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## Governance structures and coordination mechanisms in the Brazilian pork chain – Diversity of arrangements to support the supply of piglets

### RESEARCH ARTICLE

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### Abstract

This paper 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, we propose a framework to analyse how price, volume, quality and resource allocation are coordinated in a transaction. This paper builds on transaction cost economics in two ways. First, it shows that to arrange a transaction, a buyer may set CMs in distinct positions within the market-hierarchy continuum. Second, it shows that actors use plural CMs with different counterparties in similar transactions. We found four explanations for plural governance: market fluctuations, bargaining power of suppliers, stricter coordination and quality, and the exchange context.

**Keywords:** pork supply chain, coordination mechanisms, plural governance

**JEL codes:** D230, L24, L220

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## 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 (Gellynck and Molnar, 2009; Raynaud *et al.*, 2005; Schulze *et al.*, 2007; 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; Ménard, 2013; Miranda and Chaddad, 2014; Mols *et al.*, 2012; Parmigiani, 2007).

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.

## 2. Governance in food chains

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

*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 (Ghosh and John, 1999; Rindfleisch and Heide, 1997; 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 (Ménard and Valceschini, 2005; Williamson, 2008; 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).

## 2.1 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 (Ménard, 2004; Sauvé, 2013; Williamson, 1991). 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*.

## 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 CMs (Foss, 2002; Grandori, 1997) 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, 2012; Martinez and Zering, 2004). 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 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,

**Table 1.** Typology of contractual coordination mechanisms (adapted from Wever, 2012).

| Coordination mechanisms | Variables   | Values  |  |   |  |
|-------------------------|---|---|--|---|--|
|                         |   | Market ←  |  | → Hierarchy                                     |  |
| Price                   | <ul style="list-style-type: none"> <li>• Setter</li> <li>• Duration</li> <li>• Criteria</li> </ul>      | 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                  | <ul style="list-style-type: none"> <li>• Duration</li> <li>• Amount</li> <li>• Specification</li> </ul> | Spot volume                                     | Fixed volume with min/max deviations               | Fixed volume                                    | Internal volume                            |
| Quality                 | <ul style="list-style-type: none"> <li>• Setter</li> <li>• Monitor</li> </ul>                           | Spot market specifications/<br>Public framework | Third party quality coordination                   | Counterparty quality coordination               | Internal quality coordination              |
| Investments             | <ul style="list-style-type: none"> <li>• Types</li> <li>• Sources</li> </ul>                            | No (external) investments used                  | Debt security                                      | Convertible debt security                       | Equity security                            |

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 (Raynaud *et al.*, 2005; Schulze *et al.*, 2007; Williamson, 1991).

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.

### 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; Ménard, 2013; Mols *et al.*, 2012; Parmigiani, 2007). 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.* (2012) 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 GSs 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.

## 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<sub>1</sub>**: which GSs and CMs are predominantly used to support the supply of piglets in the BPC?

**RQ<sub>2</sub>**: 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<sub>3</sub>**: why do actors rely on distinct CMs (plural forms) to support similar exchange relationships in the supply of piglets in the BPC?

## 3. Data collection

Data were collected by means of semi-structured interviews (n=41) with representatives of the sector and the institutional environment (Table 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. 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.

**Table 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 <sup>1</sup> : 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 |
| Slaughterhouse 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.  |

<sup>1</sup> IOF = Investor owned firms; Coops = Cooperatives; MI = Mini integrations.

## 4. 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, 2015). The main importers of Brazilian pork in 2014 were Russia (38%), Hong Kong (22.6%), Angola (10.7%), Singapore (6.6%) and Uruguay (4.2%) (MAPA, 2015). 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, 2015).

Overall, BPC meets public standards and specific customer requirements. The Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA, 2015) 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, organic production, differentiated retail schemes and regional production adopted in Europe (Becker and Staus, 2009; Bonneau *et al.*, 2011; Grunert *et al.*, 2011; Trienekens *et al.*, 2009; 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 farmers. 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 data from SIPS, personal communication) meets stricter requirements and is reliant on coordination supported by contracts (Table 3). The following sections explain and illustrate CMs buyers use to support the supply of piglets in the BPC.

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

**Table 3.** Supplying arrangements in the Brazilian pork chain.

| Main 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                     |



‘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.

