

**PRODUCT DIFFERENTIATION AND THE ROLE OF
CONTRACTS: THE US PORK INDUSTRY CASE**

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by

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ABSTRACT

This dissertation studies factors influencing the rapid transition from spot markets to contracts recently observed in the exchanges between farm producers and processors or distributors. In particular, it attempts to fill gaps between the existing literature on organizational form choice and processors' or retailers' practices on contract choice recently observed in the agro-food sector by offering theoretical arguments and empirical analysis. On the theoretical side, it explores two aspects of transactions between processors or retailers and growers through which two major innovations to the existing literature will be made: attributes of products to be exchanged; and the interaction between processors' or retailers' product differentiation activities in downstream markets and their procurement practices in upstream markets.

The research proposes that a contract provides a platform for bilateral planning and incentive designing for the production and exchange for buyer-specific products, which is less accessible through spot markets governing instantaneous exchange. It discusses that the individual processors or retailers' increasing demand for idiosyncratic agricultural products in upstream markets is derived from their product differentiation activities in

downstream consumer markets. Based on the concept of product specificity to a buyer, it then extends the existing theories of contracts into the context of the agro-food sector where transition from spot markets to contracts has been recently widespread.

On the empirical side, the product specificity analytical framework is applied to a more comprehensive analysis of contract structure and choice in the US pork industry. This dissertation analyzes long-term hog procurement contract documents using the notion of product specificity to a buyer and the agency theory's measurement difficulty-based contract externality and task programmability arguments. The analysis results show long-term hog procurement contracts are designed in ways to save costs associated with procuring intertemporally consistent carcass qualities and reducing hog growers' incentive distortion arising from difficult-to-measure meat quality attributes including marbling, muscle color, and meat tenderness.

Finally, based on these findings from hog contract analysis, this research generates testable hypotheses regarding product specificity and measurement difficulty explanations for contracts, and for more comprehensive empirical tests of existing theories of contracts, temporal specificity hypothesis is included. The primary data generated from a survey of pork packers support the product specificity and measurement difficulty predictions but do not support the temporal specificity explanation that is most often suggested in the literature. The empirical results suggest that the dramatic change in organization form in the pork industry may be better explained by looking at attributes of hogs to be exchanged rather than attributes of assets required for the transactions.

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Chapter 1 INTRODUCTION

This dissertation examines factors influencing the rapid transition from spot markets to various types of contracts recently observed in the exchanges between farm producers and processors or distributors. In particular, it considers how processors' optimal implementation of product differentiation strategy in downstream markets affects backward coordination in terms of the choice of contracts vis-à-vis spot markets. Recognizing the fact that recent adoption of procurement (or marketing) contracts are more frequently observed in exchanges for differentiated agricultural products, it investigates how processors' or distributors' needs to procure buyer-specific products influence the relative costs of spot markets and contracts. The research offers an analytical framework to explain the buyers' choice of contracts, by abstracting common characteristics from various contracts, creating a notion of 'product specificity to a buyer', and incorporating the product specificity into existing theories of contracts. It also provides empirical analyses that consist of an analysis of long-term hog procurement contract documents and an econometric analysis of survey data concerning pork packers' choice of organization forms.

Contract transactions have been expanding in both U.S. and European countries. According to USDA data, vertical contracts govern 39 percent of the value of the U.S. agricultural production in 2003, up from 28 percent in 1991 and 11 percent in 1969 (MacDonald and Korb, 2006). In early 1960s, the vast majority of agricultural commodities were traded in various types of spot markets including auctions, decentralized, individual negotiation, and price making by buyers, and contracts were

used in a limited number of commodities including sugar crops, processing vegetables, specialty crops, and chicken. Contracts now cover almost all of the agricultural commodities to some degree. Tobacco, hogs, and winegrapes are epitomes of commodities rapidly adopting and diffusing contract transactions while rice, cotton, dairy, and beef cattle are ones that have increased the share of existing contract use. Contracts have been favored for transactions of certain types of grains and oilseeds like identity-preserved corn and soybeans, wheat for baking, and soybeans and canola purchased for specific compounds (Mussell, et al., 2003). Certain type of products within a commodity group favor contracts while others still prefer traditional spot markets. Common contract-favored characteristics of products may be found across commodities. In most commodities, therefore, it is commonly observed that multiple organization modes currently exist in a commodity class. Contract transactions have been expanding in European countries too. In recent years, large retailers have progressively entered into long-term relationships with processors and growers via formal contracts, which is distinguished from the U.S. experience.

The various newly developed types of contracts in the agro-food sector have now become a normal transaction arrangement rather than an aberrant case. However, we do not know much about how transactions through contracts differ from those through spot markets, relative to our understanding of the price-quantity determination mechanism. There is not much to explain why economic agents choose a contract shunning spot markets. The vast majority of existing literature on vertical contract practices in the agro-food sector aims to document the increasing trend of contract practices and potential factors influencing the trend (Barry, et al., 1992; Hayenga, et al., 2000; MacDonald, et

al., 2004; Sykuta and James, 2004; Menard and Klein, 2004; USDA GIPSA, 2005; Menard and Valceschini, 2005) or explain the internal structure of a group of contracts and consequences of a contract adoption. For example, Hueth and Melkonyan, 2004 analyze incentive structures for quality in sugarbeet contracts while Goodhue, et al. 2003 look at the same aspect in winegrape contracts. Sykuta and Parcell, 2003 examine the allocation of decision rights over delivery in I-P soybean contracts. Knoeber and Thurman, 1995 estimate the risk shift associated with contractors' ownership of input and output in broiler production contracts relative to independent chicken growers' case. In contrast, studies on the choice between contracts and spot markets in agro-food sector have been rarely found.

From theoretical point of view, comparative analysis of spot markets vs. long-term contracts has been approached from transaction cost economics (TCE) and measurement cost theory. TCE initiated by Oliver Williamson (1979, 1996) and Klein, Crawford, and Alchian (1978). TCE regards the observed discrete organizational modes as ones developed in order to economize on transaction costs in a discriminating way. A long-term contract is regarded as a governance to protect one party's investment in transaction relationship-specific durable assets or the value of transaction relationship from trading parties' potential opportunistic behavior. Therefore, added contractual safeguards including information disclosure and dispute-settlement machinery as well as the contract duration to cover the longevity of the assets invested are emphasized (1996: 104). Williamson (1996) lists six types of asset specificity: physical asset, site and human-asset specificity, brand name capital, dedicated assets, and temporal specificity. He also

adds that the first five forms create bilateral dependency and pose added contractual hazards (p.105-106).

The asset specificity explanation of long-term contracts has been supported by a few empirical studies (see Joskow, 1985 for coal-burning electricity industry case and Lyon, 1994 for the UK engineering sub-contracting case) relative to a large body of empirical literature on make-or-buy decision. The physical asset and site specificity consideration has been also adopted to explain the contracts used in the U.S. hogs and broiler industry without empirical evidence (Martinez, 1999, 2002). Brand name capital, which has been fairly explored in the context of franchising, has been taken into consideration to explain the contracts used between processor and growers in France for transactions of differentiated chickens (Menard, 1996). Finally, temporal specificity arising mainly from perishability of products such as raw milk, chicks, pigs, eggs, fruits, and vegetables might be the most applicable candidate of asset specificity consideration of the choice of contracts for organizing agricultural transactions (Masten, 2000a). Menard (1996) also points out the role of temporal specificity in explaining the transactions of fresh chickens in France. Looking at the observed various mix of organization forms in perishable products, however, the question arises of whether perishability alone leads to contracts or vertical integration as Williamson (1996) already pointed out.

The basic idea of asset specificity explanation of the choice between long-term contracts vis-à-vis spot markets is in that the hybrid as an alternative to vertical integration provides trading parties with safeguards against rent-dissipating behaviors, including a legal guarantee of repeated exchanges and dispute resolution apparatus. While asset specificity concerns may explain some long-term contracts, it may be limited

for explaining a large number of short-term marketing contracts, specifically single-season contracts used in grains, tobaccos, fruits, vegetables, and etc. Furthermore, TCE focusing on the attributes of assets required for transactions may not be sufficient to explain a processor's or retailer's simultaneous use of spot markets and contracts for procuring a raw material input. For example, it is frequently observed that large hog buyers concurrently use spot markets, short-term or long-term marketing contracts, production contracts, and in-house production to procure slaughter hogs and large hog sellers simultaneously use spot markets and marketing contracts. However, the attributes of assets adopted by either the large hog buyer or seller do not seem to be discrete across alternative transaction arrangements. Therefore, in order to explain the recent practices of organizational form choice in the agro-food sector, it is needed to consider aspects of transactions other than asset characteristics.

Measurement costs branch of organizational form theories may be informative to explaining contracting practices in the agro-food sector. Measurement difficulties of attributes of products, assets, or outcomes of workers have received much attention from measurement cost theorists and normative agency theorists as a potential factor to affect the choice of organizational forms (see Barzel, 1982, 2005 for the former, and Holmstrom and Milgrom, 1994; and Holmstrom, 1999 for the latter). While normative agency theory focuses on the rationale of the firm vis-à-vis markets and organizational architecture within firms, Barzel's measurement cost theory informs the choice between spot markets and contracts.

Barzel claims that when the variability of the measured attributes of products at stake becomes non-trivial, market arrangements emerge in order to reduce the losses

from economic traders exploiting measurement errors (1982: 28). He enumerates product warranties, proxy measurement, futures markets, brand names, share contracts, and repeat purchases. Under exclusive dealing contracts or long-term relations, the buyer saves the costs of measuring at purchase time (Gallick, 1984; Barzel, 2005). Based on Barzel's works and Klein (1996)'s self-enforcing range framework, Masten (2006) claims that the value of long-term contracts may originate from their capabilities serving to save the costs to negotiate a price for each transaction in a series by 'intertemporal bundling' of heterogeneous transactions. Martinez and Zering (2004) use the measurement cost consideration to explain long-term hog procurement contracts.¹

Whereas the measurement cost consideration may be revealing to explaining long-term contracts that do not involve investment in transaction relationship-specific durable assets, it is also limited to explaining single-season contracts frequently observed in the grain, oilseed, and tobacco industry as is TCE. Furthermore, it is not clear what factors determine the choice between non-bilateral devices such as public standard and grade and long-term contracts, to lessen sellers' misrepresentation incentives or haggling costs to determine the price of each transaction.

This dissertation attempts to fill gaps between the existing literature on organizational form choice and processors' or retailers' practices on contract choice recently observed in the agro-food sector by offering theoretical arguments and empirical analysis. On the theoretical side, I look at two aspects of transactions between processors or retailers and growers through which two major innovations to the existing literature

¹ By analyzing a limited sample of long-term marketing contracts, they find that long-term marketing contracts whose clauses contain standards for minimum live or carcass weight and have minimum quality requirements that allow packers to reduce the costs of measuring and sorting hogs into narrower quality groupings.

will be made: attributes of products to be exchanged; and the interaction between processors' or retailers' product differentiation activities in the downstream markets and their procurement practices in the upstream markets.

First, the research develops a notion of 'product specificity to a buyer' as a catalyst influencing the choice between spot markets and contracts for the transactions of agricultural products. Let's briefly explain the idea of product specificity to a buyer. Following Lancaster's (1966) tradition, I define goods as a package of attributes. If a processor or retailer wants to procure a class of products that contain a unique package of attributes deviated from the existing definition of the products, the products are defined as ones specific to the buyer. Once a buyer desires to procure a class of idiosyncratic products, then the capabilities of spot markets would be significantly diminished since spot markets function under a presumption that products to be exchanged are *ex ante* defined among all potential traders.

For example, suppose a pork packer wants to buy slaughter hogs of 200-pound live weights which are much lighter than hogs of average weights of 260 pounds transacted through spot markets. If the packer attempts to use auction markets or individual negotiation at the farm gate to buy market-ready hogs, then the buyer may fail to obtain an optimal amount of the desired hogs unless the information on the amount and specifications of the buyer's desired hogs and the corresponding incentive prices are *ex ante* disseminated to potential hog sellers. However, the need to *ex ante* communicate regarding the buyer's desire for a specific attribute of hogs may not be effectively afforded by spot markets since spot market exchanges feature instantaneous exchange

and anonymously disconnected transactions, based on which spot markets can realize the least costs of communication with others, one of their organizational capabilities.

The pork packer instead goes to potential hog sellers before they enter into production in order to transmit information regarding purchase quantity of hogs with the desired weights and acceptable incentive prices for the sellers if the production of hogs specific to the packer incurs any additional costs. The way that the pork packer adopts to procure the desired slaughter hogs described just above is called deferred exchange, which is a fundamental characteristic of contract exchanges. A contract therefore provides a platform for bilateral planning of the production and exchange for products specific to a buyer, which is less accessible through spot markets governing instantaneous exchange. The contract may be informal or formal. However, if the pork packer's needs to procure lighter hogs are derived from its market strategic position in the downstream pork consumer markets where product differentiation activities are prevalent, then the pork packer would be more willing to make a formal contract to secure hog growers' commitment on the contract since otherwise suboptimal quantity of the lighter hogs would be likely to result.

The product specificity explanation of contract choice has little things to do with a contract's safeguard function against rent-dissipating behavior supported by asset specificity or against misrepresentation incentives supported by measurement errors. The explanation instead highlights the organizational capability of contracts, *ex ante* bilateral communication for planning of buyer-specific products and designing incentives, as compared to spot markets' organizational capability of savings in communication costs. This dissertation demonstrates how the notion of 'product specificity to a buyer' or

‘buyer-specific product’ accounts for the majority of single-season marketing (or procurement) contracts.²

Second, based on the concept of buyer-specific products, the research attempts to extend the existing theories of contracts into the context of the agro-food sector. In particular, it provides discussions how the choice of contracts in the agro-food sector can be better explained by interaction between buyer-specific products and measurement difficulties or brand name capital than by the latter two explanations only. The research uses tobaccos, identity-preserved grains, hogs, and French beef cases to illustrate how the specificity of products to a buyer play a catalyst role for the buyer to choose contracts when the unique package of the product attributes involve distinct sources of measurement difficulties and investment in brand name capital in downstream markets.

Related to the second contributions to the existing literature, this research provides an in-depth analysis of *long-term* hog procurement contracts extending Masten (2006)’s argument of ‘intertemporal bundling of heterogeneous transactions’. While Masten emphasizes savings on costs associated with pricing non-contractible attributes of a task in a transaction, I examine savings on price adjustment costs for measurable quality attributes of intermediate goods under circumstances where production costs of the quality attributes are volatile and thereby the price adjustment costs increase with product specificity to a pork packer. In this regard, the research provides findings on intertemporal incentive devices to realize hog buyers’ desire for intertemporally consistent quality attributes of hogs as an explanation of *long-term* hog procurement contracts, which has not been explored by the existing literature.

² For convenience, this research abbreviates ‘product specificity to a buyer’ to ‘product specificity’ and interchangeably uses it with ‘buyer-specific product (s).’

On the empirical side, recognizing the fact that there are a few contract empirical studies analyzing contract documents in the agro-food sector, this dissertation analyzes long-term hog procurement contract documents in the pork industry using the notion of product specificity to a buyer and the agency theory's contract externality (Holmstrom and Milgrom, 1991, 1994; Holmstrom, 1999) and task programmability arguments (Ouchi, 1979; Eisenhardt, 1985). The pork industry was chosen for the analysis because it has experienced rapid change in organization form in recent decades and, to my knowledge, is the only one in the agro-food sector where long-term contracts govern the vast majority of transactions in the upstream agricultural product markets.

In addition, given the lack of empirical literature testing contract theories in the agro-food sector, an econometric analysis of data concerning potential factors influencing the decision to contract in an industry would be beneficial to identify the sources of coordination difficulties in spot markets as well as to deepen our understanding of the choice of alternative organization forms. The dissertation reports results from a survey of the U.S. pork industry in attempt to provide such an analysis.

The dissertation is organized with three self-contained independent essays and an over-arching literature review chapter. As a result, there is some unavoidable overlap between the four chapters. The dissertation proceeds as follows. The chapter 2 surveys the existing theoretical and empirical literature on vertical contracts. It begins with an overview of the literature of traditional industrial organization's approach to vertical contracts made between manufacturers and distributors or retailers, pointing out the limitations of the market structure approach on contracting. It then introduces existing theories of contracts developed in recent decades, with attempts to compare and contrast

among the theories. In addition, the chapter surveys extant empirical studies of the choice and design of contracts in industries other than the agro-food sector to weigh the empirical validations and limitations of the theories and how they may be refined. The last part of the chapter investigates existing literature on vertical contracts made in the agro-food sector to draw on what has been done and what needs to be done to provide a conceptual framework for the choice of contracts. It discusses directions for future research on contracting in the agro-food sector, on which the following chapters will build.

Chapter 3 provides the theoretical arguments for characteristics of spot markets versus contracts and the relation between product differentiation strategy in downstream markets and the transition from spot markets to contracts in upstream markets. In particular, it proposes a notion of ‘product specificity to a buyer’ as a key driving factor for the transition from spot markets to contracts. The chapter then offers an analytical framework to explain multiple sources for the choice to contract by incorporating the notion of product specificity into explanatory variables offered by existing theories. It also discusses how the introduction of product specificity enriches existing explanations of choice to contract. Based on the analytical framework, it presents four representative examples recently experiencing the transition: identity-preserved grains, tobacco, hogs, and French beef.

Chapter 4 presents analysis of hog procurement contracts to explore factors influencing the choice of contracts vis-à-vis spot markets in a circumstance where product differentiation comes into play. Based on the analysis of a unique data set of hog procurement contracts obtained from USDA GIPSA, it discusses how the theoretical

framework developed in chapter 3 explains the structures and provisions observed in the contracts. In particular, it examines how product specificity explains the contracts, highlighting transaction costs associated with implementation of optimal quality incentive-pricing and sellers' potential moral hazard supported by measurement difficulty.

Chapter 5 provides additional empirical evidence to examine factors influencing pork packers' choice of long-term contracts or internal production, shunning spot markets. It constructs three testable hypotheses. The first hypothesis is based on an asset specificity explanation while the second one is built on a measurement difficulty or contractual externality explanation. The last hypothesis is derived from a product specificity explanation. Using survey data collected from managers in pork packing plants, the chapter presents econometric analysis for testing the hypotheses, showing that the data support the measurement difficulty and product specificity explanations for pork packers' choice of non-spot market organizational form to procure slaughter hogs. Chapter 6 offers conclusions and suggestions for further research.

Chapter 2 LITERATURE REVIEW

1. Introduction

This chapter reviews the existing theoretical and empirical literature on vertical contracts made between firms in value chains. It begins with an overview of the literature of traditional industrial organization's approach to vertical contracts made between manufactures and distributors or retailers, with pointing out the limitations of the market structure approach on contracting. It then introduces existing theories of contracts developed in recent decades, with attempts to compare and contrast among the theories. The first part of the chapter systematically examines extant empirical studies of the choice, design, and the economic performance of contracts in industries other than the agro-food sector to weigh the empirical validations and limitations of the theories and how they be refined.

The last part of the chapter investigates the existing literature on vertical contracts made in the agro-food sector to draw on what has been done and what should be done to provide a conceptual framework for the choice of contracts and contract design issues. It concludes with directions for future research on contracting in the agro-food sector, on which the following chapters will build.

2. Traditional Industrial Organization's Approach to Vertical Contracts

Contractual form or design, or the organization of economic activity in general, had received little attention from economists until Ronald Coase's seminal 1937 paper, even if different organizational forms hold distinct resource allocation mechanisms and thereby exhibit significant implications for economic agents' activities for resolving transaction difficulties in an economic system. Neoclassical economists have approached vertical contracts with an angle of imperfect competition, which erodes one of the important assumptions on which the standard Arrow-Debreu equilibrium model relies.

The standard static Arrow-Debreu general equilibrium model (Arrow and Debreu, 1954) generates a central result that when there are competitive markets and associated prices for all goods and services in the economy, no externalities, and no informational asymmetry, a socially optimal allocation of resources can be achieved by independent private decisions coordinated through the markets, and the result will be Pareto efficient. This model can be generalized to a setting where time and uncertainty is incorporated, defined as the notion of a contingent commodity (Arrow, 1953; Debreu, 1959). A contingent commodity is a contract that promises the future delivery of one unit of a particular good if a particular state of nature occurs. If there is a complete set of such contingent contracts, we have the idealized situation of complete contingent markets. In this way the model with time and uncertainty can be reduced to the model without uncertainty, and in this model all the decisions are taken at the initial date without contract execution problems.

Along with this paradigm, neoclassical economists have tended to view aberrant forms of inter-firm vertical transactions as exertion of market power or a means of market power maintenance (evidence of market power). Particularly, traditional industrial

organization researchers have focused on vertical restraints observed in the relationship between manufacturers and distributors. Vertical restraints include terms for payments such as non-linear prices (two-part tariff or quantity discounts), royalties and slotting allowances, and terms limiting one party's decisions such as resale price maintenance, quantity fixing, tying, exclusive dealing, exclusive territories and franchising (see Tirole, 1988; and Rey and Verge, 2005, for overview of the literature). For example, minimum price and exclusive territories have been examined with an angle of collusion such as dealer cartels and monopolization (Telser, 1960; Jullien and Rey, 2000). On the other hand, Rey and Stiglitz (1988, 1995) attempted to show that vertical restraints such as exclusive territories and delegation of the pricing decisions to the retailers can also help to reduce inter-brand competition. Finally, some literature has viewed exclusive dealing contracts as a means of foreclosure and raising rival's costs (see Aghion and Bolton, 1987; and Bernheim and Whinston, 1998, for example).

However, let alone the fact that those arguments described above have not been much supported by empirical evidence (see Lafontaine and Slade, 2005), it is important to note that their focal interest is not on the contracting per se, but on the market structure (level of concentration, conditions of entry, the extent of inter-brand competition, etc.). For example, Rey and Verge (2005) conclude that if the market structure ensures a vigorous competition among rival vertical structures, vertical restraints are unlikely to harm economic efficiency or reduce competition.

3. Theories of Contracts

Studies on contracting as a unit of analysis have developed since the 1970s, mainly inspired by Coase (1937)'s discovery of transaction cost concept and the work of Akerlof (1970) and Arrow (1971) on information asymmetry and uncertainty, among others. Based on the pioneer works, and starting with discontent regarding the Arrow-Debreu model, a large number of economists have contributed to establishing contract theory in its own way. This chapter briefly introduces four theories of contracts established thus far: normative agency theory (or incentive theory), property-rights theory and transaction cost economics. We also briefly introduce two other branches of contract theory: measurement costs and positive agency theory. The first three contract theories and the other two branches have different assumptions, focal points, and methods (Brousseau and Galchant, 2002). This review is expanded upon in subsequent chapters as is relevant to the analysis.

3.1 Normative Agency Theory

Normative agency theorists regard all contracts as incentive contracts because a contract is required when an economic agent (principal) delegates a task to another party (agent). They illustrate the principal's bounded rationality as a motivation of delegation when facing complex problems, resulting in decreasing returns associated with the diversity of tasks (Laffont and Mortimort, 2002). Delegation, however, as they propose, cannot avoid information asymmetry problems in which the principal does not get access to the exact information that the agent has on certain variables such as the innate ability and behavior of the agent during the period of contract formation and execution. Therefore, an agency analysis provides a second-best incentive structure for the agent,

based on information that can be included in the contract. Depending on whether the variable is *ex ante* or *ex post*, one calls the problem as adverse selection or moral hazard, respectively. Regardless of the two types of models, incentive theorists attribute the information gap between the two contracting parties to the distortion of optimal allocation of resources. Consequently, the normative agency models have devoted to providing various second-best optimal incentive schemes to reduce the information cost to the principal, or information rent for the agent: for example, a menu of contracts characterizing the optimal rent extraction-efficiency trade-off faced by the principal for *ex ante* hidden information setting; and reward contracts containing optimal trade-offs between risk sharing and incentives for *ex post* hidden action setting (Laffont and Mortimort, 2002; Hart and Holmstrom, 1987).

The second best incentive schemes are derived and implemented based on the following four key assumptions (Laffont and Mortimort, 2002; Salanie, 2005). First, the probability distribution of the private information of the agent is common knowledge. Second, the principal is a Bayesian expected utility maximizer, which means the principal moves first as a Stackelberg leader anticipating the agent's subsequent behavior and optimizing accordingly within the set of available contracts. Third, economic agents are endowed with hyper-rationality that they have abilities to receive and process information for computing their expected values. With those three assumptions, the most efficient solutions can be derived given information constraints. Finally, normative agency models assume a complete contract in that it takes into account all variables that would be relevant during the contract length and thereby there is no probability that the contract is breached or renegotiated, so called full commitment. With another assumption of the

existence of a costless and benevolent court of law that enforces contracts, contract implementation issues therefore are beyond the theory's concern.

Although the realization of optimal joint-surplus may require multiple types of cooperation between contracting parties, normative agency theorists have greatly devoted to featuring the numeric conditions for incentive compatibility between contracting parties to resolve incentive misalignment under asymmetric information. This chapter uses the term of incentive alignment principle in a more broad sense in order to include other theories' relevant suggestions. While incentive misalignment may produce several possible consequences, two basic types of the results have been found: shirking and contractual externality. The two types of the results are often used interchangeably. Shirking here denotes agents' behaviors deviated from the level of efforts desired or specified in the contracts provided by principal, mainly due to the status of *non-residual claimants*. Therefore, under non-trivial monitoring costs, the principal should provide agents with strong incentives to induce best efforts through contract design. The strongest incentive is to make agents residual claimants. However, providing strong incentive itself is not the only issue because disturbances intervene in the application of the simple rule to real contracting process. Normative agency theorists therefore have been looking at the disturbances, including agents' risk attitudes and two-sided moral hazard, in order to explain various types of incentive provisions observed in contracts that deviate from the simple performance-based pay rule.

The second type of possible consequence from incentive misalignment, contractual externality, is owing not to weak incentives but to too strong incentives arising from the agent' status of *residual claimant* in a circumstance where tasks are multiple and

performance measures are imperfect. Contractual externality refers to an externality arising from a contract where the incentives that influence one decision affect optimal incentives with respect to other decisions (Holmstrom, 1999; Baker and Hubbard, 2001). Since independent contracting parties have strong incentives to maximize their own profit, even at the cost of the other parties, suboptimal outcomes may result in terms of joint-surplus maximization. The concept of contractual externality is proposed by Holmstrom and Milgrom (1991, 1994) who view the firm as an incentive system rather than as response to the cost of market contracting. The theory supposes that there are many sets of tasks (for example, single task or multi-tasks) for agencies to accomplish and many instruments like asset ownership, contingent rewards, and job restriction, for the principal to utilize in order to achieve optimum total surplus. All those three instruments influence different dimensions of the worker's task portfolio and are complementary for optimal incentive system (Holmstrom and Milgrom, 1994). The theory proposes the relationship between measurement difficulty and the adoption of instruments. Both shirking and externality result in a suboptimal outcome in joint-surplus, but the former arises from ownership unified to one party and the latter results from the separated ownership. Observed contract provisions regarding pricing and non-pricing restrictions on contracting parties' behavior or decision have been the domains of empirical applications of the incentive alignment explanations.

