (i.e. *Buying and Selling* contracts). Bargaining power, on the other hand, explains why the firm faces difficulties in enhancing the volume of supply supported by stricter coordination (i.e. *Partnership Contracts*). In line with this, in Case B and Case D, incentives offered by potential buyers suggest that competition triggers plural governance. Hence, these support the *strategising* view in two dimensions. First, they illustrate the difficulties an actor may face in coordinating a transaction as desired. Second, they provide examples of (plural) CMs used to overcome such difficulties.

In this paper, the analysis of plural coordination is limited by its exploratory nature and by few case studies. However, the proposed framework includes CMs identified by means of interviews with companies that hold the lion's share of pig production in Brazil. It makes our results representative. The application of the framework should be extended to other food chains. It could bring further insights into its validity and refinements to fit specific contexts.

3.6. Conclusions

This research has corroborated assumptions on the complexity of CMs that underlie a GS (Wever, 2012) and the use of plural GSs (Bradach and Eccles, 1989; Heide, 2003; Ménard 2013). First, this paper identified the main CMs used to support the supply of piglets in the BPC. Second, the framework of CMs provides more precise definitions about what is coordinated by a GS than so far provided in the literature (Raynaud et al., 2005; Schulze et al., 2007; Gellynck and Mólnar, 2009).

The framework of CMs elaborated in this paper supports a comprehensive analysis of plural forms of governance used in supply relationships in the BPC. Predominantly, actors rely on different hybrid arrangements in which they allocate critical and/or support resources, set price incentives so that suppliers use these resources efficiently and/or meet quality requirements.

With respect to the framework Ménard (2013) proposes to analyse plural GSs, the results obtained in this paper do not fit the assumptions on *monitoring complexity* and *ambiguity*. In the BPC, buyers hold the capabilities and resources that are necessary to coordinate transactions (Miranda and Chaddad, 2014) and have a clear view on how to seize returns from these relationships. Furthermore, the results show that, to improve coordination and quality, actors (cooperatives) use in combination with basic GSs, stricter CMs that feed the exchange relationship with better knowledge, efficiency and quality compliance (Heide, 2003; Parmigiani 2007; Mols et al., 2011).

This paper offers interesting insights into the assumption of *strategising* proposed by Ménard. Regardless of the (possible) endogenous causality among the aspects we found - bargaining power of suppliers and the incentives given by competitors - these factors contribute to the explanation of why plural forms are used. The studies in the cooperatives show that the organisational context in which the transactions are embedded may affect coordination and result in plural governance. This variable could be tested in further analysis on production organisation in cooperatives.

Finally, TCE theory was useful for supporting the elaboration of the framework used to analyse the main CMs and GSs that chain actors use to organise transactions in the BPC. However, in line with the literature on plural governance, the results show that TCE does not offer sufficient explanations. Combining organisational (capabilities, competences) and

neoclassical theories (competition), may offer a more comprehensive approach to addressing the phenomena of plurality. This paper has contributed with additional explanations to be examined in these fields.

CHAPTER 4

Vertical and Horizontal Relationships – Implications for Farmer Performance in the Brazilian Pig Production [3]

[3] This chapter is based on:

Martins, F.M., Trienekens, J.H., Omta, S.W.F., 2017. Vertical and Horizontal Relationships – Implications for Farmer Performance in Brazilian Pig Production. Submitted to a journal for publication. Under review.

4. Vertical and Horizontal Relationships – Implications for Farmer Performance in the Brazilian Pig Production

4.1. Introduction

Supply chain management (SCM) comprises activities and practices adopted throughout chain stages with the aim of ensuring operational efficiency, product quality, value creation and competitiveness for chain participants (Tan et al., 1998; Beamon, 1999; Cai et al., 2009; Shepherd and Gunter, 2010). In this regard, achieving performance in supply chains depends on how chain actors coordinate operations to support the flow of inputs, and on joint decision-making on aspects such as the improvement of processes and quality of products. It implies establishing collaborative relationships involving the exchange of information, inputs and knowledge (Li and Lin, 2006; Dyer and Singh, 1998; Poppo and Zenger, 2002).

In literature, vertical relationships have been examined via two main concepts: information exchange (IE) and relationship quality (RQ). Network relationships are the main aspects addressed in horizontal relationships (HRs).

Concerns with quality (i.e. food safety, welfare, sustainability) and competition have led food companies to increasingly adopt schemes of vertical coordination, supported by contracts, to purchase raw materials (Raynaud et al., 2005; Swinnen and Maertens, 2007; Dries, 2015). Through contracts buyers provide farmers with technical advice, communicate the requirements farmers need to meet in the exchange, and align incentives to farmers (Jang and Olson, 2010; Goodhue, 2011). In these relationships farmers and buyers maintain frequent interaction to cope with production. Therefore, information exchange and relationship quality may be important mechanisms to support these relationships. However, farmers and buyers involved in less integrated exchange relationships (e.g. spot markets) may also benefit from good levels of IE and RQ (Coronado, et al., 2010; Lu et al., 2008b; Denolf et al, 2015).

Information Exchange is the degree to which supply chain partners transfer one to another information which enable them to take operational, tactic, and strategic decision making (Cheng, 2011; Tran et al., 2016). By sharing information on inputs, quality and processes, suppliers and buyers are able to identify causes of problems and opportunities to improve their responsiveness, meet consumers preferences and increase their competitiveness (Li et al., 2006; Prajogo and Olhager, 2012; Huo et al., 2014). Studies conducted in food chains have demonstrated that IE between farmers and buyers has positive effects on efficiency, quality of products and profits (Han et al., 2009; Coronado et al., 2010; Peng, 2011).

Literature has shown that Relationship Quality refers to positive characteristics of a relationship that enable partners to cooperate towards common goals (Nyaga and Whipple, 2011; Khüne and Gellynck, 2013). Different conceptual elements have been used to explain RQ in literature. For instance, Naudé and Buttle (2000) use indicators of trust, satisfaction, coordination, power and profit. Commitment, trust, satisfaction in the relationship and the use of relationship specific investments are the dimensions of RQ used by Nyaga and Whiple

(2011). In spite of the differences among constructs, a number of studies have demonstrated positive influences of RQ on performance (Nyaga and Whiple, 2011; Molnár et. al., 2010; Odongo et al., 2016). Moreover, literature has demonstrated that RQ positively influences information exchange in supply chains (Sheu et al., 2006; Prajogo and Olhager, 2012; Wu et al., 2014).

Horizontal relationships refer to mechanisms used by actors participating in the same chain link (i.e. suppliers) to share experiences, information, knowledge and resources. In food chains, HRs may be supported by farmers' associations, cooperatives, NGOs and rural extension agencies. Moreover, HRs can be grounded in social ties, not necessarily requiring formal support mechanisms. Literature has demonstrated that farmers who interact in HRs improve their performance (Lu et al., 2008b; Hennessy and Heanue, 2012; Hansen, 2015), gather more information on transactions (Brito et al., 2015), and build better relationship with buyers (Lu et al., 2012).

Studies on SCM have used diverse types of indicators to analyse performance in supply chains. Profits, quality, responsiveness, product innovation, sales growth and market share are indicators commonly used in constructs that measure performance in manufacturing sectors (Li et al.,2006; Prajogo and Olhager, 2012; Wu et al.,2014). Aramyan et al. (2007), proposed an integrated framework with indicators of efficiency, responsiveness, flexibility and food quality, to measure performance in food supply chains. The present study focuses on performance of pig farmers delivering live pigs to buyers operating in a quite concentrated and not differentiated market channel. Fitting these conditions, this paper looks at three important constructs - Financial Performance, Quality and Transaction Costs – that are found in literature (Aramyan et al.,2007; Lu et al., 2008b; Han et al., 2009).

A number of studies analyse how IE influences performance (Li et al., 2006; Han et al., 2009; Coronado et al., 2010). Other studies have looked at the impact of RQ on performance (Molnár et al., 2010; Nyaga and Whipple, 2011; Odongo et al, 2016). However, few studies have examined how IE and RQ, as two complementary elements of vertical relationships, influence performance and how they impact on each other (Prajogo and Olhager, 2012; Wu et al., 2014). Likewise, HRs have been examined for influences on performance (Lu et al., 2008b; Hennessy and Heanue, 2012; Hansen 2015). Other studies have examined how HRs influence VRs (Lu et al., 2012; Brito et al., 2015). However, literature has not examined how HRs and VRs interact and influence performance.

To fill these gaps, this paper analyses, through a single structural model, how VRs (i.e. IE and RQ) and HRs interact and influence performance of pig farmers in the Brazilian pork chain.

Brazil is the fourth largest global producer and exporter of pork. Brazil produced 3,5 million tons in 2015, which represented 3,2% of the world production. In the same year, the three countries that led production were China (54.9 million tons), European Union (23,3 million tons) and United States (11,1 million tons). Brazil exported 542,000 tons, which represented,

8.6% of global exports in 2015. European Union (2,4 million tons), United States (2.3 million tons) and Canada (1,2 million ton) led the world exports in 2015 (USDA, 2016). The main importers of Brazilian pork are Russia, which constitutes 45% of the imported volume, Hong Kong (23%), Angola (6.5%), Singapore (5.2%) and Uruguay (4.2%) (MAPA, 2016). Southern Brazil is the region that maintains the biggest share of production with 61% of the sows. Other important regions are the southeast (21%) and mid-west (16.5 %). The number of pig farmers in Brazil is estimated at about 42,000 (ABCS, 2016). The per capita consumption is about 15 kg per year (ABPA, 2016).

The Brazilian Pork Chain (BPC) is highly concentrated at the processing stage. In 2014, four firms and two cooperatives maintained 69% of the slaughters in Brazil (Sips, 2014). Pig production is typically organized in schemes of vertical coordination supported by contracts between buyers and farmers. The main companies detain ownership on breeding farms, feed mills and processing plants. At the production stage these companies maintain contracts with farmers to produce piglets and finished pigs. This model of organisation is also adopted by smaller firms and cooperatives in Brazil. However, spot markets are also used to cover part of the supply (Martins et al., 2017). Therefore, this study differentiates the analysis for spot market farmers next to contracted farmers (Table 4.1).

This paper focuses on performance of pig farmers delivering piglets ad finished pigs. In Brazil, pig production is normally arranged in sequential production stages. In weaning farms, piglets are born and raised until they reach 7-8 kg. Then the piglets are transferred to nurseries where they will reach 22-25 kg. Some chains use farrowing farms in which piglets are born and raised until they are 22-25 kg. In finishing farms, the pigs reach the slaughtering weight (100-125 kg). The farrowing-to-finish system gathers the three stages in one farm. In the BPC, Investor Owned Firms (IOFs), Cooperatives (Coops) and Mini Integrations (MIs) use contracts to produce pigs. A smaller part of the supply is delivered in spot markets. Below, the main characteristics of the transaction contexts examined in these research are explained.

Transaction Contexts

In the BPC, farmers that supply spot markets (SM) are known as independent producers. However, transactions based exclusively on markets are rare. The majority of these farmers maintain informal and preferential relationships, based on market prices, with a selected number of buyers. The main buyers of SM farmers are local slaughterhouses and other farmers.

Mini Integrations (MIs) are vertical schemes led by big producers (i.e. the integrators) that use contracts or informal long-term relationships with farmers to purchase pigs (Martins, et al., 2017). In transactions with finishers, MIs use input providing contracts (i.e. feed, piglets). MIs supply local slaughterhouses or big pork processors in the national market. MIs use markets to set piglet prices and internal prices for finished pigs.

The main cooperatives (Coops) in the BPC own slaughterhouses and supply customers such as local supermarkets and big (national) retailers and international clients. However, there are also cooperatives that deliver live pigs to processors. In transactions with piglet farmers, cooperatives normally sell the feed farmers use in production or require that farmers use a feed that meets the required nutrition standards. Moreover, cooperatives set recommendations on the genetics that piglet farmers use. Many cooperatives maintain breeding farms to produce the sows and deliver them (sell) to farmers. To support transactions with finishers, Coops use input providing contracts. This research includes small, medium and the biggest Coops that produce pork in Brazil. Moreover, it includes two central organisations which maintain affiliated cooperatives. These central cooperatives are, actually, food companies operating in sectors such as pork, poultry and dairy. Slaughters in cooperatives are estimated at about 24% of the total volume in Brazil (SIPS, 2014). The cooperatives used in this study slaughter about 19 %.

Investor owned firms (IOFs) are big companies that are leaders in pork production and exports in Brazil. These companies supply big retailers, restaurant networks and international customers. IOFs maintain about 52% of the slaughters in Brazil (SIPS, 2014). These firms maintain breeding farms and feed mills and use input providing contracts in transactions with piglet farmers and finishers. This research includes the two biggest IOFs that produce pork in Brazil. Together, these firms were responsible for about 42 % of the slaughters in 2014.

Table 4.1. Main transaction contexts and types of contracts in the Brazilian Pork Chain

		Contracted Production		
	Spot Market	Mini Integrations	Cooperatives	Investor Owned Firms
	Market and informal relationships	Informal relationship and Partnership Contract	Buying and Selling and Partnerships Contract	Partnership Contract
Market share[a]	24%[b]		24%	52%

a- Estimates based on sector data (SIPS).
b- Regards SMs and MIs.

4.2. Theoretical Framework

The theoretical framework is grounded in two streams of literature. The first investigates how VRs, through Information Exchange and Relationship Quality, influence performance. The other stream regards the influences of HRs on performance. In this study, we look at these relationships and include the analysis of how HRs influence VRs (Figure 4.1). Further, the framework is applied to verify whether the effects of HRs and VRs differ when tested in spot markets and contracted production.

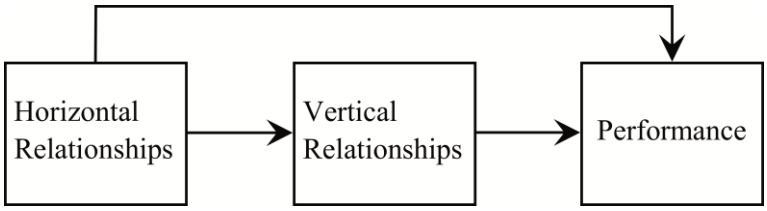

Figure 4.1. General research framework

4.2.1. Vertical Relationships

Information Exchange

Literature has demonstrated that IE enables supply chain actors to improve the efficiency of processes, quality of products and performance of individual firms as well as the supply chain as a whole. Various studies have demonstrated the importance of IE for supply chains. Li et al., (2006) demonstrated that the level of information exchange (and information quality) included in management practices improves market and financial performance and enhances competitive advantages. Prajogo and Olhager (2012) found that IE (along with information technology), improves, through logistics integration between chain partners, performance on costs, products and flexibility. Similar findings were found Huo et al., (2014) that analysed the effects of internal IE as well as IE with customers on supply chain performance. Studies in the food sector present similar findings. Analysing relationships between processing firms and customers in the Chinese pork chain, Han et al., (2009) found that the use of integrated information management, moderated by the adoption of quality management practices, has positive impacts on firms sales, market share, profitability and customer satisfaction. Coronado et al., (2010) found positive effects of information exchange on efficiency and quality in the Mexican avocado supply chain. Peng (2011) demonstrated that IE between companies and suppliers in the Chinese poultry sector improves quality, efficiency and profits. Based on these studies, we may imply that IE with buyers may help Brazilian pig farmers improve their financial performance, quality of deliveries and to lower their transaction costs. Therefore, we formulate the following hypothesis:

> $H_{1:}$ *There is a positive relationship between information exchange among pig farmers and buyers and pig farmers' performance in the Brazilian pork chain.*

Relationship Quality

The importance of Relationship Quality (RQ) for supply chain performance has been explained in different studies. Nyaga and Whiple (2011) found direct effects of RQ on operational (i.e. order processing, deliveries) and strategic (i.e. profitability, market share) performance. These effects were found in both long term collaborative and arm's length relationships. Lu et al., (2008) demonstrated that vegetable farmers increased their

profitability and efficiency by building up trust with suppliers and investing in transaction-specific assets. Molnar et al., (2010) found that trustworthy promises and information, fair price setting, respect for mutual interests and a willingness to solve conflicts are characteristics of food chains with high levels of performance. Odongo et al., (2016) demonstrated that RQ (trust, commitment, information sharing, power and dependency) improve performance in the upstream and downstream relationships of a focal firm. Therefore, one may expect a positive influence of RQ between Brazilian pig farmers and their buyers on farmers performance. The above explanation supports the statement of the following hypothesis:

$H_{2:}$ *There is a positive relationship between relationship quality among pig farmers and buyers and pig farmers' performance in the BPC.*

