The role of governance structures in supply chain information sharing

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RESEARCH ARTICLE

Abstract

Information sharing in supply chains may result in concerns related to information security, information access privileges, and allocation of claimed benefits. To mitigate such concerns in order to efficiently and effectively share information, relationships among the supply chain actors need to be managed and effective governance structures need to be chosen. Despite initial research, a comprehensible supply chain analysis of the role of governance structures in information sharing is missing. The aim of this paper is, therefore, to investigate how and to what extent supply chain information sharing can be explained by supply chain governance structures. To take into account the multi-dimensionality of information sharing, the specifications of which information to share and how to share it are considered. Based on case study data from three European pork supply chains, we conclude that information sharing cannot be solely explained by governance structures. The results show that information sharing is apart from governance structures strongly determined by quality regulations, financial strength (power) of the chain partners, and the relationships that are aimed for. Consequently, our study challenges the general assumption that a more integrated governance structure is accompanied by more types of information shared through the use of automated information systems.

Keywords: governance structure, information exchange, supply chain, case study research, pork

1. Introduction

Companies are becoming aware that, in order to reduce costs and remain competitive, they have to closely cooperate with their supply chain partners (Baihaqi and Sohal, 2013; Ghosh and Fedorowicz, 2008). Supply chains aim to optimise the operational efficiency of delivering desired products or services to end consumers on time and at minimal cost (Ghosh and Fedorowicz, 2008). Therefore, supply chain partners need to share information, resulting in better decision making in planning, ordering, and capacity allocation (Cheng, 2011). Such advantages have been widely and frequently documented (Baihaqi and Sohal, 2013; Cachon and Fisher, 2000; Cheng, 2011; Lee *et al.*, 2000; Li and Lin, 2006; Yu *et al.*, 2001). Thus, through supply chain information sharing, a competitive advantage for the supply chain and a win-win situation for all supply chain partners can be attained (Cheng, 2011; Li and Lin, 2006; Yu *et al.*, 2001).

Information sharing may, however, result in some drawbacks. Information security, information access privileges, allocation of claimed benefits, and cost-benefit ratios are particular concerns for collaborating supply chain partners (Lee and Whang, 2000; Premkumar, 2000). These concerns are derived from the fact that supply chain partners often have conflicting business goals and hence different reasons for information sharing. To mitigate such concerns in order to efficiently and effectively share information, relationships among the supply chain actors need to be managed and effective governance structures need to be chosen (Ghosh and Fedorowicz, 2008). A governance structure is defined as 'the set of coordination mechanisms that create incentives to interact and safeguards that protect each party against the risk of opportunistic behaviour on the part of the other' (Nicolaou, 2008). It is generally believed that closer relationships or more integrated governance structures result in more types of information being shared (Cheng, 2011).

Despite initial research, a comprehensible supply chain analysis of the role of governance structures in information sharing is missing. The aim of this paper is to investigate how and to what extent supply chain information sharing can be explained by supply chain governance structures. Since most of this literature has only considered the dyadic buyer-supplier relationship (Kembro and Näslund, 2014), the unit of analysis is extended to a four-tier supply chain. As advised by Chandra *et al.* (2007) and Yao *et al.* (2008), specifications of which information to share and how to share it are considered. By doing so, the multi-dimensionality of information sharing is taken into account. In line with the suggestions from Kembro and Näslund (2014), transaction cost economics, which is a dominant theory for explaining governance structure choices, is used to address the multi-dimensionality of information sharing. Since little in-depth research has been conducted on this relationship, exploratory case study research is appropriate to obtain novel and nuanced insights into this link. In the present paper, we focus on the European pork industry, in which the need for information sharing is high and distinct governance structures can be found.

The remainder of the paper is organized as follows. In Section 2, the conceptual research framework is presented. After outlining the research methods in Section 3, the background of three carefully selected pork supply chains is described in Section 4. A multiple case study approach is selected, enabling us to clarify whether the findings are replicated by several cases. Then, the analysis, entailing an intra-case and cross-case analysis, is discussed in Section 5 and 6. In the cross-case analysis, overarching patterns are identified and explanations are iteratively stipulated. Concluding remarks finalize the paper.

2. Literature review

The performance of a supply chain largely depends on efficient and effective information sharing (Ghosh and Fedorowicz, 2008; Lee *et al.*, 1997). Information sharing between supply chain actors may, notwithstanding, create some drawbacks, such as information leakages and disproportionate allocation of information benefits in the supply chain. To mitigate these drawbacks, the supply chain actors should agree on appropriate governance structures, which are arrangements on supply chain transactions. Appropriate arrangements between the supply chain actors might reduce the chance of opportunistic behaviour and eventually lead to improved information sharing.

Supply chain governance structures

Considerable research has been conducted to explain the choices for particular governance structures. A dominant theory explaining these choices is the transaction cost economics (TCE) theory, often linked with the work of Williamson (1991). The central claim of TCE is that actors aim to minimise the cost of the transactions they conduct. To do so, these actors opt for a particular governance structure. In general, governance structures are placed on a continuum, ranging from spot market to vertical integration (Raynaud *et al.*, 2005). Spot-market relations are based on price mechanisms and usually have a short-term focus; the composition of supply chain actors involved may alter frequently. Actors are usually highly autonomous, making this governance structure suitable for adaption to price changes (Wever *et al.*, 2010; Williamson, 1991). Hierarchical relations are based more on formal administrative control and less on price mechanisms. In the case of vertical integration, different stages of the supply chain are owned by one actor (Wever *et al.*, 2010; Williamson, 1991). Therefore, while actors retain their decision rights in a spot market, this does not hold for vertical integration, in which actors are integrated into their buyer's or supplier's company.

Despite a consensus on the two polar forms of spot market and vertical integration, different hybrid governance structures have been defined, containing characteristics of spot market and vertical integration (Gellynck and Molnár, 2009; Raynaud *et al.*, 2005; Schulze *et al.*, 2007; Wever *et al.*, 2010). Williamson (1979) identified only one general category of hybrid governance structure, whereas other researchers identified three to five. In the present paper, we use the widespread typology of Raynaud *et al.* (2005), who identified five governance structures: spot market, verbal agreement, formal contract, equity-based contracts, and vertical integration (Figure 1).
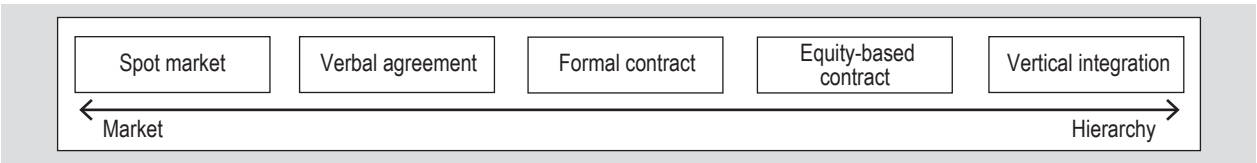
Figure 1. Typology of governance structures (Raynaud *et al.*, 2005).