3.2 Property Rights-Incomplete Contract Theory

Property-rights theory initiated by Grossman and Hart (1986) and Hart and Moore (1990, 1999) is deviated from normative agency theory in that it assumes bounded

rationality³ of courts or third party enforcers, which means that there exist certain variables whose values are observed by the contracting parties but cannot be verified *ex post* by the third parties, which is one reason for a contract to become incomplete. This non-verifiability of the value of variables therefore offers a reason for the existence of non-contractible variables because it is futile to condition a contract on the variables that cannot be used to settle a dispute. Given a contract is incomplete, the allocation of property-rights on assets becomes relevant because it affects the distribution of the residual surplus between contracting parties and their incentives to invest.

Unlike TCE, the property-rights theory does not focus on *ex post* haggling or maladaptation, but instead underscores how asset ownership influences *ex ante* investment in noncontractible assets. As Whinston (2003) and Lafontaine and Slade (2007) pointed out, the property-rights theory is similar to normative agency theory in terms of their concern on marginal productivity change effects by either asset ownership or incentive schemes. Using a circumstance of relationship-specific investments of human capital, the property-rights theory shows that the optimal allocation of property rights depends on the respective social costs of underinvestment by the parties to the contract. While the property-rights theory is largely regarded as an explanation for vertical integration, it may be informative to explaining the shift in ownership over part of the assets frequently observed in livestock production contracts, for example.

3.3 Transaction Cost Economics

³ Bounded rationality refers to human behavior that is “*intendedly* rational, but only *limitedly* so” (Simon, 1976, p.xxviii).

TCE regards a contract as a governance structure to economize on transaction costs (Williamson, 1979, 1985, 1996). Based on inductive method, transaction cost theorists categorized a variety of existing economic organizations into the three generic types: markets, hierarchies, and hybrid forms. They explain the existence of the discrete organizations by alignment between the discrete competencies and costs of each one and the underlying transaction attributes (Williamson, 1996). Along this line, they tend to view that contracts have a variety of forms and internal structures because various contracts are economic agents' responses or solutions to discrete transaction attributes or coordination problems they face. This view comes from its unique assumptions and the institutional approach to economic coordination problems. Based on the assumptions of bounded rationality of contracting parties and judge and opportunism of contracting parties, TCE explains inevitable incompleteness of contracts and illuminates the role of asset specificity and uncertainty to discriminate alternative organizational forms and to influence design of contracts (Williamson (1979, 1985, and 1996).

Comparative analysis of spot markets vs. long-term contracts has been approached from transaction cost economics initiated by Oliver Williamson (1979, 1996) and Klein, Crawford, and Alchian (1978). TCE regards the observed discrete organizational modes as ones developed in order to economize on transaction costs in a discriminating way. Each generic mode of organization, including spot markets, hybrids and hierarchies, tends to be aligned with discrete transaction attributes because each mode possesses distinguished capabilities and costs and selective intervention is not feasible (Williamson, 1996). Williamson distinguishes the three generic types of governance structures in terms of the three key attributes: incentive intensity, control instruments, and adaptability. Spot

markets feature the highest incentive intensity, few control instruments, and high adaptability to disturbance (A) which requires autonomous response while the hybrid mode, including long-term contracts, displays less incentive intensity, more detailed administrative control, higher adaptability to disturbance (C) which requires coordinated response, and lower adaptability to disturbance (A) than spot markets do. Williamson (1996) claims that if transaction efficiency can be accomplished only by transactors' "independent responses" to parametric price change, spot market organizational form would be the most efficient for affording the transaction. However, transactions requiring "coordinated responses" tend to favor hybrids or hierarchies because otherwise the individual parts operate at cross-purposes or suboptimize (1996:102).

Disturbances requiring coordinated responses take place when buyers' desired intermediate goods or services to procure are idiosyncratic ones where investments of transaction-specific physical and human capital are made. Because the longevity of assets to be invested is longer than production period of the goods in problem and the supplier is effectively locked into the transaction, "a qualified joint-profit maximization agreement (a long term contract)" is desired (1975: 104). From Williamson's point of view, a long-term contract is regarded as a governance to protect one party's investment in transaction relationship-specific assets or the value of transaction relationship from trading parties' potential opportunistic behavior. Therefore, added contractual safeguards including information disclosure and dispute-settlement machinery as well as the contract duration to cover the longevity of the assets invested are emphasized (1996: 104).⁴

⁴ Long-term contracts however may give way to hierarchies when uncertainty arises. Williamson (1971, 1975, 1979, 1996) maintains that uncertainty plays a key role of increasing the probability of postcontractual opportunistic behavior appropriating "quasi-rents" supported by asset-specificity (Klein, Crawford, and Alchian, 1978) under long-term contract execution process,

Williamson (1996) lists six types of asset specificity: physical asset, site and human-asset specificity, brand name capital, dedicated assets, and temporal specificity. He also adds that the first five forms create bilateral dependency and pose added contractual hazards (p.105-106).

3.4 Measurement Cost and Positive Agency Theory

While both measurement cost and positive agency theory of contracts are based on the assumptions of bounded rationality that transaction cost economics relies on, the emphases are different. Measurement cost explanation of contracts initiated by Yoram Barzel (1982, 2005) focuses on economic traders' opportunistic behavior by exploiting measurement errors defined as the variation between true values and measured values of individual products and thereby explains how market arrangements are developed to reduce the losses from the exploitation of measurement errors. Since sellers' misrepresentation and buyers' excess measurement and excess sorting are all wasteful use of resources, product warranties, share contracts, brand names, the suppression of information, proxy measurement, and vertical integration have been developed to reduce the rent-dissipating behaviors (Barzel, 1982). Measurement cost theory also might be relevant to explaining the role of repeat purchases on reducing the measurement losses,

resulting in maladaptation of long-term contracts because uncertainty tends to move together contractual incompleteness due to human beings' bounded rationality and the incompleteness increases the probability and frequency of contract renegotiations. The stability of long-term contracts as an alternative of vertical integration has been closely examined by Klein, Crawford, and Alchian (1978), Klein and Laffler (1981), and Klein (1996). According to these works, if brand-name capital or reputation for both parties is great, market environments are stable, and/or the business in problem is growing, long-term contracts are likely to sustain.

which may account for the incidence of long-term contracts. Therefore, the measurement cost theory is closely related with transaction cost economics.

Positive agency theory differs from normative agency theory in terms of its assumption and focal points although those two theories share the importance of incentive misalignments. Positive agency theory acknowledges bounded rationality and the existence of transaction costs as well as information asymmetry. It emphasizes the role of knowledge and information in determining the allocation of decision rights among parties in a contract. If there is no cost associated with transferring knowledge and information among parties, no agency issue might occur because there is no need to delegate decision rights to agents.

Jensen and Meckling (1992) distinguish specific knowledge from general knowledge in terms of the transfer costs and argue that decision rights over asset use should be vested with the party holding relevant knowledge for production in order to achieve the best possible economic performance within an organization. If the principal does not possess specific knowledge and the transfer is costly, she had better delegate her decision rights to an agent holding the knowledge. The delegation however always invites agency costs including monitoring and bonding costs and residual loss (Jensen and Meckling, 1976). This therefore implies that optimal design of contracts or organizational structure should weigh the trade-off between the cost of transferring specific knowledge and the agency cost associated with the delegation of decision rights. Although positive agency theory has been mostly applied to internal organization of firms, it may be informative to explaining the inter-firm contractual relationship,

particularly with regard to allocation of decision rights over the production or flow of commodities or services at stake.

3.5 Comparison among Theories

As described above, the first three theories of contracts are different from each other in that each one has its own focal points, assumptions and main empirical domain. Incentive theory emphasizes the optimal incentive compensation and performance evaluation serving to minimize asymmetric information costs, which are determined based on agents' risk preferences or cost functions and the measurement characteristics of tasks delegated while TCE focuses on how economic agents choose a particular governance form and design the internal structure of contracts in a way to minimize transaction costs and maximize mutual gains from trade given attributes of the transaction. Property-rights theory highlights ownership effects on contract choice, arguing that complementary assets should be under unified ownership. While incentive theory stands on the most restrictive assumptions and property-rights theory release the assumption of hyper-rationality of judges which incentive theory is based on, TCE relies on much less restrictive assumptions, featuring bounded rationality among all parties. However, it should be noted that opportunism on which TCE relies is a stronger assumption.

As for the empirical domain, most empirical studies of incentive theory have been applied to intrafirm contracting, labor markets and insurance markets whereas TCE-

oriented empirical research of contracts has been frequently found in contracting practices to organize inter-firm transactions, such as procurement contracts and distribution agreements used in a variety of industries. Empirical literature of the incomplete contract theory, thus far has been rarely found (see Baker and Hubbard, 2003, 2004, as two representative works). Even though the three theories of contracts have developed emphasizing mostly the different dimensions of contracts, almost all researchers have the same voice in that the contract research has not been exhaustively matured in both theory and empirics (Brousseau and Glachant, 2002; Williamson, 2002; Masten and Saussier, 2002; and Chiappori and Salanie, 2003). There remain a lot of open questions and less explored issues of contracting.

4. Empirical Studies on the Choice of Contractual Form and Design of Contracts in Vertical Transactions

Empirical research of contracting is very important because it exhibits a theory's explanatory power over observed contracting practices and facilitates the existing theory's further refinements. This section reviews the empirical research of contracting in vertical transactions between manufacturers and input suppliers, and between manufacturers and distributors, excluding applications to agricultural production which will be covered by the following section.

4.1 The Choice to Contract

Contract researchers have attempted to empirically explore what factors affect economic actors' choices between spot markets and contracts or between formal vs.

informal contracts using existing TCE or measurement cost theory. However, while there is an extensive empirical literature explaining the choice between transactions through in-house production and markets (make-or-buy decision), the transition from spot markets to contracts within the boundary of market transactions has received little attention from contract researchers. I found only two attempts, all of which approach with transaction cost economics.

Joskow (1985) investigates organizational forms governing the transaction relationship between coal-burning electric companies and coal suppliers using asset specificity-based TCE. He reports that while four different transaction governances, including spot market, short-term contract, long-term contract and vertical integration, are concurrently observed in the industry, transactions for coal produced in mine-mouth plants are substantially governed by vertical integration or long-term contracts. He argues that asset specificity such as location, physical assets, and dedicated assets appears to be the most important for mine-mouth plants and opportunism potentially the most severe and concludes that long-term contracts can be *a second best alternative* for vertical integration when economic agents who already invested in relationship-specific assets want a safeguard for protecting them from their counterparty's potential rent-dissipating behaviors.

Lyons' (1994) study of the choice between formal vs. informal contracts in the UK engineering sub-contractors and their customers shows the importance of bilateral dependency in the choice of formal contracts, implying its safeguard function against potential opportunistic behavior. By using survey data and Probit analysis, the empirical results support the hypotheses that subcontractors are more likely to have a formal

contract if the share of output going to their most important customer is large, if that output is specialized, and particularly if they are using a specific technology.

4.2 The Designing of Contracts

The structure of contractual agreements has received a lot of attentions from contract researchers. The existing contract theories described above suggest that contract structure and terms should serve to achieve two objectives: maximizing joint-surplus and minimizing contracting costs. The contract theories also propose principles of how the objectives are fulfilled through designing of a contract. Normative agency theory highly focuses on the principle of incentive alignment, targeting for the first objective, while transaction cost theory emphasizes on contractual function of managing contracting parties' potential rent-dissipating behavior, aiming to the second objective.

4.2.1 Normative agency theory

The incentive alignment principle has been tested in couple of different directions. A risk-averse agent explanation would first come. The classical moral hazard agency model predicts that contracts should provide strong incentives such as a piece rate or bonus when agents' efforts cannot be observed, but if agents are risk averse with regard to the uncertainty on the correlation between their efforts and outputs, arising from any noise term, then muted incentives such as fixed payments are desirable. Therefore, contracts should reflect optimal trade-offs between incentives and risk sharing.

Many papers have tested this moral hazard model using pricing practices in land leases and the franchising practices. The model predicts that more risky crops are more

likely to be grown under sharecropping contracts. However, most empirical results are mixed or inconsistent with the prediction (see Prendergast, 2002 and Allen and Lueck, 1999 for a survey of the literature). Contrary to the risk argument, Allen and Lueck's (1992) empirical result indicates that cash-rent contracts rather than crop-share contracts are more likely to be chosen in risky crops. In addition, similar results have been found in empirical research on the pricing of outlets under franchisors' brand names and business processes, and the choice of company operation versus franchising of outlets, not supporting the risk aversion-based predictions (see Lafontaine, 1992 for an empirical result for the pricing practices, and Lafontaine and Slade, 2001 for the summary of empirical results of the choice between franchising and company operation).

Second, incentive alignment explanations using two-sided moral hazard, but without allowing for risk aversion, have been found to better explain the pricing practices in franchising. Since it is difficult to measure the value of the intangible assets variable across time, and the efforts of both franchisees and the franchisor within a franchise affect the total surplus of the franchise, the pricing of the intangible assets should induce both parties' best efforts. Therefore, although selling the outlet at a fixed price to the franchisee completely resolves franchisee incentive issues, the price form in a typical franchise contract takes the outlet's revenue (not profit) sharing in order to encourage the franchisor to provide some valuable input in the joint-surplus creation process as well as to stimulate franchisees' efforts to reduce costs and increase revenue (Lanfontaine and Raynaud, 2002). This explanation has been supported by Lafontaine's (1992)'s empirical results indicating that royalty rates across franchises tend to vary with the relative importance of franchisor and franchisee effort.

Third, incentive alignment explanation taking contractual externality into account is also found in the domain of empirical contract literature. Brickley (1999) empirically analyzed the use of restrictions on franchisees' behavior frequently observed in franchisee agreements using Holmstrom and Milgrom's (1991) contractual externality explanation. He found that franchisors' restrictions on franchisees' passive ownership (e.g., restraint on outside activities), area development plans under condition of exclusive territory granted, and mandatory advertising expenditure are more likely when there are significant externalities among the outlets within the franchise system, measured with the closeness of outlets. This study suggests that contracts have a capability to create incentive instruments other than price, serving to maximizing joint-surplus.

4.2.2 Transaction Cost Economics

Contracting parties are also concerned about the costs associated with contract formation, execution and enforcement. Admitting the contractual incompleteness arising from the bounded rationality of contracting parties and third-party enforcers and from uncertainty, contracting parties face various types of contracting costs. TCE particularly focuses on contracting parties' wasteful efforts not to contribute to joint-surplus creation at all but to redistribute existing joint surpluses into favoring their own portion during contract period. TCE suggests that contracting parties are likely to design contracts in a way to prevent wasteful activities to dissipate or appropriate the joint surpluses. Transaction cost theory-based empirical studies of contract structure have a broader domain of contract terms to be applied, including contract duration, information disclosure, dispute resolution apparatus, and price and quantity adjustment structure.

Those contract terms are regarded as serving to safeguard investment and property against potential misappropriation by the counter- contracting party and to enhance adaptability to disturbances in a way to keep the relationship within the agreement's "self-enforcing range" (Klein, 1992) or to divide ex post surpluses "equitably" (Masten, 1988).

Several papers examine the determinants of contract duration. As transaction cost theory predicts, contract length is likely to be longer as asset specificities or the value of investments in relationship-specific assets increase (Joskow's (1987) econometric analysis of the duration of approximately 300 contracts between coal mines and power plants; and Sassier's (1999) econometric analysis of contracts for coal transportation in France). In contrast, contract duration is found to be negatively influenced by demand uncertainty (Sassier, 1999) and inefficient government regulation on contract pricing, such as price ceiling (Crocker and Masten's (1988) econometric analysis of 245 natural gas contracts). The studies suggest that contract length functions as a safeguard against contracting parties' ex post potential rent-dissipating behavior or a means for encouraging ex ante investment incentives, and more generally, tends to be determined reflecting on a trade-off between the benefits from formally extending the contractual relationship by additional period and mainly the maladaptation costs of failing to adjust to changing circumstances.

The transaction cost literature has also examined how the parties to a long-term contract design terms of trade in general, ex ante in a mutually satisfactory way, with regard to adaptation to the change in market conditions through the contract duration. Price adjustment provisions in long-term contracts have been a target for empirical

investigation in this regard. Joskow (1988) used a sample of 158 coal contracts to analyze the structure of formal price-adjustment provisions in coal contracts and to examine actual transaction-price behavior over time. He found that the vast majority of the contracts use “base price plus escalation” adjustment formula in which an initial base price is set when the contract is negotiated, and then adjustments are made to the base price using a weighted average of changes in external input prices, productivity indexes, and changes in actual costs. He also found that the adjustment provisions provide for price flexibility at least in response to changes in the costs of production but also embody some potential long-term rigidities.

Crocker and Masten’s (1991) econometric study of the price adjustment provisions using a 1982 sample of natural gas contracts in the U.S. suggest that contract provisions relating to or affecting price can be fairly complex but can be divided into four categories in terms of precision and flexibility: definite escalators; indefinite escalators; most-favored nation and right-of-first-refusal clauses; and renegotiation. They also found that price adjustment processes tend to be more flexible the longer the duration of the contracts. Crocker and Reynold’s (1993) econometric analysis of the price adjustment provisions contained in jet engine procurement contracts also provides similar results that price adjustment terms tend to contain more flexible price adjustment mechanisms as performance horizons lengthen and technological uncertainty increases. Sassier’s (2000) econometric analysis of 26 contracts for the transport of coal in France explores the factors and mechanisms influencing the observed disparity of inter-firm contract structures in terms of the completeness of contracts. He provides parallel evidence that the contracts tend to contain more detail the greater the level of asset specificity, but

include fewer provisions as uncertainty increases. His results suggest that parties' choice of contractual terms reflects a trade-off between rigidity and flexibility in order to deter parties' rent-dissipation efforts to reallocate contractual surpluses, on the one hand, and to allow rent-increasing adaptations, on the other.

According to transaction cost empirical literature analyzing contracts for transactions of mainly goods, not assets or services, in general, contract terms tend to be designed equitably in order to maximize the value of contractual relationships on the one hand, and to minimize the parties' incentives to potential rent-dissipating behaviors, on the other. By assuming human beings' bounded rationality and contract enforcement costs, therefore, transaction cost studies reveal that when contract parties stipulate the structure of contracts and specific terms of trade, they are likely to weigh a trade-off between rigidity and flexibility, and asset specificity and uncertainty significantly influencing the trade-off, resulting in the variety in the observed contract designs even in the same class of contracts in a specific industry.

4.2.3 Using Multiple Theories

Barjari and Tadelis (2001, 2003) analyze contract payment structure and award mechanism in US building construction using agency theory and transaction cost theory. Their studies highlight the role of complexity (and/or uncertainty) of the projects to be subcontracted as a primary determinant of the choice between fixed-price by auctions and cost-plus by negotiations which are commonly used in building construction contracting. In a setting where the buyer provides the seller with ex ante design of the product like building construction, they propose hypotheses that more complex projects will be

procured using cost-plus contracts and will be accompanied by low level of design completeness because there is a high probability that adaptations are needed, whereas simple projects (which are cheap to design) will be procured using fixed-price contracts and will be accompanied by high levels of design completeness. Their empirical results (2003) support the hypotheses, shedding light on the trade-off between providing ex ante incentives and avoiding ex post renegotiation costs.

4.3 Summary of the Empirical Studies

Regarding the choice to contract, most of the empirical studies are based on TCE particularly highlighting the role of asset specificity. Few empirical investigations from normative agency theory or property-rights theory have been found. This is mainly because the two theories have yet generated any testable hypotheses about the choice of long-term contracts for vertical transactions.

A couple of conclusions can be made regarding the contract design empirical literature. First, empirical results of risk-incentive trade-off explanations have been unsupported or mixed. Second, contractual externality consideration becomes a more promising dimension to look at in empirical research on contract design. This is true especially in circumstances where difficulties associated with performance measurement are prevalent in a multi-task setting. The contractual externality explanation deserves to receive attention from empirical researchers to account for contract provisions regarding pricing structure, non-price restrictions on contracting parties' behavior, and allocation of decision rights between parties.

Third, the transaction-cost economizing principle has informed researchers of how long-term contracts are implemented under uncertain market environments. Particularly, the observed various price adjustment structures have received a lot of attention from the empirical researchers to test the trade-off between rigidity and flexibility of contract terms, influenced by asset specificity and uncertainty, respectively. In this regard, contract length also has been explained by asset specificity and uncertainty.

In general, TCE-based empirical literature focuses on vertical contracts while normative agency theory-based empirical studies mainly look at insurance contracts and worker compensation contracts. Overall, the former seems to have done better to explain the observed contract choice and design than has the latter. As Masten (2002) points out, this is mainly because predictions from agency theories involve second-order relations: relative marginal productivities of effort in alternative types of asset ownership, or in the case of multi-task agency theory, the cross-partial effects of incentive instruments including asset ownership and job design, while transaction-cost economists have concentrated on generating hypotheses based on first-order relations between exogenous observables and organizational forms. Empirical studies of contract choice and design however have yet to mature and are still growing and need to extend the theory to take features of real-world applications into account (Salanie, 2002). In this regard, Barjari and Tadelis's study on contract forms on in the construction industry are decent examples in doing better jobs to account for the observed contracting behavior consuming multiple theories of contracts.

The choice between spot markets and contracts also has been less explored. Contract transactions that do not involve asset specificity wait for explanations. Innovative

extensions or further refinements of existing theories will be required to account for the transition from spot markets to contracts.⁵

5. Literature on Contracting in the Agro-Food Sector

Contracting in the agro-food sector takes place in various stages of the supply chain. Contracts can be made as a form of lease contracts for farm assets including land, equipment, and farm buildings, or custom contracts for farm equipment, in order to organize farm production. While those types of contracts deserve to receive attention from researchers, this section focuses on the literature of vertical contracts.

Vertical contracts made between farm producers and processors or distributors of farm outputs are categorized into marketing (or procurement) contracts and production contracts. One of the big differences in the two types of contracts resides in the ownership of final outputs. Production contracts designate the ownership of final outputs to farm produce processors or distributors while marketing or procurement contracts assign it to farm producers. According to USDA data, vertical contracts governed 39 percent of the value of U.S. agricultural production in 2003, up from 28 percent in 1991 and 11 percent in 1969 (MacDonald and Korb, 2006).

Since various type of contracts as well as vertical integration in the agro-food sector have evolved, a considerable body of literature has been devoted to documenting the increasing trend of contract practices and raises questions of economic rationale for the prevalent appearance of nontraditional economic coordination modes (Barry, et al., 1992;

⁵ Additionally, the observed heterogeneity in choice of contact forms and structures may be also explained by contracting parties' individual characteristics including financial constraints and reputation, and institutional environments including contract laws, enforcement system, government policy on contracting practice, and culture and norms, all of which are excluded in our survey domain of empirical literature.

Hayenga, et al., 2000; MacDonald, et al., 2004; Sykuta and James, 2004; Menard and Klein, 2004; USDA GIPSA, 2005; Menard and Valceschini, 2005; James, et al., 2006). Knoeber (1999) surveys the normative agency explanation literature on livestock contracting while Masten (2000) documents several transaction cost empirical studies on vertical coordination in agriculture emphasizing potential contractual hazards arising from perishability of agricultural goods including raw milk, fruits and vegetables. This section summarizes the existing literature on both theoretical development and empirical investigation on the choice of contracts and contract design.

5.1 Normative or Positive Agency Theory

Researchers attempt to examine several aspects of contractor's input control frequently observed in livestock production contracts. Dubois and Vukina (2004) use a contractor's input control found in hog production contracts to examine the relationship between contractors' allocation of input quantity across growers and growers' risk aversion. They propose that the quantity of tasks delegated to a farmer is adversely determined by the farmer's risk aversion, based on their conjecture that more risk-averse growers, on average, perform worse (therefore, increase the cost of moral hazard). Based on an estimation of individual risk-aversion parameters using contract growers' performance data, they find empirical support for their proposition of a negative relationship between risk aversion and the quantity of task delegation.

In contrast, Goodhue (2000) offers a different theoretical model of the processors' input control commonly used in broiler production contracts. She views the input control as a means for processors to lower the information rents they pay to highly productive

growers even though production contracts provide an excellent mechanism design to induce a grower to reveal his ability to produce broilers through requirements of investment in significant amounts of relationship-specific capital in the form of broiler houses at the beginning of the relationship. In other places, Goodhue (1999) maintains that by controlling input decisions, processors may reduce the scope of the moral hazard problem where grower decisions affect quality.

Knoeber and Thurman (1995) examine the consequential risk shift associated with the contractors' ownership of input and output and use of relative performance evaluation in resource-providing production contracts. Using panel data covering seventy-five growers' performance and payments over four years, they measure the price and production risk shift from growers to contractors, revealing that the vast majority of risk shift relates to price risk (84%) followed by common production risk (3%), and idiosyncratic production risks which growers bear are relatively trivial (3%). Hueth and Ligon (2001) consider the relative performance incentive effect of market price-based compensation. They extend a team-based moral hazard model (Holmstrom, 1982) to explain market price-based compensation provisions observed in fresh fruits and vegetable marketing contracts as an implicit form of relative performance incentive, arguing that growers' exposure to aggregate price risk is analogous to common shock in team production.

Several papers examine the incentive design mechanism to enhance product quality. Hueth and Melkonyan (2004) investigate circumstances in which the observed variation in sugarbeet contract structures can arise from differences across production regions in the nature of the tradeoff between sugarbeet quantity and quality. The authors develop a

model of contract design based on principal-agent theory to show how the value of measuring sugarbeet quality can be relatively low when the stochastic relationship between sugarbeet quantity and quality is such that growers have little control over quality such as sugar purity. They argue that in such a circumstance, a contract providing incentives for sugar purity is irrelevant because it is not an informative signal with respect to unobserved grower actions.

Similarly, using a large sample of survey data on the California winegrape industry, Goodhue, et al.'s (2003) study of choice of formal contracts and contract design reveals that production practice provisions are more likely to be found in contracts in the regions with higher priced, higher quality grapes while price incentives for any of the measurable quality characteristics are more likely to be found in contracts in the regions where the price and quality of grapes are low. They also find those two decisions are closely related to characteristics of farming and growers. Specifically, they find a higher probability of formal contracts versus oral contracts is correlated with growers in regions with the highest grape prices, where quality is highest and product differentiation is most prevalent. While Hueth and Melkonyan's study informs that high non-separability between what agents do and what nature does hinders 'price incentive' for quality (Eisenhardt, 1985; Holmstrom, 1999), Goodhue, et al.'s study suggests that outcome measurement difficulty but high task-programmability between process and outcome (Ouchi, 1979; Eisenhardt, 1985) allow principals to design production practice rules for agents to follow in order to come up with desired quality of the products at stake.