Li and Lin (2006) found that trust and shared vision between supply chain partners positively influence the level of information sharing and information quality in supply chains. Analysing the factors that contribute for successful supplier-retailer relationships, Sheu et al., (2006) found that business relationships, fostered by interdependency, intensity and trust, are crucial for developing a supply chain architecture supported by information exchange. In line with these findings, Prajogo and Olhager (2012) demonstrated that successful information integration among business partners can only be achieved if parties maintain long term relationships, wherein mutual trust develops, that go beyond purely transactional exchanges. Moreover, Wu et al., (2014) found that trust, commitment, reciprocity and power in relationships are antecedents that positively influence information sharing in supply chain relationships. All in all, these studies demonstrate that different elements that are associated to RQ positively influence IE. This leads us to propose the following hypothesis:

H_3: *There is a positive relationship between relationship quality and information exchange among pig farmers and buyers in the BPC.*

4.2.2. Horizontal Relationships

The literature has demonstrated the advantages of collaborative practices among actors that participate in the same chain link. Hennessy and Heanue (2012) found that farmers that were member of discussion groups presented higher level of adoption of technologies and obtained better profits. Faysse et al., (2012) demonstrated that local farmers' organisations help farmers to increase their knowledge and capacities. Hansen (2015) found that farmers that participate in groups designed to discuss their results with other farmers and consultants, increase their financial performance. Similarly, Lu et al., (2008; 2008b) demonstrated that participation of Chinese farmers in "guanxi" networks, where they develop social ties and interact with other farmers and business partners, enable these farmers to access modern markets and to improve their performance. Moreover, the strength of these networks is positively associated with farmers' satisfaction with their relationship with buyers (Lu et al., 2012). Brito et al. (2015) found that participating in horizontal arrangements help Brazilian dairy farmers to access more information concerning sector developments (e.g. market;

regulations, technology) and their transactions with buyers. In the BPC, where most pig production is characterised by schemes in which multiple farmers deliver to a focal buyer (e.g. firms, cooperatives), it is interesting to examine whether participation of farmers in HRs improves their VRs with buyers and performance. Therefore, the following hypotheses are formulated:

H_4: *There is a positive relationship between Horizontal Relationships among pig farmers and pig farmers' performance in the BPC.*

H_5: *There is a positive relationship between Horizontal Relationships among pig farmers and Information Exchange between pig farmers and buyers in the BPC.*

H_6: *There is a positive relationship between Horizontal Relationships among pig farmers and Relationship Quality between pig farmers and buyers in the BPC*

The following section describes the methods used to test the research model (Figure 4.2). As stated above, the model tests the hypotheses on perceptions of farmers who deliver pigs by means of contracts (i.e. MI, COOPs and IOFs) and through spot markets.

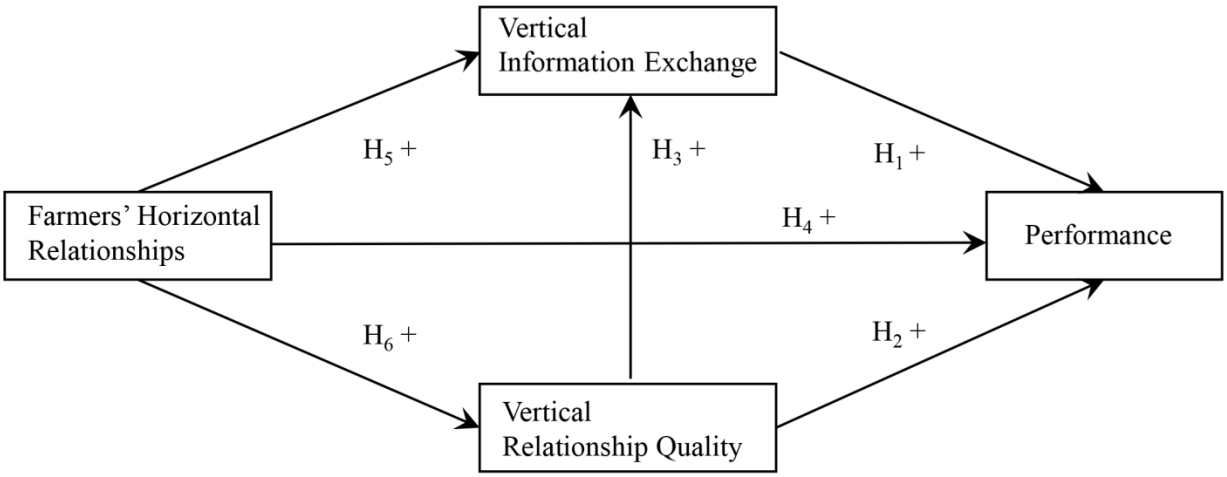

Figure 4.2. Hypotheses tested in the research framework

4.3. Methodology

4.3.1. Data Gathering

The data used in this research were obtained from a survey applied to pig farmers. The questionnaire was formulated based on a literature review of the conceptual elements of the research framework and in-depth interviews (n=41) with chain actors, including buyers (n=21), support organisations (n=10), a retailer, an information technology, feed companies (n=2) and the government (n=6). These interviews were performed between September 2014

and April 2015. The set of buyers includes small, medium and big firms and cooperatives. Together, these buyers account for the lion's share of the domestic markets as well as the exports. The retailer leads its sector in Brazil. The list of support organisations includes associations of pig farmers (the national association and 6 regional associations) and associations of slaughterhouses (the national association and 2 regional associations). The two feed companies supply important firms and cooperatives in the BPC. The information technology is the main supplier of software used in management of pig farming in the BPC. The list of representatives from the government (n=6) includes managers and staff members of departments of the MAPA-Brazilian Ministry of Agriculture, Livestock and Food Supply: Animal Health (2); Livestock Production (2); Foreign Affairs (1); Inspection Service (1). The MAPA is the main setter of requirements (i.e. regulations) in the BPC. The interviews covered topics on regulations, buyers requirements, supply chain relationships and their coordination.

The survey was carried out in the three states which form the Southern Region of Brazil: Rio Grande do Sul, Santa Catarina and Paraná. The leading firms and cooperatives are based in this area, which is responsible for about 70% of slaughters in Brazil (ABPA, 2016). The sample includes (n=269) pig farmers supplying through contracts and spot markets (Table 4.2).

In the present study, we focused on examining how HRs and VRs affect performance in different contexts.[4] Farmers in Spot Markets were selected from lists provided by state farmer associations and indicated by other farmers. Farmers involved in contractual arrangements (i.e. MIs Coops, and IOFs) were selected from lists provided by the companies. The survey was carried out between March and May 2015**.** The farmers responded to the questionnaire in the presence of the interviewer. Beforehand**,** the interviewers provided farmers with general explanations on the research and on how to fill in the questionnaire.

Table 4.2. Sample design

	Transaction Contexts				
		Contracted Production			
	Spot Market	Mini Integrations	Cooperatives	Investor Owned Firms	Total
Total (Farmers)	45	43	111	70	269

[4] A preliminary analysis of the data shows that farms in all contexts vary in size. In addition, a bivariate correlation analysis demonstrated that size does not correlate with most of the measurement items used in the model. Therefore, farm size was not included as a control variable.

4.3.2. Measurement

The first step in building the survey questionnaire was a literature review. The first lot of questions was selected from previous studies addressing elements of the conceptual framework of this research. Afterwards, in cases in that it was necessary, findings from the preliminary interviews were used to adapt the questions to the peculiarities of the pork sector in Brazil. These adaptations were made, primarily, to make the items understandable for the farmers. Table 4.3 shows the constructs, measurement items and respective coefficients of validity and reliability.

Information Exchange

The construct Information Exchange addresses information that farmers and buyers use to improve production. To define the construct, we relied on studies which examined relationships between farmers and buyers. The set of items includes technical advice of buyers and feedback that buyers give based on information provided by farmers. The items on technical advice resemble items used by Schulze et al., (2006), and Lu et al., (2008), as measures of IE. In line with these, production manuals (provided by buyers) were reported by interviewees as important instruments to support the technical advice in the BPC. Therefore, one item addressing the use of production manuals was included in the construct. Items on feedback are similar to those used by Plaggenhoef (2007) and Peng (2011).

Relationship Quality

Different conceptual elements have been used in literature to characterize RQ. For instance, Schulze et al., (2006) define RQ as a construct composed of satisfaction, trust and commitment. Commitment, trust, satisfaction in the relationship and the use of relationship specific investments are the dimensions used by Nyaga and Whiple (2011). Coronado et al., (2010) used a construct of buyer commitment to explain how buyers deal with problems and improvements in relationships with farmers. Wu et al., (2014) uses similar items to measure trust and collaboration. The (RQ) construct used in the present study is based on the above mentioned literature. It addresses trust of farmers in their buyers and the way parties deal with unexpected situations, changes in requirements and documentation.

Horizontal Relationships

The items used in the construct of HRs were inspired on studies which analyse how farmers participation in networks and discussion groups influence their performance (Lu et al., 2008b; Hennessy and Heanue, 2012), technology adoption (Faysse et al., 2012; Hennessy and Heanue, 2012; Tepic et al., 2012) and relationship with buyers (Lu et al., 2012; Brito et al., 2015). Brito et al. (2015) used cooperatives, labor unions, buying groups and associations as HRs that dairy farmers use to improve their access to information concerning sector developments and their transactions with buyers. In the present study, we refer to HRs as the interaction of pig farmers with their associations. Rather than supporting and organising

production and marketing, pig farmers associations in Brazil focus on defending interests of farmers before government and buyers, providing farmers with market and technical information, and on promoting capacitation through discussions and seminars addressing technology and sector developments.

Performance

Three constructs of performance were defined in the present study: Financial Performance, Transaction Costs and Quality. The construct Financial Performance include profits, costs and sales. The items were based on the ones used by Li et al. (2006); Lu et al., (2008b) and Nyaga and Whipple (2011). Transaction Costs includes the time and procedures to arrange the deliveries (i.e. documentation, negotiation). These items are inspired in Aramyan et al., (2007) and Lu et al., (2008b). Quality address satisfaction of buyers with quality of pigs and documentation delivered by farmers, resembling items used by Plaggenhoef (2007) and Han et al. (2009).

Table 4.3. Measurement items

Constructs	Items	Questions	Loa-dings	Cron-bach's alpha
Horizontal Relationships	HR1	I regularly participate in meetings of the farmers' association	.945	.880
	HR2	I regularly communicate with the farmers' association	.945	
Information Exchange	IE2	Our main buyers give us feedback to improve quality based on the information we deliver to them.	.862	.848
	IE3	My main buyers give me technical assistance whenever I need it	.860	
	IE4	I use a manual on production practices provided by my main buyer	.824	
	IE5	I am required to provide information on the productivity indexes to my main buyer	.803	
Relationship Quality	RQ1	I trust my main buyer(s)	.759	.754
	RQ2	My main buyer(s) and I deal smoothly with changes in requirements	.775	
	RQ3	My main buyer(s) and I deal smoothly with unexpected situations	.826	
	RQ4	My main buyer(s) and I deal smoothly with issues related to documentation of my deliveries	.699	
Financial Performance	F1	Our sales have performed satisfactorily in the last three years.	.872	.712
	F2	Our profits have been satisfactory over the last three years.	.775	
	F3	The price I get for the pigs/piglets is normally enough to cover the production costs	.747	
Transaction Costs	TC1	I spend a lot of time negotiating when selling to my main buyer	.842	.793
	TC2	Filling in documentation for deliveries takes a lot of time	.843	
	TC3	I have to use different procedures when delivering to different customers	.841	
Quality	Q1	Our main buyers are satisfied with the pigs we deliver	.852	.623
	Q2	Our main buyers are satisfied with the documentation we send with my deliveries	.852	

All measures (Table 4.3**)** used a seven-point Likert scale ranging from strongly disagree (value = 1) and strongly agree (value= 7). Respondents assigned a value equal to zero to questions that were not applicable.

4.3.3. Data Analysis

The first step after the data collection was to submit the measurement items to analysis on their validity and reliability. These assessments were performed using SPSS (Field, 2013). First, varimax rotation was used to select the measures that best relate to each construct – Horizontal Relationships, Information Exchange, Relationship Quality, Financial Performance, Transaction Costs and Quality. Afterwards, the reliability of each construct was tested obtaining the Cronbach's alpha indexes. This step allowed to purify the first selection through an interactive process. To ensure reliability items with lower loadings were eliminated of the constructs. The Cronbach's alpha was higher than 0.70 in five of the six constructs of the model (Table 4.3). The construct Quality is the only one that did not satisfy this condition but still remains in an acceptable range (Cho and Kim, 2015).

After the validity and reliability analyses the hypotheses (H_1 to H_6) were tested by means of structural equation modelling (SEM) using STATA IC 14. The main advantage of SEM is that it allows to obtain, simultaneously, estimates from all direct and indirect relationships among different constructs included in a single model (Tomarken and Waller, 2005; Lowry and Gaskin,2014). Therefore, SEM is an appropriate technique to analyse the relationships among HRs and VRs and performance of pig farmers in the Brazilian pork chain. To provide reliable estimates on the relationships, the structural model needs to present good measures of fit (Bollen, 1989; Hooper et al., 2008). The model fit was assessed verifying the root mean square of approximation (RMSEA), the normed chi squared (i.e. χ^2/df), and the comparative fit index (CFI). Before obtaining the final estimates on the relationships (H_1 to H_6) preliminary measures of model fit were used as references to, along with reliability analysis, refine the selection of measurement items. The model fit measures and estimates obtained in the relationships are presented in the next section.

4.4. Results and Discussion

This paper has examined how Vertical Relationships (VRs) between farmers and buyers and Horizontal Relationships (HRs) among farmers affect the perceived performance of pig farmers in the BPC. To address VRs (i.e. Information Exchange and Relationship Quality), the article relied on SCM literature. Studies on networks supported the theoretical background on HRs. This article differs from previous studies by combining VRs and HRs in a structural model. Moreover, the proposed structural model allowed us to infer that, when testing the hypotheses on VRs and HRs, the type of farmer-buyer relationship matters. This section presents and discusses the findings obtained in the present study.

The relationships specified in the theoretical model (Figure 2) were tested using a SEM model. Because supplier-buyer relationships (IE and RQ) may differ significantly between spot market relationships and contracts[5], the SEM model was used to test the hypotheses in two complementary samples. Sample A, includes observations in all transaction contexts. Sample B includes only farmers supplying MIs, Coops and IOFs, by means of contracts. In Sample A, the root mean square of approximation (RMSEA) was .056. The normed chi squared - i.e. the chi squared (χ^2) divided by the degrees of freedom (df) - was 3.45. Finally, the comparative fit index (CFI) was 0.929. Therefore, these values meet acceptable measures of fit (Bollen, 1989; Hooper et al., 2008). When applied in the Sample B, the model was tested for a smaller number of observations but retained acceptable measures of fit (Table 4.4).

Table 4.4. Models' Goodness of Fit

Model	χ^2	p (χ^2)	Df	χ^2/df	RMSEA	CFI
A	227.855	.000	66	3.45	.056	.929
B	211.21	.000	66	3.20	.057	.907

The standardised coefficients and levels of significance obtained in the relationships examined throughout the two models are depicted in Table 4.5.

Table 4.5. SEM outputs

Relationships		Sample A		Sample B	
		SM, MI, COOP, IOF (N=269)		MI, Coop, IOF (N=224)	
Hypotheses	Dependent Variables	Coeff.	P	Coeff.	P
H_1: Information Exchange and Performance	Quality	-.1223	.192	.4381	.006***
	Financial	.2604	.000**	.2057	.091*
	Transaction Costs	.0631	.475	.4667	.003***
H_2: Relationship Quality and Performance	Quality	.2754	.008***	-.0069	.964
	Financial	.4903	.000***	.3880	.000***
	Transaction Costs	-.1585	.090*	-.5380	.001***
H_3: Relationship Quality and Inf. Exchange	Inf. Exchange	.4049	.000***	.5751	.000**
H_4: Horizontal Relationships and Performance	Quality	.1594	.060**	.0263	.805
	Financial	.1503	.019**	.1483	.053**
	Transaction Costs	.4569	.000***	.3067	.003***
H_5: Horizontal Relationships and Inf. Exchange	Inf. Exchange	.0654	.379	.2138	.010***
H_6: Horizontal Relationships I and Rel. Quality	Rel. Quality	.1312	0.085*	.1500	.065*

***Significant at 1%; ** Significant at 5%; * Significant at 10%

[5] A t test, comparing the mean scores of farmers delivering in spot markets with farmers delivering in contracted production, revealed significant differences in the majority of the measurement items in the model (see attachments).