To describe and distinguish these governance structures, the variables 'length/frequency', 'formality of relation', and 'type of contract' are used (Lyons, 1996; Palmer and Mills, 2003; Zhang and Aramyan, 2009). First, the two-fold categorisation short (i.e. single transaction) and long-term relationship is frequently used to characterise 'length/frequency' (Raynaud *et al.*, 2005; Webster, 1992). While governance structures with short relationships are closer to spot market, longer ones move away from spot market towards vertical integration. Second, another variable to distinguish governance structures is 'formality of relation'. Formal relations encompass specific procedures and structural settings for cross-company engagement whereas informal relations do not. For instance, formality can be augmented by means of cross-company teams and regularly scheduled meetings (Cousins *et al.*, 2006). More formalisation is needed to decrease opportunistic behaviour in the relationship; relations become more formalised as they move closer to vertical integration (Raynaud *et al.*, 2005). Third, a last variable for distinguishing governance structures is 'type of contract' (Zhang and Aramyan, 2009). On the one hand, contracts can be classical forcing the partners involved to strictly adhere to the written contractual terms and conditions (Lyons, 1996; Williamson, 1985). Classical contracts typically govern transactions that are limited in scope, anonymous, and measurable (Palmer and Mills, 2003). In relational contracts, on the other hand, written terms are not the only reference as harmonising and preserving the relationships are more important (Palmer and Mills, 2003). Possible disputes are, therefore, resolved through behaviour and norms (Lyons, 1996). Some governance structures are characterised by classical contracts, such as equity-based contract and formal contract; others are characterised by relational contracts, such as verbal agreement. As suggested by Raynaud *et al.* (2005), these variables allow us to distinguish between the distinct governance structures of Figure 1.

Supply chain information sharing

As the literature has conceptualised information sharing in different ways, researchers have suggested investigating the 'what' and 'how' of information sharing (Chandra *et al.*, 2007; Christiaanse and Kumar, 2000; Ghosh and Fedorowicz, 2008; Yao *et al.*, 2008). The 'what' refers to which information to share, while the 'how' denotes the mechanisms facilitating information sharing (Kembro and Näslund, 2014). The 'how' and 'what' have, however, often been investigated only focusing on specified information categories. Emphasis has been repeatedly placed on inventory and demand information (Jonsson and Mattsson,

2013; Kembro and Näslund, 2014; Lau *et al.*, 2004); other types of information have been less well considered. On top of that, information sharing literature in many cases focuses on only one information sharing mechanism. For instance, Yu *et al.* (2001) focused on electronic data interchange (EDI) as a mechanism for sharing information, excluding any attention to other methods. Therefore, unlike the current research, multiple types of information and information sharing mechanisms are considered in this paper.

Regarding the type of information shared, most research to date has mainly investigated information related to the planning of logistics processes (demand and inventory information) (Kembro and Näslund, 2014). Planning information relates to (re)scheduling orders and forecasting demands, such as customer orders, point-of-sales data, and availability of stock (Jonsson and Mattsson, 2013). As product and process information are two other categories of particular importance for food industries, these categories are also considered in the analysis (Huang *et al.*, 2003). While product information describes the characteristics or structure of manufactured products, process information describes the characteristics of the value-adding activities during supply chain production stages. For instance, process information may encompass set-up time and the quality of the process (Huang *et al.*, 2003).

Supply chains apply several information sharing mechanisms for sharing information. Typically, since supply chains are increasingly using automated (supply chain) information systems, such systems often form the subject of research. Automated systems collect, store, process, and transmit information routinely throughout the supply chain in (near) real time (Bruns and McKinnon, 1993). However, much supply chain information is traditionally exchanged through semi-automated systems (e.g. fax, phone, or e-mail) on top of paper-based systems (e.g. information reports) and face-to-face interactions (e.g. meetings or conversations) (Chow *et al.*, 1999). In this study, four information sharing mechanisms are considered: automated systems (e.g. supply chain information systems and EDI), semi-automated systems (e.g. e-mail, telephone, fax), non-automated systems (e.g. paper-based company reports), and face-to-face interaction (McLaren *et al.*, 2002).

Conceptual research framework

In this research, we aim to investigate how and to what extent supply chain information sharing can be explained by supply chain governance structures. Based on a literature review, first, five governance structures have been identified. Second,

regarding information sharing, three information types and four information sharing mechanisms have been identified. Figure 2 summaries the conceptual research framework.

3. Research methods

Based on a literature review, Kembro and Näslund (2014) concluded that the predominant method in information sharing research is the survey method. They advised the application of case study research to achieve a nuanced picture of information sharing in supply chains (Kembro and Näslund, 2014). According to Miles and Huberman (1984), Yin (2003), and Eisenhardt (1989), case study research is an effective method for exploratory research and enables in-depth investigation. In the present research, we aim to carry out an in-depth investigation of how and to what extent information sharing can be attributed to governance structures in supply chains. A multiple case study approach was selected, enabling us to clarify whether findings are replicated by several cases (Eisenhardt, 1991; Yin, 2003).

Focus of the study

In the present paper, we focus on the European pork industry in which there is an urgent need for information sharing and distinct governance structures can be found. This industry has to cope with low profit margins and high customer expectations. High grain prices have made feed prices rise increasing the cost of pig production, and the retailer price war has caused a cascade effect on the earnings of the upstream supply chain partners. In addition, meat

crises, such as the dioxin crisis and classical swine flu, have made consumers critical about food safety, resulting in higher customer expectations. To increase profit margins and to cope with higher food safety demands, business processes along the European pork supply chains need to be made more efficient and effective. To do so, improved information exchange in pork supply chains is imperative. Furthermore, pork supply chains are often governed differently. For instance, some are highly integrated and are coordinated by a supply chain orchestrator, steering supply and demand of the entire supply chain and enforcing supply chain actors to use particular resources or follow particular quality regulations. In others, chains actors act more independently, hence the level of integration is low.

Data gathering

To build a representative case sample, three European pork supply chains with different governance structures were selected. For every case selected, 10 to 12 experts from research, supply chain actors, and government were interviewed to achieve a multi-perspective picture of these supply chains (Eisenhardt and Graebner, 2007; Rowley, 2002; Yin, 2003).

An interview protocol was used to direct and conduct in-depth interviews with the respondents from every supply chain. Respondents were initially asked to answer contextual questions to obtain a background picture of the pork supply chain. Among other things, questions were related to: type and number of actors, production volumes, distributions channels, general supply chain coordination, and quality
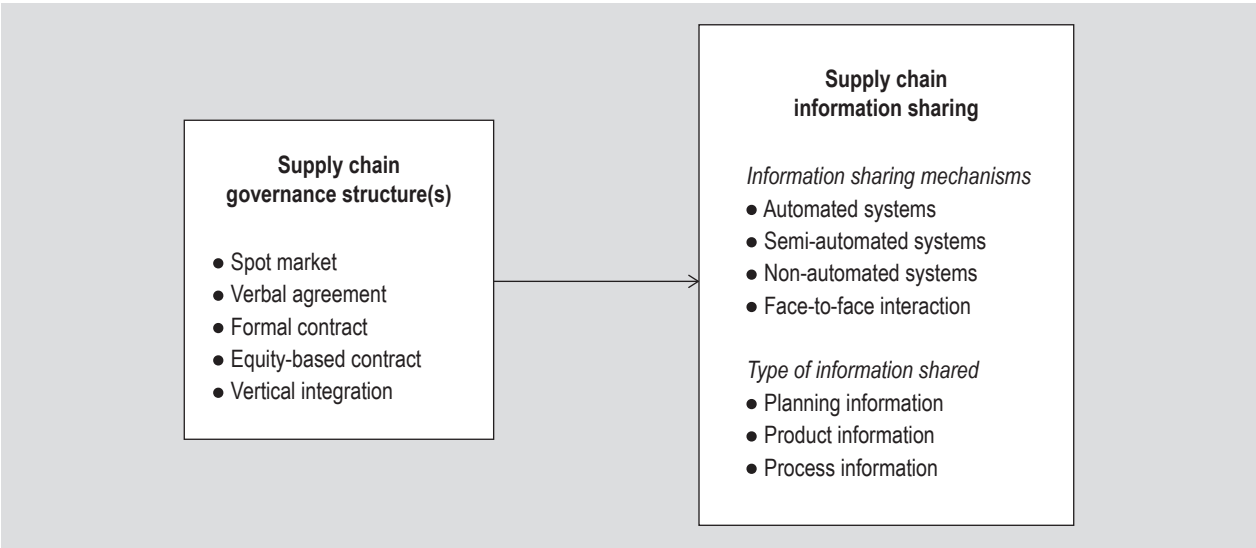