Knoeber's (1989) study on broiler production contracts informs the relevance of contractual externality explanation although the theoretical works came after his study.

He elaborated on the reasons for predominance of production contracts relative to vertical integrations in broiler industry in which producers and processors have highly specific investment relationship (site specificity). He claims that the prevalence of production contracts comes from the unique features of tournaments as a relative grower performance evaluation system (rank-order) and the grower provision of chicken houses given the processors' providing of main variable inputs to significantly affect the quality of chicken. The uses of tournaments to compensate growers reduce not only the costs of contracting but also help maintain greater incentive intensity for growers to perform, and requiring growers to provide chicken houses offers proper incentive for maintenance without any need for expensive monitoring. This study shows how contracting parties use different types of incentive instruments to get balanced incentives of workers across multitasks, the maximization of feed efficiency and chicken house longevity, for example.

Researchers also attempt to estimate optimal compensation or payment rule. Hueth and Ligon (2002) attempt to compute optimal compensation in processing-tomato contracts using nonlinear programming. Specifically, the authors use data on quality outcome for California's processing-tomato growers to estimate agents' stochastic production function and thereby estimate preference parameters (agent risk aversion and the cost of effort) to compute optimal compensation. They report that growers who face higher-powered quality incentives produce higher levels of quality outcomes and efficiency loss from information constraints are 1 percent of mean compensation.

Finally, largely based on positive agency theory Sykuta and Parcell (2003) use a sample of 23 contracts for identity-preserved, GMO-free soybeans for the 1999 to 2002

crop years to analyze the allocation of value and decision rights associated with the transaction and the resulting allocation of risk associated with various sources of uncertainty. They propose that for the allocation of production risk, the choice of acreage contracts as compared to bushel contracts is likely to occur as the degree of production variance decreases and thereby task programmability for the production increases, and for the allocation of decision rights, *Buyer's Call* contracts relative to *Harvest Delivery* contracts tend to be chosen as the marginal net benefits from the elevators' exertion of decision rights increase.

5.2 TCE or Measurement Cost Theory

Researchers use TCE to analyze the choice to contract as a discrete form of governance and the designing issue of contracts. Menard (1996)'s case study on the governance structure of the LABEL system in the French poultry industry highlights the role of brand name capital and temporal specificity on the development of contracts among economic actors in the value chain, departing from traditional market transactions. He argues that the two types of asset specificities arise from growers' choice of differentiated chickens from standard chickens. He documents detailed information regarding co-development of multiple governance structures of different degree of centralization, from a network of independent partners through a cooperative to an integrated firm using resource-providing production contracts, and various types of contracts in the same industry. The study also draws attention to the institutional environment within which contracts are designed, implemented and enforced, affecting overall costs of contracting, by closely scrutinizing "Certifying Organization," an unique

independent organization monitoring and enforcing the contracts made among all parties participated in the LABEL value chain.

Maze (2002) investigates the newly developed contractual arrangements, tripartite contracts, initiated by French retailers such as Carrefour, which include agro-food firms and farmers' associations in contrast to the usual dominance of spot market transactions in the beef sector. She focuses on the contract's role for guaranteeing the implementation of quality specifications, including traceability, and argues that the advantage of these contractual arrangements is that they provide the retailer a way to improve its knowledge about farmers' practices and the efficiency of traceability systems. Based on the joint analysis of the retailers' organizations and the full set of 15 contracts between a large retailer and its beef suppliers, including their evolution before and after the BSE crisis in 1996 (the period 1993-2000), she shows that the evolution is explained, for the retailer, by the threat of losing its reputation capital among consumers and the need to counterbalance the loss of information about farmers' breeding practices, and to codify the tacit knowledge and competencies involved for the evolution of quality.

Gallick (1984) provides empirical evidence for the measurement cost explanation of bilateral contracts. His case study on contracts governing relations between the U.S. tuna harvesters and processors proposes that saving wasteful excess measurement and sorting costs is an important factor for trading parties to depart from spot market transactions to exclusive bilateral contract transactions. He argues that the U.S. tuna marketing arrangement, which relies on exclusive dealing contracts, prevailed since the 1950s as a means of eliminating some of the marketing costs inherent in competitive auctions. Competitive bidding among tuna processors in the U.S. market is likely to result in

excessive sorting of tuna into “blocks” and duplicative inspection of each “block” of tuna offered for sale. If a processor inspected a captain’s entire catch and made an one-time offer of a single price reflecting the average quality or value of all units in the catch, sorting and inspection costs might be dramatically reduced.⁶

Martinez and Zering (2004) examines the benefits of hog marketing contracts relative to spot market transactions and limitations of marketing contracts relative to production contracts or vertical integration from a pork quality measurement cost perspective. Analyzing a limited sample of long-term marketing contracts they find that long-term marketing contracts whose clauses contain standards for minimum live or carcass weight and have minimum quality requirements allow packers to reduce the costs of measuring and sorting hogs into narrower quality groupings. They also conjecture that pork packers’ needs to secure quality attributes that are difficult to measure lead to production contracts or vertical integration given high programmability in hog production.

Finally, Balbach (1998) documents how ownership structure between farm producers and processors affects contracting costs and thereby contract design and outcomes. She maintains that a sugar processing cooperative’s exclusive adoption of

⁶ Gallick’s measurement cost explanation of the choice of exclusive dealing contracts is different from the asset specificity consideration. This view of long-term contracts has been further investigated by Lafontaine and Masten’s (2002) study of contracting between carriers and drivers in US trucking industry. Their study reveals that driver compensation for a haul tends to be determined by its noncontractible attributes such as time spent for non-driving activities. Specifically, their empirical results support that the choice between mileage-based pay and percentage of revenue-based pay is likely to be made by trade-offs between the greater objectivity and lower implementation costs of the former and the higher accuracy predictor of driver costs in the latter. Based on their findings, Masten (2006) claims that the value of long-term contracts may originate from their capabilities serving to save the costs to negotiate a price for each transaction in a series by ‘intertemporal bundling’ of heterogeneous freight transactions.

extractable-sugar contracts, which contain a more precise quality measurement and thereby offer incentives for growers to supply higher-quality sugar beets than other contracts offered by investor-owned processors, can be explained by the growers' residual claimants status in the cooperative, which reduces the costs of monitoring the processor's quality measurements and the cooperative's incentives to underreport quality.

5.3 Literature combining of Multiple Theories

Contracting parties' designing of contracts may be better explained by bringing multiple theories together. Gallick (1984)'s detailed case study of unique exclusive dealing contracts governing relations between tuna harvesters and processors uses agency theory and transaction cost theory. Exclusive dealing eliminates all alternative users (processors) of tuna harvested under contract. Hence, freshly caught tuna under contract to a processor represents an extremely specialized asset, the quasi-rent value of which is potentially appropriable. Under these conditions, processors have an ability to hold up U.S. harvesters in the sense of opportunistically taking advantage of some unenforceable provision of the contract. The costs of eliminating the hold-up incentive can be simply viewed as a cost of exclusive dealing. He argues that if the savings in the costs of contract transaction exceed the cost of preventing the holdup, exclusive dealing remains efficient. The change in fishing technology in the mid-1960s increased the expected gain and, at the same time, reduced the expected costs of processors' opportunistic behavior because the maximum delivery by an average seiner (new technology) was five times the maximum delivery of a typical bait boat (old technology), which increased the potentially appropriable quasi-rents on each tuna delivery. In response to the adverse effects of the

technological change on exclusive dealing, countervailing institutions including joint ownership of the vessel emerged in the purse-seiner period to reduce the processor's incentive to behave opportunistically.

The captain, however, has an incentive to under-supply his labor and to over-use the vessel under joint ownership given the costs of monitoring the activities of the captain are quite high. The emergence of co-ownership, therefore, was also associated with the introduction of new institutions serving to decrease the agency costs, such as annual bonuses offered by processors for exceptionally large seasonal catches and processors' payment for some repairs and maintenance of the vessel. This study demonstrates that a more comprehensive explanation for the observed design of a contract may require multiple theories given the compound and interconnected sources underlying coordination difficulties. This also illustrates the endogeneity of governance form and contract design.

Olesen (2003) conducts a case study of a contract between farmers and the processor, Danisco Foods in Demark, using incentive theory and TCE. He documents detailed information about the contracting process as well as contract structure. The contracting features two major components: contracts with the processor are negotiated through The Pea Growers' Association; and the contract production is based on one year. He argues that synchronizing issues between the processor and producers are the driving force behind the contracts, which results in the shift of decision rights over pea production affecting coordinating between production and processing stages, including the timing of sowing and harvesting. He also offers information that the payments to farmers are based on a tournament system and the price risk and part of common

production risk are shifted to the processors. His analysis of the contracts thus informs that the contracts are designed in a way that the allocation of decision rights accompanies the shift of corresponding risk. Specifically, when decision rights over the timing of sowing and harvesting need to be shifted to the processor in order to eliminate potential adverse effects of producers' decentralized decision making on the processor, payment scheme should be designed in a way to shift the risks corresponding to the shift of decision rights.

5.4 Summary of the Literature and Directions of Future Research

Although the literature on contracting in the agro-food sector covered in this section is not exhaustive, it is safe to say that contract studies have recently been burgeoning in both U.S. and European countries. Normative or positive agency theory-based empirical studies have been looking at incentive structures for quality; the risk and other consequences of shift in ownership of input and output in livestock production contracts; the allocation of decision rights over production, harvest and delivery; and the optimality of observed payment structures. In contrast, TCE or measurement cost theory-based empirical literature has focused on the contract enforcement mechanism, the choice of contracts, and effects of ownership structure on contract design. However, asset specificity-based TCE empirical studies are rarely found in the agro-food sector. The main features of the existing empirical literature and directions of future research are summarized in this subsection.

A striking feature in contract design studies in the agro-food sector is that studies that greatly emphasize incentive alignment rather than transaction cost economizing have been frequently found, although the vast majority of the studies are not based on a formal

econometric analysis. This is partly because the vast majority of contracts used in the agro-food sector are not long-term contracts but single-season contracts. As a result, there are few contract adaptation issues, which is much dissimilar with the analytical focus of long-term contracts used in energy and transportation industry.

While a growing body of literature has been devoted to analyzing contract design, analysis of the transition from spot markets to formal contracts has been much less explored. Although a large body of literature has offered explanations for the recent trend in organization of agricultural production in general, there is little systematic analysis of factors affecting the transition in a commodity or across commodities. The examination of the choice of contracts as opposed to spot markets is very important because it helps not only enhance our understandings of the sources of transaction difficulties in spot markets but also inform the background of the specific contract type or provisions chosen when parties structure the contracts. In this regard, Olesen's case study is informative in that it highlights synchronizing as a primary driver for choosing formal contracts in a circumstance where one party's independent decision is likely to result in a suboptimal outcome from the joint-surplus maximization perspective. In addition, James, et al's (2007) emphasis on complementarities in technology and organization within a food supply chain is informative in that it calls attention to simultaneous scrutiny of the characteristics of interconnected nodes in the supply chain.

One of the conspicuous facets frequently observed in agro-food sector contracting in either U.S. or European countries is in the prevalent contractual restrictions on parties' behavior and/or exertion of decision rights and asset or product ownership. Nonetheless, the role of the contractual restrictions as a coordination device is underexplored (Menard,

2004: 366), relative to a growing body of franchise literature on various contractual restrictions. In this respect, two strings of studies are required. First, there is a need for analysis of the regularities and consequences of decision right allocation and the nature and multi-component of ownership. Second, more analysis is needed on monitoring and/or enforcement mechanism implications of the provisions associated with behavioral restrictions.

Finally, the relationships among multiple instruments need to be simultaneously considered. Allocation of decision rights, incentive price structure, behavioral restrictions, and contract duration tend to be interrelated. There needs to be more in-depth scrutiny on whether the relationships between these instruments are complementary or substitute, what relative costs of alternative instruments are, and what the relevant determinants of the costs are.

To conclude, the review of the existing literature on the choice and design of contracts suggests that more works are needed in both theoretical and empirical sides to explain the choice of contract as opposed to spot markets in the agro-food sector on which this dissertation mainly focuses. On the theoretical side, two lines of inquiries are needed. First, given the nature of the research objective, analysis on fundamental common characteristics across all contracts distinguished from spot markets is required. Given the variety of contracts in terms of formality, duration, and complexity, the analysis would help us to understand primary differences between the two organization forms, isolating the idiosyncrasies from commonalities of various contracts. In this regard, Williamson's analysis on the three key attributes in the three generic types of

governance structures may be a good starting point, but a close scrutiny on the capabilities and costs of the two organization forms needs to be done.

Second, based on the comparative analysis of contracts and spot markets, there is a need to examine potential factors demanding the common capabilities of contracts and highlighting the limitations of spot markets. The influencing factors may be different from those affecting the formality, duration, and complexity of contracts and may contribute to clarify the latter factors. From this angle, existing theories of organization form choice need to be reexamined, including concerns regarding appropriation, misrepresentation, incentive distortion, and suboptimal allocation of decision rights. This dissertation addresses those two theoretical issues.

On the empirical side, two strings of works are also needed. First, the analysis of contract documents is essential to understand the mechanism underlying choice to contract as well as specific design of the contracts since contract provisions may inform potential major concerns arising when the exchanges would be organized through spot markets. Particularly, the fact that there are few contract empirical studies relying on contract documents analysis in the agro-food sector suggests that the contract document analysis is demanding. Although contract analysis may be conducted across industries or within an industry, coexistence of alternative organization forms within an industry may provide plausible ground for researchers analyzing contracts to obtain specific information concerning exchange mechanisms inherent in contracts used in the industry.

Second, given the lack of empirical literature for testing existing contract theories in the agro-food sector, an econometric analysis of data concerning potential factors influencing the decision to contract in an industry would be beneficial to identify the

sources of coordination difficulties in spot markets as well as to deepen our understanding of alternative organization forms. This dissertation takes the U.S. pork industry to conduct the empirical analysis.

Chapter 3 DOWNSTREAM PRODUCT DIFFERENTIATION AND UPSTREAM CONTRACT CHOICE IN THE AGRO-FOOD SECTOR

1. Introduction

The agro-food sector has experienced recent development of contract transactions between agricultural production and processing or distribution stages in both U.S. and Western European countries. This research explores factors other than asset specificity influencing the choice of contracts, highlighting the role of product differentiation strategy of downstream firms on the transition from spot markets to contracts in upstream markets. In order to do so, it analyzes the organizational features of spot markets and contracts, and proposes the fundamental elements of those two organizations: instantaneous and anonymously disconnected exchange versus deferred, identity-preserved and repeated exchange. Short-term contracts include the first two elements of the latter while long-term contracts possess all three. By doing so, it shows that the buyer-specific product characteristics of product differentiation strategy is likely to be incompatible with the organizational features of spot markets and sheds lights on the

capabilities of contracts being able to *ex ante* communicate with growers regarding the design of buyer-specific products and the corresponding incentive prices and restrain growers' decision rights before entering into production. Based on this analysis, it proposes that spot markets tends to be replaced with various type of contracts in upstream markets when the buyer-specific characteristics of product differentiation strategy meets the costs of measuring the attributes of search goods, experience goods, or credence goods, or invites the costs of pricing the buyer-specific attributes of the product, or is combined with investment in brand name capital in downstream markets.

The chapter is organized as follows. The following section describes the recent features of vertical contracting in the U.S. and Western European agro-food sector, underscoring the differences from traditional contracting. The third one reviews the extant asset specificity and measurement cost explanations of long-term contracts and points out their limitations in accounting for most short-term contracts and even some long-term contracts. And then the fourth section proposes an alternative explanation for the transition from spot markets to contracts analyzing party-specific product characteristics of product differentiation strategy in the agro-food sector based on the three basic elements of contracts. The fifth one illustrates how the decomposition of contract characteristics and the notion of party-specificity are informative to better explain contracts recently developed in the agro-food sector. The sixth section uses a more comprehensive analytical framework including product-specificity and other theories to explain four representative examples from recent development of contract transactions: identity-preserved grains; tobaccos; hogs; and French retailers' case. Concluding remarks follow.

2. The Features of Recent Vertical Contracting in the Agro-Food Sector

According to USDA data, vertical contracts govern 39 percent of the value of the U.S. agricultural production in 2003, up from 28 percent in 1991 and 11 percent in 1969 (MacDonald and Korb, 2006). In early 1960s, the vast majority of agricultural commodities had been traded in various types of spot markets and contracts had been used in a limited number of commodities. Commodities having favored contracts include sugar crops; processing vegetables including green peas, sweet corn and cucumbers; specialty crops such as vegetable and flower seeds, hybrid seed corn and shade-grown and aromatic tobaccos; and chicken. For the commodities listed above, contracts or vertical integration have been common for decades. The transactions of citrus crops and dairy products had been organized by either formal or informal contracts offered by farmers' cooperatives or by other types of processors or distributors (Mighell and Jones, 1963). According to Rhodes (1987), contracting has been gradually expanded in the fields of processing vegetables, potatoes, cotton, eggs, and turkeys during 1960-1980.

Table 3-1: Estimated Percentage of Agricultural Outputs Produced under Contracts

Item	1960	1980	1991-93	2003
Crop	11.6	16.7	24.7	30.8
Livestock	27.5	33.0	32.8	47.4

Source: Rhodes, 1987 for estimates in 1960 and 1980 and MacDonald and Korb, 2006 for estimates in 1991-93 and 2003.

Contract adoption and diffusion in recent decades however are significantly different from the old trends of contract adoption in terms of the spreading speed, the number of

commodities covered, and the initiating parties. Recent diffusion of contracts in overall commodities has been done with high speed (see Table 3-1), although the diffusion speed varies across commodities and region (MacDonald, et al., 2004). The number of commodities using contracts and the share of contract use in commodities has increased. Contracts now cover almost all of the agricultural commodities to some degree. Tobacco, hogs, and winegrapes are epitomes of commodities rapidly adopting and diffusing contract transactions while rice, cotton, dairy, and beef cattle are ones that have increased the share of existing contract use.

However, this is only part of the story. Contracts have been favored for transactions of certain types of grains and oilseeds like identity-preserved corn and soybeans, wheat for baking, and soybeans and canola purchased for specific compounds (Mussell, et al., 2003). Almost all of the agricultural commodities have something to do with contracts to some degree, which means that it is difficult to expect that contracts tend to stick to certain characteristics of a commodity in general. Contracts rather have something to do with certain characteristics of products for exchange. Certain type of products within a commodity group favor contracts while others still prefer traditional spot markets. Common contract-favored characteristics of products therefore may be found across commodities. After reviewing recent trends of contracting diffused in the U.S. agro-food sector, MacDonald, et al (2004) summarize that within broad commodity groups, contracts are far more likely to be used by larger producers for more-differentiated products (p.62-63).⁷

⁷ Mussell, et al.(2003) describe similar observations. After documenting 26 pricing schemes other than spot market pricing observed from various commodities including beef, hogs, grains and oilseeds, dairy, poultry and eggs, and processed food and horticulture, used in North America and European countries, they conclude as follows: “We have seen new food products emerge and

Vertical contracting used in the agro-food sector varies in terms of the duration and internal structure. Contract durations differ across commodities and even the same class of commodities. Multi-year contracts are commonly found in hog marketing and production contracts and broiler production contracts.⁸ However, the vast majority of marketing contracts used in most grains, tobaccos, fruits, and vegetables are based on one production cycle period.⁹ The internal structure of contracts also varies from contract to contract. Some grain marketing contracts are three page simple ones while many long-term hog procurement contracts take on a more complex structure specified with fifteen to twenty page-volume. Furthermore, vertical contracts significantly differ in terms of their designation of ownership of inputs and outputs. As commonly observed in the livestock industry, marketing or procurement contracts assign the ownership of raw inputs and outputs to farm producers while production contracts allocate it to processors.

The coexistence of alternative organization forms in the same commodity group is another striking feature of vertical transactions in the agro-food sector, which implies the existence of secondary markets for products using contracts or vertical integration, with some degree of market value for the products in the markets. The U.S. pork industry has been simultaneously using spot markets, marketing contracts, production contracts, and

be successful, and with them create markets for differentiated farm products that had not previously existed. In almost every case, these products had to be developed out of the tradition of commodity markets (p. 2).”

⁸ Observed short-term hog marketing contracts indicate their durations of around 6 months while the lengths of long-term hog marketing contracts range from 3 to 10 years (Muth et al., 2005; Martinez and Zering, 2004). According to USDA ARMS results, the durations of broiler and hog production contracts range from a few months to over 5 years and 21.5 percent of broiler production contracts and 30.1 percent of market hog production contracts do not even specify the duration (MacDonald and Korb, 2006).

⁹ According to the 2004 nationwide survey results on contracts used by 686 facilities of organic processors and distributors to procure 39 commodities including livestock, grains, fruits, and vegetables indicate that 73 percent of durations of total contracts are based on one production season or year while 10 percent of total contracts do not specify the length (http://www.ers.usda.gov/Data/Organic_Handlers/, December, 2007).

vertical integration, for example. Spot markets and contracts have been coexisting for the upstream transactions of most agricultural commodities including grains, oilseeds, fruits, and vegetables. Therefore, the analysis of contracts requires researchers to look at characteristics of specific products rather than generic commodities.

Formal contracts have been traditionally made between processors or input providers and growers in the U.S. However, cooperatives also have begun to use formal contracts. In particular, contracts have been favored by newly organized cooperatives such as new generation cooperatives (Harris, et al., 1996). The conventional approach to agricultural cooperatives illustrates that they do not necessarily require formal contracts made between a cooperative and the members because the farmer-members are residual claimants of the cooperative (thereby the transactions between a cooperative and the members in nature are governed by contingent contracts) and there is little significant incentive conflict (Staatz, 1989). However, since members' incentives to cheat on quality and free-ride on delivery quantity are particularly problematic in the vast majority of new generation cooperatives, which involve value-added processing and marketing activities, contracts that specify delivery rights, quality control mechanism, scheduling of delivery and remedies for contract breach become essential. Therefore, the choice of formal contracts varies across cooperatives which basically share the same class of governance structure.¹⁰

Contract transactions have been expanding in European countries too. In most Western European countries, the vast majority of agricultural products in upstream

¹⁰ One may argue that the use of formal contracts depends on cooperatives type classified by the degree of members' incentives to free-riding and its potential impacts on total joint-surplus between a cooperative and the members.

markets had been exchanged through agricultural cooperatives, auctions or traditional intermediaries. However, the traditional organization modes have become more complicated due to structural change in the retail sector and European consumers' changing demand patterns into products perceived to be safer, more healthful, or produced taking animal welfare or environmental concerns into consideration. According to a survey result, European consumers are far more concerned about food safety and process attributes of food than are American consumers (Henson, 2001). Agricultural cooperatives and investor-owned processors have become more reliant on formal contracts with members and growers to respond to the changes (see, Bogetoft and Olesen, 2004 for Denmark case, Kyriakopoulos and Bekkum, 1999 for the Netherlands case, and Menard, 1996 for France case).

Another striking feature of contract use in European countries is that in recent years, large retailers have become progressively entering into long-term relationships with processors and growers via formal contracts, which is distinguished from the U.S. experience. For example, in France, Carrefour developed premium private labels which apply to the meat, fruit and vegetable, and seafood items. In 2003, Carrefour had implemented over 250 partnership agreements with over 35,000 producers (Bazoche, et al, 2005).¹¹ The products procured by long-term contractual supply relationships between retailers and producers are differentiated from generic products which are purchased on spot markets without any formal agreements and are sold on separate store shelves (see Cordorn, et al, 2005b, Maze, 2002, and Raynaud, et al., 2005 for more detailed analysis).

¹¹ This trend has also been identified by interviews with 751 retail purchasers in 16 European countries, whose results show that in addition to traditional factors like price, quality, and the ability to supply needed volume, the ability to trace back products and the willingness of suppliers to engage in long-term relationship with retailers are the most important selection criteria (Skytte and Blunch, 2001).

To summarize, recent features in the modes of organizing transactions of agricultural products indicates considerable use of contracts away from traditional market arrangements over virtually all commodities. It is also a growing trend that certain types of cooperatives and retailers have entered into contract transactions in the agro-food sector. The duration and internal structure of contracts considerably varies across commodities and across product characteristics within same commodities, ranging from simple to complex contracts. Finally and more importantly, contracts tend to favor products of specific characteristics rather than commodities in general. In most commodities, therefore, it is commonly observed that multiple organization modes currently exist in a commodity class.

3. Asset Specificity and Measurement Cost Explanations of Contract Choice

3.1 Asset Specificity Explanation

Comparative analysis of spot markets vs. long-term contracts has been approached from TCE initiated by Oliver Williamson (1979, 1996) and Klein, Crawford, and Alchian (1978). TCE regards the observed discrete organizational modes as ones developed in order to economize on transaction costs in a discriminating way. A long-term contract is regarded as a governance to protect one party's investment in transaction relationship-specific assets or the value of transaction relationship from trading parties' potential opportunistic behavior. Therefore, added contractual safeguards including information disclosure and dispute-settlement machinery as well as the contract duration to cover the

longevity of the assets invested are emphasized (1996: 104).¹² Williamson (1996) lists six types of asset specificity: physical asset, site and human- asset specificity, brand name capital, dedicated assets, and temporal specificity. He also adds that the first five forms create bilateral dependency and pose added contractual hazards (p.105-106).

This asset specificity explanation of long-term contracts has been supported by a few empirical studies (see Joskow, 1985 for coal-burning electricity industry case and Lyons, 1994 for the UK engineering sub-contracting case) relative to a large body of empirical literature on make-or-buy decision. The physical asset and site specificity consideration has been also adopted to explain the contracts used in the U.S. hogs and broiler industry (Martinez, 1999, 2002). However, the evidence of physical asset or site specificity in a sense of investment in transaction relationship-specific assets has not been yet found in transactions in the agro-food sector (Masten, 2000a).