4.4.1. Vertical Relationships (IE and RQ)

The analysis of Sample A indicates that, in general, IE with buyers has helped farmers to improve their Financial Performance. This result corroborates Coronado et al., (2010) who found positive and direct effects of IE on quality and prices. Similarly, Huo et al., (2014) found that IE improves efficiency and the ability to meet customer requirements. The results also indicate that RQ positively affects Quality and improves Financial Performance. It demonstrates that farmers perceive that, in their relationship with buyers, trust and capacity to deal efficiently with problems are important for improving the quality of their deliveries and their margins. These findings are in line with former studies that found positive effects of RQ on profits, sales and quality (Nyaga and Whipple, 2011; Wu et al., 2014).

Impact of transaction context: spot market or contract arrangement

The results obtained in the two samples allow for a distinction to be made between influences of VRs on spot markets and contracted production. First, the results indicate that IE positively influences Quality in Sample B. This suggests that, compared to spot markets, contracted production better facilitates information sharing between farmers and buyers. This result corroborates the findings of Coronado et al., (2010) who demonstrated that IE helps farmers to improve productivity and quality. Second, the influence of IE on Financial Performance is more significant for farmers delivering in spot markets. It seems to be surprising given the levels of information exchange that are found in contractual relationships (Appendix I). A possible explanation may be that the measurement items used in IE address improvements in production and do not relate directly to financial results.

Third, the results indicate that IE increases Transaction Costs in contractual relationships. This suggests that, compared to spot markets, the exchange of information about production makes contracted farmers spend more time arranging their deliveries (i.e. filling in documentation; negotiation). At a first glance, this output refutes the expected effects of vertical coordination on transaction costs (Goodhue, 2011). However, these findings corroborate those of Lu et al., (2008b). Analysing how participation in networks influence performance, the authors found that farmers that made transaction-specific investments perceived increased time and costs to deliver their products. Nevertheless, the results indicate that RQ countervails the positive influence of IE on Transaction Costs. This suggests that better RQ reduces costs that farmers have to negotiate and deliver their pigs. In spot markets, although RQ also decreases Transaction Costs, the impact is less significant ($p< 0.10$). In general, these on influences of RQ on Transaction Cots are in line with studies that demonstrate the role of trust and cooperation to address problems in improving efficiency of processes in exchange relationships (Poppo and Zenger, 2002, Dyer and Chu, 2003).

Fourth, the influence of RQ on Quality is significant only in Sample A. This result is consistent with previous studies demonstrating that RQ increases the capacity to address customer complaints and meet quality requirements (Wu et al., 2014; Odongo et al., 2016). However, this result suggests that RQ better improves quality in spot markets. In contractual

relationships, RQ has not helped farmers, at least directly, to improve buyers' satisfaction. The results show that RQ improves IE between pig farmers and buyers in both samples. The differences in the magnitude in the coefficients suggest that, compared to spot markets, contractual relationships are more effective at facilitating this process. These outcomes are in line with studies which demonstrate that RQ improves IE in exchange relationships (Li and Lin, 2006; Prajogo and Olhager, 2012; Wu et al., 2014). Moreover, the results suggest that, in contractual relationships, RQ improves Quality through IE.

4.4.2. Horizontal Relationships (HRs)

The results for the effects of HRs on performance indicate that the interaction of farmers (in spot markets and contracted production) with their associations may help them to improve their Financial Performance. This resembles the findings of studies which found that networking and participation of farmers in discussion groups improve farmers' performance (Lu et al., 2008b; Hennessy and Heanue, 2012, Faysse et al.,2012; Hansen, 2015).

The findings indicate that HRs increase Transaction Costs in the two samples. One possible explanation may be that farmers who participate in HRs gather insights which make them spend more time to negotiate their deliveries. The literature has not provided explicit evidence on the relationship between HRs and Transaction Costs. However, these findings are in line with Lu et al., (2008), that found that farmers participating in "guanxi" networks, where they interact with other farmers and business partners, take more rounds to negotiate with buyers. Further research on how the insights farmers gather from networking or peer-to peer interactions affect the processes regarding their deliveries could provide new empirical insights into transaction cost theory.

Impact of transaction context

The results indicate a positive relationship between HRs and Quality in Sample A. The estimate was obtained with p=.06, which is quite close to an acceptable level of significance. This finding is in line with previous studies which found that farmers who participate in HRs improve production practices and obtain better performance (Hennessy and Heanue, 2012; Faysse et al.,2012; Lu et al., 2008b). In Sample B, which includes only contracted farmers, there is no significant relationship. These results suggest that HRs are more effective in helping spot market farmers to improve Quality. A possible explanation is that, compared to contracted farmers, spot market farmers tend to interact more with farmers associations, as the means scores suggest (Appendix I). An analysis of a sample including only spot market farmers would be needed to confirm this assumption.

HRs improve IE in transactions supported by contracts. This is in line with studies that demonstrated the role of farmers networking in helping farmers to get more information on their transactions (Brito et al., 2015). The relationship between HRs and IE is not significant

in Sample A**.** It may suggest that meetings and communication between spot market farmers and their association do not address aspects of transactions that affect farmer-buyer IE.
The influences of HR on RQ were not strong enough to be supported at $p<0.05$. However, the results obtained in Sample B ($p=.065$) suggest that HRs have the potential to improve RQ, as found by Lu et al., (2012). The Sample B includes piglet farmers and finishers whose relationships are supported by different types of contracts. These contracts include technical advice provided by the buyer. However, contracts differ regarding provision (or not) of inputs such as feed and animals. Thus, the routines used to support production and monitor requirements in these exchange relationships may imply distinct levels of farmer-buyer interactions that may affect their RQ. Testing the influence of HRs on RQ in different samples, including farmers supplying through distinct types of contracts, may provide more significant evidence in this regard.

The findings on the hypotheses tested through the proposed model are summarized in Table 4.6. Next section draws on conclusions, limitations and implications of the present study.

Table 4.6. Results of the hypotheses tests

Hypotheses	Dependent Variables	Sample A	Sample B
$H_{1:}$ Information Exchange and Performance	Quality	Not supported	Supported***
	Financial	Supported ***	Supported *
	Transaction Costs	Not supported	Rejected
$H_{2:}$ Relationship Quality and Performance	Quality	Supported ***	Not supported
	Financial	Supported ***	Supported ***
	Transaction Costs	Supported *	Supported ***
$H_{3:}$ Relationship Quality and Information Exchange	Information Exchange	Supported***	Supported ***
$H_{4:}$ Horizontal Relationships and Performance	Quality	Supported *	Not supported
	Financial	Supported **	Supported**
	Transaction Costs	Rejected	Rejected
$H_{5:}$ Horizontal Relationships and Information Exchange	Information Exchange	Not supported	Supported ***
$H_{6:}$ Horizontal Relationships and Relationship Quality	Relationship Quality	Supported *	Supported*

-Supported: the relationship is significant at 1% (***), 5%(**) or 10%(*).
-Not supported: the relationship is not significant.
-Rejected**:** the relationship is significant at 1% but contradicts the expected signal.

4.5. Conclusions and Implications

Theoretical Implications

This paper aimed to analyse how HRs and VRs (i.e. IE and RQ) interact and influence performance of pig farmers in the Brazilian pork chain (BPC). Literature on SCM has

presented different studies on how or RQ influence performance. Few studies have examined how IE and RQ, as constructs of VRs, influence performance and each other. Studies based on networks theory, have examined influences of HRS, separately, on performance and VRs.

The present study expands in these fields by combining, in a single structural model, constructs on vertical (i.e. VRs: IE and RQ) and horizontal relationships (HRs). The proposed model analyses the interactions among these constructs and their influence on performance of pig farmers in the BPC. The proposed model distinguishes performance in three constructs – Quality, Financial Performance and Transaction Costs. Moreover, testing the hypotheses in different samples allowed us to demonstrate that the results on interactions among the constructs and their influence on performance many be sensitive to the context (i.e. spot markets, contracts) in which transactions are conducted. The analysis was performed using SEM. This technique showed to be appropriate for allowing a simultaneous analysis on a complex set of relationships.

Regarding VR, our results corroborate previous studies which found that IE (Li et al., 2006; Han et al., 2009; Coronado et al., 2010) and RQ (Molnar et al., 2010; Nyaga and Whipple, 2011; Odongo, 2016) positively influence performance and with other studies that found a positive influence of RQ on IE (Prajogo and Olhager, 2012; Wu et al., 2014). Our findings on HRs are line with previous evidence on the influence of networking on farmers performance (Lu et al., 2008b; Hennessy and Heanue, 2012; Hansen 2015) and VRs (Lu et al.,2012; Brito et al., 2015).

Limitations and Further Research

This study is not without limitations. First, the study lacks an analysis on the impact of VRs and HRs on chain wide performance. The sample design aimed to select farmers supplying through spot markets and contracts to analyse the impacts from a farmer perspective. Moreover, the limited number of farmers supplying a single buyer prevents the use of the model to perform a significant analysis on buyer performance. Further research, applying the model in bigger samples of farmers supplying focal buyers, could fill this gap. For example, studies on contractual relationships could compare data on perceptions of farmers on HRs and VRs and their performance with actual performance indexes collected by buyers. This comparison could include farming data and information such as documentation, uniformity of pigs and carcasses collected at processing stages and reports obtained from retailers.

Second, the sample of farmers producing through contracts gathered farmers supplying MIs, COOPs and IOFs. These buyers present differences in terms of structure, view on vertical coordination and relationship with farmers. For instance, IOFs tend to use input providing contracts in all production stages. Coops and MIs focus on these contracts at the finishing stage. In addition, differently from IOFs and MIs, the relationship between farmers and buyers in Coops is twofold (Cechin et al., 2013). On one hand, farmers are members (i.e owners) of the cooperative. On the other, farmers supply pigs through contracts that set standards and incentives based on fulfilment of requirements. These peculiarities bring up

relevant implications for production coordination. Controlling for these aspects in future studies may provide more refined insights on VRs (i.e. IE, RQ) and their influence on performance.

Third, the construct of HRs, included items addressing only the participation of farmers in meetings and their communication with the association. Further analyses could include topics addressed in meetings (e.g. production quality, practices, exchange relationships) and perceptions of farmers on how effectively HRs help them to improve their decision making, VRs, and performance. Finally, future studies could include other types of HRs such as informal networking among farmers and discussions or meetings incentivized by focal buyers that deal with a large number of suppliers.

Managerial Implications

The present study allowed us to identify relevant insights for management. For example, farmers that supply spot markets retain the ownership of inputs used in production and are not required to exchange much information with their buyers. However, spot market farmers and their buyers could consider increasing the level of information exchange. This would lead to improvements regarding quality and transaction costs. In contractual relationships, especially in cases in which buyers provide farmers with inputs, information exchange is crucial to monitor aspects such as consumption of feed, growth (weight gain) and health of pigs. Moreover, in the BPC it is known that piglet farmers use software to control production and exchange information with buyers. Although buyers provide finishers with technical advice, these farmers do not use software. In spite of the differences in terms of complexity in production practices and management of these two types of farms, it shows that there are opportunities for improvement in IE even in contracted production. Buyers could consider incentivizing farmers to improve their own management so that more refined information can be used by both sides to address performance improvements. For farmers it may result in better quality, efficiency and margins. For buyers, it may result in more effective and less expensive support services, better quality of pigs to be slaughtered and enhanced information on production (i.e. documentation).

This study demonstrated the importance of HRs in improving farmer-buyers' information exchange. On the one hand this implies that it is valuable for farmers to increase their communication and their participation in meetings in the associations. On the other hand, associations can better promote events aimed at incentivising farmers to exchange knowledge with others. The results suggest that even buyers (i.e. firms, cooperatives) may benefit from promoting farmer-farmer sharing of experiences.

CHAPTER 5

Impact of buyer support on farmer investments and performance in the Brazilian pork supply chain[6]

[6] This chapter is based on:

Martins, F.M., Trienekens, J.H., Omta, S.W.F., 2017. Impact of buyer support on farmer investments and performance in the Brazilian pork supply chain. Submitted to a journal for publication. Under review.

5. Impact of buyer support on farmer investments and performance in the Brazilian pork supply chain.

5.1. Introduction

Food chains have been increasingly challenged to deliver products meeting standards on food safety, welfare and sustainable production and trade. Moreover, competition has led food chain actors to continuously adjust production and distribution with a focus on cost advantages and quality improvement. Driven by these developments, buyers in these chains are increasingly relying on production contracts with farmers to purchase raw materials – i.e. produce, livestock (Raynaud et al., 2005; Swinnen and Maertens, 2007; Gellynck and Molnár, 2009; Goodhue, 2011).

In the view of the Transaction Cost Economics theory (TCE), contracts are hybrid governance structures on the continuum between market and hierarchy (Rindfleisch and Heide, 1997; Gosh and John, 1999). Through contracts food companies specify standards, monitor processes, and support farmers with technical assistance and incentives for investments (Boger, 2001; Raynaud et al., 2005; Jang and Olson, 2010; Key, 2013; Dries, 2015). To coordinate these aspects, buyers use different combinations of mechanisms, implying different types of contracts with distinct positions on the market-hierarchy continuum (Raynaud et al., 2005; Schulze et al., 2007; Wever, 2012). For example, a contract including the provision of critical inputs, along with quality control and technical support, is more integrated than a contract including only quality control. The former is closer to the hierarchy on the continuum; the latter is closer to the (spot) market.

Transaction Cost Economics has provided a vast amount of literature on vertical coordination and contractual relationships in food chains. One of the streams of contributions stems from the emergence of food standards and aims to demonstrate how different types of governance structures align with quality standards and management systems (Raynaud et al., 2005; Schulze et al., 2007; Bahlmann and Spiller, 2009; Gellynck and Mólnar, 2009; Wever et al., 2010). In line with these developments, other studies have demonstrated the role of production contracts in supporting farmers in accessing technology, credit and resources to produce efficiently and meet quality requirements (Key and MacBride, 2003; Swinnen and Maertens 2007; Jang and Olson, 2010; Dries et al., 2009, Key, 2013; Dries, 2015).

This paper aims to analyse how buyers' support included in contracts, impacts on farmer performance, farmer investment capacity and farmer investment requirements.

The study is based on a survey, carried out in southern Brazil, applied to 199 pig farmers who supply their buyers through contracts. Brazil is the fourth largest global producer and exporter of pork. In 2015, Brazil produced 3.6 million tons and exported 542,000 tons, which represent, respectively, a participation of 3.1% and 8.6% in global production and exports (USDA, 2016). Currently, the main importers of Brazilian pork are Russia with 45% of the exported volume, Hong Kong (23%), Angola (6.5%), Singapore (5.2%) and Uruguay (4.2%)

(MAPA, 2017). The industrial herd totals 1,600,000 housed sows. The southern region of Brazil maintains the biggest share of production with 61% of housed sows. The number of pig farmers in Brazil are estimated at about 42,000 (ABCS, 2016). In the Brazilian pork chain (BPC), it is estimated that about 76 % of the production is arranged through contracts between farmers and different types of buyers (SIPS, 2014). These buyers can be divided into (large) investor-owned firms (IOFs), cooperatives (Coops) and so-called mini-integrations (MIs), which are, generally, led by large farmers that contract a group of smaller farmers. MIs deliver live pigs to different types of slaughterhouses. IOFs and cooperatives deliver pork for domestic and international markets.

Contracts in the Brazilian Pork Chain

In this paper, the analysis focuses on contracts used to support transactions with piglet farmers and finishing farmers. In these contracts, buyers normally provide farmers with support services and control processes and/or inputs that farmers use. Furthermore, buyers include incentive mechanisms which depend on standards and ownership of inputs used to produce. Overall, these schemes have led companies to produce efficiently and meet national requirements as well as those of customers in the most demanding overseas markets.

The most common types of contracts in the BPC are known as Buying and Selling, and Partnership (Miele and Waquil, 2007). The Buying and Selling contract is predominantly used to support the production of piglets. In this governance structure the buyer sets volumes in the short term (i.e. per batch), bases prices on the market and a bonus/penalty according to how much the weight of the piglets deviates from a required standard. The buyer provides farmers with technical support for production. The farmer, in turn, owns the critical inputs used in production (i.e. feed and sows). In general, it can be said that buying and selling contracts are mainly used to support the production of piglets in MIs and Coops.

The Partnership contract is mainly used to support the production of finished pigs. These contracts are long-term arrangements in which, besides technical support, the buyer provides farmers with the critical inputs used in production (i.e. animals and feed). In addition, the buyer sets (internal) base prices and bonuses based on the productivity of the inputs the farmers are provided with. Depending on their quality policy, some buyers add bonuses based on a checklist of aspects such as production practices, facilities and organisation of the farm. More recently, buyers, especially the IOFs, are implementing this contract model in the production of piglets as well. In these contracts, buyers provide the feed and lend the sows to farmers (by way of additional terms).