Figure 2. Conceptual research framework.

management systems. Thereafter, the respondents were asked questions regarding (supply chain) information sharing and (supply chain) governance structures, based on the conceptual research framework (Figure 2). In relation to the former, questions were focused on shared product, process, and planning information, and the information sharing mechanisms used. While for the latter, questions were related to length/frequency, formality of exchange, and type of contract. Questions were also asked to gain insights into major bottlenecks, best practices, and major changes that occur regarding governance structures and information sharing. For the process of ordering the obtained data, the protocol also contained several supply chain schemes, which permitted the interviewers to fill out information sharing and governance structures for every relation in the pork supply chain. The data were commonly recorded in internal reports (Briz *et al.*, 2008; UB, 2008; Wever and Wognum, 2008).

Data are based on the results of the Q-PorkChains project, in which two of the authors were involved. The aims of the 6th EU framework project, undertaken from 2007 till 2011, were to improve the quality of pork and pork products for the consumer and to develop innovative, integrated, and sustainable food production supply chains with low environmental impact. To do so, several modules were undertaken across multiple European countries. The reports used in the present paper come from a module focusing on, amongst other things, advanced inter-enterprise information systems, use of information, and governance structures in pork chains.

Data analysis

The obtained data were coded based on the constructs defined in Section 2. In Table 1, the coding rules for governance structures are presented. Mainly based on the

work of Raynaud *et al.* (2005), five governance structures are distinguished: spot market, verbal agreement, formal contract, equity-based contract, and vertical integration.

Table 2 depicts the coding rules for information sharing, conceptualised by 'type of information shared' and 'information sharing mechanisms'. On the one hand, three types of information are distinguished: planning information, product information, and process information. On the other hand, regarding 'information sharing mechanisms', automated systems, semi-automated systems, non-automated systems, and face-to-face interaction are distinguished (Mc Laren *et al.*, 2002).

Then, coded data were further analysed. Following Miles and Huberman (1984) and Eisenhardt (1989), data were initially analysed per case. After a within-case analysis, a cross-case analysis was undertaken, comparing the findings across cases. In the analysing process, overarching patterns between governance structures and information sharing were identified through 'pattern matching' (Yin, 2003). To retain theoretical flexibility, propositions were not pre-built. Consequently, findings were based on empirical evidence rather than on the researchers' presumptions (Eisenhardt, 1989). Then, explanations were (iteratively) stipulated for the patterns found, trying to explain the phenomenon (Miles and Huberman, 1984; Yin, 2003). Note that planning information is not discussed since no discrepancies across the supply chains regarding this information could be found.

4. Introduction to the case supply chains

In most European pork supply chains, similar consecutive stages, – farmer, slaughterhouse, processor, and retailers – accomplish primary chain processes (Figure 3). In addition

Table 1. Coding rules for supply chain governance structures (Raynaud *et al.*, 2005; Schulze *et al.*, 2007; Wever *et al.*, 2010).

Spot market	Exchanges are solely based on price mechanisms. Therefore, an invoice for instant exchange of goods or services is used.
Verbal agreement	Exchanges are not formalised into written, legally enforceable contracts. Performance or behavioural standards are unlikely to be specified, but if so, they are not formalised. Often, the agreements have a long-term focus.
Formal contract	Legal enforceable, written contracts are used to govern the transaction. Performance and behavioural standards, such as selling and buying obligations and details of the production process, are prescribed in the contract.
Equity-based contract	A chain actor owns stock of (one of) its suppliers/buyers. The chain actor stays independent, but is heavily reliant on other actors – e.g. its supplier(s) or buyer(s) – for several critical resources.
Vertical integration	Production and distribution of two (or more) successive stages are undertaken under common management and ownership (there is a joint-ownership of resources).

Table 2. Coding rules for supply chain information sharing (Chow *et al.*, 1999; Huang *et al.*, 2003; McLaren *et al.*, 2002).

Type of information shared	Planning information	Planning information relates to (re)scheduling orders and forecasting demands.
	Product information	Product information describes the characteristics or structure of the manufactured product.
	Process information	Process information describes the characteristics of the value-adding activities during supply chain production stages, transforming the product or adding input materials.
Information sharing mechanisms	Automated systems	These systems facilitate information sharing in a routine/structured and automated (electronic) way through, for instance, EDI and supply chain information systems.
	Semi-automated systems	These systems facilitate information sharing in an unstructured and semi-automated way through, for instance, phone, fax, and email.
	Non-automated systems	These systems facilitate information sharing in a paper-based way through, for instance, paper-based reports, invoices, and non-electronic labels.
	Face-to-face interaction	These systems facilitate interpersonal information sharing through, for instance, meetings and visits.

to these stages, others, such as feed company and breeder, deliver inputs for the primary chain actors. To start with, breeding companies, producing the genetic basis of pigs, deliver sows and semen to the farrowers. After insemination and a gestation period of two months, sows deliver around 12 piglets, weaned after two weeks. Then, piglets are reared to 25 kg in 10 weeks. These pigs are delivered to the finisher, who fattens the animals up to 110 kg slaughter weight, which takes about 6 months. The last two stages – i.e. farrowing and finishing – are often undertaken by a single farm. After farming, pigs are slaughtered, a process that entails several activities such as stunning, blood tapping, removing hairs, carcass and organ examining, splitting, chilling, and – sometimes – cutting. Slaughterhouses choose to deliver carcasses as carcass halves or as six meat cuts to the next actor. Whether carcasses are cut in two or six parts, they are typically sold to processors, as well as wholesalers and retailers. Processing companies, which might be part of a slaughterhouse or act independently, process the carcass parts further into a wide range of meat products, such as ham, steaks, loins, sausages, and spareribs. Finally, the packaged meat is sold through various customer channels, most of it through the retailer, which is the focus of this paper. However, some is distributed through so-called out-of-home channels, such as restaurant, hospitals, and business canteens.

The main supply chain stages in a (pork) supply chain are farmer, slaughterhouse, processor, and retailers. In these stages, the primary production takes place. For each relationship between these supply chain stages, marked with 1, 2, and 3, governance structure(s) and information sharing are described. In the next section, the selected supply chains are introduced by describing the background to the three supply chains and the supply chain organization.