Brand name capital, which has been fairly explored in the context of franchising, has been taken into consideration to explain the contracts used between processor and growers in France for transactions of differentiated chickens (Menard, 1996). Finally, temporal specificity arising mainly from perishability of products such as raw milk, chicks, pigs, eggs, fruits, and vegetables might be the most applicable candidate of asset

¹² Long-term contracts however may give way to hierarchies when uncertainty arises. Williamson (1971, 1975, 1979, 1996) maintains that uncertainty plays a key role of increasing the probability of postcontractual opportunistic behavior appropriating “quasi-rents” supported by asset-specificity (Klein, Crawford, and Alchian, 1978) under long-term contract execution process, resulting in maladaptation of long-term contracts because uncertainty tends to move together contractual incompleteness due to human beings’ bounded rationality and the incompleteness increases the probability and frequency of contract renegotiations. The stability of long-term contracts as an alternative of vertical integration has been closely examined by Klein, Crawford, and Alchian (1978), Klein and Laffler (1981), and Klein (1996). According to these works, if brand-name capital or reputation for both parties is great, market environments are stable, and/or the business in problem is growing, long-term contracts are likely to sustain.

specificity consideration of the choice of contracts for organizing agricultural transactions (Masten, 2000a). Menard (1996) also points out the role of temporal specificity in explaining the transactions of fresh chickens in France. Looking at the observed various mix of organization forms in perishable products, however, the question arises of whether perishability alone leads to contracts or vertical integration as Williamson (1996) already pointed out.¹³

3.2 Measurement Cost Explanation

Measurement difficulties of attributes of products, assets, or outcomes of workers have received much attention from measurement cost theorists and normative agency theorists as a potential factor to affect the choice of organizational forms (see Barzel, 1982, 2005 for the former, and Holmstrom and Milgrom, 1991; and Holmstrom, 1999 for the latter). Even if the specific points of emphasis are dissimilar between the two theories, both agree that when output is difficult to measure and inputs are the best available proxies for measuring output, the market transaction is likely to give way to in-house production because of concerns regarding wasteful excess measurement or duplicate sorting activities (Barzel, 1982) or suboptimal outcome arising from contractual externality (Holmstrom, 1999).

¹³ We conjecture that combining perishability and the absence of alternative buyers in hand together is likely to favor organization modes other than spot markets because it increases ex post bilateral dependency. The imperfectly competitive market structure facilitated by the characteristics of products requiring timely responses has received attention from economists. They traditionally attribute the development of agricultural cooperatives, ‘incomplete forward integration’ by farmers, to upstream parties’ response to potential social loss from the market power exerted by downstream parties (Hansmann, 1996; Staatz, 1989).

While normative agency theory focuses on the rationale of the firm vis-à-vis markets and organizational architecture within firms, measurement cost theory has informed the choice between spot markets and contracts. When the variability of the measured attributes of products at stake becomes non-trivial, market arrangements emerge in order to reduce the losses from economic traders exploiting measurement errors (Barzel, 1982: 28). Barzel enumerates product warranties, proxy measurement, futures markets, brand names, share contracts, and repeat purchases. Under exclusive dealing contracts or long-term relations, the buyer saves the costs of measuring at purchase time (Gallick, 1984; Barzel, 2005).¹⁴ Martinez and Zering (2004) use the measurement cost consideration to explain long-term hog procurement contracts. By analyzing a limited sample of long-term marketing contracts, they find that long-term marketing contracts whose clauses contain standards for minimum live or carcass weight and have minimum quality requirements that allow packers to reduce the costs of measuring and sorting hogs into narrower quality groupings.

Masten (2006) provides a more extended explanation based on Lafontaine and Masten's (2002) study of contracting between carriers and drivers in the U.S. trucking industry. Lafontaine and Masten found that the choice between mileage-based pay and percentage of revenue-based pay in order to compensate for a haul is likely to be determined by its noncontractible attributes such as time spent for non-driving activities. Masten (2006) claims that the value of long-term contracts may originate from their

¹⁴ Gallick argues that the U.S. tuna marketing arrangement which relies on exclusive dealing contracts prevailed since the 1950s is a means of eliminating some of the marketing costs inherent in competitive auctions. Competitive bidding among tuna processors in the U.S. market is likely to result in excessive sorting of tuna into "blocks" and duplicative inspection of each "block" of tuna offered for sale. If a processor inspected a captain's entire catch and made a one-time offer of a single price reflecting the average quality or value of all units in the catch, sorting and inspection costs might be dramatically reduced.

capabilities serving to save the costs to negotiate a price for each transaction in a series by ‘intertemporal bundling’ of heterogeneous freight transactions.¹⁵ This explanation illuminates the difficulties in pricing for a task delegated by one party to another when the task involves attributes difficult to measure, and thereby the value of ‘repeated exchange’ inherent in long-term contracts which enable the measurement errors in each transactions to average out.

3.3 The Limitations of Existing Explanations

While asset specificity concerns may explain long-term contracts, it may be limited for explaining a large number of short-term contracts used in the agro-food sector. Furthermore, an overview of contracting recently developed in the agro-food sector described at the previous section indicates that the increasing contracting phenomena do not much coincide with an increase in investment in transaction relationship-specific durable assets. Whereas the measurement cost consideration is informative to explaining long-term contracts that do not involve investment in transaction relationship-specific durable assets, it is not clear what factors determine the choice of non-bilateral devices such as public standard and grade or product warranties and bilateral contracts, to lessen sellers’ misrepresentation incentives. Furthermore, single-season contracts frequently observed in the grain, oilseeds, and tobacco industry may not be explained by ‘repeat purchases’ characteristics inherent in long-term contracts.

¹⁵ Furthermore, Masten proposes that the formal contracts’ function of economizing on the cost of pricing heterogeneous transactions may explain a class of contracts that involve little in the way of relationship-specific investments, including franchise contracts, equipment lease, distribution and advertise agreements, and software license.

Therefore, a closer scrutiny of difficulties associated with traditional spot market transactions as well as the capabilities of short or long-term contracts is required to systematically explain the transition to contracts in the agro-food sector where product attributes and biological variation are prevalent.¹⁶ This study attempts to fill the gap. It builds on the existing contract literature to expand the explanatory variables in the choice of contracts.

4. Party-Specific Products as a Driving Force of Contract Use in the Agro-Food Sector: An Alternative Explanation

4.1 Decomposition of Fundamental Characteristics of Spot Markets and Contracts

Spot markets governing transactions of agricultural products take on various types of price determination processes but can be categorized into the three categories: organized markets; individual negotiation; and price making by individual buyers or sellers (Rhodes, 1987). Organized markets include auctions, computer matching, and centralized negotiation while decentralized, individual negotiations are made at the farm gate. Price making by individual firms includes country elevator purchase of grain and some packer purchases of livestock (Rhodes, 1987: 226-248 for more details and see Table 3-2 for a summary).

Table 3-2: Types of Spot Markets Governing Agricultural Products

Types	Examples
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¹⁶ Transition from spot markets to contracts in general has received less attention from contract researchers relative to paradigm issue of make-or-buy decision. As a result, the existing literature tends to pay much attention on the limitations of long-term contracts vis-à-vis vertical integration rather than the capabilities of long-term contracts vis-à-vis spot markets.

Organized Markets - Auction - Computer matching - Centralized negotiation	Wholesale terminals and auctions of fruit and vegetables, tobacco auctions, livestock terminals and auctions, futures exchanges, electric auctions of cotton and livestock
Decentralized, Individual Negotiation - One on one at production sites - One on one over telephone - Formula pricing	Wholesale selling of meat, eggs, cash grain, cheese, some fresh fruits and vegetables. Farm sales of cattle, hogs, and raw milk
Price Making by Buyers	Country elevator purchase of grain; some packer purchases of livestock

Source: Rhodes, 1987: 228

From an organizational point of view, spot market exchange features two basic factors: instantaneous exchange and anonymously disconnected transactions. Spot market exchange assumes that making and executing an agreement virtually coincide. There is no issue associated with time lag between those two stages. It therefore implies that *ex ante* communication between potential traders are not required. Individual parties' independent decision-making leads to socially optimal outcomes without consulting others because the attributes of products to be exchanged are *ex ante* defined among all potential traders and the information of the prices are transmitted without large costs. The value of attributes of a product tends to be identical across potential buyers. The price therefore is mainly determined by the quantity dimension. This leads to the second feature of spot market exchange. The existence of the prices of pre-defined products does not much make potential traders' identity matter. Therefore, switching one trading partner to another is not costly because the value of products in the same class does not vary across buyers and measuring the value is not burdensome. Those two characteristics of spot market exchanges are fairly close to the assumptions that the Walrasian market equilibrium relies on.

In contrast, a contract organizational mode is characterized by *deferred*, parties' identity-preserved, and/or repeated exchange. Deferred exchange is defined as one that involves the passage of time for completion of an agreement. This aspect of deferred exchange has attracted much attention from economics and contract law disciplines mainly because the passage of time between the exchange of promises and their performance creates uncertainties and risks (Cooter and Ulen, 2000). The transition from instantaneous to deferred exchange implies that trading parties, particularly buyers, necessitate *ex ante communication* with appropriate sellers to *define products* to be traded before they enter into production. This difference has received less attention, however. In fact, the first aspect of deferred exchange, contract performance, is a consequential issue of one party's need and choice of direct communication with the other party. Therefore, the second aspect of deferred exchange, *ex ante* communication, deserves to be closely scrutinized in order to understand the driving forces of the transition from spot markets to contracts while the first issue may largely influence the design of the contracts.

The second feature of contract organizational form denotes the relevance of trading parties' identity. The involvement of *ex ante* communication and time dimension in deferred exchange makes the question relevant: who are the buyers and sellers engaged in the contracts? Considering that any direct communication incurs costs and the uncertainty in *ex ante* contract formation and *ex post* contract execution periods brings forth a risk premium, selecting and maintaining appropriate transaction partners is one of the major concerns for economic actors choosing deferred exchange. Moreover, the identity issue becomes more notable when contracts govern repeated exchange and specify considerable length of the contracts.

The last characteristic of contract organizational mode indicates the duration. Contracts are divided into short-term and long-term in terms of the duration. In the agro-food sector, a short-term contract is defined as one whose duration is equivalent to the time period for producing the product to be traded. Short-term contracts are frequently found in the agro-food sector, particularly in yearly production period commodities including grain, tobacco, and processing vegetables. Long-term contracts include another notable dimension of contracts, repeated transactions. Repeated transactions here considering agricultural production refer to exchanges covering more than one harvest season rather than repeated deliveries within a harvest season. Although bringing repeated transactions into a contract makes its design more complicated, this research looks at the rationale of economic actors' choice of long-term contracts versus short-term contracts.

Disentangling of fundamental features of contracts as compared to spot markets highlights that deferred exchange is required as a result of the buyers' need to ex ante consult potential sellers in order to transmit information regarding the design of products desired by the buyers. If products to be exchanged are pre-defined or homogeneous across buyers and sellers and the reservation value of specific attribute of the products across buyers, then spot markets would best afford the exchange since spot markets are assumed to consume the least costs of communication with others. Therefore, analyzing factors forcing economic traders to turn back from instantaneous exchange to deferred exchange would be critical to identify the common features of contracts of a variety in the agro-food sector. From the comparative analysis of discrete economic organizations

(Williamson, 1996), those factors may play a role for either diminishing capabilities or rising costs of spot markets or simply mounting capabilities of contracts.

4.2 The Impacts of Buyer-Specific Products on Efficacy of Spot Markets

Transactions for buyer-specific products tend to shun spot markets mainly because the advantage of spot market price system would greatly diminish with the transactions. As Hayek (1945) pointed out, one of the striking competences of the spot market system is in the savings on the economic individuals' decision making costs by taking advantage of lower costs of communication with others within a market system. Price functions as a simple but powerful signal for individual economic agents to make a right decision to respond to market change:

“The most significant fact about this (price) system is the economy of knowledge with which it operates, or how little the individual participants need to know in order to be able to take the right action (Hayek, 1945: 526).”

The competence of the spot market system, however, significantly declines when a buyer wants to procure a product deviated from the characteristics of commodity commonly defined by market participants because the price of a general commodity is not a sufficient signal for the buyer's need to procure an idiosyncratic product. Firms tend to vertically or/and horizontally differentiate their products from their rivals'. Economics researchers have approached the issue from a couple angles. As Lancaster (1990; 192) points out, the vast majority of existing economics research on product differentiation attempts to model the effects of different market structures on the equilibrium degree of product variety provided by firms. Researchers then evaluate the consumer welfare

consequences of a derived degree of product differentiation relative to some socially optimal degree of product differentiation (Tirole, 1988). Although there is a wide variety of models of product differentiation, most of the models predict that imperfectly competitive market structures, including monopoly, oligopoly and monopolistic competition, will give suboptimal product variety, whether more or less variety than is optimal (Tirole, 1988; and Lancaster, 1990).

Departing from the market power explanation of product differentiation just described, competitive market equilibrium of differentiated products has been examined by hedonic price models. Based on Lancaster's (1966) definition of goods as a package of characteristics, Rosen (1974, 2002) pioneered a model accounting for how the values of diversified goods are determined, developing a buyers' spatial bid function and a seller's spatial offer function in the market equilibrium price-quality space instead of price-quantity space on which most of price theory for pre-defined goods focuses. According to his analysis, market equilibrium of differentiated products features that in a seller's production function, marginal revenue from an additional attribute should be equal to its marginal cost of production per unit sold, and in a buyer's value function, marginal utility from an additional attribute should be equal to its marginal price.¹⁷ The studies on product differentiation from the efficiency point of view has enhanced our understanding of equilibrium of differentiated products in consumer markets and the natural tendencies toward product differentiation and market segmentation while

¹⁷ Based on Rosen's work, a body of literature develops estimation methods of demand and supply functions for differentiated products (Palmquist, 1984; Epple, 1987; Ekeland, et al., 2002 for the methods under measurable product characteristics; Berry, 1994 for the method in the presence of unobservable product characteristics).

traditional price theory focuses on the determination of price and quantities of pre-defined goods.

Research on product differentiation focuses on the market for the differentiated goods, but there is little research on the implication of downstream differentiation for organization of upstream procurement practices. If the processor or retailer's implementation of product differentiation strategy highly depends on differentiated characteristics of raw material inputs for the final products, like many differentiated food products, how does the processor or retailer secure the procurement of the differentiated raw material inputs? Can the existing spot markets still afford the processors' needs to procure differentiated raw inputs? The impacts of processors' or retailers' product differentiation strategy on the organization of transactions of the differentiated inputs in upstream markets have been underexplored. As described above, the transactions of buyer-specific products are not likely to be found in upstream spot markets because the spot markets does not effectively afford *ex ante* communication for defining products desired by individual buyers and the efficacy of auction markets decreases with the number of buyers wanting heterogeneous packages of product attributes.

4.3 Sources and Types of Product Specificity in Agro-Food Sector

The source of food product differentiation comes mainly from quality attributes, but the dimensions of quality attributes are numerous. According to Cordon, et al (2005a) and other agro-food marketing literature, quality attributes of food products are classified into four types: sensory, health or nutrition, process, and convenience attributes. Sensory attributes are the classical aspects of food quality. Those attributes include appearance,

smell and taste. Appearance attributes include size, color, fat, and marbling. Appearance and smell attributes require consumers to spend time and effort to sort products at the time of purchase, called 'search good' attributes (Nelson, 1970). Taste attributes are 'experience good' attributes that can be evaluated only after a product is purchased. Many health effects of food are of a rather abstract nature and thus do not lead to consequences that are readily accessible to experience. Recent technology development allows for processors to design certain types of product accentuating certain nutrition attributes, e.g., high-oil or protein soybean and low fat pork.

Process attributes are related to consumers' interest in processes used in food production, even when such process may have no analyzable impact on the final food product. Some consumers pay premiums for organic products; for products produced with due concern for environmental and/or animal welfare considerations; and for biotech-free products, even when these products look and taste the same as products without these attributes. Backgrounds of these attributes include product safety issues containing Bovine Spongiform Encephalopathy (BSE) and Dioxin contamination (Cordon, et al., 2005a). In particular, European consumers have increasingly valued process attributes, most of which are regarded as 'credence good' attributes (Darby and Karni, 1973). Convenience attributes are defined as aspects of a food product that save time or energy consumers typically spend on shopping, food preparation, eating and disposal.

While the four types of food quality attributes may ascribe to the sources of product differentiation in downstream markets, the first three quality attributes, sensory, health and nutrition, and process attributes, originate at the farm level production with some

degree. Hence, the first three quality attributes may influence the organization of transactions in upstream markets. However, the choice of contracts is influenced not only by how much the quality of final food products rely on the raw material inputs but also by how idiosyncratic the desired quality attributes of the raw material inputs are. The more differentiated the quality attributes desired by a buyer are from the commonly pre-defined attributes of the inputs exchanged in spot markets, the more likely the buyer will be to choose contracts shunning spot markets for procuring the inputs.

The idiosyncrasy of agricultural products being traded takes multiple types. The first type of party-specific products comes from new attributes such as organic and unique nutrition attributes which a pre-defined commodity does not hold (Product Specificity Type I). The second type of idiosyncratic products derives from unique composition of existing attributes that a pre-defined commodity possesses (Product Specificity Type II). Examples include high protein soybeans, hogs of high percent lean, and high sugar winegrapes. The third type of party-specific products originates from intertemporal consistency in the unique package of quality attributes of products (Product Specificity Type III). For example, meat packers want to procure a target size of hogs or beef cattle across suppliers and time. When consistency in specific quality attributes is valued by end-users but biological variation in animal raisings and a large number of small growers cause impediments to the meat packers' achieving the goal, the organizational differentials between spot markets and contracts may become evident.

The degree of party-specific products will increase as the number of new quality attributes added to a generic commodity grows, as deviation of the buyer-specific products from a generic commodity in terms of the composition of certain quality

attributes enlarges, and as the target zone of consistency in the quality attributes is narrower. As a buyer wants to procure more idiosyncratic raw material inputs, he needs to consider dimensions other than quantity and price, which are the major variables for most participants to take into account in spot markets. The buyer at least needs to provide information regarding the desired product characteristics different from the pre-defined commodity exchanged in spot markets and the reservation price to be paid to potential sellers. However, it is unlikely that spot markets afford the transactions due to their characteristics of instantaneous exchange. The buyer must go to communicate with potential sellers to send signals of the desired product design, offer the corresponding incentive prices, and to settle terms of deferred exchange through a formal or informal contract.¹⁸

It should be noted that the conception of party-specific products is analogous to transaction relationship-specific investment in durable assets. The former however is a broader concept than the latter in that party-specific products may or may not involve asset specificity for the transaction. The transactions of party-specific products that do not require asset specificity, therefore, exploit deferred exchange characteristics of contracts while those that entail asset specificity take advantage of deferred and identity-preserved repeated exchange characteristics of long-term contracts. Therefore, the notion of party-specific products is more rudimentary to explain the existence of short-term and long-term contracts in the agro-food sector. Regarding definition of contracts, I follow Macneil's (1978) definition, contracts are "legally binding promises." Since one of the fundamental distinctions between formal and informal contracts involves third-party

¹⁸ However, given contract dispute resolution costs and bounded rationality of judges, whether the self-enforcement or third-party enforcement is substitute or complimentary depends on the nature of contractual relationships and the underlying institutional environments.

enforcement (Masten, 2000b), formal contracts may provide more safeguard function against contracting parties' potential contractual hazard than informal contracts do.

It is also natural to deem that product specificity may create a certain magnitude of quasi-rents, the difference of values between the intended and second best use of assets required to produce the intermediate products, creating the potential for hold-ups.

However, if the buyer-specific products do not much require investment in transaction relation-specific durable assets, then product specificity would not be much contaminated by the potential for hold-ups. This is particularly true since the costs of switching existing suppliers to others are not considerable given a large number of small growers in most agricultural production sectors and there are secondary markets for the differentiated products, whose existence has been commonly observed in the agro-food sector.¹⁹

Therefore, in general, the probability of contracting parties' post contractual haggling behaviors for rent redistribution would not be great in party-specific product transactions that do not require asset specificity.

To summarize, the decomposition of the two organizational modes is fairly informative with regard to identifying the rudimentary driving force of the transition from spot markets to a variety of contracts. Buyers' needs to communicate *ex ante* with potential sellers regarding the production and exchange of the buyer-specific products

¹⁹ The magnitudes of damages from contract breach by contracting parties may not be symmetric under the existence of the secondary markets. The damages from delivery failure of a buyer-specific product may be greater than those from the buyer's acceptance failure of the product. The forgone premium to be paid to the supplier may not be sufficient for the buyer to recover the damage from the delivery failure because the buyer cannot find the differentiated product in the spot markets at hand even if he is willing to pay the premium. In this case, the expected damages incurred to the buyer from the supplier's delivery failure is more likely to take place in both his own production cost side and intertemporal damages on his own reputation from his supply shortage or failure in downstream markets. In addition to the fact that contracts are drafted and offered by buyers in its own favor, this may be one of the main reasons that many agro-food contracts specify remedy from suppliers' contract breach in more detail than for buyers' breach.

may be a common ground to explain the transition. Deferred exchange, one of the fundamental features of any kind of contract, is a necessary condition to meet the needs. I argue that the choice of contracts in an upstream market is influenced not only by how much the quality of final food products in downstream markets relies on the raw material inputs but also by how idiosyncratic the desired quality attributes of the raw material inputs are. I also offer three measures of idiosyncrasy of the raw inputs: the number of new quality attributes (Product Specificity Type I); the uniqueness in the composition of certain quality attributes (Product Specificity Type II); and a target zone of consistency in a certain quality attribute relative to the distribution of that attribute in the pre-defined commodity market (Product Specificity Type III).

5. Interactions between Product Specificity to a Buyer and Other Considerations

The notions of product specificity to a buyer and deferred exchange are informative to better understand not only the choice of contracts but also part of contract design because it sheds light on the role of other theories of contracts. Product specificity elucidates the role of measurement costs and brand name capital on the choice and design of contracts while the notion of deferred exchange illuminates synchronizing issues arising from temporal specificity. This section discusses the informativeness of the notions of product specificity and deferred exchange.

5.1 Product Specificity and Measurement Costs

Measurement cost concerns cause market participants to develop quality standards and grading, product warranties, brand names as well as share contracts and long-term

contracts. However, it is not clear under what circumstances measurement cost concerns favor contracts as opposed to spot markets. For example, quality standards and grading allow spot markets to function better than contracts because standards & grading help reduce buyers' costs to measure commodities to be traded in spot markets.²⁰ Under what circumstances do measurement cost concerns drive the choice of contracts? The research proposes that contracts are more likely to be favored when measurement difficulties meet buyer-specific products.

Public standards and grading devices would be effective only when the attributes of the commodities to be graded and the corresponding premiums and discounts, reservation prices for the attributes, are not considerably dissimilar across potential buyers: $V_i^j \approx V_i^k$, where V^j and V^k denote buyer j and k 's reservation price for a certain attribute of commodity i . However, if reservation prices for certain attribute of commodity i vary across potential buyers, $V_i^j \neq V_i^k$, then a private grading system will be likely to develop as observed in the U.S. pork industry in the early 1990s and the tobacco industry since 2001.²¹ Individual pork packers and cigarette companies began to develop their own grading systems independent of the public standards for use in contracts with suppliers/growers. The grading schemes vary across the buyers based on buyers' downstream product market and differentiation strategies (see section 6 for more details).

²⁰ Examples include the publicly defined grain grades established under 1916 grain standards act and public standards for beef and swine under the Agricultural Marketing Act of 1946, all of which have assisted spot markets to function well (Rhodes, 1987).

²¹ For example, the USDA standards segregated swine according to intended use, sex, and quality grade. Grades of slaughter barrows and gilts were based on the measurements or estimations of quality such as characteristics of leanness and firmness of fat and the combined carcass yields of the four lean cuts (ham, loin, picnic shoulder, and Boston butt). The main problem with the USDA standards was that slaughtered animals were not well differentiated by quality, so approximately 86% or more of the hogs were graded as U.S. No. 1-2 (Muth, et al., 2007). However, the issue has not been problematic until pork packers' valuing of certain quality attributes are diverse relative to each other. See the section 5 for more details.

This is the second type of agricultural product-specificity, idiosyncratic composition of quality attributes of products, using heterogeneous quality evaluation and reward grids.

Therefore, the private grading system in nature involves transactions of buyer-specific products, not generic commodities. The case implies that contract transactions become favored when market participants' efforts to reduce measurement errors are combined with buyers' needs to procure idiosyncratic products. This proposition is distinguished from the existing measurement cost explanation of contract choice that contract transactions may serve to reduce duplicate measurement and sorting activities by exploiting identity-preserved repeated exchanges.

5.2 Product Specificity and Brand Name Capital

Brand name capital plays a role in the choice of organization mode and contract design in different ways. In the context of franchising, it is expected that a franchisor's investment in brand name capital increases the probability of the franchisor's choice of ownership of outlets or more stringent contractual restraints on franchisees' actions to protect the value of relationship-specific investment from franchisees' potential free-riding on the investment (Lafontaine and Shaw, 2001; Bercovitz, 1999). In this case, brand name capital itself is a factor generating appropriable quasi-rents because the investment in brand name capital is toward enhancing consumers' perceptions and the benefits from the investment possess non-exclusiveness characteristics within the franchisee chain. On the other hand, investment in brand name capital may play a part of increasing the costs of breaking an implicit or explicit agreement that specifies providing quality-differentiated products or is made on existing investment in relationship-specific

durable assets of other types, facilitating the parties' stay within the self-enforcing range of the contracts (Klein, et al., 1978; Klein and Leffler, 1981; Williamson, 1985). In this situation, brand name capital plays a role of bonding to assure contract performance.

Related to the second role of brand name capital, in a circumstance where food processors or retailers invest in their brand name capital in the downstream consumer markets as a bonding to assure their commitment on maintaining the quality attributes differentiated from generic commodities, the notion of buyer-specific products impinges on the processors' or retailers' choices of organization mode for procuring the raw material inputs in upstream markets. In contrast with the first role of brand name capital described above, the value of food processors' or retailers' investment in brand name capital in the consumer markets may not be vulnerable to the risk of chain externalities but rather susceptible to the raw input suppliers' contract performance when the quality of the processors' or retailers' differentiated products relies on the raw material inputs and the inputs are more buyer-specific. Therefore, the more a processor's or retailer's final product relies on the quality of raw material inputs, and the more buyer-specific the raw material inputs are, the higher are the potential losses incurred from the input suppliers' failure to meet the quality and quantity requirements corresponding to the investment in the brand name capital.

In addition to the expected positive effects of party-specific products on the choice of contracts, it is anticipated that the interactions between product specificity and brand name capital affirmatively influence the processors' or retailers' interests in contract enforcement mechanisms to increase the costs of the input suppliers' breaking the

commitment, which may result in longer-term contracts or profit-sharing rules.²² This expectation is more likely as the processors' or retailers' profits rely more on the differentiated products. In this manner, the product specificity affects the relation between brand name capital in the downstream market and the choice of contract type and design in the upstream markets.

5.3 Deferred Exchange, Product Perishability, and Allocation of Decision Rights

In the previous section, I argued that the concept of deferred exchange should be underscored to expand the common ground influencing the transition from spot markets to various contracts. The research has proposed that procuring buyer-specific products favors the deferred exchange because instantaneous exchange is more likely to generate *suboptimal products* relative to the product attributes specified by individual buyers. Ex ante communication through contracts serves to resolve the mismatch between commonly pre-defined products in spot markets and buyer-specific products.