5.2. Theoretical Framework

Transaction Cost Economics (TCE) theory has largely addressed the impact of governance structures (GSs) on supply chain management. The core issue in this theory has been helping scholars and managers to identify organisational solutions to efficiently address transaction

attributes – i.e. asset specificity, measurement difficulties and uncertainty – (Ghosh and John, 1999; Williamson, 1991; 2010).

In his seminal paper, Coase (1937) explained markets and hierarchies (i.e. full integration) as alternative solutions for coordinating transactions to be chosen according to their comparable costs. Continuing developments in TCE demonstrated that hybrid GSs, presenting different levels of interdependence between participants in transactions, exist between the polar market and hierarchies (Williamson, 1991; Ménard, 2004). Franchising, cooperatives, networks, alliances, joint ventures and contracts are examples of hybrid GSs used in different types of supply chains and analysed in the literature (Ménard 2004; Ménard and Valceschini, 2005; Gereffi et al., 2005). This article is particularly focused on contracts between pig farmers and their buyers in the BPC.

In food chains, different types of contracts have been analysed for their suitability with regard to (quality) requirements, quality management systems or certification schemes (Raynaud et al., 2005; Schulze et al., 2007; Gellynck and Molnár 2009, Wever et al., 2010). Food companies and retailers have increasingly relied on schemes of vertical coordination supported by contracts with farmers to control and differentiate in quality and to ensure their participation in global markets and their supply at competitive costs (Raynaud et al., 2005; Swinnen and Maertens, 2007; Fischer et al., 2010; Jang and Olson 2010; Trienekens et al., 2012; Martinez, 2012). Farmers, in turn, enter contracts to handle production and market risks, to safeguard their investments and access resources and technology to produce (Boger, 2001; Schulze et al., 2007; Davis and Gillespie, 2007; Dries, 2015).

Production contracts may include different coordination mechanisms that buyers use according to their view on issues such as quality, production organisation and competition (Hoobs and Young, 2000; Wever, 2012). Common mechanisms found in contracts are the provision of technical assistance, control of inputs and processes, use of quality grades and price incentives. Moreover, many buyers support farmers in processes for obtaining credit for investments in resources that meet their specific requirements. The literature has demonstrated how such mechanisms help farmers to meet the required quality and produce efficiently (Key and MacBride, 2003; Raynaud et al., 2005; Dries et al., 2009; Goodhue, 2011). Moreover, in order to handle moral hazards, facilitate control of quality and seize cost advantages, some buyers provide farmers with the main inputs used in production (Goodhue, 2011; Dries, 2015). For example, slaughterhouses may provide pig farmers with genetics (i.e. sows) to ensure that the pork meets the desired levels of fat, texture and coloration (Martinez, 2012). In line with this, processors provide farmers with feed to address concerns about food safety. In these contracts farmers do not need to produce or purchase inputs, which in many cases represent the majority of production costs. Therefore, resource-providing contracts are expected to enable farmers to increase their focus on processes, and improve quality and productivity (Paul et al., 2004; Key and Mc Bride, 2008; Dries, 2009; Saenger 2013). From the above, the following hypothesis is formulated:

> H_1 – *There is a positive relationship between buyer support and farmer performance in Brazilian pig production.*

The existing knowledge on vertical coordination clearly shows that contracts have helped farmers to access expertise and technologies which are necessary to produce (Dries et al., 2009; Key, 2013). Therefore, one might expect that in this support relationship farmers become aware of investment requirements for their farm, in order to maintain the relationship with the buyer. This assumption leads us to test the following:

> H_2 – *There is a positive relationship between buyer support and farmer investment requirements in Brazilian pig production.*

The literature has demonstrated that the support included in production contracts has increased farmers' capacity to invest in resources to meet the exchange requirements (Barry et al., 1992; Swinnen and Maertens, 2007; Dries et al., 2009). For example, to align investments with standards, there are buyers who support farmers with projects specifying facilities and equipment. In many cases, this support includes preparation of documents to be used in credit arrangements. Moreover, farmers might use their contracts with reputable buyers as evidence of trustworthiness to obtain credit (Key and McBride, 2003; Falkowski, 2012). In addition, resource-providing contracts enable farmers to reduce expenditures in production and to increase their capacity to invest in fixed resources (Davis and Gillespie, 2007; Key, 2013). Therefore, we derive the following hypothesis:

> H_3 – *There is a positive relationship between buyer support and farmer investment capacity in Brazilian pig production.*

Credit access enables farmers not only to expand their production scale but also to produce more efficiently Key (2013). In addition, depending on the requirements to be met in a transaction, contracts are means by which buyers specify the resources (i.e. fixed assets) that suppliers should use to meet the desired quality (Hoobs and Young, 2000; Boger, 2001; Raynaud et al., 2005; Martinez, 2012). Therefore, farmers with good investment capacity are likely to meet the requirements in the exchange. From the above, we hypothesise that:

> H_4 – *There is a positive relationship between farmers' investment capacity and their performance in Brazilian pig production.*

The support included in contracts is seen as a means by which buyers communicate the requirements (Jang and Olson, 2010; Goodhue, 2011) farmers need to meet in the exchange. This communication takes place, for example, in regular visits in which buyers provide technical advice based on the performance of the farmer. Therefore, one may imply that farmers are required to make investments when they need to improve quality or to produce more efficiently. From the above, we formulate:

H_{5-} *There is a negative relationship between farmer investment requirements and their performance.*

The model (Figure 5.1) tests the above explained hypotheses based on perceptions of pig farmers delivering through contracts. First, we analyse results obtained in a sample including piglet farmers and finishers. Afterwards, we compare estimates obtained for these two types of farms.

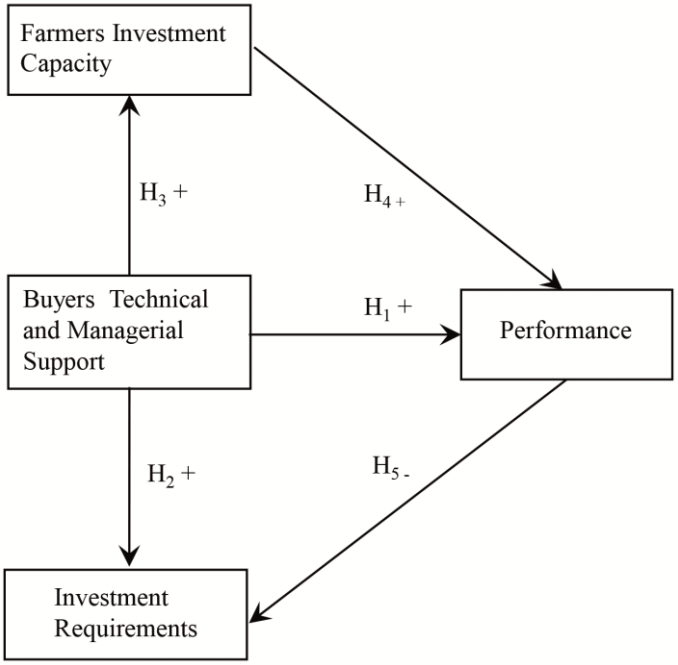

Figure 5.1. Hypotheses tested in the research framework

5.3. Methodology

Data were collected through a survey questionnaire which was formulated based on the literature and 41 in-depth interviews with chain actors in the BPC. These interviews included representatives of the government, farmer and slaughterhouse associations, companies which buy and process pork, (feed) suppliers, one retailer and one information technology firm. The main topics addressed in the interviews were transaction requirements, buyer-supplier relationships and their coordination (e.g. support services, input allocation).

The survey was carried out in the three states that form the southern region of Brazil. This region is where industrial production started in Brazil. Despite the important participation of the south-east, which accounts for 16.2% of the slaughters, and the emergence of the mid-west (14.2%) since the late 1990's, most of the firms and cooperatives that lead processing and exports in Brazil are concentrated in the south. The region maintains 69.6 % of the

slaughters and 61% of the Brazilian herd (ABPA, 2016; ABCS, 2016). The production technology, practices and contracts used to organise the supply in this area provide a representative picture of the Brazilian pork sector. The sample includes (n= 199) pig farmers, who produce through contracts, in the three states: Rio Grande do Sul, Santa Catarina and Paraná. The farmers were selected in consultation with buyers and from lists provided by the buyers, so as to derive a diverse set of farmers. The questionnaires were applied, in person, between March and May 2014. Before responding to the questionnaire, farmers were given a general explanation of the research and how to fill in the form. The hypotheses were tested in a structural equation model (SEM) using STATA IC 14.

Measurement

The first list of measurement items was derived from literature supporting the research framework. Afterwards, based on findings obtained in the interviews, the list was refined to adapt the items to the characteristics of the BPC and to make the questions comprehensible for farmers. The items and constructs used in the model were assessed for their validity and reliability. These assessments were performed using SPSS (Field, 2013). Table 5.1 shows, measurement items and constructs and respective loadings and coefficients of reliability (Cronbach's alpha).

The items on buyer support were derived from different studies. The item on technical assistance is similar to that used by Lu et al., (2008) and Coronado et al., (2013). The item on buyer feedback used to improve quality resembles questions used by Plaggenhoef (2007) and Peng (2011). Items such as support to get credit and technical advice, which contractors provide farmers with, were based on Dries et al. (2009) and Key (2013). The questions regarding technical meetings and training are based on findings obtained in the interviews. However, these questions follow the rationale of questions on managerial and collaborative practices used by Han (2009).

Although the importance of contracting in helping farmers to access resources and technologies has been demonstrated, as exposed above, studies on vertical relationships normally include questions to explain investments that address specific market requirements (Schulze et al., 2007; Plaggenhoef, 2007; Coronado et al., 2010; Peng 2011). Studies barely include explicit questions on farmer investment capacity or buyer support in investments (Lu et al., 2008). Therefore, based on the rationale used in previous studies (Swinnen and Maertens, 2007; Key, 2013), this article includes questions relating to farmer access to credit and capacity to invest.

The questions on investment requirements were based on studies analysing how quality affects transactions in food chains (Plaggenhoef, 2007; Lu et al., 2008; Coronado et al., 2010)

Table 5.1. Measurement items

Constructs	Items	Questions	Loadings	Cronbach's alpha
Buyers Support	BS1	My main buyer(s) give(s) me administrative support to obtain credit to invest in my farm	.463	.66
	BS2	My main buyer(s) give(s) us feedback to improve quality based on the information we give them.	.554	
	BS3	My main buyer(s) organise(s) technical meetings regularly	.754	
	BS4	My main buyer(s) stimulate(s) me (or my staff members) to do training on production practices	.734	
	BS5	My main buyer(s) give(s) technical assistance whenever I need it	.468	
	BS6	I use a manual on production practices provided by my main buyer	.694	
Investment Capacity	IC 1	I can sufficiently invest in the maintenance of my farm	.911	.85
	IC 2	I can sufficiently invest in requirements set by my main buyer	.897	
	IC 3	I can sufficiently invest in requirements to comply with public regulations	.822	
Investment Requirements	BR1	I will be required to invest in new technologies on acclimatisation, watering, fans within the next few years	.870	.83
	BR2	I will be required to invest in animal welfare (group housing) within the next 3 years	.814	
	BR3	I will be required to invest in sanitation of production processes within the next 3 years	.843	
	BR4	I will be required to improve the disposal of manure within the next 3 years	.756	
Financial Performance	FIN 1	Our sales have performed satisfactorily in the last three years.	.805	.72
	FIN 2	Our profits have been satisfactory over the last three years.	.877	
	FIN 3	The price I get for the pigs/piglets is normally enough to cover the production costs.	.718	
Production and Quality	PQ1	The mortality rate on my farm is lower than the average found on other farms.	.584	.71
	PQ2	The feed conversion on my farm is better than the average obtained by other farmers.	.552	
	PQ3	My main buyer is satisfied with the quality of the pigs I deliver	.825	
	PQ4	My main buyer is satisfied with the documentation I send with my deliveries	.698	
	PQ5	We deliver higher quality than the average pig producers.	.729	

Regarding performance, the items on Financial Performance include profits, costs and sales resembling items used by Li et al., (2006), Aramyan et al., (2007), Han et al., (2009) and Nyaga and Whipple (2011). The items on quality resemble the ones used by Plaggenhoef (2007) and Han et al., (2009). Feed conversion and mortality are indicators commonly used in the pork sector.

5.4. Results

The analysis in the full sample includes piglet farmers and finishers, supplying MIs, Coops, and IOFs (n=199). Regarding the model's fit, the Chi Squared ($\chi 2$) value is 291.473 (p=.000), the root mean square of approximation (RMSEA) is .055. The normed chi squared (i.e. χ^2/df) is 4.11. Finally, the comparative fit index (CFI) is 0.91. Therefore, these values meet acceptable measures (Bollen, 1989; Hooper et al., 2008).

The estimates obtained from the SEM model (Figure 5.2) indicate, first, that the support provided by buyers positively affects farmer financial performance, production and quality performance, investment capacity and investment requirements. However, the difference between the standardized coefficients suggest that the support has been more effective in helping farmers to increase their incomes than improving their investment capacity. For example, the items on technical assistance and feedback on quality are the ones with highest mean scores within the construct Buyers Support. The item on support for procedures to get credit, however, is the one with the lowest score. This might explain the lower impacts of buyer support on farmers investment capacity. However, further research would be needed to test this assumption.

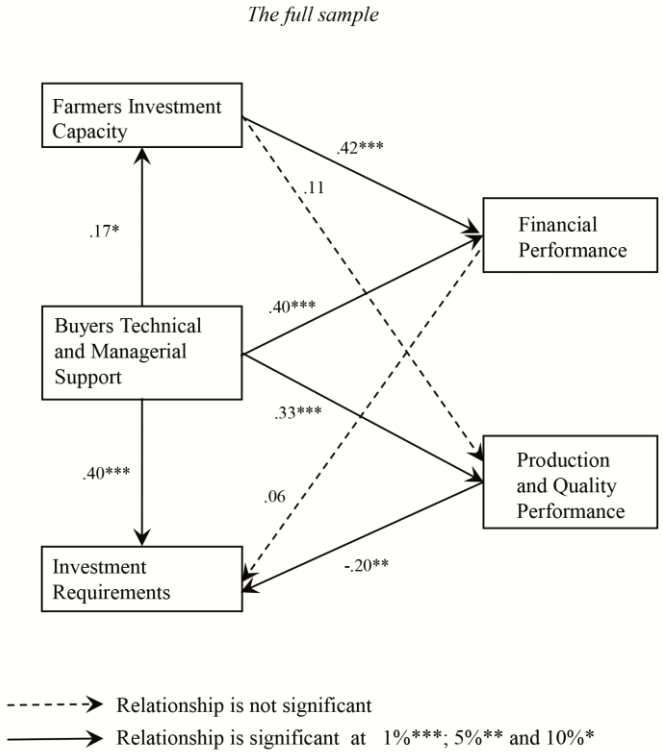

Figure 5.2. Estimates in the full sample

We found a positive relationship between farmer investment capacity and financial performance. However, investment capacity does not influence performance in production and quality. The relationship between farmer investment requirements and performance is significant when it regards production and quality performance. As expected, this demonstrates the effectiveness of buyer support, in which technical assistance and feedback

on quality are included, in signalling to farmers the need for improvements in productivity and quality. As the results suggest, financial performance is not associated with the need for investments. Further analyses would elucidate, for example, whether it happens because farmers deliver good performance, as the mean scores suggest (Appendix 5.1).

The analysis of the full sample demonstrated a positive relationship between buyer support and farmer investment capacity, investment requirements to farmers and performance. However, the results suggest a relatively low (although significant) effect of buyer support on farmer investment capacity and non-significant effect of farmer investment capacity on production and quality performance. Moreover, the model indicates that the performance in production and quality signals to farmers the need for investments.

The results obtained in the full sample provide a general view of how the relationships established in the model work in transactions involving buyers and farmers. However, the sample includes piglet farmers and finishers. In what follows, the SEM model is used to compare the results obtained in these two production stages.

Production Stages

In the BPC, piglet farmers who produce through contracts, normally own the main inputs meeting standards specified by their buyers. Cooperatives, for instance, recommend that farmers purchase the feed the cooperative produces or allow farmers to produce their own feed using specific premixes. Nevertheless, some companies, especially IOFs, are increasingly shifting their supply policy towards more integration and control. These buyers, therefore, require that farmers use the feed and genetics they (IOFs) provide**.**

In contracts that support production at the finishing stage, besides services, farmers are provided with feed and piglets. Regarding this production stage, this model of contract is consolidated throughout the Brazilian pork sector, whatever the type of buyer. (i.e. MIs, Coops, IOFs).