Supply chain A

Supply chain A is a regional supply chain that produces fresh processed pork meat in the Northwest of Germany. It operates in a central region of the 'pork belt', which has the highest density of pork production in Europe. Supply chain
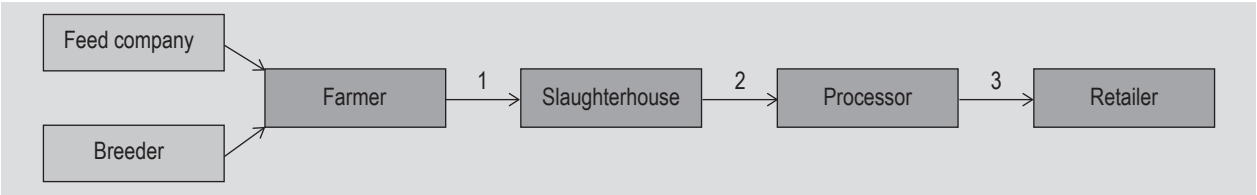

Figure 3. European pork supply chain.

A produces around 1 of the total German pig production, resulting yearly in 50,000 tons of processed pork meat. In particular, 500 pig farmers deliver 500,000 pigs to the farmers' cooperative every year. The cooperative has its own slaughterhouse and processing plant. The processed meat is, thereafter, distributed through 150 licensed distributors, such as local butchers and regional retailers, emphasising the quality, the regional aspect, and the transparency of this supply chain's meat.

Coordination of the supply chain is accomplished by the office of the farmers' cooperative. It steers the total pig/meat production of the supply chain and contractually enforces the supply chain's actors to follow certain quality regulations and standards. These quality standards and regulations come on top of public national German quality standards. For instance, the cooperative sets specific standards for farm management regarding feed given, health management, and animal husbandry. If farmers do not grow the corn for the feed themselves, they are obliged to buy feed from one of the four preordained feed producers. The feed and additional supplements, such as vitamins, need to be mixed according to fixed feed recipes. Furthermore, no medicaments or antibiotics are allowed to be used; only vaccinations are permitted. In addition to the farms, other supply chain actors, such as slaughterhouse, processor, and service providers (e.g. pig transporters) are also obliged to follow certain regulations to assure quality.

Supply chain B

Supply chain B is a local and very traditional supply chain located in the Southwest of Spain. This chain is particularly known for its production of dry-cured ham and forelegs, derived from special breeds and pigs reared and fed in a specific ecosystem. Favourable climatic conditions, and other ecological, human, and technical factors, enable the production of particular dry-cured hams and forelegs. Around 2,000 farmers produce more than 500,000 pigs, slaughtered and processed at one of the 72 processing companies. In total, these companies produce more than 400,000 pieces of dry cured hams and forelegs, representing a market share of around 30%. The primary customer's channels are delicatessen stores and specialised retailers.

Coordination in the supply chain is organised by an inspection body (i.e. Control Board), with whom the actors in the supply chain are contractually registered. The Control Board monitors compliance with production standards under the umbrella of the European certification Designation of Origin (PDO). PDO regulations are used to classify and describe food produced in a particular European

region with inherent natural factors. The regulations cover a wide range of subjects and impact the supply chain's actors. For instance, regulations relate to identification, breed choice, weight of slaughtering, production of cured hams, etc. The Control Board and additional independent controlling inspection agencies inspect the farms involved, the slaughterhouses, and the processing companies to see whether they are following the regulations imposed.

Supply chain C

Supply chain C is located in the Netherlands. Pigs are delivered to several slaughterhouses by more than 2,000 farmers, which produce more than 7 million pigs. After being processed, meat is predominantly distributed through retailers. Since the supply chain does not have its own brand, most meat is sold through the retailer's own brand. This supply chain exports 70% of its slaughtered or processed meat to countries all over the world. In the supply chain, the slaughterhouse and meat processing companies are owned by one (slaughtering) company. This company has one main agrarian shareholder, which is an association of almost 17,000 agricultural entrepreneurs. The association looks after the interests of its members by providing business advice to them and investing in companies and projects that positively affect (agricultural) entrepreneurship.

In supply chain C, the slaughtering company is supplied by independent farmers. Most partners in this chain (contractually) comply with Dutch IKB (integral chain management – integrale ketenbeheer) regulations. Participating partners need, therefore, to sign a yearly contract requiring compliance with the regulations. The aim of IKB is to regulate the meat production to ensure satisfactory quality and to safeguard animal health and welfare. Regulations are particularly related to product safety, traceability, animal health, animal welfare, feeding, and hygiene. For instance, at the farm level independent control bodies of IKB require extensive documentation of procedures regarding feeding, vaccinating, and housing.

5. Within-case analysis

The intra-case analysis encompasses two objectives. After the data are presented per supply chain, explanations for the role of governance structures in information sharing are discussed. Before moving on to the cross-case analysis, the findings of the within-case analysis are summarised in Table 3.

Table 3. Summary of within-case analysis.[1]

	Supply chain A			Supply chain B				Supply chain C		
	FA-SL	SL-PR	PR-RE	FA-SL	FA-PR	SL-PR	PR-RE	FA-SL	SL-PR	PR-RE
Governance structures	Equity-based contract	Vertical integration	Verbal agreement	Spot market	Verbal agreement	Verbal agreement	Verbal agreement	Spot market	Vertical integration	Formal contract
Product info	Traceability • Farm ID Product quality • Bearing conditions • Health status, incl. *Salmonella* status	Traceability • Farm ID • Slaught. ID Product quality • e.g. sorting • Bearing conditions • Health status, incl. *Salmonella* status Lab results (pork) • Cleanness	Traceability • Slaught. ID Product quality • Product specifications incl. *Salmonella* status	Traceability • Requirements Product quality • Type of carcass • Final weight	Traceability • Farm ID Product quality • e.g. illnesses	Traceability • Requirements Product quality • Type of carcass	Traceability • Slaught./ Proc. ID • Retailer Product quality • Type of product • Ingredients • Preservation requirements	Traceability • Farm ID Product quality • Carcass info • Technical info incl. liver or lung problems, & fat percentage	Traceability • Farm ID Product quality • Cutting Lab results (pork) • Food safety • Animal welfare	Traceability • Slaught./ Proc. ID Product quality • Certification • Health status • Cutting/ packaging
Process info	Operational info Feeding Medicament info Biological data	Operational info (FA + SL) Feeding (FA) Medicament info (FA) Biological data (FA)			Operational info Feeding	Operational info *(on request)* Feeding	Feeding	Feeding	Feeding (FA) *(schemes)* Lab results (SL)	Feeding (FA) *(schemes)* Vaccinating *(schemes)* Lab results (SL)

Table 3. Continued.

	Supply chain A			Supply chain B				Supply chain C		
	FA-SL	SL-PR	PR-RE	FA-SL	FA-PR	SL-PR	PR-RE	FA-SL	SL-PR	PR-RE
Information sharing mechanisms	Automated • Supply chain information system	Automated • Supply chain information system	Automated • EDI				Automated • EDI	Automated • Inter-organizational information system	Automated • Internal ICT system	Automated • EDI
	Semi-automated • Phone, fax, e-mail	Semi-automated • Phone, fax, e-mail	Semi-automated • Phone, fax, e-mail		Semi-automated		Semi-automated	Semi-automated • Phone		
				Non-automated • Invoices • Identification labels	Non-automated • Invoices • Identification labels	Non-automated • Invoices • Identification labels	Non-automated	Non-automated • Paper bills • Supplier magazine		Non-automated • Invoices
					Face-to-face interaction		Face-to-face interaction			