Additionally, the notion of deferred exchange also sheds light on individual trading parties' potential *suboptimal decisions* where one party's decisions maximize private surplus but are suboptimal from the joint-surplus maximization standpoint. Given human beings' bounded rationality (Simon, 1972), those suboptimal decisions are likely to take place when both parties' decisions are complementary, meaning the value of making one decision is a function of how the other is made (Milgrom and Roberts, 1995).²³ For example, if growers' decisions on timing to harvest or deliver processing agricultural

²² See Codorn, et al., 2005b and Maze, 2002 for the case of France retailers' investment in private labels.

²³ James, et al. (2007) also use the notion of technology or organizational complementarity to explain the different adoption and diffusion of contracts and vertical integration across regions and commodities in the U.S. agro-food sector.

products are independently made for their own interest, the processing facilities may suffer from cyclical over or under utilization.²⁴ Milgrom and Roberts (1992) called it a synchronization problem arising from design attributes that force multiple parties' decision to fit together, otherwise the resulting failures of fit are very costly. Strongly complementary *activities* are a common source of design attributes, as observed in the activities of growers and a processor and the flow of perishable products. Milgrom and Roberts suggest that a "centralized setting of design variables tends to reduce both the costs of errors and the amount of communication and search necessary to identify an optimal decision" (p117).²⁵

In this regard, temporal specificity arising from perishability of agricultural products may cause the decisions of the growers and processors to be complementary and result in allocation of decision rights through a contract. This is another implication of product perishability, whereas the TCE literature focuses on potential strategic delay supported by temporal specificity, inducing in-house production (Masten, et al., 1991) or long-term contracts (Pirrong, 1993). Therefore, it is plausible that the allocation of decision rights might be required in order to achieve the socially optimal outcome if a mismatch between

²⁴ Olesen' (2003) study on the contracts between pea growers and the processor, Danisco Foods, in Demark provides an example. The timing of the harvest is extremely important to the farmers in terms of the value of the peas. If the peas are harvested too late, they will be overripe and the taste ruined. If the peas are harvested too soon, the yield is too low. The harvesting should be within a range of 24 hours. Once the peas have been harvested they must be frozen within 4 hours to remain fresh. From the processor's standpoint, Danisco Foods wants the harvesting period to be as long as possible in order to utilize the capacity at the factory. For this reason, it wants some farmers to sow very early and other farmers to sew very late, even though this reduces their yield. On the other hand, the farmers want to choose the sewing time, so their yields are maximized. These factors call for very accurate planning. The harvesting must be synchronized to match the capacity at the factory, taking into account transport time and the ripeness of the peas.

²⁵ Organization theorists have paid much attention to similar issues and explained mechanisms to resolve coordination problems arising from the lack of shared and accurate knowledge about the decision rules (Gulati, et al., 2005; Eckhard and Mellewig, 2005; Mayer and Argyres, 2004; Thompson, 1967).

the decisions of growers and processors with regard to timing of harvest and delivery results in suboptimal outcomes. In this case, the decision rights should be allocated to the party with which the value of the allocation is greater.²⁶

The allocation of decision rights however might create net losses and thereby not be realized when the party exerting the decision rights does not bear the full costs of the decision.²⁷ Hence, it is rational that contracts specify the resolutions corresponding to the costs, including compensation schemes that shift corresponding risks to the party with the decision rights. In other words, if the adverse effects of the growers' decisions on the other contracting party are greater than the potential negative effects of the move of the growers' decision rights to the processor on growers' surplus, then the decision rights are likely to shift to the processor with a side payment or other compensation that includes corresponding risk shift.²⁸

In addition to the need to consult potential buyers regarding design of products to be exchanged, the need to reallocate decision rights over growers' production and marketing

²⁶ This idea may partly explain the failure of most chicken feed companies establishing production contracts with growers in the 1950s (Martinez, 1999) and of most hog feed companies launching production contracts with growers since the 1990s (Freese, 1994; 2006). The shift of animal ownership from growers to the feed companies does not create much value relative to the case of processors who operate large slaughtering and processing plants that require timely flow of mature animals.

²⁷ This is emphasized by Barzel (1989) and has been pointed out by Harris and Massey (1968) in the analysis of the agro-food sector. After analyzing the total sample of 420 vertical contracts made between farmers and processors or distributors, or seed companies, covering livestock, poultry, and eggs, seeds, fruits, vegetables, nuts, and crops, Harris and Massey propose that there should be alignment between allocation of decision rights and allocation of the corresponding risks. However, they find that some of contracts require that the farmer follow the precise instructions of the contractor's fieldman while the contractor disclaimed liability not only for the results of the instructions but for any act or omission on the part of the contractor's personnel (p. 96). They argue that if the contract specifies transferring management control without transferring a commensurate quantum of risk bearing, it places the farmer in a state of "entrepreneurial disequilibrium" (p. 96).

²⁸ The allocation of decision rights to accomplish synchronization has been analyzed by the contract design studies of Bogetoft and Olesen (2002) and Sykuta and Parcell (2004).

domain before entering into production also calls for deferred exchange, which is a key feature of contract.²⁹ Obviously, spot markets cannot afford the need for decision rights reallocation since spot markets feature instantaneous exchange. Therefore, it would be more beneficial to look at causes of decision rights reallocation rather than temporal specificity itself.

5.4 Summary

This section has described how the notions of product specificity and deferred exchange, and the interaction effects of the two concepts with other factors inform the analysis of contract choice and design. The analysis implies that there are multiple factors influencing the choice of contracts and that even the design of a contract may be better explained by a combination of multiple factors. It may be valuable to recapitulate the main driving sources of contract choice and exhibit relating them to the three elements of contracts.

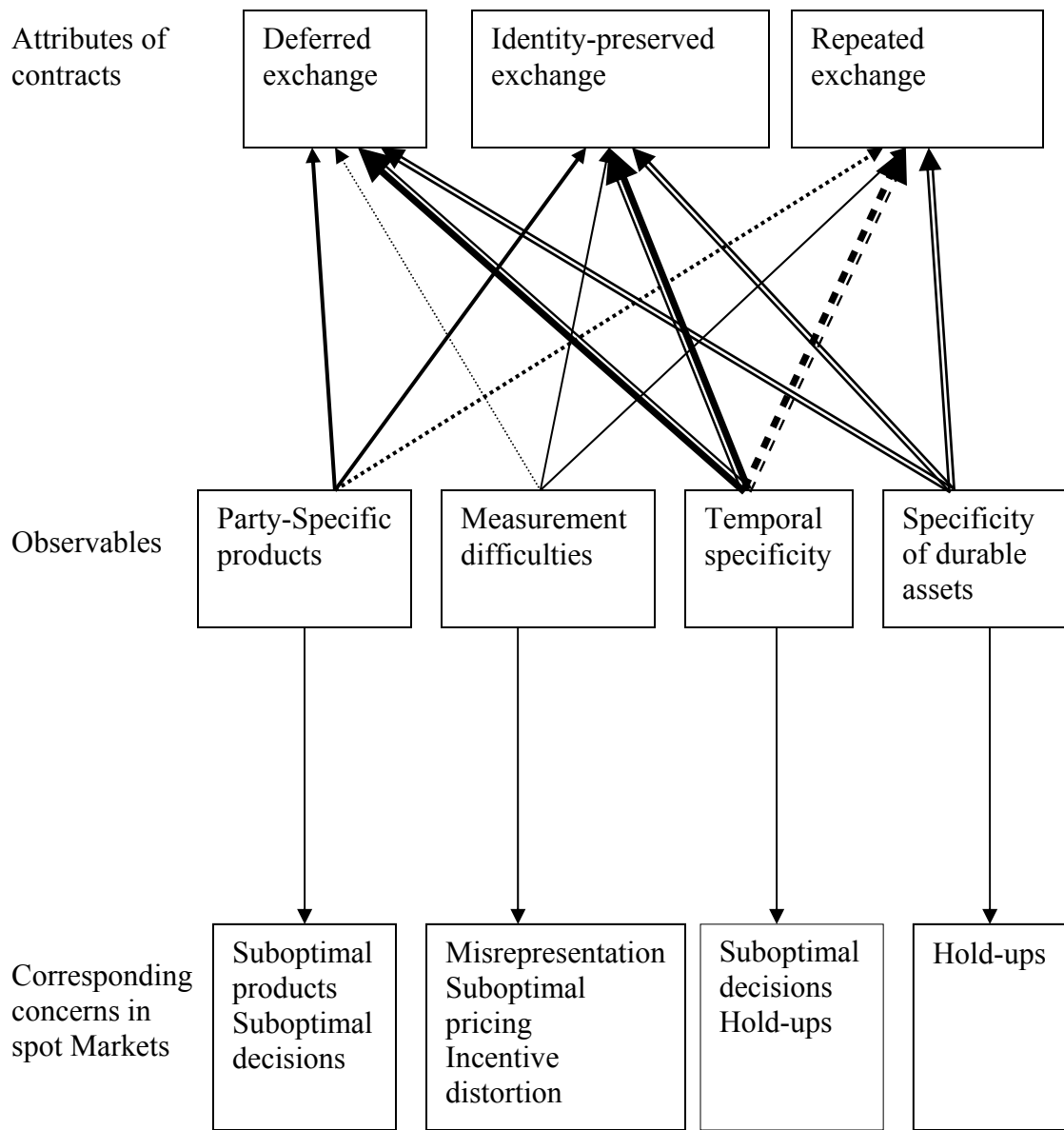
Figure 3-1 summarizes the four sources of favoring contracts vis-à-vis spot markets, applicable to the agro-food sector: specificity of durable assets; temporal specificity; measurement costs; and product specificity. Transactions involving investment in relationship-specific durable assets cannot be afforded by spot markets because the transactions necessitate *ex ante* communication between buyers and sellers about buyers' intended transaction-related variables and *ex ante* guarantee of repeated transactions and other safeguard against parties' potential rent-dissipating activities supported by the asset specificity. In the case of choosing contracts, all three characteristics of contracts,

²⁹ It should be noted that the need of reallocation of decision rights may arise from other factors such as the costs to transfer specific knowledge (Jensen and Meckling, 1992).

deferred, identity-preserved, and repeat exchange, apply in order to resolve the consequential concerns of ex post holdups or ex ante underinvestment.

Temporal specificity may create potential hold-up concerns or either party's suboptimal decisions on synchronizing issues, thereby deferred and identity-preserved exchange characteristics of contracts are required to secure transaction parties' timely responses by specifying a pre-arranged schedule for delivery time and quantity or even

Figure 3-1: Factors Influencing Choice of Contracts in the Agro-Food Sector



the timing of seeding, planting or harvesting. Since the nature of the two potential concerns arising temporal specificity differs from each other, specific conditions

affecting the magnitude of the two concerns may be different, and thereby the corresponding contract designing issues may differ. Temporal specificity may or may not require repeated exchange depending on the nature of production or contractual relationships at stake. For example, raw milk is a constant flow output after milk cows begin to produce while processing vegetables and chickens have their own production period and one-time delivery is feasible. Therefore, contracts governing raw milk transactions tend to cover repeated exchange while contracts organizing transactions of the latter products tend to cover one-time exchange other things being equal.

Measurement cost is another source of contract use in several ways. Under a circumstance where the attributes of products can be measured but measurement errors arise from the variation in the attributes, contract transactions may serve to reduce duplicate measurement and sorting activities by exploiting identity-preserved repeated exchange. However, I argued that choice to contract is more likely to arise when the measurement errors impinge on buyer-specific products. Trading parties' concern on reputation and the costs of one-time misrepresentation or cheating tend to grow as the time period of repeated exchange get longer. The second type of measurement difficulties take place when a buyer attempts to price a buyer-specific attribute of products whose production costs are volatile but should be estimated due to the absence of multilateral competitive bidding mechanism for the attribute. In this case, identity-preserved repeated transactions may serve to average out the errors associated with the prices, intertemporal bundling of the heterogeneous transactions as Masten (2006) points out.

The last type of measurement difficulties arise under a multi-task setting. If it is difficult to measure a certain valuable attribute of a product which also includes other

easy-to-measure attributes on which price is determined, then incentive distortion might take place. Difficulties in determining an incentive price for the difficult-to-measure attribute may induce the sellers to sacrifice the attribute for reward from the other attributes. The measurement concern may be resolved by either contracts or in-house production. While existing literature focuses on vertical integration as a resolution (Holmstrom and Milgrom, 1991; 1993; Holmstrom, 1999; Barzel, 1982; Eisenhardt, 1985; Ouchi, 1979), this research highlights contracts that may help resolve the unbalance between incentives, creating instruments that restrict the sellers' decision affecting the difficult-to-measure attribute under circumstances where integrated ownership incurs potential offsetting losses including costs of monitoring employees losing initiatives and other administrative costs. If the processors or retailers have information regarding the correlations between growers' certain production practices and the quality outcome, then contracts might be chosen in order to take advantage of the deferred exchange element through which grower behavior-based control can be employed.³⁰ Processors or retailers through contracts may determine specific raw material inputs or production practices that growers should observe, expecting products that differentiate from generic products.

Finally and more generally, transactions for party-specific products are likely to favor contracts because otherwise the idiosyncratic products are not found in spot markets and because parties' *ex post* decisions on production or marketing would

³⁰ This sheds light on the concept of "task programmability". According to organizational approach to the choice of control strategy, knowledge of transformation is important to choose behavior-based control given difficulty to measure output (Eisenhardt, 1985; Ouchi, 1979). This idea can be applied to a circumstance where certain quality attributes of raw material inputs are difficult to measure but valuable to the processors or retailers. However, contractibility of control has been less explored.

suboptimize without *ex ante* communication for the fabrication of the products. Product specificity therefore necessitates deferred and identity-preserved exchange but may or may not require repeated exchange attributes of contracts.

6. Illustrations

The research has claimed that product specificity is a necessary condition to choose contracts for a variety in agro-food upstream markets. However, it does not argue that product specificity is a necessary and sufficient condition for the choice of all contracts. Some contracts may be explained only by product specificity, but others may be explicated by other considerations or may be better clarified when the notion of product specificity interacts with other considerations. This section utilizes the four sources of contract choice and three elements of contract organizational mode to illustrate observed contracts recently developed in the agro-food sector: marketing or procurement contracts for identity-preserved grains and oilseeds, tobacco and hogs in the U.S., and beef procurement contracts initiated by French retailers.

6.1 Identity-Preserved Grain Purchase Contracts

Grains are typical commodities that have been traditionally exchanged through spot markets or futures markets. However, in recent years contracts have been adopted to organize transactions of some types of grains, especially identity-preserved grains. Identity-preserved grains are defined by grains that retain specific identities from other grains. The identities provide specific traits such as higher oil, protein, or sucrose content, or non-GM character. The grains which include corn, soybeans, canola, sunflowers and

wheat are used for a variety of purposes such as animal feeds, milling for food products and seeds.³¹ The identity-preserved grains are a typical example of product specificity type I or II whose sources reside in the non-GM traits or the unique composition of nutrition from generic grains. While those two possess different types of buyer-specific products, the sources for realizing the products are same, i.e., using specific seeds and following management practices to avoid contamination.

Agro-food firms have initiated differentiated products based on recently developed biotechnology which enables them to procure grains holding target composition of quality attributes. However, it is not likely that the buyer-specific grains are procured at the spot markets that feature instantaneous exchange because spot markets do not hold devices to transmit to industry buyers the information regarding the product design *specific* to the individual industry sellers. The buyers must use deferred exchange to meet their needs to procure the specific raw material inputs. The buyers may accomplish their needs to procure the buyer-specific grains by offering contracts to potential grain growers.

Observed identity-preserved grain procurement contracts are fairly simple because in most case the design of buyer-specific grains can be realized by using specific seeds. Most of the contracts specify the growers' obligations of using specific seeds and segregation practices, sample test for quality traits at delivery, acre-based quantity, one production year-duration of contracts, and compensation schemes of premiums added to

³¹ Even in the same grain the purposes are greatly diverse. For example, identity-preserved corn varieties include high-oil, nutritionally enhanced, and high-lysine corns primarily used in animal feeds; waxy and high-amylase corns for wet corn milling applications; white and hard endosperm/food grade corns used in dry milling for food products; corn marketed as non-GM; or seed corn (MacDonald, et al., 2004).

market price at the time of delivery.³² Contract quantities are determined based on acres because of the potential costs incurred from sellers' commitment in fixed quantity due to yielding uncertainty given product specificity to a buyer. Regarding the timing of delivery, there are two options for growers to choose: harvest delivery and buyers' call. In contrast with harvest delivery denoting a field-to-elevator delivery during the harvest season, buyers' call refers to arrangements where the growers store the grain and the buyer determines the timing of delivery, which results in allocation of sellers' decision rights. Sykuta and Parcell (2004) argue that buyers' call allows elevator to coordinate (i.e., synchronize) delivery to maximize efficient use of fixed elevator capacity and handling.

6.2 Tobacco Purchase Contracts

Most tobacco used to be exchanged through auction markets. However, the U.S. tobacco industry has experienced a dramatic replacement of auction markets with marketing contracts since 2001. Contracts, which covered only 9 percent of flue-cured tobacco and 28 percent of burley tobacco in the 2000 marketing year (ending June 2001), encompassed 81 percent of flue-cured tobacco and nearly two-thirds of burley tobacco in the 2001 marketing year (Dimitri, 2003).

Industry observers have not found any specific changes in technological configurations in either tobacco production or processing, but suspect the huge litigation influenced cigarette manufacturers' procurement of tobaccos in terms of quality (MacDonald, et al., 2004). Comparative analysis of auction and contract price data

³² IP soybean and corn purchase contract samples used for the analysis obtained from http://www.state.ia.us/government/ag/working_for_farmers/contracts/index.html.

indicates that contract price rewards more for high-quality tobacco and at the same time penalizes more for low-quality tobacco than do auction markets (Dimitri, 2003).

However, a question should arise: why would participants in the auction market not adopt incentive prices for quality as strong as in the contract transactions?

Closely looking at the provisions of tobacco contracts from product-specificity standpoint, one can see that provisions regarding valuing tobacco quality are dissimilar across tobacco buyers (Isaacs, et al., 2005).³³ The number and types of grades and the associated prices vary across buyers, resulting in dissimilar grade-price matrices.³⁴

Therefore, as the research has claimed, product specificity type II has come into play in the tobacco case. The transition from tobacco auction markets to contract transactions may have something to do with the deviation of individual tobacco manufacturers' definition of tobacco quality attributes and the associated valuation from the commonly used USDA grade of tobaccos.³⁵

Observed tobacco procurement contracts are more complex than identity-preserved grain contracts mainly because of the complexity of grading quality and the costs of measuring quality attributes difficult to measure. The contracts specify desired leaf characteristics including weight, dimensions of bales, moisture level and stalk positions,

³³ The dissimilarity is also found in the sample tobacco contracts across tobacco companies, which are available at <http://www.cpes.peachnet.edu/tobacco/contracts/contracts.htm>.

³⁴ For example, some buyers prefer 4 stalk positions while others desire three stalk positions. Some buyers reward more for high grade-tobacco and punish less for low grade-tobacco than others do. Some tobacco contracts specify more narrowly defined grades and styles of tobacco than others do.

³⁵ In this regard, Philip Morris's remark on the reasons of entering into contracts in 1999 would be informative. Cigarette production requires a particular blend of different tobaccos, specifically "narrowly defined grades and styles of flue-cured and burley tobacco to produce very flavor-specified blend for our high quality cigarettes" (Phillip Morris, 1999, cited from Dimitri, 2003). A confidentiality clause specified in one of the tobacco contracts is also informative. The tobacco purchase agreement specifies confidentiality regarding purchasing requirements, specifications, purchasing charges, grades, prices, and etc.

grade and pricing, grading-related dispute resolution process, restrictions on growers' behaviors for tobacco production, and contractors' rights to inspect growers' behaviors. Most contracts stipulate growers' obligations on following recommended agronomic and cultural practices such as using only non-GM seed varieties that meet minimum standards and regulations on applications of chemicals and fertilizer. Those provisions are related to reducing costs to measure quality attributes difficult to measure.

Regarding contract quantity, the contracts vary in terms of rigidity while in most contracts the quantities are pre-specified based on growers' quotas. Some contracts specify exclusive dealing while others are flexible as specifying no obligation to deliver any minimum amount of tobacco. Finally, contract lengths vary among buyers, ranging from one to three year agreements. However, there are little differences between one-year and three-year contracts in terms of their structure and provisions and most one-year contracts specify automatic renewal from year to year unless either party's desire to terminate.

6.3 Long-Term Hog Procurement Contracts

The U.S. pork industry experienced a dramatic change in organizational form since the early 1990s. Before the decade, slaughter hogs had been transacted mostly through terminal or auction markets, intermediaries such as dealers or order buyers, or packers' plants or buying stations (Lawrence, et al., 1997). However, the spot market transactions between the hog production and processing stages dropped significantly from 82.5% of total hog transaction in 1993 to 11% in 2005. Over the same period, the use of various

hog procurement (marketing) contract transactions increased from 11% to 67%.³⁶ The hog procurement contracts are divided into short-term and long-term contracts. Most short-term hog procurement contracts hold 6-month duration while the durations of long-term contracts range from 3 to 10 years. The vast majority of hog procurement contracts are long-term contracts which covered 58 percent of total transactions of slaughter hogs in 2005 (Jang and Sykuta, 2007).

The rapid adoption of long-term hog procurement contracts can be explained by product specificity type II and III and measurement costs arisen as a result of pork packers' product differentiation strategy in downstream consumer markets. According to the industry participants, hog quality attributes are divided into three categories: measurable quality attributes of individual hogs such as size of pork cuts and leanness of hogs; meat quality attributes difficult to measure including intra-muscular fat (marbling), muscle color, and meat tenderness; and consistency in the two quality attributes (Smith, 1999; Webb, 2003). Given various usages of hog carcasses ranging from fresh pork products to processed products such as sausage, ham, and lunch meat, the values of correlations between the quality attributes of hogs and final pork products vary across pork packers based on their downstream market strategic positions.³⁷ Given packer's and

³⁶ Exchanges of slaughter hogs also include pork packers' own production of hogs, which increased from 6.4% to 23.8% in the same period (Jang and Sykuta, 2007). A large part of pork packers' own production of hogs are implemented by outsourcing production of feeder pigs or slaughter hogs while maintaining pork packers' ownership of animal, which is called as hog production contracts. Production contracts have also been widely used by large hog production firms. Pork packers' vertical integration with hog production firms necessarily includes the production contracts. See James, et al, 2007, for the analysis of the rapid adoption of hog production contracts.

³⁷ For example, at the domestic level, heavier hogs, for exporting, lighter hogs are preferred. Pork packers who market case-ready fresh products are more likely to sensitive to quality consistency attributes and quality attributes difficult to measure than ones who sell boxed frozen products or further processed products.

processors' differentiated downstream products, increasing divergence in definition and valuing of hog characteristics between individual hog buyers and pre-defined hog commodity has begun to degenerate the advantage of spot markets.

Observed long-term hog procurement contracts stipulate contractor-specific grade-price grids, called as carcass-merit programs³⁸, contractor-specific intertemporal target hog qualities, the corresponding intertemporal incentives (a contract premium per head), and enforcement mechanisms of growers' intertemporal performance of target qualities (See chapter 4 for more details). The intertemporal incentives and enforcement mechanisms can be regarded as one of the advantage of long-term contracts serving to save the costs of measuring marginal production costs of quality attributes for optimal pricing in a circumstance where the marginal costs are volatile.³⁹

In addition, most long-term contracts specify the allocation of growers' decision rights over production practices but the degree of the restrictions are dissimilar across contracts: contractor's exclusive decision, mutual consent, contractor's recommendation, or grower's exclusive decision, on the use of specific genetics or nutrition program. According to the animal science literature, hog production exhibits a certain degree of task programmability regarding correlation between inputs and difficult-to-measure

³⁸ Carcass merit programs establish a matrix of premiums and discounts for combinations of certain carcass characteristics (e.g., weight, percent lean, back fat), which are then added to the market price of a "base hog" that represents the benchmark or base characteristics of the merit program. Producers receive the net price based on the relevant quality characteristics of the hogs they deliver.

³⁹ This intertemporal incentives and the associated enforcement instruments are similar to ones used for disciplining employees within firms. Pork packers use the record of past performance of hog producers to award or penalize their past decisions, anticipating the effects of increasing the costs of producers' decisions made only for his own interests. See Jang and Sykuta, 2007 for the analysis of relations between quality price rigidity and the suboptimal outcome of qualities and the effects of intertemporal incentives and enforcement mechanisms. And see Barcala, et al., 2003 for a case study of the relation between the choice of contracts and needs to procure homogeneity in the qualities of beefs marketed by multiple growers.

quality attributes outcomes.⁴⁰ Therefore, the provisions of decision rights allocation can be understood as pork packers' efforts to reduce costs of measuring hog quality attributes difficult to measure, whose values vary across pork packers.

6.4 Beef Procurement Contracts: French Retailer Case

French retailers' recent adoption of contracts to procure beef meat also illustrates the relevance of product-specificity concept (type I and II) to the choice of contracts even when brand name capital and output measurement difficulties come into play. Unlike the U.S. retailers, French retailers since the 1990s began initiating private labeling to differentiate their agricultural products from generic commodities, among which the most conspicuous items are differentiated beefs. The retailers that have invested in private labeling have simultaneously developed contractual arrangements with suppliers shunning the traditional procurement methods such as ordering generic meat products from the beef processors.⁴¹ The development of private labeling and contractual arrangements has been explained by external shocks such as BSE crises and food safety issues in the 1990s (Maze, 2002).

However, we claim that the food safety issue itself is not sufficient to explain the choice of contracts. Every cattle producer, processor and retailer should have followed the rigorous regulatory rules of the minimum quality standards (MQS) increased after

⁴⁰ For example, 50 % variation of marbling stems from genetics, for tenderness, 26%, for Ultimate pH, 21%, and for Drip loss, 16% (Chesnais, 2002).

⁴¹ Codorn et al. (2005b) point out that the initiatives of retailers' private labeling may partly result from the lack of national brand of beef processors. Like transactions between retailers and processors, in 1994-995, cattle marketing was organized mostly through market intermediaries, like producers' groups, private middlemen,, marketplaces, and direct relationships with slaughtering firms (Maze, 2002).