Therefore, in this section we split the full sample into piglet farmers and finishers to analyse how the hypotheses specified in the research model (Figure 5.1) work in these distinct groups and to refine the insights obtained from the analysis of the full sample. To do so, dummy variables were included in the dataset to distinguish farmers of the two groups. The first group includes 91 piglet farmers, supplying MIs, Coops and IOFs. This subsample includes 31 farmers who are provided with genetics and feed by their buyers (IOFs). The second group includes 108 finishing farmers also supplying MIs, Coops and IOFs. The model applied to the group of piglet farmers presented a chi-squared value equal to 254.589 (p =.000), RMSEA equal to .067. The normed chi-squared value (i.e. χ^2/df) is 3.59. The CFI is equal to .86. In the finishers group the chi- squared value is 293.253 (p=.000), RMSEA equal to .076. The normed chi-squared value (i.e. χ^2/df) is 4.13. The CFI is equal to .83. The estimates obtained in these subsamples are presented in Figure 5.3.

Table 5.2. Number of observations in the subsamples

Type of Farm	Main inputs are not provided	Main inputs are provided	Total
Piglets	60	31	91
Finishing	---	108	108
Total	---	139	199

Influences of Buyers Support

By applying the model in different production stages it was possible to demonstrate that some relationships specified in the research model work differently from one sample to another. First, the relationship between buyer support and production and quality performance in the sample of finishers presents a higher level of significance than in the sample of piglet farmers. Second, the relationships between buyer support and investment capacity and between investment requirements and production and quality performance are significant only at the finishing stage. The main explanations for these differences derive from the characteristics of contracts used in the different types of farms.

For example, some processors, concerned with food safety issues and meat quality, maintain their own feed mills and breeding farms to ensure that their pork is produced with inputs that meet standards of the most stringent markets. In these cases, the very quality of the inputs contributes to farmers' performance. In addition, producing inputs incurs high costs for these companies (e.g. facilities, logistics, genetic programmes). Therefore, it is logical to assume that when buyers provide inputs, their support services are stricter and more fine-tuned than the services provided to farmers who do not receive such inputs. These supposedly higher quality services are likely to be more effective in pointing out problems of quality, thereby positively affecting farmers' perception of the need for investments.

Contrary to our expectations, we found that buyer support does not influence investment capacity and does not have such a strong effect on production and quality performance of piglet farmers. Curiously, the mean scores perceived by piglet farmers on the items regarding technical meetings and training (Appendix 5.1) are higher than those perceived by finishers. At a first sight, this makes sense because, compared to finishing pigs, producing piglets involves more activities. For example, piglet farmers need to handle the (re)placement of sows, the birth and the growth of piglets and, in many cases, produce feed on their own. The scores suggest that buyers have provided farmers with training and meetings that address the technical and managerial capacities necessary for production. However, the estimates suggest that, compared to the sample of finishers, this support has been less effective.

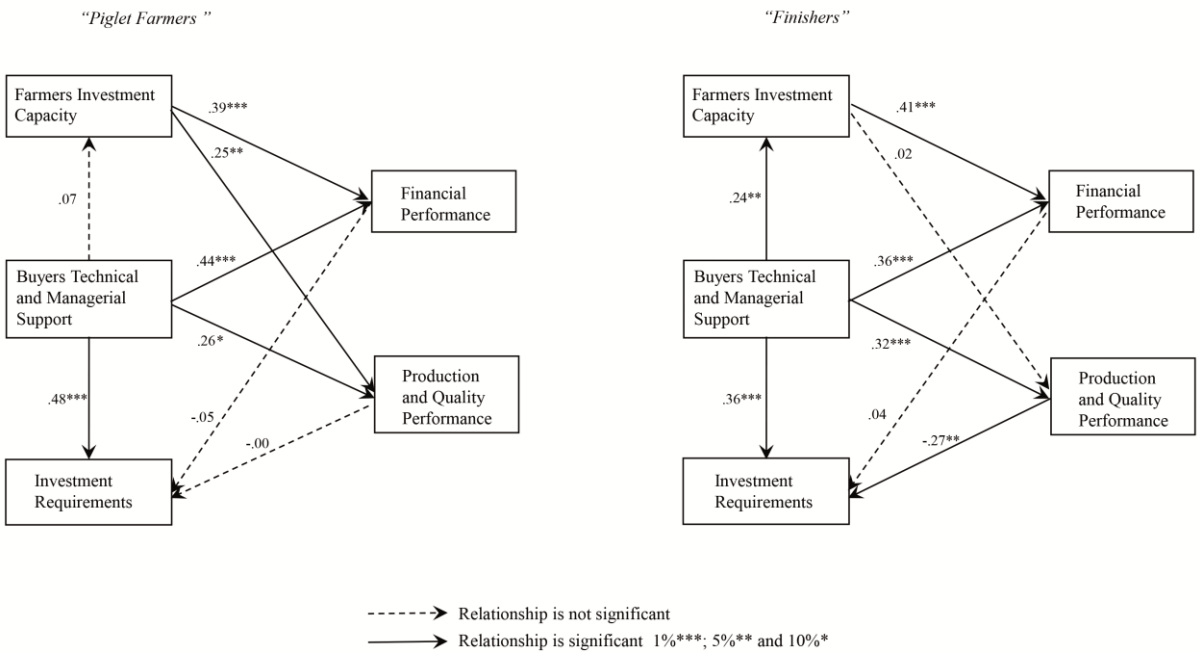

Figure 5.3. Estimates at different production stages

The positive relationship between buyer support and investment capacity of finishers meets our expectations. As finishers do not need to invest in the production of piglets and feed, they may have more capital available to make investments. However, regarding piglet production, this relationship is not significant. This sheds light on the support that buyers provide to help farmers access credit. This support (Table 5.1) normally includes administrative procedures, documentation and projects that farmers need to present to obtain credit from financial institutions. For example, in the BPC, many buyers are incentivising farmers to implement European standards (i.e. group housing) on animal welfare. When farmers use sows owned by the buyers (which prevails in the IOFs), these companies specify facilities and equipment addressing not only animal welfare but also biosecurity issues. To expand production that meets EU standards, these companies support farmers in accessing specific credit lines. When it comes to food safety and biosecurity, companies that export use similar procedures to support investments in facilities and equipment. The model does not allow us to distinguish the effects of buyer support in credit from the other items in the construct. The significant results in the sample of finishers suggest that buyer support is more effective in improving investment capacity when buyers retain ownership of the (main) inputs that farmers use. In the sample of piglet producers, farmer ownership of inputs prevails. However, one third of the farmers in this sample use inputs provided by their buyers. Therefore, further research, analysing the relationship between buyer support and investment capacity in a sample including only farmers using sows and feed provided by the buyer, would help to confirm whether or not, regardless of the type of farmer (i.e. piglet farmer/finisher), the effectiveness of the support is associated with (buyers) ownership of the main inputs.

Investment Capacity

Investment capacity improves financial performance in both types of farms. However, the relationship between investment capacity and production and quality performance is significant and positive only in the sample of piglet farmers. Since piglet famers need to perform more activities to produce, as explained above, they may have a better understanding than finishers about how to align investments with the need for improvement in production. Moreover, it is possible that finishers use their investment capacity, for example, to enhance their production scale (i.e. size of the batches that are delivered) rather than addressing improvements in production and quality.

Investment requirements for farmers

The insignificant relationship between investment requirements and financial performance indicates that margins and sales do not inform farmers about the need for improvements (i.e. investments) in their facilities, equipment and practices. In line with our expectations, the estimates indicate that, for finishers, the need for investments is associated with low performance in quality. However, this assumption does not hold for piglet farmers. Curiously, even perceiving good performance in production and quality, piglet farmers scored higher than finishers on three items of the construct investment requirements: acclimatisation, sanitation and manure disposal. A possible explanation is that these farmers perceive the need for investments for other reasons, such as a strategic view of innovation (i.e. continuous improvement) or changes in requirements. Further research would indicate other contractual or non-contractual aspect(s) affecting farmer investments.

5.5. Discussion and Conclusions

Grounded in Transaction Cost Economics, the literature has demonstrated that food companies specify standards, implement coordination mechanisms to support/align farmer investments, control processes and provide farmers with technical and managerial support for production practices (Boger, 2001; Jang and Olson, 2010; Key, 2013; Dries, 2015). Case studies have demonstrated how contractual mechanisms align with quality standards (Raynaud et al., 2005; Wever et al., 2010) and enable food chains to address institutional changes – e.g. withdrawing of state control in transition economies – and access competitive markets (Swinnen and Maertens, 2007; Dries et al., 2009). Moreover, econometric approaches have been used to demonstrate how contracts affect farmer productivity (Key and Mc Bride, 2003; Paul et al., 2004), quality (Saenger et al., 2013) and access to capital (Falkowski, 2012; Key, 2013).

In contrast to previous contributions, the present paper analyses, in an integrated model, how contracts, through support services, affect farmer performance, investment capacity and investment requirements. In addition, these relationships are analysed in two types of production systems, in which distinct contractual mechanisms prevail. To our knowledge

these relationships have not previously been investigated, together, in a structural (SEM) model. Table 5.3 presents an overview of the results.

The full sample

The results obtained in the full sample (Sample A), demonstrate that, looking at contractual relationships as a whole, buyer support included in contracts between buyers and Brazilian pig farmers have been effective in helping farmers to improve their performance. These findings are consistent with the effects of contracting found in previous studies (Key and MacBride, 2003; Paul et al., 2004; Raynaud et al., 2005, Saenger et al., 2013). Moreover, our findings corroborate the studies that found positive relationships between contracting and farmer access to capital (or credit) that is necessary to make investments addressing the requirements of their buyers (Barry et al., 1992; Swinnen and Maertens, 2007; Dries et al., 2009, Falkowski, 2012; Key, 2013).

We found a positive influence of investment capacity on performance. Although this impact is higher in financial performance than in production and quality performance, these results support previous evidence (Dries et al., 2009; Key, 2013). Finally, the results support the hypothesis of a negative relationship between required investments of farmers and the quality that farmers deliver. To our knowledge, this hypothesis has not been tested in a structural model before. However, this finding supports assumptions derived from descriptive analysis on the role of production contracts (Jang and Olson, 2010).

Table 5.3. Results of the hypotheses tests

Hypotheses	Independent variables	Dependent variables	Full sample	Piglet farmers	Finishers
H_1	Buyer support (services)	Financial Performance	Supported***	Supported***	Supported***
		Production and Quality Performance	Supported***	Supported*	Supported***
H_2		Investment Requirements	Supported***	Supported ***	Supported***
H_3		Investment Capacity	Supported**	Not supported	Supported**
H_4	Investment capacity	Financial Performance	Supported***	Supported***	Supported***
		Production and Quality Performance	Not supported	Supported**	Not supported
H5	Financial Performance	Investment requirements	Not supported	Not supported	Not supported
	Production and Quality Performance	Investment requirements	Supported**	Not supported	Supported**

-Supported: the relationship is significant at 1% (***), 5%(**) or 10%(*).
-Not supported: the relationship is not significant.

Comparing Piglet Farmers and Finishers

The results obtained in the full sample support most of the hypotheses established in the research model. However, splitting the sample into farmers delivering at different farming

stages – production of piglets and finishing – helps to demonstrate how different types of contracts affect the way buyer support impacts on the other variables.

The estimates demonstrate that the support provided to finishers, which includes provision of inputs, has a greater influence on farmer investment capacity and performance. These results corroborate studies demonstrating the positive effects of resource-providing contracts. For example, Key (2013) suggested that farmers provided with inputs have more capital available to make investments. Moreover, buyers ensure better quality in final products (i.e. pigs) not only by providing inputs meeting their standards (Martinez, 2012; Dries, 2015) but also through support services (i.e. technical assistance; feedback) for farming processes (Goodhue, 2011). Second, the relationship between investment capacity and production and quality performance is significant – and positive – only for piglet farmers, supporting evidence found in studies which analysed the impacts of contracts that do not include input provision (Dries et al., 2009).

The present study advances research in this area by distinguishing the role of different coordination mechanisms in contracts used to support transactions in a single food chain (i.e. sector). Relying on TCE, the present study analysed, through a SEM model, impacts of support mechanisms included in production contracts to support the supply of piglets and finished pigs in the Brazilian pork sector. The findings demonstrated that, in general, the support services provided by buyers improve farmer performance and investment capacity and affect the investments that farmers will need to address. These results are consistent with literature looking at the advantages of vertical coordination. Using a dummy variable to split finishers from piglet farmers allowed us to demonstrate, for these two groups, distinct influences of the independent variables on performance, investment capacity and investment requirements.

Limitations

The present study is not without its limitations. First, the number of observations in subsamples prevented us from providing more consistent comparisons between effects of resource (input)-providing contracts and contracts not providing inputs.

Second, in the present study, input provision is addressed by using a dummy variable to split the sample. Therefore, the items on input provision were not included in the constructs within the model. Regarding the finishing stage, it would not make sense because provision of feed and piglets is a characteristic inherent to this type of contract in the BPC. However, regarding piglet farmers, future studies could be refined, on buyer allocation of inputs, by using different items for feed (i.e. purchased, produced on their own, provided by the buyer) and genetics/sows (i.e. purchased, using through loans, provided). In addition, studies could benefit from distinguishing between items in services – e.g. using items on credit, managerial support, technical support in different constructs. These refinements would provide interesting insights from comparisons among coordination policies.

Third, in line with the above, the model has not addressed the peculiarities of each production system. For instance, production of piglets and finishing have specific performance indicators that were not included in the model (i.e. production of piglets per sow; weight deviation). Using these indicators in future studies would help to provide stronger evidence of the effects of the support on performance of each production stage.

Managerial Implications

These findings bring implications for decision making where support services, control and provision (or not) of inputs are addressed. For example, in contracts with piglet farmers, where there is less integration (i.e. most farmers are not provided with inputs), we found that the services do not improve investment capacity and production and quality performance. On the one hand, the results may indicate a need for improvements in the support services companies provide to these farmers. On the other hand, because piglet farmers present high mean scores on their performance (i.e. financial and quality) and investment capacity, these results might suggest that piglet farmers are less dependent on services that buyers provide. Therefore, the present study provides insights that might help decision makers to identify coordination mechanisms to support transactions more efficiently.

For example, in the BPC IOFs aim to implement the resource-providing model for all suppliers of piglets. However, many piglet farmers prefer to maintain their autonomy over the resources used in production. The predominant view of cooperatives, in turn, is to preserve farmers' (coop members') autonomy and not to allocate inputs in the production of piglets. However, cooperatives produce feed and recommend that farmers purchase it. Farmers who do not buy the coop's feed use premixes meeting requirements of the coops. However, there are cooperatives that implement quality programmes, with voluntary adherence, addressing specific good agricultural and managerial practices. To participate in these programmes farmers are obliged to use the inputs provided by the cooperative. Therefore, facing alternative coordination mechanisms and respective constraints (i.e. competition; cooperative view) buyers can benefit from the present study as a background against which to analyse the policies that best meet their demands on coordination. Such an alignment could address not only trade-offs between services and input provision, but also incentive mechanisms (e.g. bonus based on quality).

Theoretical Implications

For the theory, our findings are in line with the view that distinguishing the role of different mechanisms underlying a contract improves our understanding of how a governance structure (e.g. a production contract) coordinates a transaction (Wever, 2012). Following the TCE theory, when it comes to identifying the most efficient solution between markets and hierarchies (full integration), a contract including services and inputs provision is supposed to be more *integrated* than one which includes only services (Martins et al., 2017). The present study demonstrated, that buyer support in more integrated contracts (i.e. to support transactions with finishers) improves financial performance, production and quality

performance, investment capacity and future requirements (Goodhue, 2011; Dries, 2015). In the sample of piglet farmers, in which less integrated coordination mechanisms prevail, the effects of buyer support were restricted to financial performance and future requirements. Therefore, our findings expand empirical and theoretical insights about how efficiently different governance structures align with transaction attributes.

In the present study, we focused on resource allocation as the coordination mechanism distinguishing contractual arrangements. However, further research analysing the effects of mechanisms such as quality grades and price incentives in production contracts would additionally provide interesting theoretical and empirical insights into the alignment between GSs and quality (Williamson, 1991, Raynaud et al., 2005, Wever, 2012;).

Moreover, the fact that support mechanisms have lower and insignificant effects, respectively, on production and quality performance and investment capacity of piglet farmers, suggests that other contractual or extra contractual aspects affect these variables. For example, it would be interesting to investigate the extent to which the experience and knowledge farmers accumulated in previous relationships, or even in transactions with current buyers, could lead buyers to (re)align the support services more efficiently.

CHAPTER 6

General Discussion and Conclusions

6. Discussion and conclusions

This chapter discusses the results obtained in the analyses developed in this thesis. Section 6.1 presents the answers to the research questions. Section 6.2 draws on theoretical contributions. Section 6.3 discusses methodological issues. Section 6.4 discusses the main implications for policy and management. Section 6.5 presents the main conclusions, and Section 6.6 depicts limitations and directions for further research.