1 FA = Farm; SL = Slaughterhouse; PR = Processor; RE = Retailer; EDI = Electronic Data Interchange.

Supply chain A

In supply chain A, the farmer-slaughterhouse relationship is steered by equity-based contracts, the slaughterhouse-processor relationship by vertical integration, and the processor-retailer relationship by verbal agreements. Slaughterhouse and processor are both owned by the farmers' cooperative and are hence vertically integrated; there is a joint ownership of resources. To become a member of the farmers' cooperative, farmers need to purchase a minimal financial stake in it. Consequently, equity-based contracts are put in place between farmer and slaughterhouse. Through the acquisition of a stake, farmers obtain decision rights and farm management advice from the cooperative's consultants. The contracts also stipulate that: (1) farmers must deliver all pigs to the slaughterhouse, which is obliged to take all pigs delivered; and (2) farmers and other actors in the supply chain must follow the supply chain's quality regulations and standards. Consequently, equity-based contracts prevent farmers from easily switching to an alternative buyer. Finally, the processor-retailer relationship is steered through verbal agreements, suggesting that retailers can easily change their meat supplier(s). Despite this, since retailers have particular customers demanding meat products with the supply chain's brand, they have established long-term relationships with the processor. Considering the governance structures of Figure 1, supply chain A as a whole can be situated on the right side of the governance continuum; supply chain partners rely on more hierarchical governance forms to coordinate their transactions.

In the integrated relationships of farmer-slaughterhouse and slaughterhouse-processor, product information, mainly encompassing origin and quality of the pig and meat products, is shared between the partners. In particular, farm and slaughterhouse exchange the following information: farm identification, bearing conditions, health status, *Salmonella* status and quality status. All shared information between farmer and slaughterhouse is also available to the processor. In addition to this, slaughterhouse and processor also share information regarding sorting (inherent product characteristics of pork), and carcass cleanness (lab results). Processor and retailer, transacting through verbal agreements, share traceability and quality information (e.g. *Salmonella status*) as well. Furthermore, process information, such as (pig) medicaments and feeding information is forwarded in the supply chain. However, between the processor and retailer, few types of process information are exchanged.

The following conclusions can be drawn regarding the role of governance structures in type of shared information in supply chain A. First, compared to the relations steered by verbal agreements, the more integrated farmer-slaughterhouse and slaughterhouse-processor relations share more types of detailed information, and more types of process information in particular. Presumably, more types of confidential process information are only shared in more integrated relationships, in which the risk of information leakage is low. Equity-based contracts might oblige supply chain actors to share specific process information whereas vertically integrated partners typically have access to the same information. Apart from governance structures, the type of exchanged information can be explained by the supply chain's quality regulations and standards to a great extent. Since the farmers' cooperative sets requirements on the feed given, health management, and health husbandry, particular quality information is shared throughout supply chain A. In the processor-retailer relationship, the processor forwards aggregated information regarding origin and product specifications (product quality) connected to the unique products delivered. The exchanged information reflects the two unique selling propositions of the supply chain's meat products.

A large part of the information in the farmer-slaughterhouse and slaughterhouse-processor relationships, steered by means of integrated governance structures, is (continuously) shared through the cooperative's automated supply chain information system. External buyers and suppliers, however, have no access to the cooperative's information system. Retailers do not share information with the processor through the cooperative's information system but through their own EDI system. To complement continuous information exchange in supply chain A, complementary information between the supply chain's actors is often exchanged by means of telephone, fax, and email.

The following conclusions can be drawn regarding the role of governance structures in information sharing mechanisms. First of all, the large amount of information shared in supply chain A – between the farmers, slaughterhouse, and processor – is facilitated by the (automated) supply chain information system of the farmers' cooperative. Due to the high level of integration, risks for possible information leaking are low. The farmers' cooperative has invested in a supply chain information system to facilitate continuous information exchange between the supply chain partners. However, less integrated relationships, such as processor-retailer, also share information electronically through EDI. Usage of automated information systems in less integrated relationships can make transactions more cost-efficient.

Finally, case A shows that the use of automated information systems is complemented by phone, fax, or email. Such semi-automated information mechanisms might be used by the supply chain partners: (1) to circumvent a technical defect of the automated information system(s); (2) to provide information in the format that the information receiver wants; or (3) to provide follow-up explanations with respect to the transaction(s). In particular, in this supply chain, the phone is often used because of personalised relationships between supply chain partners due to long-term collaboration.

Supply chain B

The relationships in supply chain B are directed through verbal agreements or spot market. On top of the farmer-slaughterhouse, slaughterhouse-processor, processor-retailer relationships, the farmer-processor relationship is also of importance as farmers and processors make bilateral agreements concerning the production and transaction of the supply chain's pigs. Despite the fact that there are no written contracts between the long-term collaborating farmer and processor, they agree on the production and transaction at the beginning of the season. Farmers follow the PDO quality regulations and have made farm investments to do so. The farmer-slaughterhouse and slaughterhouse-processor relationships are derived from the farmer-processor relationship. Solely based on price mechanisms, the farmer delivers its pigs to an accredited slaughterhouse, which after slaughtering forwards the pigs to the processor. Finally, the processor-retailer relationship is steered through verbal agreements, which are long-term and informal in nature. Exchanges are not formalised into written, legally enforceable contracts. Consequently, the level of integration is rather low and retailers can easily change their supplier. However, retailers do not often switch processor as they have long-term relationships with these actors. Considering the governance structures of Figure 1, supply chain B as a whole can be situated on the left side of the continuum; supply chain partners rely more on market governance forms to coordinate their transactions.

In the farmer-slaughterhouse relationship, steered by spot market, farmers share information with the slaughterhouse(s) regarding traceability and quality of the pigs delivered, including the following: traceability (requirements), type of carcass, final weight, and quality of the animal. In the slaughterhouse-processor relationship, governed by verbal agreements, (limited) information regarding traceability and type of carcass is forwarded. Between the farmer and processor, transacting pigs through verbal agreements, directly product information is also

exchanged: illnesses, if applicable, traceability, feed, and quality information. Finally, processors deliver product information regarding type of product, preservation requirements, and used ingredients to the retailer. On top of product information, few types of process information are exchanged in the farmer-processor, slaughterhouse-processor, and processor-retailer relationships.

The following indications can be drawn regarding the role of governance structures in the type of information shared. First of all, it appears that all low-integrated relationships exchange few types of process information. Presumably, the involved supply chain actors consider process information confidential and do not want to share it since the risk of information leakage is high. Moreover, farmers and processor do not have close relationships with the slaughterhouse as the slaughterhouse is just an accredited service provider. Furthermore, regarding the type of shared information, it seems that particular genealogical information and feed information is exchanged (i.e. traceability and type of carcass/product) across the supply chain to classify the animals and products to the particular breed used in supply chain B. In other words, the quality regulations, which relate to identification, breed choice, feed, weight of slaughtering, and production of cured hams, (contractually) require the supply chain partners to exchange particular information.

In this supply chain, paper-based information sharing mechanisms are employed in the four investigated relationships. In the farmer-slaughterhouse relationship, governed by spot market, labels (attached to the pigs) and (paper) invoices are mainly used to exchange product information. For instance, pigs delivered to the slaughterhouse are sealed with an identification number, indicating their provenance. In the other three relationships, steered by verbal agreements, differences in mechanisms can be observed. While (paper) invoices are mainly used in the slaughterhouse-processor relationship, all information sharing mechanisms distinguished in this study are employed to share information in the processor-retailer relationship. In the farmer-processor relationship, except for automated systems, all information sharing mechanisms are used.