BSE crises burst.⁴² The MQS has been supported by certification and monitoring of implementation and record-keeping, so the public quality standards include issues of asymmetric information and moral hazards given output measurement difficulties. Notwithstanding, few retailers use contracts to procure beef that meets only MQS (Codorn, et al., 2005b). Almost all of retailers that have adopted contracts with suppliers procured beef products differentiated from generic beef commodities meeting MQS. The degree of quality differentiation in beef products varies across private labels. Even within a retailer chain, generic beef has been sourced from traditional markets while differentiated beef has been procured from contractual arrangements. According to Codorn, et al. (2005a), contracts have been developed with the implementation of segmentation brands and chain brands which are more vertically differentiated.⁴³ Beef products to be sold under segmentation brands have been procured through sequential “two-party” contracts between retailers and slaughterers, and between slaughterers and producers, while beef products under chain brands have been sourced using “three-party” contracts among a retailer, processors and growers (Codorn, et al., 2005a). According to Maze (2002) and Codorn, et al. (2005b), the three-party contracts specify the rigorous

⁴² For example, MQS in beef imposed by the French government includes the prohibition of growth stimulants, steroids, growth-inducing antibiotics, and ground animal parts in cattle feed, required traceability (each animal part is precisely identified and allows traceback to the specific animal), country of origin/birth, of raising, and of slaughter, registration number of the slaughterhouse, of the parts-cutting room (and whether it is monitored and certified), obligatory labeling at the points of sale and labeling of origin of meat served at restaurants (Codorn, et al., 2005a).

⁴³ Codorn, et al. (2005a) report that there are three groups of private retailer brands: substitution brands, segmentation brands, and chain brands. Substitution brands are store labels without any specific quality associated with the label and are similar to the standard product. The substitution brand beef products are sold at a 5-percent premium over prices of standard beef products. Segmentation brand beef products are higher quality ones that is certified either through internal control or through an independent third party, and are sold at up to 10 percent price premium over the standard product. Chain brand beef products are produced via a quality-controlled system that may be designed to meet higher product safety standards or specific production or slaughtering processes and are sold at up to 25-percent price premium.

restrictions on producing and processing practices of beef.⁴⁴ The contracts include cost-plus pricing based on the reference to local cattle market prices.⁴⁵

Therefore, the introduction of process attributes of quality difficult to measure itself does not directly influence the choice of contracts. Rather retailers' strategies of differentiating their products from others in the process attributes incite contract choice. Retailers' desire to procure buyer-specific beef products requires contractual relationships with suppliers while standard beef products can be procured through spot markets. Furthermore, the example of the three-party contracts demonstrates the importance of communication costs in contract implementation. The example indicates that the more coordinated actions on a vertical value chain are required, the more likely tripartite contracts are adopted. The chain brand, one of the highest degrees of product differentiation labeling, has adopted "three-party" contractual relationships, which may serve to reduce duplicate communication costs and losses from potential miscommunications particularly when the retailers' product-specificity becomes increasing and closer coordinated responses to change in market environment are required.⁴⁶

⁴⁴ The three-party contracts initiated by Carrefour require for producers and processors to satisfy MQS, complete traceability and meat safety, and sensory attributes of the meat, for example. The process attributes related to food safety include the specification of the animal's race and the commitment to floor on time pasture-feeding and production records verified by government and monitored by a third party expert. The sensory quality attributes contain specifications related to musculature and fat; commitment to a maximum age at slaughter of cows of 28 months to 9 years old; specification of minimum carcass weight (300 kg for cows); and commitment to minimum aging of the meat (12-18 days of aging) as a guarantee of tenderness (Codorn, et al., 2005b).

⁴⁵ Specifically, price premiums based on process attributes of the beef quality and measuring the sensory attributes of the beef quality are paid to growers, and compensation is attributed for the costs supported by the producers' association. The rewards for slaughtering firms are based on their slaughtering costs, a negotiated margin (around 2%), and a compensation for specific traceability costs (Maze, 2002).

⁴⁶ Two more potential interesting points in the contracts include provisions regarding the contract duration and the flow of information and products, but those have yet been discovered by existing

7. Concluding Remarks

This chapter has proposed that the recent development of contract use in the agro-food sector can be explained by product specificity to a buyer resulting from processors or retailers' increasing adoption of differentiation strategy in downstream consumer markets. Instantaneous and anonymously disconnected exchange characteristics of spot markets require the existence of pre-defined products perceived among market participants. However, increasing divergence between the individual buyers' definition and valuing of a product and the commonly perceived pre-definition of the product degenerates the advantage of spot markets. This research identified three types of buyer-specific agricultural products which necessitate deferred, identity-preserved, or repeated exchange characteristics inherent in contracts: new quality attributes, unique composition of extant quality attributes, and intertemporal consistency in the unique package of quality attributes.

The notions of product specificity and deferred exchange are informative to better understand not only the choice of contracts but also part of contract design because it sheds light on the role of other theories of contracts. Product specificity elucidates the role of measurement costs and brand name capital on the choice and design of contracts while the notion of deferred exchange illuminates synchronizing issues arising from temporal specificity. The research has claimed that product specificity is a necessary condition to choose contracts of a variety in agro-food upstream markets under measurement cost concerns or brand name capital considerations. However, it does not argue that product specificity is a necessary and sufficient condition for the choice of all contracts. Some contracts may be explained only by product specificity, but others may

literature.

be explicated by other considerations or may be better clarified when the notion of product specificity and other considerations interact. The four representative examples of contracting analyzed above have fairly well collaborated with the propositions.

In relation to the TCE of contracts, the proposition of party-specific products as one of the major driving forces for the choice of contracts is not inconsistent with Oliver Williamson's argument that transactions requiring coordinated responses tend to favor hybrids or hierarchies. But it is less compatible with his following claim that investment in transaction relationship-specific assets is a main source of disturbance requiring coordinated responses. The research claims that if one wants to distinguish between spot markets and various types of contracts within the boundary of arm-length transactions rather than between market transactions in general and in-house production at least in agricultural upstream markets, then the concept of party-specific products would be more informative than asset specificity. Product specificity may better explain the prevalence of short-term contracts and various contract design mechanisms observed in the agro-food sector. However, when one combines it with measurement costs and temporal specificity, the explanations would much better collaborate with observations in the agro-food sector because processors' or retailers' product differentiation strategy should be implemented under circumstances where biological variation in quantity and quality, difficult-to-measure quality attributes difficult to measure, and/or perishability of agricultural products are prevalent.

From the empirical research standpoint, it should be noted that product-specificity is a strategic choice variable for processors or distributors to conduct activities of market strategic positions rather than a simple exogenous variable. Therefore, the decision to

market a specific product itself is an endogenous variable like the decision to invest in a specific asset (Masten, 2002). From a firm's strategy point of view, it is instructive to understand the interactions of firms' behaviors in between downstream and upstream markets in that market strategic position, technology, and organizational choice are interdependent strategic decisions (Nickerson, 1997).

Finally, with regard to the relation between technology development and the choice of organization mode, it is valuable to note that contracts, as an organization mode governing transactions, are more likely to be observed when industries experience development of technology associated with discovering, measuring, and producing new attributes of products rather than technology associated with productivity enhancement. Therefore, contracts may provide a mode for governing or facilitating technology for pioneering products and this view may partly explain the differences in adoption of organization forms across industries or countries in the agro-food sector. In this respect, Macneil (1978)'s remark is instructive.

“Advanced economies require greater specialization of effort and more planning than can be efficiently achieved by present exchanges through discrete transactions: *they require the projection of exchange into the future through planning of various kinds* (Macneil, 1978: 857, emphasis added).”

Chapter 4
AN ANALYSIS OF HOG PROCUREMENT CONTRACTS
– UNDERSTANDING CONTRACT CHOICE BY ANALYZING CONTRACT
DOCUMENTS -

1. Introduction

This chapter applies the product specificity framework developed in the previous chapter to an analysis of procurement contract structures in the US pork industry. The objective of the research is to scrutinize two questions. First, what impediments lead hog buyers and sellers to shun spot market organization favoring transactions through contracts? In a transaction cost economics' term, what attributes of transactions differentiate between those two organizational forms for transactions of slaughter hogs? Second, how do contracts help resolve those impediments? More specifically, what kind of institutional devices are created through the design of contracts?

The use of long-term contracts has been explained by their function as a safeguard against rent-dissipating activities in the context of relationship-specific investments (Williamson, 1975, 1996; Klein, et al., 1978). Emphasized are contract provisions of contractual safeguards including information disclosure and dispute-settlement machinery as well as the contract duration to cover the longevity of the assets invested (Williamson, 1996: 104).

This research considers attributes of hogs to be exchanged rather than attributes of assets required for the transactions since hog transactions do not seem to involve considerable differences in quasi-rents between contracts and spot markets. Most large hog processors or packing plants concurrently use multiple organization forms including

spot markets, short-term or long-term contracts, and in-house production, to procure hogs, and many large producers transact with multiple buyers and simultaneously employ contracts and spot markets. This feature of the pork industry case is distinctive from the cases that most transaction cost empirical literature has employed, in which trading parties rely exclusively on an alternative organization form and there are few secondary markets at hand. The research instead contemplates the effects of a buyer-specific definition of hog attributes on the choice between spot markets and contracts.

Based on the existing literature on the challenges associated with coordination of hog quality between processors and producers in the US pork industry, this research develops a proposition that buyer-specific definition of hog attributes, rigidity of price for certain hog quality attributes, and measurement difficulties of certain hog quality attributes induce hog buyers to shun spot markets favoring various types of contracts. Specifically, individual pork packers' different valuing on a certain hog attribute and diverse preference on the composition of hog attributes diminish the effectiveness of auction markets that feature competitive bidding under pre-definition of standard hogs shared among participants. Product specificity thus lead packers and processors to replace auction markets with transactions at packing plants or packers' buying stations where pork packers unilaterally post their definition of hog attributes and the associated price menus. However, posting a price menu does not necessarily require buyers to enter legally binding *long-term* contracts. There must be something more that leads to a switch from spot to contract.

A contract may be required for pork packers when the incentive price for certain hog quality attributes posted by individual packers does not meet the producers' calculation of

first order condition for production of the quality attributes of hogs which should be constantly marketed. This suboptimality may take place when the factors influencing the marginal costs of the quality attributes are volatile at the same time as the quality incentive price is rigid. If a contract can be structured to help redress the suboptimality, pork packers would be likely to offer the contract to producers. Secondly, because certain hog quality attributes are costly to measure and the associated incentive price is difficult to determine, pork packers may eschew spot market transactions in favor of alternative method of acquiring the desired attributes. If the correlation between output quality attributes and inputs becomes certain (Ouchi, 1979; Eisenhardt, 1985), then packers are likely to have interest in contracting for control of the inputs.⁴⁷

Based on the two propositions concerning the impediments associated with coordination of hog quality described above, the research analyzes hog procurement contracts using a recent sample of the contracts offered between 2001 and 2007 by 32 pork packers accounting for 93% of the U.S. total number of slaughter hogs. The research finds two sets of the contract provisions that have something to do with hog buyers' desire for intertemporal consistency in measurable quality attributes and for managing potential adverse outcome of difficult-to-measure hog quality attributes. The first set of the contract provisions, which are not discussed in existing studies, are construed as institutional devices to help achieve intertemporal consistency in hog carcass weights and

⁴⁷ According to existing theories of organization forms, packers instead may choose vertical integration or vertical quasi-integration (production contracts). Measurement cost theory (Barzel, 1982) and normative agency theory (Holmstrom, 1999) of organizational form claim that when output is difficult to measure and inputs are the best available proxies for measuring output, the market transaction is likely to give way to in-house production. Agency theory of organizations (Eisenhardt, 1985; Ouchi, 1979) adds task programmability to the conditions for the shift enhancing the effectiveness of monitoring efforts within organizations. The choice between contracts and vertical integration is beyond this dissertation's scope.

leanness, one of the greatest challenges in the US pork industry (NPPC, Pork Quality Audit, April 1994). The observed provisions of the long-term hog procurement contracts include setting intertemporal target quality, providing contract premium, and enforcing intertemporal target quality performance. In addition, I find that contract base-hog pricing structures observed in some long-term contracts also help producers make decisions on intertemporally consistent hog weights. The second set of the contract clauses deal with the potential adverse outcome of difficult-to-measure hog quality attributes, including reallocation of decision rights over hog production practices from producers to packers.

My findings are consistent with survey results reported by Hayenga, et al. (2000) concerning 13 largest pork processors' motivations for the use of long-term marketing contracts in 1999.⁴⁸ The results of the hog procurement contract analysis are partly consistent with Martinez and Zering (2004)'s findings from the analysis of a small sample of hog procurement contracts offered in the Midwest between 1996 and 2001⁴⁹. In particular, my findings of reallocation of decision rights over hog production practices are consistent with Martinez and Zering's measurement cost explanation concerning difficult-to-measure hog quality attributes while the other findings on difficulties

⁴⁸ The survey results indicate that securing more consistent quality hogs ranked first, followed closely by securing higher-quality hogs and assuring food safety. Next group of three motivations that include reduction of plant operating expenses, week-to-week supply or price management, and reduced search costs.

⁴⁹ Specifically, they maintain that the long-term nature of the contracts reduces the costs of pricing by limiting the number of times that producers must evaluate alternative carcass merit programs offered by packers. Assuming that hogs are more uniform when the ownership of the hogs is unified, they claim that minimum volume requirements allow packers to measure hogs based on sample by reducing the number of hog suppliers. Finally, they put forward that the input requirement and monitoring provisions reduce the costs to measure pale, soft, exudative (PSE) and safety attributes of hogs.

associated with providing optimal incentive price to obtain intertemporal consistency in hog quality are not found in their analysis.⁵⁰

My proposition relating adjustment costs of prices for intertemporal quality production to the value of long-term contracts is parallel to Masten (2006)'s emphasis on the costs incurred at "the processes through which parties arrive at and enforce the resulting prices"⁵¹ and more generally, the costs of discovery of relevant price in market transactions (Coase, 1937; Cheung, 1983).

Hog contract provisions concerning reallocation of decision rights over hog production practices highlight the relevance of contractual externality explanation in the context of multiple attributes of pork quality, some of which are difficult to measure (Holmstrom and Milgrom, 1991; Holmstrom, 1999). A contractual externality arises when the incentives that influence one decision affect optimal incentives with respect to other decisions. Pork packers that value the noncontractible quality attributes, therefore, are likely to shun spot markets featuring instantaneous and anonymously disconnected exchange and instead adopt contracts through which they create instruments to lessen potential contractual externality. It has been found that the contracting parties in hog procurement contracts utilize restrictions on hog producers' alienable decision rights in order to address the contractual externality issue

⁵⁰ This proposition is different from Martinez and Zering (2004)'s explanation of measurement cost saving effects of minimum volume requirement provision. We suspect that their account is less convincing because quality price is paid to hog producers based on not sample evaluation but measuring carcass weights and leanness of individual hogs.

⁵¹ Based on his recent studies of contracting in the U.S. trucking industry, Masten reveals that the value of long-term contracts may originate from saving the costs to negotiate a price for each transaction in a series by 'intertemporal bundling' of heterogeneous freight transactions between carriers and drivers (Masten, 2006; Lafontaine and Masten, 2002). However, while Masten emphasizes savings on measurement costs arising from non-contractible attributes of a task in a transaction, this research highlights savings on adjustment costs of price for quality production stemming from the volatility of the production costs.

The chapter is organized as follows. The following section of the chapter begins with introduction to the US pork industry background, highlighting dramatic change in the structure governing slaughter hog transactions and challenges in coordinating the vertical transaction of hogs. The third section explains the sources and characteristics of hog procurement contract data to be analyzed, and describes the overall structure of the contracts. The fourth section is dedicated to the analysis of the contract structure and design, particularly focusing on the two sets of contract provisions concerning institutional devices for intertemporal consistency of quality and allocation of decision rights over hog production practices to address quality attributes difficult to measure. Concluding remarks follow.

2. The Organization of Transactions of Slaughter Hogs and Industry Background

2.1 Dramatic Change in the Organizational Forms Governing Slaughter Hog Transactions

As briefly described at the introduction section, the U.S. pork industry has experienced dramatic change in organizational form since the 1990's. Before the decade, slaughter hogs were exchanged mostly through spot transactions at plant or buying stations, intermediaries such as dealers or order buyers, and terminal or auction markets (Lawrence, et al., 1997).⁵² However, the spot market transactions between hog production and processing stages significantly fell from 82.5% of total slaughter hog

⁵² Based on the survey results of the 19 largest pork packers conducted in 1993, Lawrence, et al, reported that transactions through spot at plant or buying station share 68% of total slaughter hogs, 17% were from those through dealer or buyer, and 2% were from those through terminal or auction. They also mentioned the ongoing trend of the shift from terminals and auction markets to direct movement of hogs to packers within spot market organization.

transactions in 1993 to 10.6% in 2005.⁵³ Over the same period, transactions through various types of hog procurement (marketing) contracts increased from 11% to 65.6%. Packers' own production of hogs including hog procurement through production contracts also increased from 6.4% to 23.8% in the same period (see Table 4-1).⁵⁴ Therefore, the vast majority of organization forms to exchange slaughter hogs between the hog production and processing stages has been changed from spot markets to procurement contracts over the past two decades.

Table 4-1: Percent of U.S. Hogs Procured by Different Organization Forms, 1980-2005

Organization Forms	1993	1999	2002	2005
Spot markets	82.5	35.8	15	11
Marketing contracts	11	62.0	64	67
- Short-term	NA	NA	9	9
- Long-term	NA	NA	55	58
Packer-owned	6.4*	NA	19	22

* Data is collected for 1994.

- Data of 1980 are sourced from Martinez and Zering (2004), and those of 1993 and 1999 are based on industry surveys (Hyenga, et al., 1996 and Grimes, et al., 2003). Data of 2002 and 2005 are based on USDA Livestock Mandatory Price Reports. These data are sourced from information regarding hog transactions for 32 largest packers' procurement of slaughter hogs, which account for 93.5% of total number of slaughter hog as of the end of 1999. Therefore, the statistics tends to underestimate spot market transactions because it does not account for hog transactions made by large number of small pork packers.

⁵³ These data are sourced from USDA AMS information regarding hog transactions for 32 largest packers' procurement of slaughter hogs, which account for 93.5% of total number of slaughter hog in 1999. Therefore, the data tend to somewhat underestimate spot market transactions because it does not account for hog transactions made by a large number of small pork packers.

⁵⁴ Hog production contracts have been found in the transactions between pork packers or company hog farms and contract growers for delegating tasks of farrowing or raising baby pigs. In production contracts where the contractors provide material inputs such as baby animal or sows, feed, and veterinary service to contractees who own animal houses and equipments, the contractors retain the title of the intermediate goods over the production period and compensate for the growers' performance based on relative performance evaluation. See Muth, 2005 for more details of hog production contracts.

From the cross sectional aspect of the phenomena, the choice of organization forms to exchange slaughter hogs varies across pork packers and hog producers. According to the industry observers and SEC filings of publicly traded pork companies, some pork packers heavily use procurement contracts, while others greatly rely on internal organization. A large number of small pork packers still exclusively rely on spot markets to procure slaughter hogs. In general, most pork packers or pork packing plants simultaneously use spot markets, procurement contracts, and in-house production for procuring slaughter hogs. The hog producers' portfolios in the use of spot markets and marketing contracts to sell market- ready hogs are also diverse. Survey results reveal that large hog producers rely more on marketing contracts while small hog producers use spot markets more, though most hog producers simultaneously use both organization forms (Lawrence and Grimes, 2007).

While the multiple organization forms to exchange slaughter hogs currently coexist, this research focuses on the transition from spot markets to hog procurement contracts. Particularly, it analyzes contract documents to identify institutional differences between spot markets and contracts with respect to dealing with coordination difficulties associated with transactions between pork packers and hog producers. Before entering into the contract analysis, we briefly discuss the nature of the industry and recent changes in the industry structure to consider the potential sources and types of impediments associated with coordination.

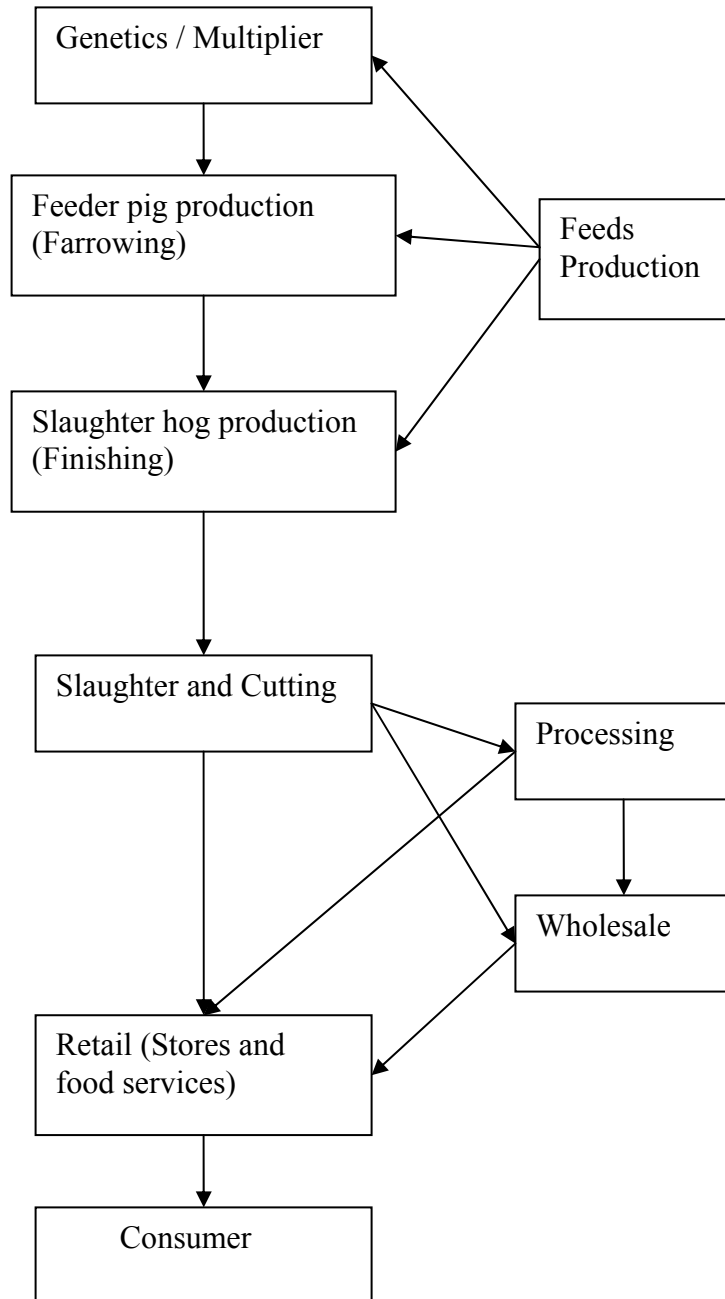
2.2 The Nature of the Pork Industry

The nature and characteristics of the pork industry influences the circumstances that affect the relative costs of spot markets and long-term contract transactions. It can be summarized that the nature of the industry involves three distinctive features. First, the pork industry exhibits exchange of goods sequentially transformed, in which combining genetics and sows generates baby pigs in farrowing stage of hog production and then they are transformed into hogs to be slaughtered in the finishing stage of hog production, which again are transformed into fresh pork products in slaughter and first processing stage of pork production (see Figure 4-1).⁵⁵ The quality of products in one stage, therefore, heavily relies on intermediate goods produced in previous stage(s) of the chain. Effectively measuring and pricing the attributes of intermediate goods secures the vertical exchange and otherwise costly measurement hinders market exchange. Technology and institutions to reduce the measurement costs tend to develop in the industry.

Second, like any other firms, hog producers make various decisions to achieve profit maximization given the prices of inputs and output and the best available production technology. However, similar to other agricultural production, but unlike most manufacturing industries, the hog production sector is subject to biological constraints of swine production, which trigger impediments in the vertical coordination between hog production and processing stages at the same time as provide opportunities for the transaction parties to seek an organizational strategy to minimize their adverse effects on the vertical coordination. Biological constraints include 1-year biological production

⁵⁵ Fresh pork products may be further processed into lunch meat, hot dogs, bacon, sausage, smoked ham, and other processed pork products. 38 percent of pork consumed was fresh and 62 percent processed in USA during 1994-1996 (Davis and Lin, 2005). Genetics production also has been separated from farrowing stage of hog production.

Figure 4-1: Pork Supply Chain: the Flow of the goods sequentially transformed



cycle of hogs and biological variation in hog growth rate. The former biological constraint plays a role in causing a four-to-five year “hog cycle,” featuring periods of under and over-production within a cycle.⁵⁶

The biological variation in hog growth rates involves two factors: seasonality and variation in attributes of individual hogs. Seasonality indicates that hog supplies tend to decrease during the hot summer months during which demand is high, and increase from the beginning of the fall season.⁵⁷ Seasonality is a major factor causing high hog prices in the summer season and low prices in the winter. Variation in attributes of individual hogs includes in growth rate and other quality attributes such as leanness, color, marbling, etc.⁵⁸ This type of biological constraint hinders hog producers’ attempts to produce standardized hogs in terms of weight and other quality characteristics.

From the organizational economics standpoint, it should be noted that production of homogeneous hogs across producers and over time is costly given the biological constraint. Obviously, science and technology to lessen the constraint are more likely to develop as the reward for more consistent quality of hogs increases. On the other hand, the outcomes of weight and other quality characteristics of individual hogs are somewhat determined by hog producers’ decisions on the timing to market and the choice of production technology, incorporating the prices of feed and unit weight of hogs as well as the opportunity costs of the technology. This implies that incentive structures targeting

⁵⁶ Slaughter plants are likely to be underutilized during in the low volume stage of the hog production cycle while hog producers tend to put more efforts to seek outlets for their hogs during the high volume stage of the cycle.

⁵⁷ This tendency is due to lower farrowing performance during the winter months and slower animal growth rates during the hot summer.

⁵⁸ For that reason, hogs have been originally priced on the basis of unit weight of individual hogs, not on the head basis or on the bundle of hogs unlike grains and fruits.

quality outcomes should reflect the uncertain and volatile nature of the production cost structure of the hog quality.

Third, pork processing operation is characterized by continuous slaughtering and processing of a large quantity of hogs, a feature similar to the manufacturing industry. The countenance of assets employed in pork packing plants is akin to most manufacturing operations in that goods in process are mobile and assets are fixed. However, unlike many manufacturing operations, it is almost impossible for pork packers to hold a buffer inventory of live hogs that absorb the supply fluctuations and permit work to continue at the slaughter stage when problems in certain hog production units arise.