## 5. Results

### 5.1 A modified framework of coordination mechanisms (based on the Brazilian pork chain)

Wever’s (2012) framework comprises CMs on Price, Volume, Quality and Investments and respective variables (Table 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, 2012; Martinez and Zering, 2004; Miele and Waquil, 2007; Schulze *et al.*, 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<sup>1</sup>. 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*, *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.

<sup>1</sup> In countries such as the Netherlands and Germany buyers use (spot) market prices to define base prices for finished pigs (Schulze *et al.*, 2007; Wognum *et al.*, 2009). However, penalties are applied, for instance, if pigs present lesions. In the USA, and Canada companies use market prices and bonuses based on carcass quality (Martinez, 2012; Martinez and Zering, 2004; Saab and Neves, 2009). PDOs and PGIs use specific reference markets to set prices (Wever, 2012). Because BPC is a special case in which chain actors use more segmented schemes to organise production, this supply chain presents diverse settings of coordination.

The aforementioned mechanisms were used to refine the values of Price Criteria in the framework (Figure 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.

### ■ Volume

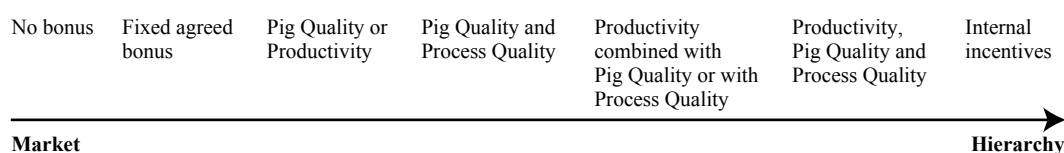
Wever (2012) uses the variables Volume Term and Amount Specification to explain coordination on Volume. The values for Volume Term are *Short Term*, *Medium/Long Term*, and *Indefinitely*. These values fit periods used in BPC. For instance, to handle market fluctuations, some buyers use spot markets 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



**Figure 1.** Bonus criteria values.

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, Critical Resources and Buyer's Support Resources illustrate differences in how the arrangements identified in the research coordinate transactions (Table 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 4.** Coordination mechanisms used in the supply of piglets.

| Arrangements         | Variables <sup>1</sup> | Market ← | → Hierarchy |
|----------------------|------------------------|----------|-------------|
| Investor owned firms | BC                     |          | X           |
|                      | CR                     |          | X           |
|                      | SR                     |          | X           |
| Cooperatives         | BC                     |          | X           |
|                      | CR                     | X        |             |
|                      | SR                     |          | X           |
| Mini integrations    | BC                     | X        |             |
|                      | CR                     | X        |             |
|                      | SR                     |          | X           |
| Spot markets         | BC                     | X        |             |
|                      | CR                     | X        |             |
|                      | SR                     | X        |             |

<sup>1</sup> BC= Bonus criteria; CR = Critical resources; SR = Support resources.

## 5.2 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. First, CMs underlying a GS used by a cooperative is analysed. Afterwards, we present three different cases and analyse how and why individual 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 coordination mechanisms – Singular cooperative

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 a SC, located in Rio Grande do Sul State, in the south of Brazil. The cooperative produces pork, dairy and poultry products. To produce pigs, Case A uses contracts with 20 weaning, 60 nursery and 200 fattening farmers. The slaughters were estimated at about 290,000 heads in 2014 (SIPS, personal communication). 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 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.

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 selling and buying contracts (Miele and Waquil, 2007). In what follows, we present cases on plural governance.