Again, the following indications can be drawn with respect to the role of governance structures in information sharing mechanisms. First, relationships steered by less integrated governance structures use, in supply chain B, non-automated information systems to support information sharing. Labels, invoices, phone, and face-to-face interaction are ways to exchange information. Moreover, in this supply chain, more than 2,000 traditional small farms and 72 traditional

processing companies are involved, making it difficult to implement electronic information exchange between farmers and processing companies. These companies probably have little financial strength (few financial resources), limited power, and little willingness (actors are very traditional) to lead the design and implementation of an automated information system. In the farmer-processor relationship in particular, face-to-face interaction is used because the supply chain partners know each other personally due to long-term collaboration.

Supply chain C

In supply chain C, three governance structures can be distinguished: vertical integration, formal contract, and spot market. While the relationship between farmer and slaughterhouse is governed through the spot market, the slaughterhouse-processor and processor-retailer relationships are steered by respectively vertical integration and formal contracts. Transactions between farmer and slaughterhouse are solely based on price mechanisms and typically focused on the short term. However, around 90% of the slaughterhouse's pigs are delivered by farmers with whom it has long-term relationships. The slaughterhouse is, furthermore, vertically integrated with the processor since both slaughtering and processing are performed by a single company. Lastly, relationships between processor and retailer are increasingly long-term and strictly contractual in nature. These contracts encompass strict (quality) requirements, suggesting that non-compliance with requirements results in legally enforceable penalties for the processor. Furthermore, through contracts, the processor aims to have a constant demand and retailers a constant (preferably flexible) supply. Considering the governance structures of Figure 1, supply chain C as a whole can be situated in the middle of the continuum; supply chain partners rely on both hierarchical and market governance forms to coordinate their transactions.

In the three relationships of farmer-slaughterhouse, slaughterhouse-processor, and processor-retailer, product information is exchanged. In the farmer-slaughterhouse relationship, governed by spot market, farmers obtain detailed insights into the quality of the pigs delivered in the form of carcass information, such as fat-meat percentage and anomalies (e.g. lung problems and liver problems). This information permits the farmer to compare the quality of its carcasses with his previous deliveries and with his counterparts. Also in the other – more integrated – relationships of supply chain C, multiple types of product information are shared. While slaughterhouse and processor exchange product information with respect to

animal welfare, food safety, product quality (cutting) and traceability, processor and retailer share transaction specific information – cutting and packaging – and info connected to the label (covering health status of animals, certification, and origin). Regarding process information, farmer and slaughterhouse share only feeding schemes whereas slaughterhouse and processor exchange only laboratory results of hygienic conditions. In the processor-retailer relationship, more types of information are shared: feeding schemes, vaccination schemes, and hygienic conditions of the slaughtering (in most cases through labels).

The following conclusions can be drawn regarding the role of governance structures in the type of shared information. First, it appears that integrated relationships share several types of product information. However, in the less-integrated farmer-slaughterhouse relationship, a rather equal level of product information is exchanged. Presumably, the slaughterhouse shares detailed carcasses information and provides access to it intended to build strong and long-term bonds with its farmers. Through such information, the farmer can enhance his decision making and can therefore improve his farm management. Supply chain C also stipulates that, apart from governance structures, the IKB regulations play a key role in the type of exchanged information. These regulations contractually oblige the supply chain actors to share particular quality information. For instance, since IKB farmers are only allowed to buy feed from certified suppliers, feeding schemes information (i.e. process information) is exchanged between farmer and slaughterhouse. Moreover, as IKB also encompasses hygiene regulations, slaughterhouse and processor exchange lab results (regarding hygienic conditions). Supply chain C further indicates that differences in (bargaining) power between the supply chain actors might play a role in information sharing. As they are highly concentrated, retailers in the Netherlands have a strong position and can, therefore, easily require processors to deliver particular product and process information (even beyond the stipulations of the formal contracts). The retailer, in turn, is less inclined to share customer information, despite the desire for information of the upstream partners.

The overall observation is that all relationships of supply chain C share information through automated systems. To communicate with its large number of farmers, the slaughterhouse designed and implemented an automated system to exchange – mainly – carcass information. In this spot-market relationship, carcass information is also communicated to the farmers by means of paper invoices. Also, farmers receive an electronic newsletter and a supplier magazine from the slaughterhouse. Furthermore, the vertically

integrated slaughterhouse-processor relationship shares information by means of an internal information system whereas the processor and retailer, steered by formal contracts, mainly transfer information through an EDI system.

The following conclusions can be drawn regarding the role of governance structures in information sharing mechanisms. In supply chain C, information is predominantly shared through automated information systems. The vertically-integrated slaughterhouse-processor relationship exchanges information through an internal information system as they are owned by the same company. Furthermore, retailer(s), that have formal contracts with the processor, have implemented an EDI system for order-efficiency reasons. Thus, an analysis of these relationships indicates that integrated relationships use automated systems to share information. However, supply chain C shows that less integrated relationships – such as farmer-slaughterhouse – also share information through an automated inter-organisational information system. Presumably, such a system is developed and implemented by the slaughterhouse: (1) to build stronger and more long-term bonds with farmers; or (2) to make the recurrent information sharing more cost-efficient as the slaughterhouse is supplied by more than 2,000 farmers. In addition, this supply chain has supply chain partners that have sufficient financial strength to design and implement automated information systems. Both slaughterhouse and retailer(s) use such an automated system to exchange information with their suppliers. Finally, for the same reasons as mentioned in the other supply chains, analysis of case C reveals that automated information systems are complemented by other information sharing mechanisms. In particular, it may be the case that farmers do not have internet access and are in favour of receiving information about their slaughtered pigs on paper, or via fax or telephone.

6. Cross-case analysis

In Section 5 we presented and interpreted the link between supply chain governance structures and supply chain information sharing for each case (Table 3). This step provides input for the cross-case analysis, where patterns across cases are built. Possible rival patterns are explained through the contextual factors of every case. As a result, the following main observations have been stipulated based on this cross-case analysis.

Observation 1: Relationships steered by more integrated governance structures exchange more types of information (especially process information) than the ones governed by less integrated governance structures.

First of all, we single out the overall observation that relationships steered by more integrated governance structures (e.g. vertical integration, equity-based contracts, and formal contracts) exchange more types of information than the ones governed by less integrated governance structures (e.g. spot market and verbal agreements). Observation 1 is consistent with the literature arguing that governance structures may facilitate information sharing among supply chain members. Several authors have indicated that integrated supply chains share more (types of) information than less integrated ones (Dowlatshahi, 1997; Simatupang *et al.*, 2002; Skjøtt-Larsen *et al.*, 2003). Increased access to product and process information can trigger several opportunities for the supply chain partners to collaboratively improve decision making and processes. Integrated (supply chain) governance structures have lower risks of opportunistic behaviour. Specifically, these structures can minimise information risks, such as information leakages, between supply chain partners (Ghosh and Fedorowicz, 2008).

Furthermore, based on the cross-case analysis, it seems that process information in particular is shared more in integrated supply chain governance structures than in less integrated ones. Process information, such as feeding, vaccination schemes, operational information, and hygienic conditions, can be regarded as more confidential than product information since this information relates to the specifications of a firm's core production processes.

Observation 2: Strong supply chain partner with sufficient financial strength (financial resources) and (bargaining) power may initiate information sharing through automated information systems, regardless of the type of governance structure.