Nonstorability of live hogs requires pork packers and hog suppliers to coordinate the product flow in a timely manner given the features of the sequential process of hog production and processing. Hog sellers' failure to seek buyers of slaughter hogs in time deteriorates the quality of hogs and incurs additional costs to maintain the live hogs and additional transportation costs to deliver to next best alternative buyer. Similarly, buyers who do not secure appropriate quantity of hogs to slaughter in time would suffer from idle operation of slaughtering plant. One may refer to it as temporal specificity (Masten, et al., 1991; Williamson, 1996; Masten, 2000) or a synchronizing issue (Milgrom and Roberts, 1992; Bogetoft and Olesen, 2002). Furthermore, nontrivial transportation expenses of slaughter hogs and the negative impacts on hog quality of hauling distance from a hog production station to a slaughter plant make the synchronizing issue or temporal specificity worse.⁵⁹ This coordination issue regarding product flow leads to a

⁵⁹ Pork packers usually purchase hogs locally-within 150 miles of the slaughterhouse-so facilities consequently located near hog farms considering economic distance of hog transportation subject

question of what circumstances influence the relative costs between spot markets and contracts.

2.3 Recent Changes in the Industry Structure and New Challenges in the Coordination

The US pork industry has experienced significant change in both the supply and demand side during the past three decades. On the supply side of the industry, the structural and technological change in both hog production and processing stages has considerably influenced the characteristics of the upstream markets of the industry. Due to the hog production technology and the feeding and disease control knowledge advanced during 1980s, the vast majority of hog farms have been dramatically shifted from small family farms into horizontally integrated factory-style corporate farms⁶⁰. This shift has also been supported by the specialization of hog raising into farrowing, nursing and finishing stages and production contracts through which transactions of animals are organized.⁶¹ One of the striking consequences of the shift in the upstream markets includes the greatly decreasing number of the hog sellers that possess the vast majority of slaughter hogs. In 1988, 60% of the US total slaughter hogs were marketed by

to transportation costs and meat quality concerns (MacDonald and Ollinger, 2000).

⁶⁰ From the organizational economics standpoint, the horizontal integration of firms in hog production can be explained by the change in the costs of shirking and the benefits from specialization. More specifically, moral hazard costs are significantly diminished by adapting in-house hog production method where random production shocks such as weather and disease contaminations are greatly controlled at the same time as the gains from specialization are multiplied through high separability of both tasks and stages given mobility of animals in the production process, unlike fixity of field crops in production process (Allen and Lueck, 2002). See also Rich (2007) for descriptions of the role of hog biology in the structural change and the change in the status of hog growers.

⁶¹ During 1978 to 1995, farrow-to-finish integrated hog operations fell from 78 percent of all US hog farms to 35 percent while three-site disintegrated hog production system increased into 65 percent (Martinez, 2002). (to mention the impact of all-in/all-out system on synchronizing issue)

approximately 29,000 hog sellers, but in 1997, 63% of the total hogs were sold by about 3,441 hog production firms. In 2006, 64% of hogs were sold by only 191 hog production firms.⁶²

The pork processing stage also has experienced mounting consolidation and plant modernization since 1980s. Pork packing plants have become split into a small number of sizable plants that specialize in slaughtering of hog species only and a large number of small plants that may slaughter various species of animals. Furthermore, the capacity and operation speed in modernized, large plants are considerably distinguished from those in small and older plants, implying that timely flow of slaughter hogs between the production and processing stages becomes more critical as plant size increases.⁶³ The consolidation and modernization of packing plants and firms have also generated a smaller number of hog buyers possessing sizable capacity. The number of pork packing plants sharing 90% of the US slaughter hogs was 87 in 1981, 39 in 1994 and just 28 in 2006. It is expected that pork packers that adopted modern, sizable packing plants featuring a steeper short-run average cost curve are more likely to expose the potential adverse consequences from synchronizing issue and seasonality inherent in the pork industry.

On the demand side of the industry, pork packers' increasingly salient competition in product design which has been recently added to the traditional type of competition in price has also considerably affected the transaction characteristics in the upstream markets. Pork packers' involvement in product differentiation activities can be viewed as

⁶² These estimate data were drawn from Lawrence and Grimes (1995, 2007) and "Hogs and Pigs," USDA NASS.

⁶³ Martinez (1999) and Hayenga (1998) suggest that modern, speedy processing plants require tight control over inflow of live animal inputs because they have more sharply sloped short-run average cost curve.

an intention to avoid price competition or to meet diverse consumer preference.⁶⁴

According to a large body of the descriptive industry publications on characteristics of the changing consumer market for meat products, it is construed that competition on pork product design has been mainly driven by the change and heterogeneity in consumers' value function of pork products in the domestic and foreign markets. Furthermore, it is widely accepted that the competition on pork product design has been facilitated by competition with chicken products.⁶⁵

Consumers' value function of pork products has been changed into the emphasis on the three classes of pork product attributes: leanness; meat quality attributes difficult to measure including marbling, muscle color, and meat tenderness; and the consistency in the size and leanness of pork cuts and other quality attributes.⁶⁶ The diversity in consumers' or buyers' value function of pork products has developed with market segments for example, between domestic and foreign markets and between case-ready

⁶⁴ Traditional industrial organization economists have suspected firms' product differentiation activities as strategic behaviors to avoid price competition and have examining equilibrium results of the imperfectly competitive market structure on optimal product diversity (See, Tirole, 1988 and Lancaster, 1990 for a survey of the literature). On the other hand, a group of economists including Lancaster (1966) and Rosen (1974) viewed products as a bundle of characteristics and developed competitive market equilibrium of differentiated products called as hedonic price model. Based on a large body of descriptive literature on the change in the demand side of pork industry, our research adopts the latter approach, admitting the heterogeneous value function of attributes of a class of products across consumers or groups of consumers. See also Antle (1999), for highlighting the impacts of agricultural product differentiation on the costs of production.

⁶⁵ Chicken production surpassed pork in 1986 and beef 10 years after. Increasing competition with chicken products has forced pork packers to take into more account on pork quality attributes, particularly on leanness which has been valued as a major source of competitiveness of chicken products.

⁶⁶ An emphasis on leanness had emerged in the 1980s, with human health research reports linking fat and cholesterol to cardiovascular disease in people (Martinez and Zering, 2004). Meat quality attributes to difficult to measure and the consistency attributes have been becoming valuable in pork packers' branded fresh pork products and products sold to food service chains, which feature repeated purchase and thereby reputation (Miller, et al., 1999; Smith, 1999). The market share of branded fresh pork products and pork products used at food service chains has been increasing particularly since the late 1980s (MacDonald, et al, 2000; Muth, et al, 2005).

branded fresh pork products and boned or boxed pork products or further processed pork products. For example, at the domestic market level, pork packers who process most of their hogs prefer a lighter carcass while others prefer a heavier carcass for boned or boxed products. Restaurants prefer relatively small loins, which come from 215-230 pounds hog compared to the standard 270-pound hogs (Martinez and Zering, 2004). Marbling is desirable for fresh loins, but less desirable for processed products. At the export market level, a lighter hogs with more tendered meat and more marbling are preferred at the Japanese consumer markets, for example (Ray and Cravens, 2002; Miller, et al., 1999).⁶⁷

Given the nature of the pork industry described in the previous subsection, the increase in the number of attributes of pork products and growing heterogeneity in consumers' value function of pork products have brought about great challenges in slaughter hog transactions to be made in the upstream markets. First, in order to increase the leanness and thereby reduce fat portion of hogs, which is one of the major challenges driven by change in consumer preference for pork products, most of large pork packers has replaced measurement on live weight with that on carcass weight and percent lean or backfat (called as carcass merit program). Based on performance of carcass weight and percent lean, quality attributes of hogs are rewarded or discounted.⁶⁸ Since the degree of

⁶⁷ The US pork exports have exponentially increased since the 1990s, from 1% in 1985 to 9% in 2005, as a percent of total production. Approximately half of the exports have been accomplished to Japanese markets where competition in meat quality attributes is salient (Martinez and Zering, 2004).

⁶⁸ The share of hogs sold through carcass merit evaluation and pricing systems jumped from 11% in 1982 and 25% in 1993 into 75% in 1999 (USDA, 2001). Measurement on carcass weight and estimation of percent lean help reduce measurement error, the discrepancy between expected weight of a slaughter hog's marketable elements based upon measurement and its actual weight, as opposed to live weight measurement. In this regard, the development of the new measurement method is valuable because the price would not function efficiently unless the measurement error

the quality incentives and the target quality attributes are unilaterally determined by individual packers, the new measurement method is regarded as private grading system which is fundamentally different from USDA standards formerly used. The private nature of carcass merit programs enables individual pork packers to design target weight and lean percent in a way to meet the consumer preference at the market where they position on. It also should be noted that the new measurement and pricing method largely relies on recent development of hog production technology such as genetics and nutrition program, with which hog producers may somewhat control the quality of market-ready hogs.

Second, achieving consistency in hog quality has been one of the greatest challenges in repeated transactions of slaughter hogs, pork cuts, and processed pork products. Packers, processors and retailers all ranked lack of uniformity in live hogs, carcasses, and retail cuts with regard to size and backfat as the most important quality issue facing the industry (NPPC, Pork Quality Audit, April 1994).⁶⁹ From pork packers' standpoint, consistency has to do with variances within a group of hogs delivered from a seller, across hog sellers, and over time while the goal to reduce fat is rather related to the concept of mean.

Given the volatile nature of the unit price of slaughter hogs and the feed price, intertemporal variance in certain quality attributes cannot be controlled only by static quality incentive prices built in carcass merit programs. The concern arises from the

is diminutive enough that the value of total marketable elements of a hog is fully reflected in the price paid to hog producers (Barzel, 1982). The overall effects of new measurement and incentives on fat reduction have been supported (Meisinger and Powell, 2004). Their estimates based on survey indicate that on average, backfat was reduced by 36% during 1993-2003.

⁶⁹ In addition, a high variance in hog carcass weights and lean percentages causes reduction in labor productivity in a pork packing plant, especially on with high speed of operating packing facilities because inconsistent hog weights and fat percentages trigger interruptions in labor working and more time to trim fat.

erosion effects of volatility in market prices of a base hog and feed prices on the incentives (premiums and discounts based on carcass weights and percent lean) since changes in market price of a base hog or in the price of feed will change the net return function for hog producers given a 3-week marketing horizon within which hog producers determine the timing to market hogs.⁷⁰ Depending on the nature of the quality price matrix and the relative magnitude of market price fluctuations, producers may no longer have incentive to deliver the desired quality hog. Therefore, carcass merit programs that may be used through spot market organizations do not sufficiently ensure intertemporal target consistency in hog weights. It is interesting to see how pork packers create institutional devices to address this issue through contracts.

Finally, the fact that hog quality attributes difficult to measure had been becoming valuable in the downstream markets have left pork packers another great challenge in transactions of slaughter hogs. Hog quality attributes such as meat color, marbling, and tenderness are not impossible to measure, but it is fairly costly to measure on individual hog basis in high-speed slaughter lines. Furthermore, the measurement of the quality attributes post slaughtering involves potential moral hazard issue and disputes since the quality outcome results from a sort of team-production among the economic agents in the production, transportation, and slaughtering stage of the value chain. Therefore, packers' creation of pecuniary incentives based on objective performance measurement of individual hogs is virtually impractical. To make things worse, providing incentives for

⁷⁰ This point is consistent with the simulation results of Poray (2002)'s study on the effects of alternative organizational forms on the hog quality outcome. The results indicate that more tight coordination form can result in a statistically significant reduction in the variability of the quality of pork produced. He claims that pork packers' objective to procure hogs possessing target weight and leanness may not be accomplished only by hog quality incentive price due to the incentive conflicts arising when hog producers make a decision on timing to market given a 3-week marketing horizon.

measurable quality attributes such as leanness and size may adversely influence the outcome of the quality attributes difficult to measure since hog producers have strong incentives to invest in the outcome of the former attribute at the sacrifice of that of the latter attribute particularly when they make a decision on selecting genetics and feeding program. This challenge is not likely to be resolved through spot market organization because it features instantaneous and anonymously disconnected exchange. The following sections examine how hog procurement contracts are designed to address the recent challenges described thus far.

3. Contract Data and the Structure of Hog Procurement Contracts

3.1 The Contract Data

The contract data to be analyzed have been downloaded from Swine Contract Library website operated by USDA Grain Inspection Packers and Stockyards Administration (GIPSA, <http://www.usda.gov/gipsa/>) on January 4, 2007. GIPSA is establishing regulations to implement a Swine Contract Library as mandated by the 106th Congress under the Livestock Mandatory Reporting Act of 1999 (LMRA). The LMRA contained provisions for both Mandatory Price Reporting (MPR) that are administered by Agricultural Marketing Service (AMS) and the Swine Contract Library that are administered by GIPSA.

The swine contract library requirements apply to packers who purchase at least 100,000 swine per year and slaughter at packing plants with a federally inspected slaughter capacity of 100,000 swine or more per year. This covers 54 plants owned or

used by 32 packers as of December 1999. These packers are required to provide an example of each contract they currently have with a producer or producers or that is currently available at each plant that they operate. Each packer must submit a new example contract when existing contract changes and notify GIPSA immediately if an example contract is expired or withdrawn.

Table 4-2: Classifications of Hog Procurement Contracts by AMS and GIPSA

AMS	Swine or pork market formula	Include contracts in which the pricing determination is a formula price based on a market for swine, pork, or a pork product
	Other market formula purchase	Include contracts in which the pricing determination is a formula price based on the Chicago Mercantile Exchange Lean Hog futures market
	Other purchase arrangements	Include fixed price contracts, cost of production formulas, formula purchases with a floor, window, or ceiling price
GIPSA	Swine or pork market formula	Include contracts in which the pricing determination is based on a market for swine, pork, or a pork product, fixed price contracts, cost of production formulas, formula purchases with a floor, window, or ceiling price
	Other market formula purchase	A price formula based on one or more futures or options contracts, or on one or more feedstuff markets, such as the market for corn or soybeans

Sources: <http://marketnews.usda.gov/portal/lg>, http://scl.gipsa.usda.gov/revcontract_select.aspx

Due to the confidentiality restrictions of the LMRA, however, the contracts themselves or other proprietary information are not available. The GIPSA instead provides a summary of the information by contract type and region. Based on

determination of base price of hogs to be exchanged, the contracts posted at the GIPSA website are classified into two types: swine or pork market formula contract and other market formula contract (see Table 4-2 for the comparison with AMS' classification of the contracts). The swine or pork market formula contracts includes contracts in which the pricing determination is based on a market for swine, pork, or a pork product, fixed price, cost of production formulas, and formula purchases with a floor, window, or ceiling price. Other market formula contracts contains contracts in which a price formula is based on one or more futures or options contracts, or on one or more feedstuff markets, such as the market for corn or soybeans. The GIPSA presents the information it receives in four categories: base price determination, premiums and discounts, application of ledger, and other provisions. Therefore, due to the nature of the disentangled and then rearranged contract data, it has limitations to cross-sectional analysis among contracts and examination of relationships between exogenous variables and contract design, which means that it does not allow us to directly test existing theories of contracts.

However, the contract data permit us to draw an overall picture of the hog procurement contracts that represent almost all of the hog procurement contracts recently used since the slaughter hogs procured by the 32 packers account for 96% of the U.S. total number of hogs slaughtered in federally inspected plants. Furthermore, based on the comparison with a limited sample of 19 hog procurement contracts posted at the Iowa Attorney General website, it has been found that the GIPSA contract data includes fairly entire provisions of the contracts. The data also allow us to document variations in specific contract provisions.

3.2 The Structure of Hog Procurement Contracts

Before we analyze the contracts, it should be noted that the contracts are not designed in a way to tailor individual hog sellers' innate ability but take on a 'take-or-leave-it' form. Most pork packers that want to procure slaughter hogs through contracts make a sample of contracts which specify terms of transactions reflecting their objectives and then offer hog sellers. Therefore, the structure and specifications of the hog procurement contract offered by a pork packer are almost identical across hog sellers but those of hog procurement contracts varies across pork packers and packing plants even in a packer. This implies that 'a menu of contracts' explanation in dealing with adverse selection of sellers does not collaborate with the contract practice in the transactions of slaughter hogs. This can be explained mainly by the fact that a large portion of the contracts determine the base price of hogs based on the spot market hog price which serves to eliminate potential information rents through competitive market forces.

Existing theories of contract provide no unifying analytical structure as well as unifying definition of contract. Normative agency theory focuses on planning or promise aspect of contracts while transaction cost theory emphasizes on safeguard or enforcement aspect of contracts (Hart and Holmstrom, 1987; Williamson, 1985). Macaulay (1963)' definition of contracts includes both aspects. "Contract,..., involves two distinct elements: (a) rational planning of the transaction with careful provision for as many future contingencies as can be foreseen, and (b) the existence or use of actual or potential legal sanctions to induce performance of the exchange or to compensate for non-performance." Furthermore, describing the structure of existing contracts is not simple because each contract provisions may be interrelated with regard to the two aspects of

contracts. Given our objectives of the research that underscore examination of the exact nature of coordination difficulties associated with hog transactions and how contracts are designed to address the impediments, it would be safe to follow the Macaulay's definition of contract in exhibiting the structure of hog procurement contracts.

Table 4-3: The Structure of Hog Procurement Contracts

Operative terms and mechanics of hog transactions	<ul style="list-style-type: none"> - Definition of hogs to be exchanged - Pricing structure and rules - Allocation of decision rights over hog production practice - Coordination of the quantity and delivery of the hogs
Clauses of managing contract performance	<ul style="list-style-type: none"> - Adaptation to change in future circumstances and duration - Remedy for contract breach - Dispute resolution rules - Information disclosure of entities and other miscellaneous terms

The research presents the structure of the hog procurement contracts by breaking down of the provisions into two parts: the operative terms of the transactions; and provisions associated with managing contract performance (see Table 4-3, for a skeletal outline of the contract provisions). The first part includes the definition of the hogs to be transferred, pricing rules, specification on quantity and delivery, and other provisions to deal with potential moral hazard issues affecting the outcomes of hogs to be traded. The second part of the contracts is dedicated to stipulating terms associated with managing contract performance, such as adaptation to change in circumstances to be occurred during contract execution period, remedy for contract breach, dispute resolution rules, information disclosure, and other miscellaneous terms. Looking at the observed contract data, in general, specifications in the second portion of the contracts looks like uniform

across contracts while the design associated with the first part of the contracts varies across contracts. Let's illustrate the details of each portion of the contracts.

3.2.1 The Operative Terms of the Hog Transactions

The operative terms and mechanics of the hog transactions are composed of three portions: the definition of hogs to be exchanged and the associated pricing rules; the allocation of decision rights over hog production practice; and coordination of quantity and delivery of the hogs. First, contracting parties, particularly pork packers through contracts specify attributes of hogs to be exchanged between the buyer and seller and the associated pricing rules. Individual pork packers' definition of slaughter hogs to buy is important because it reflects the packers' objectives of contracting and affects hog pricing structure and the price of an attribute of hogs. One of the contract analysis results indicates that the definitions of hogs to be exchanged contain a combination of three dimensions of attributes.

Table 4-4: Unit and Attributes Used for Definition of Hogs to Be Exchanged through Contracts

		Unit of definition	
		Individual hogs	Group of hogs
Attributes of a hog	Measurable attributes	Carcass weight or percent lean of a hog	Standard deviation of individual carcass weights or lean percentages of hogs in a point of time or a period of time
	Attributes difficult to measure		Sample estimate of firmness, water holding capacity, marbling, coloring, etc

The first dimension of attributes of hogs used in the definitions includes measurable quality attributes of individual hogs such as live or carcass weight or percent lean of a

hog. The second one indicates quality attributes costly to measure, including firmness, water holding capacity, marbling, and coloring, estimated on the base of sampling from a group of hogs. The last dimension of attributes of hogs indicates the distribution of individual carcass weights or lean percentages in a point of time or a period of time (see Table 4-4 for more clarification). The last one has been little found in the existing literature. This will be examined at the next section in more detail. The definition of hogs to be exchanged varies across contracts in terms of attribute dimension and specification of an attribute. Some contracts include specifications of only the first two dimensions of attributes while others contain specifications of the three dimensions of attributes. Furthermore, specifications of an attribute of hogs are diverse among contracts. Desired carcass weights or percent lean specified by pork packers vary across contracts, for example (see Table 4-5 for more details).

Table 4-5: Diversity of Carcass Merit Programs Partially Observed

Target carcass weight range (pound)	Target lean percent or backfat	The highest available premium
207-221	57%	109% of base price
191-217	0.51-0.60 inches	109%
188-222	backfat 16mm	107%
181-215	0.51-0.90 inches	108%
176-208	54-57%	\$5.23
173-217	54-57%	\$4.00
173-250	≥60%	112%
173-250	60%	112%
172-195	0.60-0.79 inches	104%
170-222	>52%	100% (no premium but discounts)
170-222	53-54.9%	
170-222	no target	\$2.75
168-208	49-61%	\$0 (no premium but discounts)
164-207	60%	\$5.23
148-236	no target	\$6.00
		104.2%

The pricing structure observed in the contracts is composed of two parts: base price and price for quality. The base price of a hog is determined on the basis of a pound while price of quality applies to a head. The determination of the base price varies across contracts but it is classified into four types. The first type of the base price determination is called as swine or pork market formula in which base price is determined by swine or pork price set by spot markets at the time of delivery. The second type is named as window or floor price formula. Window price formula includes floor and ceiling price set at the time of signing on a contract and sharing rule of the gap between reference price falling outside of the window zone and either floor or ceiling price. The reference price adopted in the window price formula is similar to that of swine or pork market formula. The third type called as cost-plus price formula uses corn and soybean prices to determine hog production cost. Hog procurement contracts using this formula also specify certain amount of fixed payment added to the estimates of the production cost. The last type of the base price determination is related to futures or option market price. The Chicago Mercantile Exchange (CME) Lean Hog futures price is frequently used in this type where hog sellers instruct packers to lock in a price relative to the CME Lean Hog futures prior to the beginning of the delivery period.

The price of hog quality comprises two parts in relation to the definition of the attributes of hogs: price on measurable quality attributes of individual hogs and price on the distributional quality attributes of a group of hogs delivered. Observed all hog procurement contracts include a table of carcass merit program, a pricing scheme for measurable quality performance based on measurement of carcass weight and lean percent or backfat of individual hogs. Price for those two quality performance of

individual hogs is paid with the form of premiums and discounts which are made on the in-or-out status of individual hog's carcass weight and percent lean from the target range set by a pork packer. Premiums and discounts, or adjustment rates are established as a form of percentage of base price of a hog or an absolute money amount on head basis. The target range of the two carcass characteristics and the adjustment rates are dissimilar across contracts.

The second part of the pricing of hog quality indicates that pricing on distribution of quality attributes of a group of hogs delivered is associated with the third dimension of hog attributes described above. A number of hogs may be grouped into load or lot, or a period of delivery time, for example a weekly, monthly, quarterly, or yearly base to assess the distribution of the carcass weights and lean percentages. This part of the pricing of quality has been little found in the existing literature. To get a sense of how contracts specify the pricing, some quotations from actual contracts would be beneficial.

“Packer and producer acknowledge the importance of normal weight distribution within producer hogs. In addition, packer and producer acknowledge minimizing the variation within producer hogs is an important objective. Therefore, in accordance with meeting target weight and normal weight distribution provisions, the standard deviation of individual carcass weights in producer hogs delivered each week, should be no greater than 17 pounds (packer will calculate carcass weight standard deviation for all producer hogs each weekly period).”

“With respect to producer's failure to meet the average annual weight requirements of hogs, producer shall pay packer an amount equal to \$0.20 per head for each pound that producer's hogs average weight is below 270 pounds on an annual basis, times the

number of head delivered during the year in question, or times a specified number, whichever is greater.” (Contract Summary Report, Swine or Pork Market Formula, National, USDA GIPSA, SCL website)

This type of pricing based on distribution of quality attributes of a group of hogs will be examined in more detail at the next section. With regard to pricing structure, it should be noted that explicit pricing on hog quality attributes difficult to measure are rarely found in the contract documents.⁷¹ Finally, many contracts specify a fixed amount of contract premium per head which is not generally found in the hog spot market transactions. The contract premium varies across contracts. For example, it ranges from zero to 4 dollars per hundred pounds of a live hog in swine or pork market formula contracts. The contract premiums are often negotiated between the pork packer and hog producer at the initial time of contract execution and may be related to the perceived overall quality of producer’s hogs by the buyer. The initial amount of premium may be modified during contract execution period. But this contract premium is different from the premiums and discounts specified in carcass merit program in that the former is determined by the perceived overall quality of producer’s hogs by the buyer while the latter is determined by outcome of specific quality attributes of individual hogs. The provision of contract premium has not been found in existing literature.

The third part of the operative terms of hog transactions is concerning the allocation of decision rights over the hog production practice. Typical arm-length transactions are made based upon economic agents’ independent decision on their own production affairs such as choice of production technology and types of inputs. In addition to specifying

⁷¹ This finding is consistent with existing literature (Smith, 1994). See also Berg and Cannon (2006) for the discussion of costs associated with measuring and rewarding the quality attributes from the animal science perspective.

products to be exchanged and pricing rules, however, many hog procurement contracts include restrictions on hog sellers' decision rights over the selection of genetics and nutrition program. The degree of the contractual restrictions on hog sellers' decision rights are classified into three: pork packers' exclusive decision on genetics and/or nutrition program; both parties' mutual consent on the selection; and pork packers' recommendation on the selection. Therefore, the degree of restrictions varies across contracts. It is construed that the contract provisions have something to do with packers' belief concerning the correlation between the inputs and hog quality attributes difficult to measure, and it will be further analyzed at the following section.

The last part of operative terms of hog transactions is devoted to specifying coordination of hog quantity and delivery. The contract provisions include temporal and intertemporal coordination. For long-term coordination of hog quantity between the pork packer and hog producer at the contract, most contracts specify the consistent numbers of hogs to be delivered on a monthly or quarterly base. In addition, the contracts stipulate that hog producers are obliged to report to pork packers the projection of hog production quantity on a weekly, monthly, quarterly, and/or yearly basis during contract execution period. The clauses aim to reduce the potential adverse effects of the biological uncertainty and other unexpected circumstances of hog production on the operational efficiency of packing plants. For temporal coordination of hog delivery, contracts let pork packers exert decision rights over the synchronizing issue of hog flow based on the information of the hog production schedule and the packing plant operation. Producers are required to give notice of the exact number of hogs to be delivered in a coming

delivery week. Based on this information provided by hog producers, pork packers designate delivery date and time and/or the number of hogs in the delivery week.