**Table 5.** Coordination mechanisms in Case A.<sup>1</sup>

| Coordination mechanisms   |           |  |
|---------------------------|-----------|--|
| Variables                 | Values    |  |
| Price                     |           |  |
| Base price reference      | Market    | <ul style="list-style-type: none"> <li>• Centralized market</li> <li>• <b>Reference market</b></li> <li>• Party to the transaction</li> </ul>  |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>• Internal price</li> </ul>   |
| Term                      | Market    | <ul style="list-style-type: none"> <li>• <b>Short term</b></li> <li>• Medium-Long Term</li> </ul>  |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>• Indefinitely</li> </ul>   |
| Bonus criteria            | Market    | <ul style="list-style-type: none"> <li>• No bonus</li> <li>• Fixed agreed bonus</li> <li>• <b>Pig quality or productivity</b></li> <li>• Pig quality and process quality</li> <li>• Productivity combined with pig quality or process quality</li> <li>• Productivity, pig quality and process quality</li> </ul>  |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>• Internal incentives</li> </ul>  |
| Volume                    |           |  |
| Term                      | Market    | <ul style="list-style-type: none"> <li>• Short term</li> <li>• Medium-long term</li> </ul>   |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>• <b>Indefinitely</b></li> </ul>  |
| Amount                    | Market    | <ul style="list-style-type: none"> <li>• Specified per order</li> <li>• Base volume with allowable deviations</li> </ul>   |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>• <b>Fixed amount (based on internal demand)</b></li> </ul>   |
| Quality                   |           |  |
| Setter                    | Market    | <ul style="list-style-type: none"> <li>• <b>Public actor</b></li> <li>• Public actor and third party</li> <li>• Public actor, third party and party to the transaction</li> <li>• Public actor and party to the transaction</li> <li>• Public actor, third party and internal setting</li> </ul>   |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>• Public actor, and internal setting</li> </ul>   |
| Monitor                   | Market    | <ul style="list-style-type: none"> <li>• Public actor</li> <li>• Third party</li> <li>• Third party and party to the transaction</li> <li>• <b>Party to the transaction</b></li> <li>• Third party and internal monitoring</li> </ul>  |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>• Internal monitoring</li> </ul>  |
| Resources allocation      |           |  |
| Critical resources        | Market    | <ul style="list-style-type: none"> <li>• Resources are not allocated nor approved by the buyer</li> <li>• Farmer uses feed or animals approved by the buyer</li> <li>• <b>Farmer uses feed and animals approved by the buyer</b></li> <li>• Resources are partially allocated by the buyer (feed or animals)</li> <li>• Resources are totally allocated by the buyer (feed and animals)</li> </ul> |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>• Feed and animals are used internally</li> </ul>   |
| Buyer's support resources | Market    | <ul style="list-style-type: none"> <li>• No buyer's resources are allocated</li> <li>• Technical support in production according to suppliers request</li> <li>• Regular technical support in production</li> <li>• Regular technical support in production and in projects</li> <li>• <b>Regular technical support in production, in projects and information exchange</b></li> </ul>             |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>• Support is used internally</li> </ul>   |

<sup>1</sup> Bold values: the coordination mechanisms assume different positions within the market-hierarchy continuum.

### 5.3 Cases on plural forms

This section presents three cases to explain the use, by one buyer, of different CMs to support similar transactions (Table 6). The identification of GSs follow the nomenclature used in BPC.

#### ■ Case B – Investor owned firm

In the BPC, driven by cost efficiency and strict quality, IOFs rely on quasi-integration GSs to support production (Table 4). 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 (the values assumed by this firm in the framework of CMs are highlighted in bold in Table 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, farmers 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*.

**Table 6.** Plural governance structures used in the case studies.

|                              | Case B                 | Case C                      | Case D  |
|------------------------------|------------------------|-----------------------------|---|
| Type of arrangement          | Investor owned firm    | Cooperative                 | Cooperative   |
| Type of transaction          | Farrowed piglets       | Farrowed piglets            | Weaned piglets  |
| Volume                       | 235,000 sows           | 23,000 sows                 | 41,000 sows   |
| Types of governance          | Partnership: 68%       | Centralised production: 78% | Buying and selling: 28%                                 |
| structures and participation | Lending: 24%           | Buying and selling: 22%     | Buying and selling with stricter CMs <sup>1</sup> : 55% |
|                              | Buying and selling: 8% | –                           | Lending: 17%  |

<sup>1</sup> CMs = coordination mechanisms.