Apart from governance structures, the financial strength and (bargaining) power of the supply chain partners impacts information sharing. If there is a partner with sufficient financial strength and (bargaining) power, information may be exchanged through automated information systems as well. Observation 2 can be illustrated by comparing the farmer-slaughterhouse relationship of supply chains B and C. Even though both relationships are steered by the spot market, the way these actors share information is distinct. In supply chain C, farmer(s) and slaughterhouse share information through an online inter-organisational information system whereas labels (attached to the pigs), paper invoices, phone, and face-to-face interaction are mainly used to exchange product information in supply chain B. This discrepancy may be explained by the fact that processing in supply chain B is spread over 72 traditional processing companies (most having few resources). The

context of supply chain B makes it difficult to implement automated information systems for information sharing between farmers and processing companies.

Furthermore, in all three cases, information between processor and retailer is typically shared by means of EDI systems. Due to the large number of transactions, retailers often require their suppliers to exchange information through EDI. Retailers can usually oblige their suppliers to do so because of their strong position in the supply chain. For instance, supply chain C shows that retailers in the Netherlands are highly concentrated and hence have a strong position; three retailers own more than 80% of the market. Retailers, in turn, are less inclined to share customer data, despite the wishes of the upstream partners to do so. In summary, in relationships that have a strong partner with sufficient financial strength, most information is exchanged through automated information systems.

Note that observation 2 seems to contradict the existing literature base. Scholars, such as Auramo *et al.* (2005) and Vickery *et al.* (2003), claimed that relationships steered by more integrated governance structures commonly employ automated information systems. In this research, we illustrate that both integrated and non-integrated governance structures employ automated information systems. Cross-case analysis shows that the financial strength and bargaining power of the involved partners may provide a better explanation for the decision on whether or not to design and implement an automated information system.

Observation 3: Relationship management influences information sharing – i.e. both information sharing mechanisms and type of information shared – in supply chains.

Particular information also seems to be exchanged with suppliers for relationship management. Especially when this information is valuable for better decision making and consequent process improvements, suppliers tend to continue the relationship with their buyer. This link is depicted in supply chain C. For example, in the farmer-slaughterhouse relationship of supply chain C, farmers obtain detailed dynamic insights into the quality of the pigs delivered in the form of carcass information, such as fat-meat percentage and anomalies (e.g. lung problems and liver problems). This information enables the farmer to make analyses by comparing the quality of his carcasses with his previous deliveries and with his counterparts. In this relationship, which is steered through the spot market, farmers often prefer to continue delivering to this slaughterhouse since such product information is valuable for the farmer and can help to improve farm management.

Next to the type of information shared, the choice of information sharing mechanisms also seems to be affected by relationship management. Again, this can be illustrated by supply chain C. The carcass information, as described above, is sent to the farmer by means of an automated online inter-organisational information system. The automated system enables the farmer to easily access the carcass information and to make trend and benchmark analyses. However, farmers may not have internet access and might prefer to receive the information about their slaughtered pigs on paper, or by fax or telephone. To make concessions to the farmers, the slaughterhouse continues to send paper invoices containing quality data. Lastly, to further improve relations with its farmers, the slaughterhouse sends an electronic newsletter and a supplier magazine. Consequently, the slaughterhouse has built long-term (and trusting) relationships with most of its farmers; these relationships are shifting, therefore, on the governance continuum (Figure 1) towards verbal agreements.

Observation 4: Quality regulations influence the type of information shared in a supply chain to a great extent.

Observation 4 holds for all relationships. From the cross-case analysis, we discovered that quality regulations greatly influence the type of information shared among supply chain partners. In supply chain A, the farmers' cooperative, the supply chain's coordinator, makes demands about feed given, health management, and animal husbandry (supply chain A). For instance, medicine information is forwarded as pigs should not be treated with medicines after they reach 40 kg. In supply chain B, PDO quality regulations (supply chain B), which relate to identification, breed choice, weight of slaughtering, and production of cured hams, require the supply chain partners to exchange particular information. In particular, specific information is exchanged (i.e. traceability and type of carcass/product) across the supply chain to classify the animals and products to the particular breed used. Also supply chain C stipulates that IKB quality regulations (supply chain C) play a key role in the type of exchanged information. For example, since IKB farmers are only allowed to buy feed from certified suppliers, feeding schemes information (i.e. process information) is exchanged between farmer and slaughterhouse. In conclusion, quality regulations greatly influence the type of information shared. Note that quality regulations is a mechanism, just like governance structure, to achieve coordination in the supply chain (Trienekens and Wognum, 2013).

7. Concluding remarks

The main contribution of the present paper is to shed light on and provide new insights into the complex interplay between governance structures and information sharing. First, the paper accounts for the multidimensionality of information sharing; specifications of which information to share and how to share it are considered. Second, since most of this literature has only considered the dyadic buyer-supplier relationship, the unit of analysis is extended to a four-tier supply chain.

Based on empirical data, several main observations were extracted. Generally, relationships steered by more integrated governance structures exchange more types of information than the ones governed by less integrated governance structures. In particular, more types of process information are shared in the former than the latter. Integrated (supply chain) governance structures decrease the risks of opportunistic behaviour and minimise information risks, such as information leakages, between the supply chain partners. First, this paper also concludes that information sharing, conceptualised by the type of information shared and information sharing mechanisms, cannot be solely explained by governance structures. Our study challenges the general assumption that a more integrated governance structure is accompanied by more types of information shared through the use of automated information systems. Second, the study stipulates that, apart from governance structures, quality regulations play a key role in the type of exchanged product and process information as they require the supply chain actors to share particular information. For safeguarding and control, the partners might require the exchange of information that allows them to verify if the quality protocols are being followed. The study shows as well that financial strength and relationship management play a role in the type of information shared and information sharing mechanisms. If there is a partner with sufficient financial strength and (bargaining) power, information will in many cases be exchanged through automated information systems, e.g. for cost-efficiency reasons. Despite its striking relevance, the combination of postulated factors influencing information sharing has received little attention in the literature.

Built observations form a useful step for understanding a nuanced picture of the role of governance structures in information sharing. Since the observations in this study are based solely on three cases from the European pork industry, the generalisability of the observations can clearly be questioned. Consequently, to investigate whether the findings of the present study hold true for supply chains in other industries, further research in a wider range of contexts is compulsory. Furthermore, it would also be interesting to investigate how particular information that is shared through specific information sharing mechanisms impacts the performance of supply chains. In the literature, several measures of supply chain performance can be found (e.g. Beamon, 1999; Gunasekaran *et al.*, 2004; Huang *et al.*, 2003). For instance, Gunasekaran *et al.* (2004) developed a framework to measure operational, tactical, and strategic supply chain performance. Even though information sharing has often been considered as an important enabler of improved supply chain performance, a comprehensive supply chain analysis of the role of information sharing in supply chain performance is missing. Therefore, it should be investigated how and to what extent supply chain information sharing impacts supply chain performance.

References

Auramo, J., J. Kauremaa and K. Tanskanen, 2005. Benefits of IT in supply chain management: an explorative study of progressive companies. International Journal of Physical Distribution & Logistics Management, 35(2): 82-100.

Baihaqi, I. and A.S. Sohal, 2013. The impact of information sharing in supply chains on organisational performance: an empirical study. Production Planning & Control, 24(8-9): 743-758.

Beamon, B.M., 1999. Measuring supply chain performance. International Journal of Operations & Production Management, 19(3): 275-292.