6.1. Answers to the research questions

The main goal of this thesis is to analyse and explain the diversity of governance structures (GSs) and coordination mechanisms (CMs) used to support transactions between pig farmers and their buyers in the Brazilian pork chain (BPC). This study investigates the diverse types of CMs that are used, the relationships between CMs and quality requirements and relationships between CMs and farmer performance and investments. Transaction Cost Economics (TCE) is the main theoretical approach used in this study.

Insights from the literature on the alignment between quality standards and governance structures (GSs) were used to support the analysis of the diversity of coordination mechanisms (CMs) used to meet quality requirements of customers in the BPC (Raynaud et al., 2005; Schulze et al., 2007; Wever et al., 2010). An extended view of TCE (Wever, 2012), looking at CMs behind GSs was used to explain the complexity of aspects that are coordinated by a single GS. Moreover, TCE was combined with neoclassical and capabilities theories (Parmigiani, 2007; Mols, 2011; Ménard, 2013; Miranda and Chaddad, 2014) to analyse the use of plural GSs to purchase pigs in the BPC. Insights based on Supply Chain Management (SCM) were added to investigate how interactions between vertical relationships (VRs) and horizontal relationships (HRs) affect farmer performance. Finally, SCM and TCE were used to analyse impacts of buyer support on farmer performance and investments.

The thesis focuses on transactions between pig farmers and buyers conducted in different contexts (i.e. spot markets, mini integrators, singular cooperatives, central cooperatives and investor owned firms) but includes the institutional environment (i.e. government, support organisations) in the analysis.

Four research questions were formulated:

- *What are the main (GSs) CMs used to support quality requirements in transactions between buyers and pig farmers in the Brazilian pork chain?*

- *Which factors may explain the diversity of CMs used to support similar transactions in the BPC?*

- *What are the impacts of vertical and horizontal relationships on farming performance in the Brazilian pork chain?*

- *What are the impacts of buyer support on farmer investments and farmer performance in the Brazilian pork chain?*

The research consisted of two main steps. In the first step, data were obtained through interviews (n=41) with different stakeholders of the Brazilian pork sector, including the main companies that produce pork (slaughterhouses and processors), state and national farmer and slaughterhouse associations, government, supporting companies (i.e. feed, information technology) and one of the main retailers in Brazil. The findings obtained in this step were important for supporting a qualitative analysis of the main GSs and CMs used to support transactions in the BPC. More specifically, the qualitative research focused on the diversity of GS, the complexity of CMs underlying GSs and the use of plural CMs.

Moreover, the interviews were used to support the elaboration of constructs to be tested in the second step of this study. The second step included data collection through a survey questionnaire (n=269), applied in southern Brazil. Respondents included farmers supplying in different transaction contexts – markets, mini- integrations, (singular and central) cooperatives and firms.

The answers to the four research questions are discussed in Sections 6.1.1 to 6.1.4.

6.1.1. Differences in Quality Governance

Chapter 2 analyses CMs, underlying different GSs, in relation to quality requirements in the BPC. The following research question is addressed:

What are the main (GSs) CMs used to support quality requirements in transactions between buyers and pig farmers in the Brazilian pork chain?

Overall, the literature has explored the relationship between generic types of GSs (i.e. contracts, vertical integration) and characteristics of quality standards. These standards are analysed for characteristics such as ownership (i.e. public; private; third parties), scale (i.e. number of suppliers) and scope (i.e. chain steps covered by the standard). On the one hand, these studies have indicated that strict GSs (i.e. vertical integration, strict contracts) are used to support transactions driven by private standards, performed with narrow scopes and small scale (Wever et al., 2010). On the other hand, transactions driven by public standards, large scale and wide in scope, are normally coordinated by less strict GSs (e.g. spot markets), in many cases with the support of third parties to monitor compliance (e.g. industry or retailers' certifiers) (Schulze et al., 2007; Bahlmann and Spiller, 2009; Wever et al., 2010).

Chapter 2 goes a step further than studies that focus on the alignment between generic GSs and quality standards. In the BPC, coordination on quality is managed by individual buyers instead of third parties as seen, for instance, in European pork chains (Bahlmann and Spiller, 2009; Wever et al., 2010). Therefore, this study analyses the relationships between quality requirements and CMs that buyers set in their contracts with pig farmers. The data were obtained through interviews (n=41) with different types of buyers, government and other stakeholders of the BPC.

The results demonstrate a prevalence of public regulations as the main quality driver in the BPC. Buyers set different requirements on practices, facilities and inputs used by farmers. These requirements imply the use of contracts with different coordination mechanisms. The main differences in CMs may concern input allocation (i.e. feed, animals) and criteria on prices. However, even if companies are dealing with similar quality requirements, they may use different CMs to coordinate transactions.

6.1.2. Diversity of Arrangements to Support Similar Transactions

Chapter 3 aims to explain the complexity of CMs underlying a GS and the reasons why chain actors use plural GSs (and CMs) to support similar transactions. The chapter relies on different case studies on the supply of piglets to address the following research question:

Which factors may explain the diversity of CMs used to support similar transactions in the BPC?

For TCE theory, it is of central importance to identify GSs that most efficiently fit transaction attributes – uncertainty, measurement difficulties, asset specificity (Williamson, 1991; Ghosh and John, 1999, Williamson, 2010). Moreover, the institutional environment influences transaction attributes and governance choices through regulations, quality standards and requirements (Williamson, 2000; Ménard and Valceschini, 2005). The TCE view on efficient alignment indicates a discrete solution (GS) within the market-hierarchy continuum (Williamson, 1991, 2010). Chapter 3 addresses two limitations of this traditional view. First, it neglects the fact that a single GS may include CMs assuming different positions in the market-hierarchy continuum (Grandori, 1997; Wever, 2012). Second, it contradicts empirical and theoretical insights demonstrating that chain actors use more than one GS to support transactions (Bradach and Eccles, 1989; Heide, 2003; Parmigiani, 2007; Mols, 2011; Ménard 2013).

Regarding the first limitation, Wever (2012) proposed a framework including different values of CMs on price, quality, volume and investments to demonstrate how a GS encompasses diverse coordination mechanisms. In Chapter 3 the framework proposed by Wever (2012) is refined to address peculiarities found in production contracts used in the BPC. A case study illustrates CMs on price, quality, volume and resource allocation (i.e. inputs, technical support) used by a cooperative in southern Brazil to support the purchase of piglets. Afterwards, the chapter analyses three case studies to explain why individual actors use

plural GSs (and CMs) to purchase inputs. At this point, the literature on plural governance (Heide, 2003; Parmigiani, 2007; Mols, 2011; Ménard 2013) is used to support the analyses and draw discussions. The modified framework of CMs is used to illustrate how price, quality, volume and resource allocation are coordinated differently by the different GSs used by individual buyers.

First of all, the results corroborate the assumption that a GS includes different CMs assuming different levels of control (i.e. positions in the continuum). In the first case study it is demonstrated that the cooperative uses regional markets to define base prices (i.e. less strict coordination) but also sets a bonus based on the quality of piglets (stricter coordination). The volume of the deliveries is also set by the cooperative. Regarding quality, farmers meet public standards and requirements set by the cooperative (i.e. stricter coordination). Finally, regarding resource allocation, the cooperative provides farmers with technical support (i.e. strict coordination).

Second, the findings support previous evidence demonstrating that actors use plural forms of governance. Findings in an IOF, for instance, demonstrated that a buyer may combine contracts with different settings for resource allocation and prices. To support the majority of their supply of piglets, the firm uses a strict contract (i.e. partnership contract) providing farmers with the critical inputs (i.e. feed and sows). In this contract, the firm defines, internally, the base prices of the piglets. The firm adds a bonus based on the productivity farmers obtain in production. To support a minor part of the supply, the firm also uses a less strict contract (i.e. buying and selling contract), allowing farmers to use their own inputs. In this contract, base prices follow a regional market. Two main explanations for the use of both contracts alongside each other were found. The first is the bargaining power of farmers. One group of farmers produced the piglets purchased by a certain branch of the firm and resisted producing through stricter mechanisms. The other reason is competition with other buyers. In a region that surrounds another branch of the firm, other buyers kept less strict contracts with their suppliers**.** Therefore, the firm also had to offer less strict contracts.

Another case study demonstrated that competition forces a cooperative to adopt, with some of their farmers, CMs that are stricter than usual. Buyers that surround a production branch of the cooperative use price incentives, such as bonuses based on quality, which may be attractive for the cooperative farmers. The findings in these two cases help operationalise the strategic view maintained by Ménard (2013).

In a third case, it was found that a cooperative uses central farms and contracts to produce piglets. In one of the central farms the cooperative implemented European standards on animal welfare. The cooperative board used this farm to gain knowledge about the implementation of the new standards and to facilitate the adaptation of EU standards in contracts with piglet farmers. This case supports assumptions based on the development of capabilities between buyers and suppliers (Parmigiani, 2007; Mols, 2011).

Finally, the findings suggest that the transaction context (i.e. type of buyer -supplier relationship) also matters for the application of diverse coordination mechanisms to purchase piglets. For instance, for cooperatives, the relationship with farmers regards supply and membership. Unlike other types of buyers, cooperatives need to handle this dual relationship when negotiating contractual changes with farmers. One case analysed in Chapter 3 addresses the implementation of a programme aimed at improving productivity and quality in a cooperative. To participate in this programme farmers were required to accept the implementation of strict mechanisms in their contracts. For example, the cooperative set strict control on inputs used by farmers and farmers were obliged to implement farming management routines. To deal with resistances, the cooperative stimulated farmers to adhere voluntarily to the programme. Farmers who did not enter the programme could maintain their supply through less strict coordination mechanisms.

6.1.3. Horizontal and Vertical Relationships and Performance

Chapter 4 analyses buyer-farmer relationships, looking at information exchange and relationship quality, and interactions among farmers promoted by farmer associations. It addresses the following research question:

What are the impacts of vertical and horizontal relationships on farming performance in the Brazilian pork chain?

Various studies on Supply Chain Management (SCM) have demonstrated that, to achieve high levels of performance, chain actors rely on joint decision-making when establishing common goals and alignment of processes. The alignment of these vertical relationships (VRs) requires the implementation of schemes enabling chain actors to exchange information on production and to support a smooth flow of products throughout the chain (Li et al., 2006; Han et al 2009; Huo et al., 2014).

Moreover, the literature has shown that relationship quality (RQ) improves performance (Nyaga and Whiple, 2011; Molnár et. al., 2010; Odongo et al., 2016) and information exchange (Sheu et al., 2006; Prajogo and Olhager, 2012; Wu et al., 2014) in vertical relationships. The literature on networks has indicated that horizontal relationships (HRs) also influence performance in VRs. HRs concern interactions among actors that participate in the same chain link. These interactions enable participants to share experiences, knowledge and information that help them to enhance their individual performance (Lu et al., 2008b; Hennessy and Heanue, 2012; Hansen, 2015) as well as improve their (buyer-supplier) VRs (Lu et al., 2012; Brito et al., 2015).

Few studies have examined how VRs influence performance in food chains using information exchange (IE) and relationship quality as distinct constructs. Moreover, few studies address the effects of HRs on VRs and the joint effect of HRs and VRs on performance. Chapter 4 addresses these gaps by analysing, through a structural model, how VRs (through IE and RQ) and HRs (through interactions promoted by farmers associations)

interact and influence the performance of pig farmers. The model distinguishes performance in three constructs – Quality Compliance, Financial Performance and Transaction Costs. Moreover, the model compares results for spot market farmers with results for contracted farmers. Data were obtained by means of a survey questionnaire applied to 269 farmers in southern Brazil.

The chapter makes two main contributions to the literature. First, the structural model integrates the effects of HRs on VRs and of HRs and VRs on performance. Looking at VRs, the influence of IE on quality is significant only in transactions supported by contracts. The influence of RQ on quality is significant only in spot markets. Moreover, HRs improve VRs only for contracted production through improvements in IE. Second, the results suggest that the influence of HRs on performance is affected by the governance structure (i.e. markets, vertical coordination) of that support transactions. For instance, the results suggest that the influence of HRs on quality is not significant for contracted farmers. However, the findings suggest that HRs help spot market farmers to improve quality. A possible explanation is that, compared to contracted farmers, spot market farmers presented higher levels of interaction with farmer associations. These results also bring interesting policy and managerial insights for farmers' organisations (i.e. associations) as well as individual buyers and suppliers. These implications are further discussed in Section 6.3.

6.1.4. Buyer Support, Farmer Performance and Investments

Chapter 5 analyses contractual relationships between buyers and pig farmers, with the focus on buyer support, to address the fourth research question of this thesis:

What are the impacts of buyer support on farmer investments and farmer performance in the Brazilian pork chain?

In this research question, investments concern two aspects. The first is the farmer capacity to invest in transaction-specific resources. The second concerns the investments that the farmer is required to make to improve performance. Various studies based on Transaction Cost Economics have demonstrated that mechanisms of support included in schemes of vertical coordination have helped farmers to improve product quality, produce efficiently and invest in resources that meet transaction requirements (Swinnen and Maertens 2007; Jang and Olson, 2010; Key, 2013; Dries, 2015). By means of contracts, buyers may support farmers with technical assistance in production and with arrangements that facilitate access to credit for investments in resources that meet buyer-specific requirements. However, few studies use quantitative analyses to demonstrate such influences. Moreover, most of these studies have addressed these effects separately.

Chapter 5 addresses this gap by analysing, through a single structural model, relationships between buyers' support, farmer investment capacity, farmer investment requirements and farmer performance. The model distinguishes performance in two constructs – Financial

Performance, and Production and Quality Performance. Moreover, the relationships are analysed in two different types of farms (i.e. piglet production and finishing) which are distinct in terms of buyer resource allocation (i.e. input provision). In addition to the support services, finishing farmers are provided with inputs (i.e. feed and piglets). For piglet farmers the support is, predominantly, restricted to services. Data were obtained by means of a survey questionnaire applied to 199 farmers producing through contracts in southern Brazil.

The results obtained in the sample that groups the two types of farms demonstrate that buyer support improves farmer investment capacity (Dries et al., 2009, Falkowski, 2012; Key, 2013). In addition, farmer investment capacity influences performance positively (Dries et al., 2009; Key, 2013). The results also demonstrate an expected negative relationship between quality that farmers deliver and investment requirements (i.e. to improve performance) for farmers. This corroborates assumptions made in descriptive analysis on the role of production contracts (Jang and Olson, 2010). Finally, it was found that buyer support helps farmers to improve their performance. These findings are consistent with results found in previous studies (Paul et al., 2004; Raynaud et al., 2005, Saenger et al., 2013).

The results obtained by splitting the sample into farmers delivering piglets and finished pigs show distinct impacts of buyer support. For instance, the support provided to finishers, which includes provision of inputs, has a greater influence on farmer investment capacity and performance. This result supports findings from studies demonstrating the positive effects of resource-providing contracts (Goodhue, 2011; Key, 2013; Dries, 2015). Second, investment capacity only improves the production and quality performance of piglet farmers.

The main contribution of this chapter is to distinguish the impact of different coordination mechanisms in contracts used to support transactions in a food chain, i.e. the effects of resource allocation on farmer investment capacity, farmer investment requirements and farmer performance.

6.2. Theoretical and methodological contributions

First Contribution

The emergence of food crises in the late 1990s and early 2000s triggered various developments regarding the organisation of food chains to support the implementation and the management of food standards worldwide (Trienekens and Zuurbier, 2008; Heyder 2010, more recent ones). These developments were of special interest for many scholars who relied on TCE to analyse the alignment between GSs and quality standards (Raynaud et al., 2005; Gellynck and Molnár, 2009; Wever et al., 2010). In general, these studies contributed to the literature by identifying a wide array of hybrid mechanisms (e.g. contracts, cooperatives) fulfilling different positions within the market-hierarchy continuum. These studies mostly

analysed generic types of contracts and generic characteristics of quality standards to indicate whether or not GSs and quality standards were properly aligned.

However, when quality is predominantly coordinated by individual buyers rather than certification schemes, which is the case in the BPC, generic characteristics of GSs and quality standards do not provide sufficient background to understand chain organisation. Therefore, the first contribution of this thesis is going a step further than the alignment between GSs and quality standards. The first chapter examines CMs (i.e. pricing, resource allocation) underlying GSs and quality requirements (underlying quality). Looking at relationships between CMs and quality requirements allowed us to understand the diversity of arrangements used to comply with quality requirements in the BPC, which is driven by a quite homogenous set of quality standards.