**Table 7.** Plural forms of coordination mechanisms used to support the supply of piglets in an IOF.<sup>1,2</sup>

| Variables                 | Values    |  |
|---------------------------|-----------|--|
| Price                     |           |  |
| Base price reference      | Market    | <ul style="list-style-type: none"> <li>Centralised market</li> <li><b>Reference market (BS 8%)</b></li> <li><b>Party to the transaction (P 68%; L 24%)</b></li> </ul>  |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>Internal price</li> </ul>   |
| Term                      | Market    | <ul style="list-style-type: none"> <li><b>Short term (BS 8%; L 24%)</b></li> <li><b>Medium-long term (P 68%)</b></li> </ul>  |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>Indefinitely</li> </ul>   |
| Bonus criteria            | Market    | <ul style="list-style-type: none"> <li>No bonus</li> <li>Fixed agreed bonus</li> <li><b>Pig quality or productivity (BS 8%)</b></li> <li>Pig quality and process quality</li> <li><b>Productivity combined with pig quality or process quality (L 24%)</b></li> <li><b>Productivity, pig quality and process quality (P 68%)</b></li> </ul>  |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>Internal incentives</li> </ul>  |
| Volume                    |           |  |
| Term                      | Market    | <ul style="list-style-type: none"> <li>Short term</li> <li>Medium-long term</li> </ul>   |
|                           | Hierarchy | <ul style="list-style-type: none"> <li><b>Indefinitely (P 68%; L 24%; BS 8%)</b></li> </ul>  |
| Amount                    | Market    | <ul style="list-style-type: none"> <li><b>Specified per order (BS 8%)</b></li> <li>Base volume with allowable deviations</li> </ul>  |
|                           | Hierarchy | <ul style="list-style-type: none"> <li><b>Fixed amount (based on internal demand) (P 68%; L 24%)</b></li> </ul>  |
| Quality                   |           |  |
| Setter                    | Market    | <ul style="list-style-type: none"> <li><b>Public actor</b></li> <li>Public actor and third party</li> <li>Public actor, third party and party to the transaction</li> <li><b>Public actor and party to the transaction (P 68%; L 24%; BS 8%)</b></li> <li>Public actor, third party and internal setting</li> </ul>  |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>Public actor, and internal setting</li> </ul>   |
| Monitor                   | Market    | <ul style="list-style-type: none"> <li>Public actor</li> <li>Third party</li> <li>Third party and party to the transaction</li> <li><b>Party to the transaction (P 68%; L 24%; BS 8%)</b></li> <li>Third party and internal monitoring</li> </ul>  |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>Internal monitoring</li> </ul>  |
| Resources allocation      |           |  |
| Critical resources        | Market    | <ul style="list-style-type: none"> <li>Resources are not allocated nor approved by the buyer</li> <li>Farmer uses feed or animals approved by the buyer</li> <li><b>Farmer uses feed and animals approved by the buyer (BS 8%)</b></li> <li><b>Resources are partially allocated by the buyer (feed or animals) (L 24%)</b></li> <li><b>Resources are totally allocated by the buyer (feed and animals) (P 68%)</b></li> </ul> |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>Feed and animals are used internally</li> </ul>   |
| Buyer's support resources | Market    | <ul style="list-style-type: none"> <li>No buyer's resources are allocated</li> <li>Technical support in production according to supplier's request</li> <li><b>Regular technical support in production (BS 8%)</b></li> <li>Regular technical support in production and in projects</li> <li><b>Regular technical support in production, in projects and information exchange (P 68%; L 24%)</b></li> </ul>                    |
|                           | Hierarchy | <ul style="list-style-type: none"> <li>Support is used internally</li> </ul>   |

<sup>1</sup> P = partnership; L = lending; BS = buying and selling.<sup>2</sup> Bold values: the coordination mechanisms assume different positions within the market-hierarchy continuum.



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.

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 properties 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 selling and buying 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 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 SC 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 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 regular 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, personal communication). 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 CMs in this case (Table 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.

## 6. 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.

### 6.1 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 (Raynaud *et al.*, 2005; Schulze *et al.*, 2007; Williamson, 1991).

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.

### 6.2 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 8), corroborates the perspective that internal and contracted production improve their capabilities and performance (Heide, 2003; Mols *et al.*, 2012; Parmigiani, 2007).

**Table 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.<br>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.<br>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 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 D 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 C corroborate the strategizing 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 standards. Regarding Ménard's (2013) assumptions, the results fit only the strategizing 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 strategizing 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.

## 7. 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 (Gellynck and Mólnar, 2009; Raynaud, 2005; Schulze *et al.*, 2007).

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; Mols *et al.*, 2012; Parmigiani, 2007).

This paper offers interesting insights into the assumption of strategizing 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.

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