Briz, J., I. De Felipe and S. Pena, 2008. D-4.1.1: Pork meat chains in Spain. Universidad Politecnica de Madrid, Madrid, Spain.

Bruns, Jr., W.J. and S.M. McKinnon, 1993. Information and managers: a field study. Journal of Management Accounting Research, 5: 84-108.

Cachon, G.P. and M. Fisher, 2000. Supply chain inventory management and the value of shared information. Management Science, 46(8): 1032-1048.

Chandra, C., J. Grabis and A. Tumanyan, 2007. Problem taxonomy: a step towards effective information sharing in supply chain management. International Journal of Production Research, 45(11): 2507-2544.

Cheng, J.-H., 2011. Inter-organizational relationships and information sharing in supply chains. International Journal of Information Management, 31(4): 374-384.

Chow, C.W., G.L. Harrison, J.L. McKinnon and A. Wu, 1999. Cultural influences on informal information sharing in Chinese and Anglo-American organizations: an exploratory study. Accounting, Organizations and Society, 24(7): 561-582.

Christiaanse, E. and K. Kumar, 2000. ICT-enabled coordination of dynamic supply webs. International Journal of Physical Distribution & Logistics Management, 30(3/4): 268-285.

Cousins, P.D., R.B. Handfield, B. Lawson and K.J. Petersen, 2006. Creating supply chain relational capital: the impact of formal and informal socialization processes. Journal of Operations Management, 24(6): 851-863.

Dowlatshahi, S., 1997. The role of product design in designer-buyer-supplier interface. Production Planning & Control, 8(6): 522-532.

Eisenhardt, K.M. and M.E. Graebner, 2007. Theory building from cases: opportunities and challenges. Academy of Management Journal, 50(1): 25-32.

Eisenhardt, K.M., 1989. Building theories from case study research. Academy of Management Review, 14(4): 532-550.

Eisenhardt, K.M., 1991. Better stories and better constructs: the case for rigor and comparative logic. Academy of Management Review, 16(3): 620-627.

Gellynck, X. and A. Molnár, 2009. Chain governance structures: the European traditional food sector. British Food Journal, 111(8): 762-775.

Ghosh, A. and J. Fedorowicz, 2008. The role of trust in supply chain governance. Business Process Management Journal, 14(4): 453-470.

Gunasekaran, A., C. Patel and R.E. McGaughey, 2004. A framework for supply chain performance measurement. International Journal of Production Economics, 87(3): 333-347.

Huang, G.Q., J.S. Lau and K. Mak, 2003. The impacts of sharing production information on supply chain dynamics: a review of the literature. International Journal of Production Research, 41(7): 1483-1517.

Jonsson, P. and S.-A. Mattsson, 2013. The value of sharing planning information in supply chains. International Journal of Physical Distribution & Logistics Management, 43(4): 282-299.

Kembro, J. and D. Näslund, 2014. Information sharing in supply chains, myth or reality? A critical analysis of empirical literature. International Journal of Physical Distribution & Logistics Management, 44(3): 179-200.

Lau, J.S., G.Q. Huang and K. Mak, 2004. Impact of information sharing on inventory replenishment in divergent supply chains. International Journal of Production Research, 42(5): 919-941.

Lee, H.L., and S. Whang, 2000. Information sharing in a supply chain. International Journal of Manufacturing Technology and Management, 1(1): 79-93.

Lee, H.L., K.C. So and C.S. Tang, 2000. The value of information sharing in a two-level supply chain. Management Science, 46(5): 626-643.

Lee, H.L., V. Padmanabhan and S. Whang, 1997. The bullwhip effect in supply chains. Sloan Management Review, 38(3): 93-102.

Li, S. and B. Lin, 2006. Accessing information sharing and information quality in supply chain management. Decision Support Systems, 42(3): 1641-1656.

Lyons, B.R., 1996. Empirical relevance of efficient contract theory: inter-firm contracts. Oxford Review of Economic Policy, 12(4): 27-52.

McLaren, T., M. Head and Y. Yuan, 2002. Supply chain collaboration alternatives: understanding the expected costs and benefits. Internet Research, 12(4): 348-364.

Miles, M.B. and A.M. Huberman, 1984. Qualitative data analysis: a sourcebook of new methods. Sage publications, Beverly Hills, CA, USA.

Nicolaou, A.I., 2008. Research issues on the use of ERPS in interorganizational relationships. International Journal of Accounting Information Systems, 9(4): 216-226.

Palmer, N. and A. Mills, 2003. Classical versus relational approaches to understanding controls on a contract with independent GPs in South Africa. Health Economics, 12(12): 1005-1020.

Premkumar, G.P., 2000. Interorganization systems and supply chain management. Information Systems Management, 17(3): 56-69.

Raynaud, E., L. Sauvee and E. Valceschini, 2005. Alignment between quality enforcement devices and governance structures in the agro-food vertical chains. Journal of Management & Governance, 9(1): 47-77.

Rowley, J., 2002. Using case studies in research. Management Research News, 25(1): 16-27.

Schulze, B., A. Spiller, and L. Theuvsen, 2007. A broader view on vertical coordination: lessons from German pork production. Journal on Chain and Network Science, 7(1): 35-53.

Simatupang, T.M., A.C. Wright and R. Sridharan, 2002. The knowledge of coordination for supply chain integration. Business Process Management Journal, 8(3): 289-308.

Skjøtt-Larsen, T., H. Kotzab and M. Grieger, 2003. Electronic marketplaces and supply chain relationships. Industrial Marketing Management, 32(3): 199-210.

Trienekens, J. and N. Wognum, 2013. Requirements of supply chain management in differentiating European pork chains. Meat Science, 95(3): 719-726.

UB, 2008. D-4.1.1: Case study reports per selected chain Germany. University of Bonn, Bonn, Germany.

Vickery, S.K., J. Jayaram, C. Droge and R. Calantone, 2003. The effects of an integrative supply chain strategy on customer service and financial performance: an analysis of direct versus indirect relationships. Journal of Operations Management, 21(5): 523-539.

Webster, Jr, F.E., 1992. The changing role of marketing in the corporation. The Journal of Marketing, 56: 1-17.

Wever, M. and N. Wognum, 2008. D-4.1.1: Fresh pork meat chain in the Netherlands. Wageningen University, Wageningen, the Netherlands.

Wever, M., N. Wognum, J. Trienekens and O. Omta, 2010. Alignment between chain quality management and chain governance in EU pork supply chains: a transaction-cost-economics perspective. Meat Science, 84(2): 228-237.

Williamson, O.E., 1979. Transaction cost economics: the governance of contractual relations. Journal of Law and Economics, 22(2): 233-261.

Williamson, O.E., 1985. The economic intstitutions of capitalism, The Free Press, New York, NY, USA.

Williamson, O.E., 1991. Comparative economic organization: the analysis of discrete structural alternatives. Administrative Science Quarterly, 36: 269-296.

Yao, D.-Q., X. Yue and J. Liu, 2008. Vertical cost information sharing in a supply chain with value-adding retailers. Omega, 36(5): 838-851.

Yin, R., 2003. Case study research: design and methods. Sage Publications, Beverly Hills, CA, USA.

Yu, Z., H. Yan and T.E. Cheng, 2001. Benefits of information sharing with supply chain partnerships. Industrial Management & Data Systems, 101(3): 114-121.

Zhang, X. and L.H. Aramyan, 2009. A conceptual framework for supply chain governance: an application to agri-food chains in China. China Agricultural Economic Review, 1(2): 136-154.