Second contribution

The second chapter explores in more detail the complexity of GSs chosen by individual actors to support transactions. First, the chapter refines the framework of CMs, underneath GSs, proposed by Wever (2012). In this framework, each CM – i.e. prices, volume, quality and investments – assume values at different positions on the continuum between market and vertical integration. We propose refinements in this framework for the BPC with values of price references, setters and monitors of standards and resource allocation that are more suitable and flexible for addressing transactions between buyers and food processors. In line with the model proposed by Wever (2012), the modified framework allows us to demonstrate that a single GS may include distinct CMs assuming different positions on the market-hierarchy continuum. A case study of a contract used by a cooperative to purchase piglets, demonstrates, for instance, that the cooperative uses markets to set base prices and the farmer owns the inputs used to produce. These settings on prices and input allocation assume *market-like* positions in the framework. However, the cooperative also provides farmers with technical support, monitors processes to control quality and sets the volumes delivered by farmers. These settings assume hierarchical positions within the framework.

In addition, Chapter 2 relies on the same framework to explore the phenomena of plural governance. The literature in this field has provided different explanations as to why actors use more than one mode of organisation to support similar transactions. One stream of this literature has shown that buyers combine strict and less strict GSs to develop capabilities along with suppliers (Parmigiani, 2007; Mols, 2011). Moreover, the study relied on the framework proposed by Ménard (2013) to test three assumptions about why actors use plural forms: ambiguity regarding returns from specific investments, monitoring complexity and strategy.

The chapter makes three main contributions addressing the theory of plural governance. The first is to provide further insights to operationalize the strategic view proposed by Ménard

(2013). As illustrated above, competition with other buyers makes companies use CMs, in part of their contracts, that do not match their respective strategies on coordination.

Second, the results obtained in one cooperative showed the choice for a certain governance structure to develop capabilities (Parmigiani, 2007; Mols et al 2011). A case study demonstrated that a cooperative uses central farms and contracts to gain knowledge and to facilitate the implementation of new standards in contractual relationships.

Finally, the findings suggest that the type of buyer-supplier relationship (i.e. transaction context) might be an additional (i.e. transaction context) element supporting theoretical assumptions on plural governance. As explained above, cooperatives maintain supply and membership relationships with farmers. A case study demonstrated that a cooperative used voluntary adherence to lessen the resistance of farmers to adopt stricter standards and coordination settings required in a quality programme. The cooperative maintains less strict coordination mechanisms in contracts with farmers that do not participate in the programme.

Third contribution

Production contracts are the main GSs used to support transactions in the Brazilian pork sector. Spot markets are used to supply local slaughterhouses and part of the supply of big processors. Supported by these GSs, farmers and buyers establish vertical (VRs) and horizontal (HRs) relationships through which they exchange inputs information and knowledge. Studies on Supply Chain Management theory have found that VRs improve performance in supply chains (Han et al 2009; Huo et al., 2014; Nyaga and Whiple, 2011; Molnár et. al., 2010). Studies on networks theory have demonstrated that HRs improve performance (Hennessy and Heanue, 2012, Hansen, 2015) and VRs (Lu et al., 2012, Brito et al., 2015*).*

In general, the results obtained in Chapter 4 are in line with findings of the above mentioned literature. However, these studies examined influences of VRs and HRs separately. Chapter 4 makes two main theoretical contributions. First, this chapter performs a quantitative analysis combining in a single structural model constructs on vertical (VRs) and horizontal relationships (HRs) to analyse their effects on the performance of pig farmers. In this study, VRs are analysed through two constructs that interact– Information Exchange and Relationship Quality. Second, the analysis includes farmers supplying through contracts and spot markets. The results indicate that the effects of HRs on VRs, and from both on performance, might be sensitive to the context – i.e. markets or vertical coordination - in which transactions are conducted.

Fourth contribution

Through contracts with farmers, food companies specify standards, monitor processes, and support farmers with technical assistance and incentives for investments (Boger, 2001; Raynaud et al., 2005; Jang and Olson, 2010; Key, 2013; Dries, 2015). The way in which

production contracts coordinate each of these aspects implies different levels of integration – i.e. positions on the market-hierarchy continuum (Raynaud et al., 2005; Schulze et al., 2007; Wever, 2012). Chapter 5 examines the influence of buyer support on farmer performance and investments in two types of transactions: contracts between buyers and piglet farmers and contracts between buyers and finishers. In the first, buyer support is predominantly performed through technical assistance. In the second, the support includes technical assistance and provision of inputs.

The results obtained in the full sample, which includes piglet farmers and finishers, demonstrate that buyer support included in contracts between buyers and Brazilian pig farmers is effective in helping farmers to improve their performance. These findings are consistent with the effects of contracting found in previous studies (Key and MacBride, 2003; Paul et al., 2004; Raynaud et al., 2005, Saenger et al., 2013). Moreover, our findings corroborate studies that found positive relationships between contracting and farmer access to capital that is necessary to make investments addressing the requirements of their buyers (Barry et al., 1992; Swinnen and Maertens, 2007; Dries et al., 2009, Falkowski, 2012; Key, 2013).

Chapter 5 makes three contributions to theory. First, a single model tests the influence of buyer support on farmer performance, of buyer support on farmer investment capacity, of farmer investment capacity on farmer performance and the influence of farmer performance on investments requirements (i.e. to improve performance). Previous studies examined these relationships separately. Overall, the results indicate a positive influence of buyer support on farmer performance, in line with previous studies (Key and Mc Bride, 2008; Dries, 2009; Saenger, 2013). In addition, the results demonstrate that the buyer support has been effective in helping farmers to invest in production resources (Falkowski, 2012; Key, 2013). Moreover, the results indicate a positive influence of investment capacity on performance. Second, the study advances on TCE by enabling a comparison of the role of different coordination mechanisms used to support transactions in a single food chain (i.e. pork chain). The findings indicate that the significance of the relationships tested in the model differs in transactions with different resource allocation settings. For example, the results show that the support including provision with critical inputs (along with services) has a greater influence on performance and investment capacity than the support restricted to services (e.g. technical support, credit arrangements). Third, results supported the hypothesis that farmers are required to make investments to improve performance. The literature clearly demonstrates that buyer support helps farmers to improve performance and increase their investment capacity. However, we have not found previous studies analysing, in a quantitative model, the influence of farmer performance on investments requirements.

Methodological contributions

As explained in Chapter 1, this thesis combines qualitative and quantitative approaches to address the research questions. The qualitative approach was based on interviews performed with key stakeholders in different regions of Brazil. It included different types of chain actors, representatives of government and support organisations. This step allowed us to

capture information and opinions on the main issues that affect quality and coordination in the Brazilian pork sector. Issues affecting quality include aspects such as regulations, requirements of national and international customers, institutional bottlenecks and problems regarding compliance in the supply chain. Issues related to coordination included production organisation, types of contracts and coordination mechanisms (CMs) used by companies. Moreover, the qualitative research stimulated an attempt to investigate CMs in different contexts – Spot Markets, Mini Integrations, Singular Cooperatives, Central Cooperatives, Investor Owned Firms. Along with the literature, insights from the qualitative research supported the formulation of propositions to investigate the diversity of CMs used to support transactions (Chapters 2 and 3). Finally, the interviews provided empirical elements to support, along with the literature, the building of the survey questionnaire used in the quantitative approach.

The survey questionnaire was applied to 269 pig farmers supplying different firms, cooperatives and mini integrations located in southern Brazil. Data obtained through the questionnaire were analysed, in chapters 4 and 5, through structural equation models (SEM). In Chapter 4, previous studies on the influences of HRs (Hennessy and Heanue, 2012; Lu et al., 2012) and VRs (Fynes et al., 2008; Wu et al., 2014) allowed us to analyse, in a single model, relationships between HRs and performance, HRs and VRs and VRs and performance. In the first interaction, the model was tested in a sample including farmers supplying through contracts and spot market farmers. In the second interaction, the analysis included only contracted farmers. In Chapter 5, the SEM model was built based on studies analysing influences of buyer support included in contracts on farmer performance (Key and Mc Bride, 2008; Saenger, 2013) and on farmer investment capacity (Falkowski, 2012; Key, 2013). The model integrates these two relationships and sets investment capacity as an independent variable influencing performance. In addition, performance is used as an independent variable influencing investments that farmers are required to make (i.e. to improve quality and productivity). The sample included two subgroups of contracted farmers producing piglets and finished pigs. In the subsample of finishers, the support includes services (e.g. technical advice) and inputs (e.g. piglets and feed). In the subsample of piglet farmers, the support is restricted to services for the majority of farmers. First, the model was applied in the full sample. Afterwards, the model was tested in the two subsamples.

The combination of qualitative and quantitative approaches allowed us to explore the diversity of GSs and CMs used to support transactions.

6.3. Policy and Managerial Implications

The findings of this study have practical implications for the Brazilian pork supply chain and its institutional environment. The BPC is finding it increasingly challenging to increase both internal consumption and exports. Achieving quality at competitive prices puts more pressure on chain actors to produce more efficiently. It has implications for the relationships between buyers and farmers and their performance.

Firstly, public actors could rely on insights from this thesis to reflect on institutional settings addressing quality management. For example, the findings suggest that buyers set requirements on their own, addressing gaps in public standards. Therefore, it may be of interest to analyse the impacts of a further setting of public regulations on good agricultural and management practices, establishing more standardisation of processes and facilities in pig production. Regardless of possible improvements in the performance of pig farming (i.e. productivity, quality compliance), it would be of special interest to see whether or not these settings would reduce the need for private coordination. For contracted production, it would challenge the current view on production organisation. In the BPC, companies focus on producing inputs for farmers as a means to increase quality control and obtain cost advantages. For independent farmers that do not receive support through contracts, new regulations could be analysed for their impacts on market access and/or the establishment of more stable exchange relationships.

Secondly, looking at different types of buyers, this research found far more differences in GSs and CMs than in quality requirements. Therefore, buyers that use contracts to arrange their supply could benefit not only from improvements in regulations, as explained above, but also from sector or individual initiatives that could make vertical coordination more efficient. At the sector level, processors (i.e. cooperatives, IOFs) could analyse how the alignment of industry standards with the support of third party certification schemes might contribute to improvements in performance (e.g. quality, production, transaction costs) as is seen in Europe (Schulze et al., 2007; Bahlmann and Spiller; 2009; Wever et al., 2010). Compared to adjustments in public standards, as suggested above, the implementation of sector standards would have even stronger effects on coordination policies set by companies.

Thirdly, the findings on plural forms demonstrate that individual companies purchase animals through different CMs. Companies could make a more in-depth analysis of the trade-offs between performance on quality and production and transaction costs incurred in each arrangement used. For individual buyers, this kind of analysis may help identify more efficient forms (GSs/CMs) of coordination, considering their contexts of exchange and strategic issues, as explained above. For example, it could be of special interest for central cooperatives (CCs) where the alignment of standards and coordination policies throughout affiliated cooperatives is more complex. Affiliated cooperatives supply different volumes to the central cooperative. This potentially affects power disputes among the affiliated coops. Moreover, affiliated cooperatives may differ in terms of standards and coordination mechanisms used.

Fourthly, findings on the impacts of HRs on VRs and farmer performance provide interesting insights for farmers' associations and individual actors. For example, farmer associations may increase efforts to provide independent spot market farmers in particular with capacitation programmes and to increase information-sharing among farmers. These actions may improve farmer performance and smooth their relationship with buyers (Lu et al., 2008; 2012; Brito et al, 2015). Such efforts could be also incentivised within environments supported by vertical coordination. For instance, firms could promote more technical

meetings allowing farmers to share their experiences regarding production practices and performance. Moreover, through technical support, companies could benefit from increasing information exchange not only with farmers who use buyer inputs but also with those who allocate their own inputs (i.e. animals, feed) in transactions.

Finally, results on how buyer support influences farmer performance and investments suggest that buyers who use contracts may refine policies on technical advice and credit facilitation, according to the characteristics of different types of farmers or production systems.

6.4. General Conclusions

This thesis focuses on analysing the governance structures (GSs) used to support transactions between different types of buyers and pig farmers in the Brazilian pork chain. In Chapters 2 and 3, this research takes a qualitative approach to exploring the diversity of GSs and CMs existent in the sector. Chapter 4 relies on a structural model to analyse the effects of horizontal and vertical relationships on farmer performance. Likewise, Chapter 5 analyses the effects of buyer support on farmer performance and investments. In what follows, the main conclusions stemming from the thesis are drawn.

First, buyers use a diverse set of GSs and underlying CMs to support pig production, meeting a set of quality requirements with low diversity. Government and specific customers are the main setters of requirements that drive quality in the Brazilian pork chain. The sector does not rely on certification schemes led by third parties to set and control quality. Individual companies that purchase pigs through vertical coordination schemes assume a key role in setting and monitoring requirements to be met by farmers.

Second, focusing on GSs that best fit their organisational characteristics, many buyers use additional (plural) forms of governance to support similar transactions. The exploratory approach developed in Chapter 3 allowed us to find plural forms driven by copying coordination mechanisms adopted by competitors, the development of capabilities along with suppliers, (farmers) bargaining power of farmers and market fluctuations. The findings also suggest that the type of buyer-supplier relationships (e.g. cooperatives) may force buyers to choose GSs that are less strict than might have been expected.

Third, vertical relationships (i.e. information exchange and relationship quality) between pig farmers and their buyers, and horizontal relationships among farmers, positively influence farmer performance. Moreover, horizontal relationships enhance vertical relationships through improvements on information exchange. However, the intensity of these influences may be sensitive to the context (i.e. spot markets or contracts) in which transactions are executed.

Fourth, in contractual relationships between pig farmers and buyers, the support services provided by buyers positively influence farmer performance and investment capacity. In

addition, this support may affect the investments farmers need to make to improve quality of deliveries and financial performance. However, the magnitude of these influences may be affected by the type of farm (i.e. piglet production; finishing) and type of contract (with/without input provision).

6.5. Limitations and Further Research

This thesis contributes further insights into food chain organisation by depicting the diversity of GSs and CMs used to support transactions in the BPC. A quantitative analysis, using a structural model, demonstrated the importance of strengthening horizontal and vertical relationships among chain actors for farmer performance. Finally, also using a structural model, the thesis provides relevant insights concerning how buyer support influences farmer performance and investments. Below, the main limitations of this thesis are explained and implications for further research are proposed.

The first limitation of the present thesis concerns the scope of analysis. The focus of the study is on transactions between pig farmers and buyers. Future studies could extend the analysis to another chain links. For instance, the influence of GSs (e.g. supply chain relationships and buyer support) on performance could be measured at the processing stage and even be extended to retailing. Upstream, studies could include assessment on the quality of critical inputs farmers purchase or are provided with.

Second, this thesis identified various GSs and CMs used to handle a quite homogenous set of requirements. It may lead to the assumption that, in general, quality has been met at different transaction costs associated with these different GSs. However, this assumption is limited by the diversity that was found in the coordination settings. Likewise, the literature has relied on exploratory approaches to analysing the alignment of contracts with quality standards (Raynaud et al., 2005; Schulze et al., 2007; Gellynck and Molnár, 2009; Wever et al., al 2010). Studies exploring the costs inherent to these GSs, along with impacts on performance, would provide more concrete insights into the efficiency of these alignments.

Third, the quantitative analyses included farmers supplying different types of buyers through different types of GSs. However, further studies with larger samples of the different chain actors and of the different buyers would allow the comparative analyses on coordination to be refined. For instance, regarding the effects of horizontal relationships (HRs) and vertical relationships (VRs) analysed in Chapter 4, it could be of interest to analyse how HRs influence VRs and the performance of pig farmers supplying different types of buyers (e.g. firms or cooperatives). Coordination in cooperatives and firms, for instance, is constrained by different characteristics regarding the relationship with farmers and views on production organisation, as illustrated in Chapters 1 and 2. Regarding the influence of buyer support, investigated in Chapter 5, a more detailed sample design would a more in-depth analysis of the extent to which the transaction context affects CMs, performance and investments.

Finally, it would allow for a more refined assessment of the impact of the buyer support included in different types of contracts on farmer performance**.**

Fourth, the analysis on the influence of VRs and HRs on performance also brings some limitations. The first limitation is that the study focuses on farmer performance. Future studies could address this gap by, for example, by examining how farmer performance impacts on quality of downstream processes. This analysis could include farming data and information such as documentation, uniformity of pigs and carcasses collected at processing stages and reports obtained from retailers. In addition, the analysis does not take into account differences among buyers in contractual relationships. In cooperatives, for instance, the relationship between farmers and buyers implies not only the supply through contracts. These farmers are also members and owners of the cooperative. Controlling for these aspects in future studies may provide more refined insights on VRs and their influence on performance in different transaction contexts. Finally, the construct of HRs used in this study only addresses the participation of farmers in meetings and their communication with farmers' associations. Future studies could benefit from including further items on HRs. The constructs could include items such as topics discussed in meetings (e.g. quality, technology) and perceptions of farmers on how effectively HRs help them to improve their decision making, their relationship with buyers and performance. Other constructs could include the promotion of farmer-farmer HRs by focal buyers and *farmer-to-farmer* informal interactions.

Fifth, some constructs used in the structural models (i.e. Chapters 4 and 5) did not include measurement items addressing specificities regarding buyer coordination, farming management and performance that are used in distinct types of farms. These may include, for instance, the frequency with which buyers visit farmers to provide technical support and monitor compliance with requirements, bonus criteria buyers use as incentives, quality of inputs provided to farmers and management practices used by farmers. Exploring the effects of these specifications on farmer performance and investments would provide buyers with a better understanding of how to establish more efficient coordination.

Summary

Consumers preferences and food developments have continuously triggered changes in regulations and the implementation of various quality standards and certification schemes. New quality demands also imply new coordination arrangements between buyers and suppliers in food chains. Literature has demonstrated that food companies use different types of governance structures (GSs) to support transactions with farmers. Through these GSs companies monitor processes, control inputs used in production and provide farmers with technical support (Raynaud et al 2005; Gellynck and Molnár 2009; Goodhue, 2011).

However, little attention has been paid to the complexity behind the GSs used to support transactions between buyers and suppliers. This complexity regards the diversity of arrangements used by companies dealing with similar transactions. Looking at this complexity, there are grounds for interesting insights for scholars, managers and policy makers. First, it allows us to understand which aspects are coordinated by a GS. For example, a contract, a type of GS, may include distinct mechanisms to coordinate prices, quality and resource allocation. Second, it refines insights concerning the reasons why chain actors choose distinct GSs (and underlying coordination mechanisms) to support transactions. Third, it allows for a more precise evaluation of how GSs influence performance in exchange relationships.

Brazil is the fourth largest global producer and exporter of pork. In a context of high competition and increasing concerns with food quality, companies need to implement effective governance structures to support transactions with farmers. For the BPC, ensuring quality and producing efficiently are of growing relevance in the battle to maintain and improve its competitiveness. Quality requirements in the BPC are in general based on public regulations and on a few specific requirements of certain (export) markets. Overall, these requirements present low diversity. However, a diversity of GSs (i.e. types of contracts) is found throughout the sector and within individual supply chains.

The main goal of this thesis is to analyse the GSs used to support transactions between buyers and pig farmers in the Brazilian pork chain. In general, the study depicts the diverse types of GSs that are used and analyses the relationships between GSs and quality requirements; the reasons why individual actors use plural coordination mechanisms; and relationships between GSs, farmer investments and performance.

The research objectives are addressed in four chapters, building on qualitative and quantitative research. These chapters expand studies on transaction cost economics, supply chain management and network theories addressing vertical and horizontal relationships in food supply chains.

Chapter 2 analyses the relationships between quality requirements and coordination mechanisms used by buyers in transactions with farmers. Interviews with key public and private actors identified the main regulations, requirements of customers and supporting coordination mechanisms set in spot markets, mini-integrations, singular and central cooperatives and investor owned firms. Transaction Cost Economics theory has provided various studies explaining how different types of GSs support transactions in food chains. These studies have focused on identifying a generic GS (e.g. type of contract) that most efficiently fits a generic type of quality standard (e.g. public/ private) (Raynaud et al., 2005; Schulze et al., 2007; Wever et al., 2010). Chapter 2 goes deeper by examining the relationships between coordination mechanisms (underlying governance structures) and quality requirements (underlying quality standards). This study allowed us to demonstrate that diverse CMs may be used to support a non-diverse set of quality requirements. The differences in coordination regard aspects such as references for base prices, criteria for bonus, control on inputs and processes and resource allocation.

Chapter 3 relies on exploratory approaches to explain the complexity in coordination from the perspective of buyers. First, based on literature and interviews, the chapter proposes a modified framework to explain the complexity of coordination embedded in a GS (Wever, 2012). The framework sets values of CMs on price, volume, quality and resource allocation ranging in the market-hierarchy continuum. In addition, the chapter analyses how and why individual buyers use plural coordination mechanisms to support similar transactions (Heide, 2003; Parmigiani, 2007; Ménard, 2013). The framework is applied in four case studies addressing relationships between different types of buyers and piglet farmers. The contribution of this chapter for literature is twofold. First, the framework allows to explain that a single GS (e.g. a contract) may include CMs on distinct positions within the market-hierarchy continuum. Second, it provides explanations on why actors use plural CMs with different counterparties in similar transactions. The chapter demonstrates that buyers use plural CMs to address aspects such as market fluctuations, bargaining power of suppliers and the need to adopt different coordination settings on quality. In TCE these findings corroborate with studies demonstrating that, for efficient alignment, a discrete solution (GS) is not sufficient to explain the complexity underlying governance choices. Moreover, the findings are in line with studies demonstrating that buyers use plural GSs to develop knowledge along with suppliers and to handle strategic constraints. Finally, the findings obtained for cooperatives, where relationships with farmers involve membership and supply, suggest that the type of buyer-supplier relationship (e.g. membership and supply in cooperatives) may push actors towards plural coordination.

Chapter 4 uses structural equation modelling (SEM) to analyse possible influences of Vertical (VRs) and Horizontal Relationships (HRs) on performance of pig farmers. Data were obtained through a survey questionnaire, applied in southern Brazil, to 269 farmers supplying through contracts and in spot markets. The VRs were examined via constructs Information Exchange and Relationship Quality between farmers and buyers. The construct on HRs address the interaction of farmers with farmer associations. Previous studies grounded on transaction costs economics, supply chain management and network theories have analysed

these relationships partially. Mostly, literature has found positive relationships between VRs and performance (Coronado et al., 2010; Huo et al., 2014)); HRs and performance (Hennessy and Heanue, 2012; Lu et al., 2008b); and HRs and VRs (Lu et al., 2012, Brito et al., 2015). Chapter 4 expands on this literature by integrating these relationships in a single model. In line with former studies, the results demonstrate that VRs and HRs improve performance**.** Moreover, the HRs influence VRs by improving information exchange between farmers and buyers. In addition, the findings suggest that the context in which transactions take place (i.e. spot market, contracting), may affect the influence of HRs (on performance and VRs) and VRs (on performance).

Chapter 5 analyses influences of buyer support on famer performance and investments through a SEM model. Data were obtained from 199 pig farmers supplying through contracts in southern Brazil. Literature has demonstrated that, through production contracts, food companies control quality and provide farmers with technical assistance (Dries, 2009; Goodhue, 2011). These support mechanisms help farmers to meet compliance with transaction requirements (Paul et al.,2004), to improve productivity (Key and MC Bride, 2008) and to access credit for investments (Falkowski, 2012). Studies have focused on the influences of buyer support on performance or on investments. The SEM model proposed in Chapter 5 goes beyond and allows a joint analysis on these relationships. In addition, the model tests a relationship between performance and farmer investment requirements. The sample includes piglet farmers and finishers. The contracts supporting relationships with these two types of farmers distinguish in terms of buyers resource (i.e. input) allocation in the transaction. In the subsample of piglet farmers, buyer support through services prevails. Finishers are provided with services and critical inputs. First, the model was tested in the full sample. The results demonstrated positive influences of buyer support on farmer performance and farmer investment capacity. In addition, a negative relationship was found between performance and investment requirements. This supports the hypothesis that farmers are required to make investments to improve quality and productivity. The second interaction compared influences of different settings of resource allocation (i.e. including input provision or not). The findings demonstrate that support including inputs provision to farmers has a positive impact on performance and investment capacity.

Chapter 6 synthetises the main findings, explains the main theoretical, policy and management implications and limitations of this thesis.

General Conclusions

The main conclusions obtained through the qualitative and quantitative studies presented in the present thesis are summarized below.

- Buyers use a diverse set of GSs and underlying CMs to support transactions with pig farmers, meeting a set of quality requirements with low diversity. Government and specific customers are the main setters of quality requirements in the Brazilian pork chain. Companies that purchase pigs through vertical coordination schemes assume a key role in setting and monitoring requirements to be met by farmers.

- Focusing on GSs that best fit their transactions with farmers, buyers use additional (plural) forms of governance to support similar transactions. It was found that plural forms may be driven by copying coordination mechanisms adopted by competitors, the development of capabilities along with suppliers (farmers), bargaining power of farmers and market fluctuations. The findings also suggest that the type of buyer-supplier relationships (e.g. cooperatives) may force buyers to choose GSs that are less strict than could have been expected.

- Vertical relationships (i.e. information exchange and relationship quality) between pig farmers and their buyers positively influence farmer performance. Moreover, horizontal relationships between farmers may enhance farmer performance and their vertical relationships with buyers.

- Buyer support, through services, improves farmer performance and investment capacity and influences the investments farmers need to make to improve performance. However, the magnitude of these influences depend on the type of farm (i.e. piglet farmers; finishers) and the provision (or not) of inputs to farmers.

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Appendices

Appendix 4.1 – Means Comparison

Constructs	Items	Spot Markets		Contracted		(t) - equal variances not assumed	Sig.
		Mean	Standard deviation	Mean	Standard deviation		
Horizontal Relationships	HR1	4.63	2.36	4.26	2.45	.930	.356
	HR2	4.77	2.32	3.77	2.42	2.566	.013*
Information Exchange	IE1	2.85	2.29	6.21	1.30	8.345	.000**
	IE2	1.94	1.77	6.72	.836	-15.441	.000**
	IE3	1.77	1.52	5.80	1.85	-13.348	.000**
	IE4	1.66	1.44	5.52	2.21	-12.347	.000**
Relationship Quality	RQ1	6.38	.747	6.56	.958	-1.441	.154
	RQ2	5.64	1.40	5.85	1.38	-.914	.364
	RQ3	5.51	1.56	5.80	1.47	-1.099	.276
	RQ4	6.11	1.402	6.61	.816	-2.313	.025*
Quality Compliance	Q1	6.47	.625	6.03	.958	3.886	.000**
	Q2	6.60	.618	6.33	.932	2.432	.017*
Financial Performance	F1	5.29	1.39	5.32	1.28	-.151	.880
	F2	3.87	1.52	4.75	1.51	-3.568	.001**
	F3	3.91	1.83	5.33	1.49	-4.896	.000**
Transaction Costs	TC1	2.89	2.00	1.70	1.43	3.639	.001**
	TC2	3.27	2.08	2.23	1.77	3.043	.003**
	TC3	3.47	2.02	3.00	2.10	1.059	.293

** Significant at 99%; * Significant at 95%.

Appendix 5. 1 – Means in the full sample and subsamples – piglet farmers/finishers

Constructs		Full Sample		Piglet farmers (A)		Finishers (B)		t test (A/B) – equal variances not assumed	
	Items	Mean	S.D.	Mean	S.D.	Mean	S.D.	t	Sig.
Buyers Technical and Managerial Support	BS1	4.45	2.49	4.70	2.37	4.10	2.47	1.26	.212
	BS2	6.29	1.21	6.24	.83	6.24	1.44	.013	.990
	BS3	5.07	2.01	5.49	1.64	4.72	2.23	2.08	.041**
	BS4	5.35	2.00	6.03	1.32	4.90	2.22	3.41	.001***
	BS5	6.77	.795	6.57	.835	6.84	.492	-1.81	.076*
	BS6	5.84	1.81	5.78	1.67	5.84	1.87	-.149	.882
Investment Capacity	IC1	5.22	1.76	5.00	1.49	5.37	1.88	-1.14	.259
	IC2	5.03	1.75	4.81	1.41	5.13	1.92	-1.00	.322
	IC3	5.16	1.78	5.19	1.51	2.32	1.75	-.40	.689
Investment Requirements	IR1	5.62	1.64	6.14	1.29	5.23	1.77	3.11	.002***
	IR2	5.34	1.78	5.22	1.79	5.34	1.80	-.35	.727
	IR3	5.30	1.65	5.84	1.32	5.00	1.76	2.85	.005***
	IR4	4.76	2.10	5.27	1.76	4.39	2.28	2.27	.025**
Financial Performance	F1	5.31	1.27	5.16	1.14	5.09	1.42	.299	.766
	F2	4.76	1.52	4.43	1.24	4.53	1.65	-.361	.719
	F3	5.38	1.47	5.22	1.42	5.11	1.54	.352	.726
Production and Quality Performance	PQ1	4.58	1.47	4.30	1.56	4.68	1.54	-1.25	.216
	PQ2	4.69	1.46	4.89	1.58	4.53	1.46	1.17	.245
	PQ3	6.07	.92	5.86	.787	6.03	.920	-.97	.336
	PQ4	6.38	.87	6.24	.76	6.35	.817	-.72	.476
	PQ5	5.23	1.33	5.35	1.00	5.03	1.38	1.44	.154

Differences are significant at 1% (***); 5 % (**); 10% (*)

Entities, companies and organisations that participated in the research

Agriness
Agropecuária Ceccagno
Asa Alimentos
Associação Brasileira de Criadores de Suínos (ABCS)
Associacao Brasileira de Proteína Animal (ABPA)
Associação Catarinense de Criadores de Suínos (ACCS)
Associação de Criadores de Suínos do Rio Grande do Sul (ACSURS)
Associação dos Granjeiros Integrados do Estado de Goiás
Associação dos Suinocultores do Estado de Minas Gerais (ASEMG)
Associação Goiana de Suinocultura (AGS)
Associação Paranaense de Suinocultores (APS)
BRF
Capal Cooperativa Agroindustrial
Comercial Farinella
Copagri
Cooperalfa
Cooper Amauc
Cooperativa Agropecuária Mista Nova Mutum (Coopermutum)
Cooperativa de Producao e Consumo Concordia (Coperdia)
Cooperativa Central Aurora Alimentos (Aurora)
Cooperativa Languiru
Cooperativa Regional Sananduva de Carnes e Derivados (Majestade)
Cooperativa Tritícola Erechim (Cotrel)
C.Vale Cooperativa Agroindustrial
Daros e Lodi
Fatec
Friella
Frigorífico Sol Nascente
Frigorífico Varpi
Frimesa
Frisia Cooperativa Agroindustrial
Granja Bagda
Grupo Pão de Açúcar (GPA)
Lar Cooperativa Agroindustrial
Laticínios São João
Master Agroindustrial
MigPlus
Ministério da Agricultura Pecuária e Abastecimento (MAPA)
Primato Cooperativa Agroindustrial
Seara Alimentos

Sindicato da Indústria da Carne e Derivados (SINDICARNE-SC)
Sindicato das Indústrias de Produtos Suínos do Estado do Rio Grande do Sul (SIPS)
Suinocultura Gobbi
Suinocultura Klockner
Suinocultura Tesser

About the Author

Franco Muller Martins was born in Pelotas, Rio Grande do Sul, Brazil, on May, 8, 1969. He graduated in Agricultural Engineering at Universidade Federal de Pelotas in 1992. After his graduation he worked in projects on production and management farms and processing companies in the rice sector in Rio Grande do Sul state. Between 1995 and 1996 he followed the MSc program in Production Engineering at Universidade Federal de Santa Catarina. In 1997 he was admitted as assistant professor at the Universidade Luterana do Brasil, in Canoas, Rio Grande do Sul, where he worked until 2005. During this period, he taught courses such as farming management, production planning and control and economic analysis of projects. Since middle 2005 he works as a researcher at the EMBRAPA (Brazilian Agricultural Research Corporation- Division on Swine and Poultry Production), in Concordia, Santa Catarina. In 2013, he enrolled in the PhD program of Management Studies Group, Wageningen University. His current research interests are production organization, management and competitiveness of food supply chains.

Franco Müller Martins
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Wageningen School of Social Sciences

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Organisation of Agribusiness, BEC31306	WUR	2013	6.0
Advanced Food Quality Management, FQD35806	WUR	2014	6.0
Quantitative Data Analysis: multivariate techniques, YRM60306	WUR	2016	2.0
Thesis proposal	WASS	2013	6.0
B) General research related competences			
WASS Introduction Course	WASS	2103	1.0
Writing Grant Proposals	WGS	2016	2.0
'Governance Structures and Coordination Mechanisms in the Brazilian Pork Chain'	26 th Annual IFAMA World Conference, Aarhus, Denmark	2016	1.0
'Governance Structures and Coordination Mechanisms in the Brazilian Pork Chain – Diversity of Arrangements to Support the Supply of Piglets'	WASS PhD day	2016	
Summerschool IOEA	Cargése, France	2016	3.0
'Governance Structures and Coordination Mechanisms in the Brazilian Pork Chain - Diversity of Arrangements to Support the Supply of Piglets'	Institutional & Organizational Economics Academy (IOEA) – Cargése, France	2016	
C) Career related competences/personal development			
Scientific Writing	WGS	2016	1.8
Project & Time Management	WGS	2013	1.5
Total			**30.3**

*One credit according to ECTS is on average equivalent to 28 hours of study load

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