3.2.2 Managing Contract Performance

After delineating the operative terms of hog transactions in the first part of the agreement documents, the pork packer puts an effort on spelling out a set of clauses that serve to the flexibility of the contracts as well as induce both parties to commit on the value-creation activities. Every contract involving deferred exchange is exposed to uncertainties and risks due to the passage of time between the exchange of promises and their performance. Given the bounded rationality in foreseeing future contingencies and the costs to delineate every possible future circumstance, any contracts must be incomplete. However, contractual relationship tend to be exposed to risk of contracting parties' breach taking advantage of the incompleteness of the contract as the contractual incompleteness grow. Therefore, transaction cost theory of contracts predicts that contracts tend to be designed reflecting the trade-off between rigidity and flexibility serving to prevent the contractual relationship from either party's potential opportunistic behavior at the same time to moderate potential maladaptation (Williamson, 1985; Saussier, 2000). The provisions aiming to optimizing contract performance found in the hog procurement contract data have something to do with the trade-off. Three distinct sets of contract provisions have been observed in the contract data: adaptation to change in circumstances to be occurred during contract execution period, remedy for contract breach, and dispute resolution procedures.

The adaptation-related clauses include change in the definition of hogs to be exchanged and the pricing rules and flexibility in the hog quantity coordination. The contracts provide packer with the rights to change carcass evaluation methods, the premium and discount schedules, and target weights, with specified period of time of grace before being effective. The contracts also confer hog producers' rights to refuse the change had the change adversely affected the producers' profit. The contracts also specify alternatives to current use of reference price quote in case that it discontinues.

In order for contracts to be flexible enough for both parties to adjust to the uncertainty in hog supply, the contracts include tolerance zone on delivery quantity and renegotiation for producers' hog production expansion. Tolerance zones range from ± 10 to 25% on weekly, monthly, quarterly, and/or yearly delivery quantity across contracts. In addition, the contracts specify that if producers wish to expand its production capacity and sell more hogs annually, pork packers will approve or disapprove the delivery of the additional hogs. The adaptation-related clauses have to do with contract length. It is natural that long-term contracts are more likely to involve the contract adaptation-related clauses more than short-term contracts. The contracts vary in terms of contract duration, covering from 6 months through 5 years to no pre-determined length. The contracts also vary in terms of their renewal, from automatic renewal for successive 6 months through 3 years to no specification of renewal.

Specifications of an optimal remedy for contract breach secure optimal commitment to performing (Cooter and Ulen, 2000). The hog procurement contracts include penalty for deficiency of intertemporal hog weight or percent lean requirement and one for causing packer's reduction in operational efficiencies. Most contracts specify liquidated

damages for shortage on the producer's required delivery of specified hogs in weekly, monthly, quarterly, and/or yearly basis. Specific amount of liquidated damages varies across contracts, ranging from 5 to 24 dollars per head applied to deficient amount of the hogs. A few contracts include 'specific performance', specifying that "due to the unique nature of producer's hogs, the remedy at law for any breach, or threatened breach, by producer of its obligations under this agreement will be inadequate." With regard to intertemporal quality attributes-related remedy, contracts specify penalty for average lean percentage or annual weight requirement deficiency. Contracts, for example, delineate that "with respect to producer's failure to meet the average annual weight requirement of hogs, producer shall pay packer an amount equal to \$0.20 per head for each pound that producer's hogs average weight is below 270 pounds on an annual basis, times the number of head delivered during the year in question, or times a specified number, whichever is greater.". These remedy clauses are corresponding to the contract premiums for distribution attributes of hog quality.

In addition, dispute resolution rules are essential for contract enforcement. Most of hog procurement contracts specify that any controversy or claim, or the breach shall be settled by binding arbitration conducted in accordance with the governing rules of the American Arbitration Association or Judicial Arbitration and Mediation Service and court as a final resort. Some contracts specify the procedure of resolution only through state or federal courts. With regard to information disclosure of producers' production activities, it has been found that hog procurement contracts specify disclosure of information concerning packers' measurement activities of hogs delivered and producers' production activities including use of genetics, feeding program, and health management.

Contracts also confer packer rights to inspect the hog production facilities and to confirm and verify that producer is fulfilling producer's responsibilities of meeting packer's process verification standards and all applicable health and feeding programs or other production criteria.

Finally, the remainder space of hog procurement contracts are dedicated to specifications on some boilerplate of the commercial trade: assignment of agreement, authority to enter agreement, clear title, confidentiality, financial soundness, force majeure, indemnity, notice, other agreements between parties, other business conditions, records/documentation, relationship of parties, right to assign, rights/obligations of successors, transfer of title, compliance with applicable laws, default, severability, third party guarantees, waiver of enforcement, etc.

4. Institutional Analysis of Hog Procurement Contracts

This section analyzes the institutional distinctions of long-term hog procurement contracts as compared to the spot markets. In the spirit of Ronald Coase' emphasis on the institutional structure of production (1972, 1991), it is dedicated to examining how long-term hog procurement contracts address the recent challenges in exchange of slaughter hogs described at the earlier section. As seen at the previous section, we exhibit that most hog procurement contracts apportion most of their space to specifying pork packers' objectives, incentive structure for hog producers to commit in the objectives, allocation of decision rights over hog production and delivery, and monitoring and enforcement schemes. This means that the structure of hog procurement contracts are far beyond the descriptions that frequently found in the agricultural economics research sector, as typical

hog procurement contracts consist of carcass merit program and base-price structure (Muth, et al., 2005). It is identified that distinguished institutional features of long-term hog procurement contracts include intertemporal incentive and enforcement structure and the allocation of decision rights over hog production and timing of delivery (see Table 4-6 for the summary).

Table 4-6: Institutional Instruments to Coordinate Hog Attributes Defined by Hog Buyers

Hog Attributes	Institutional Instruments
Target carcass weight or percent lean of a hog	Carcass merit program
Target distribution of carcass weight or lean percentages of hogs in a period of time	- A combination of intertemporal incentive payment and evaluation of intertemporal performance - Window price or cost-plus price
Target mean and variance of meat firmness, water holding capacity, marbling, and coloring of hogs in a period of time	Contractual restrictions on producers' decision rights over the selection of genetics and nutrition program for hog production

4.1 Creating Contractual Instruments for Intertemporal Quality Consistency under Volatile Production Costs of Quality

As mentioned at earlier section, achieving consistency in hog quality attributes such as hog weight has been one of the greatest challenges in the pork industry not only because it incurs additional costs due to biological variation in growth rates of hogs but also because individual hog weight itself is a choice variable for producers' profit maximization. Hog producers determine the weight of individual hogs in a way to adjust the timing to market hogs reflecting unit price of hogs, feed price, and feed conversion ratio given a 3-week marketing horizon. Therefore, variation in hog weights per batch

and over time is a natural result of hog producers' profit maximization behavior given the biological and economic constraints.

While premiums and discounts in carcass merit program provide producers with incentives to control biological variation in growth rates of hogs, the fluctuations of the two classes of market prices erode the incentive effects of the carcass merit program on quality consistency. For example, increase in feed price may weaken the competence of the quality incentive scheme since feed price increase forces producers to feed less than weight desired by a pork packer. Similarly, increase in base-hog price pushes sellers to feed more, which may result in overweight hogs. So, in fact, given any quality pricing structure, changes in market price of a base-hog or in the price of feed will change the net return function for producers. Depending on the nature of the quality price matrix and the relative magnitude of market price fluctuations, producers may no longer have incentive to deliver the desired quality hog. That is erosion effect of market price volatility on quality price incentives

Obviously pork packers may adjust the intensity of the quality incentive to changes market circumstances surrounding hog producers by manipulating 'adjustment rate.' However, it is costly for pork packers not only to calculate changing optimal 'adjustment rate' conditional on their marginal benefits from and marginal costs of the scheme being equal but also to timely disseminate the information of the change. For those reasons, the frequent changes in adjustment rate have not found in the industry practices compared to the volatility of the hog and feed market circumstances. Consequently, the costs associated with the quality price rigidity may elicit additional instruments not available in spot markets.

How do long-term contracts address the erosion effects of the quality incentive scheme? It has been found that observed long-term contracts are equipped with two distinguished set of contractual instruments to resolve the issue. Many long-term contracts include a set of provisions to create and enforce intertemporal incentive scheme while some contracts establish base-hog price determination structure which help reduce the erosion effects. Many long-term contracts allow for hog buyers to establish long-term hog quality target, create long-term incentives for hog sellers to commit in the target quality, and enforce their target quality performance. Let's illustrate them in more details by using the provisions of existing contract documents.

Table 4-7: Intertemporal Target Carcass Weights Specified in Contract Clauses

Individual hog base (pounds)	Load base (pounds)	Weight distribution base
152-259; 163-215; 155-237; 170-222; 175-206; 164-215; >155; 163-215; 189; >167; 111-222; 155-241; 160-249; 170-221; 168-205; 160-270; 170-222	<229 in average per load; <222 in average per load; 178-200 in average per load; 163-192 in a weekly average; 189-211 in weekly average and >200 in an average annual weights; ≥ 190 in monthly average	Standard deviation of individual carcass weights delivered each week should be no greater than 17 pounds
18 observations	6 observations	1 observations

Pork packers establish target quality performance for hog suppliers to accomplish during contract duration in their long-term contracts: average live or carcass weight or weight range per load, average week and/or annual percent. The objectives of setting target quality performance include accomplishing optimal average of carcass weights and lean percentages and minimizing the standard deviation of individual carcass weights and

lean percentage, per load and during contract duration. The contract data indicate that 18 observations specify target carcass weights based on individual hog, 6 observations on load, and 1 observation on weight distribution (see Table 4-7).

In order to police actual quality performances of a hog supplier agreed on a long-term contract, it specifies a pork packer's rights to weekly, monthly, quarterly, or annually evaluate the supplier's quality performance. It also enforces underperformed suppliers by using penalties which include increase in the sort loss deduction to the failure to meet the target standard deviation, some other reduction of the contract price to the failure to meet target average weight or lean percentage. The contract data indicate that 5 observations specify penalties for failure to meet quality standards (see Table 4-8). Certainly, pork packers offer inducement to the suppliers to accept the contracts. The contracts specify absolute value of contract premium to be paid hogs delivered, which is not available to hogs transacted through spot markets. It is found that 38 observations in the contract data specify contract premiums (see Table 4-8). To recap, the logic behind the intertemporal incentive and enforcement instruments is that the future reward and penalty scheme based on intertemporal performance shadows today's behavior.

Therefore, quality price of hogs transacted through long-term contracts is determined by the following two terms: quality incentives at time t (almost identical incentives as within spot market) and quality incentives during certain period of time (incentives in long-term contract transactions). Price of a hog = base-hog price + quality incentives at time t + quality incentives during certain period of time.

Table 4-8: Contract Premiums and Penalties

Contract premiums	Penalties for failure to meet quality standards
Contract premiums range from \$0.5 to \$4.0 per hundred pounds	<ul style="list-style-type: none"> - \$1 per head for Any lot of hogs with an average lean percentage lower than 50% - \$1 per head for any load of an average lean percentage lower than 50% - \$0.25 per carcass cwt. for monthly average live weight lower than 257 pounds - \$2 per carcass cwt. when target quality attributes are not met - Severer discount rate would apply when target weight range is not met
38 observations	5 observations

Another set of contractual instruments for intertemporal consistency in quality which are found in some long-term hog procurement contracts has to do with certain type of base-hog price determination structure such as “cost-plus price,” “floor price,” and “window price” formula. While the base-price structure of “swine or pork price formula” contract is basically determined in reference to the spot market hog price at the time of delivery⁷², the base-price in those three types of price formulas is determined in a way to reduce the adverse effects of base-hog price volatility on either party’s income stream. Furthermore, the three types of price formulas help producers have less incentive to adjust market timing to the changes in market hog price or feed price (in cost-plus price formula) because the contract base-price paid is more stable than market hog price or reflect feed price change (in cost-plus price formula).

⁷² According to Joskow’s (1988) claim, the fact that base-hog price is determined by spot market price at the time of delivery implies that asset specificity associated with the transactions is low, goods are relatively homogeneous in terms of quality and other additional costs accrued to transactions, and market supply and demand condition for goods are relatively volatile. But, it should be noted that one of the distinctions of hog contract pricing is that the base-hog price and price for quality is determined independently and the latter is basically determined by the quality outcome and the consumer value on the quality in the downstream markets where pork packers take strategic position.

Base-price in the cost-plus price or guaranteed minimum price, and floor price contracts is determined by a formula including corn and soymeal prices and a prespecified hog production efficiency plus a fixed payment (from zero to a some amount of dollar value). The contracts set a minimum (floor) price level reflecting feed prices at the time of delivery (e.g., 6-week moving average of Omaha corn and Decatur/Central Illinois 44% soymeal prices). Therefore, the floor price moves together the market feed price at the time of delivery. The contracts guarantee the minimum price, which means that producers are paid the minimum price when market hog price is less than the minimum price at the time of delivery. Many of the contracts specify that producers are paid hog or pork market price or according to a rule of splitting of the difference between the market price and the minimum price when the market price is greater than the guaranteed minimum price. However, the base price structure in the contracts are designed in a way that the weighted average price paid under the contracts is equal to that under spot markets using some tools such as “ledger”, splitting rule, or a careful design of minimum price. A ledger account plays a role of a record-keeping to come up with the accumulated amount of the negative deviations of hog prices from production costs being equal to that of the positive deviations when contract expires. Contract length tends to align with the time period of hog cycle such as five or ten years and is renewable if the ledger balance remains.

Implication of the floor price or cost-plus price contracts for producers’ decision on the timing to market is that producers have less incentive to adjust market timing to the changes in market feed or hog price because the contract base prices paid reflect feed price change and are more stable than spot market hog price. In this regard, the pricing

structure of the contracts help significantly reduce opportunity costs of decision on timing to market in a way to align with pork packers' objective of consistency in hog weights.

Base-price structure of window price contracts is similar to that of the cost-plus price or floor price contracts, except that ceiling and floor prices are specified at the time of signing on a contract. Some window price contracts fix the ceiling and floor prices while others let the prices change according to the change in feed price. Some contracts use ledger account or splitting rule while others do not. Regardless of specific tools, every window price formula tends to be designed in a way to reduce the variation of contract prices paid and at the same time as equalize the accumulated amount of negative deviations of market hog prices from ceiling price with that of the positive deviations of market hog prices from floor price when contract expires. Similar to cost-plus price contract case, the contract is renewable if the balance remains.

Given the prevalence of a 4-5 year hog cycle and seasonality, both parties expect that a window price contract with duration close to the hog cycle period would generate lower variance of base-hog prices than a contract directly adopting market prices at the time of delivery do while mean price would be the same. Therefore, the nature of the window price is not in the shift of risk but in the minimization of the risk by crafting a rule to split the positive or negative deviations from stipulated window price zone. As a result, the reduced volatility of base-hog price helps lessen hog producers' incentives to change the weights of market-ready hogs, resulting in more consistent hog weights over time.

Those two set of instruments created through long-term contracts have little to do with safeguard against opportunism and therefore investment in relationship-specific

durable assets. The impediments in hog exchange stem from buyers' implementation costs associated with quality incentive pricing under circumstances where quality production costs are volatile and the target quality attributes of hogs are buyer-specific. This is not a moral hazard issue but transaction cost in identifying and providing state-contingent optimal price, highlighting the costs associated with price determination process. Spot markets that govern instantaneous and anonymously disconnected exchange are inflexible in dealing with the exchange impediments. Long-term contracts are more flexible in managing the issue since they govern deferred, identity-preserved and repeated exchange based on which incentives can be intertemporally bundled and quality performance can be intertemporally enforced.

4.2 Contracting for Decision Rights under Potential Contractual Externality

A critical set of provisions identified in the hog procurement contracts is contractual restrictions on hog producers' decision rights over the selection of genetics and nutrition program for hog production. However, the degree of the contractual restrictions varies across contracts. Some contracts specify that hog producers should respect pork packers' exclusive decision rights. Others require hog producers to obtain pork packers' approval when producers select inputs for hog production. Some contracts implicitly or explicitly stipulate packers' rights to recommend concerning the input use (see Table 4-9 for variations on the contract clauses). Regardless of the variations in the contractual restrictions, most contracts require producers to share information with packers about the genetic line, breeding stock, and nutrition program that they use or change.

Table 4-9: Contract Clauses Regarding Decision Rights on Production Practices

Specifications	Genetics	Nutrition program
Packers' approval or mutual agreement on the use of	11 observations	5 observations
Packers' exclusive decision rights on the use of	2 observations	6 observations
Packers' restrictions on specific nutrition		7 observations
Specifying output quality requirements implying appropriate use of	6 observations	4 observations

The contractual restrictions on producers' decision rights over hog production practices can be explained by potential adverse effects of producers' input selection on a certain quality attributes of hogs to be exchanged which are costly to measure and thereby explicitly reward. As animal science and technology regarding genetics and nutrition program have considerably developed during recent decades, task programmability in hog production has been enhanced. However, hog producers have interest in the production cost efficiency effects of the alternative inputs while pork packers are more interested in the quality differential effects. Problems may arise when slaughter hogs are exchanged in spot markets which govern spontaneous, anonymously disconnected exchanges because certain quality attributes such as meat color, firmness, and texture are costly to measure, and thereby pork packers are not equipped with appropriate incentive instruments to induce hog producers to align with their interests.

Furthermore, packers' provision of incentive price for leanness through carcass merit program may hurt the incontractible quality outcome of the inputs selected by hog producers which is driven by the incentive price. This may be called as contract

externality (Holmstrom and Milgrom, 1991; Holmstrom, 1999). Contractual externality arises when the incentives that influence one decision affect optimal incentives with respect to other decisions. It may become prevalent when the outcome of a task is costly to measure at the time of exchange but is valuable to buyer and the task is not separable from another task whose outcome is easy to measure. Since independent contracting parties have strong incentives to maximize her own profit even at the cost of the other parties, suboptimal outcomes may take place in terms of joint-surplus maximization. Given meat quality attributes such as meat color, firmness and texture are difficult to measure and thereby less contractible, contract externality would become problematic when hog producers' activities to enhance the contractible quality attributes including percent lean adversely affect the incontractible quality attributes. As described at previous section, the contractual externality issue has become noticeable as the experience good attributes have become valuable in the consumer markets and leanness of hogs has been emphasized.

Therefore, pork packers should develop instruments to avoid a bad case where slaughter hogs purchased are contaminated by inferiority of incontractible quality attributes. The possible incentive instruments include regulating incentive intensity on a task whose performance is easy to measure, the contractual restrictions on an agent's extricable decision rights on a task whose performance is difficult to measure, and reallocation of ownership (Holmstrom and Milgrom, 1991, 1994). While regulating incentives for the measurable quality attributes such as leanness is feasible in spot markets,⁷³ the other instruments are not feasible in spot markets which feature exchanges

⁷³ Martinez and Zering (2004) use the theory to explain the pork packers' design practice of carcass merit program, showing the slightly muted incentive for the measurable quality attributes.

based on measurement of output. Particularly contracting for decision rights becomes promising when hog production-related variables affecting the outcome of incontractible quality attributes are contractible. It has been found that selection of genetics and nutrition program and designing of production facilities are contracted between pork packers and producers. Typical provisions of the contractual restrictions are as follows:

It is mutually understood between the producer and packer that the producer will produce hogs that, on average, will have a meat quality (which includes firmness, water holding capacity, marbling, coloring, and chemical composition) which in all respects conform to the requirements, protocols, standards and quality guidelines established in this agreement or hereafter established or adopted in the sole discretion of packer. The producer will use genetics to produce hogs that on average will have a meat quality that equals or exceeds that meat quality of all other hogs delivered to packer for slaughter.

The producer shall provide packer with 60 days written notice prior to implementing any proposed material change in genetics, nutrition or production management that may have an adverse effect on the kill performance and/or value of meat derived from the hogs. The packer shall provide the producer, within 15 days of receipt of producer's notice, of any objections to any such material change. If the packer has such objections, then the producer shall not implement such material change in a manner that results in actual delivery to packer of hogs bearing such change in attributes.

Unlike contractual restrictions on retailers' extricable decision rights or actions in franchising relationship where the costs of monitoring franchisees' activities are high and

We also identified that some of carcass merit programs in the contract data reflect the subdued incentives. However, it should be noted that regulating the incentive intensity is implemented without relying on long-term contracts.

horizontal and/or vertical chain externality issue is critical,⁷⁴ pork packers' use of the contractual restrictions in hog procurement contracts require knowledge of correlation between alternative inputs and the multiple dimension outcomes in the domain of hog production where pork packers are not specialized. Therefore, the degree of asymmetry in allocation of decision rights over hog production practices may be correlated with the degree of pork packers' investment in knowledge of the correlations.⁷⁵ One remaining issue is how contracting parties conclude to mutual consent when alternative inputs would generate conflicting outcomes, cost vs. quality effectiveness, for example.

4.3 Product Perishability and the Synchronization of Actions and Decisions

The last set of provisions stipulated in hog procurement contracts are concerning coordination of hog quantity and delivery. The essential elements of the provisions include mutual communication of future quantity flow projection, pork packer's decision rights over temporal coordination, setting tolerance zone, and remedy for delivery shortage. As described earlier, timely flow of slaughter hogs has become crucial between sizable, modernized processing plants and production facilities operated by large firms.

⁷⁴ See Brickley (1999) and Arrunada, et al. (2001) for empirical studies on contractual restrictions in franchise agreements.

⁷⁵ Even if the knowledge of production is important to contract formation and execution particularly when party-specific products come into play, it has had little attraction from existing theories of contracts. Normative agency theory assumes that production technology is common knowledge (Fudenberg, et al., 1990) while transaction cost theory acknowledges the imperfection of production knowledge (Williamson, 1996) but has rarely incorporated it into its analysis. Positive agency theory instead emphasizes the role of local knowledge to realize production cost minimization (Jensen and Meckling, 1992). It proposes co-localizing of decision rights and specific knowledge through alienating of decision rights when production knowledge is costly to transfer. The fact that some economists including Demsets (1991), Langlois and Foss (1999), and Nickerson (1999) have begun to emphasize the implications of imperfect knowledge of production on organizational design suggests that there is room for further development on the issue.

Some literature reports survey results that producers and packers use long-term contracts to reduce uncertainty in quantity flow. However, on assessing organizational differential effects on supply uncertainty, we suspect that the effects are not substantial and the provisions are basically auxiliary.

Under conditions where there are a few large buyers and many small sellers, the intermediate goods to be exchanged are non-storable and perishable, and the quantity and prices of the goods are daily and seasonally volatile, the possibility of failure to procure hogs of optimal number through spot markets always exist. Therefore, both hog buyers and sellers have incentives to make a pre-arranged delivery schedule to secure optimal flow of the inputs or outputs. It has been found that they have utilized informal agreements to make a pre-arranged schedule even though they show limitations on legal enforcement aspect. In contrast, formal contracts provide more secured enforcement mechanism for an explicitly specified delivery schedule mutually agreed upon.

However, differential effects of long-term contract transactions over spot markets transactions on the probability of failure to procure hogs of optimal number would not be considerable so long as hog production is subject to biological or environmental shocks out of control by economic agents. Competition among buyers and sellers in spot markets makes the probability of suboptimal in daily procurement quantity across buyers stochastic. If a pork packer procures all of hogs to be slaughtered only through long-term contracts and the others use spot markets, then the pork packer would enjoy reducing the probability of sub-optimality caused by unexpected interruptions in the contract sellers' hog productions by using spot markets temporally, which in turn increase the others' probability of sub-optimality. For that reason, presumably every hog buyer tends to

engage in long-term contracts and thereby most hog buyers' concurrent use of long-term contracts and spot markets is likely to occur. Therefore, a long-term contract itself does not generate considerable differential effects on reduction of uncertainty in hog quantity flow.

But, so long as buyer and seller enter into lock-in relationship through a long-term contract, the contract should specify clauses concerning safeguard to protect either party from the counter party's potential opportunistic behaviors on delivery commitments, which are not available to informal relational contracts. This safeguard function of long-term contracts comes out in order not to shun opportunistic behaviors in anonymous spot market transactions but to discourage either party's ex post incentives to renege the bilateral contract agreed upon in order to take a larger benefit from turning into alternative transaction opportunities. These opportunities in pork industry mostly stem from hog and feed market circumstances where the discrepancies between the contract price and alternative transaction prices of hogs or the expected loss from committing the contracts expand.

Long-term hog procurement contracts typically delineate remedy for damage from delivery shortage for certain period of time by specifying liquidated damages such as five, twelve or twenty four dollars per head or replacement costs which are opportunity cost of hog supplier's renegeing contract. They also specify remedy for hog supplier's damage caused by pork packer's default, by using replacement costs. Delivery shortage assessment is made on weekly, monthly, quarterly, and/or yearly base because delivery schedules are made on the basis of specified number of hogs per week, month, quarter, and year. In order to distinguish between opportunistic behaviors and unavoidable results,

they set tolerance zone on the variation of quantity actually delivered from agreed delivery quantity. The tolerance zone varies across contracts or packers, e.g., $\pm 10\%$ per each time periods, or $\pm 25\%$ for only annual number.

5. Concluding Remarks

The research has reported the structure of hog procurement contracts and has analyzed three sets of contract provisions with an institutional approach. By so doing, it reveals that pork packers' choice of long-term hog procurement contracts has to do with their organizational capabilities to create intertemporal incentive instruments and afford contractual restrictions on hog producers' decision rights over production practices. The intertemporal incentive instruments aim to induce hog producers to continuously commit to provision of consistent quality of hogs under circumstances where production costs of the target quality are volatile. In this regard, long-term contracts are more flexible in dealing with transaction costs associated with quality-price determination process since they govern deferred, identify-preserved, and repeated exchange based on which incentives can be intertemporally bundled and quality performance can be intertemporally enforced. Another competence of long-term contracts identified in the hog procurement contracts involves flexibility in creating safeguard against potential adverse consequences of hog producers' selection of alternative inputs on quality attributes of hogs difficult to measure. Contracting for producers' decision rights over hog production practices affecting incontractible quality attributes of hogs provides hog buyers with instruments to resolve contractual externality arising under measurement difficulty.

In contrast with existing literature on the choice of long-term contracts which emphasizes ex ante underinvestment incentives or ex post opportunistic behaviors supported by relationship-specific investments, our findings highlight transaction costs associated with implementation of optimal quality incentive-pricing and sellers' potential moral hazard supported by measurement difficulty. In addition, while most existing empirical literature on long-term contracts has been made in energy industry, our study on long-term contracts has employed a manufacturing industry where interaction between upstream and downstream markets is salient. As expected in any other food industries, we found in the pork industry that pork processors' product differentiation activities in downstream markets influence a way of organization of production in upstream markets. Individual pork processors' market strategic positioning in increasingly differentiated consumer markets facilitates buyer-specific definition of hogs to be exchanged which damage the competence of auction markets operated based on predefinition of hogs. Particularly, pork packers who strategically position on consumers highly valuing on the consistency in meat quality attributes are more likely to enter into long-term contractual relationship with hog producers. In the transition from spot markets to contracts, it is naturally assumed that differential effects of large size hog producers on unit costs of managing contracts come into play. Therefore, it is safe to say that diversity in consumers' value function in downstream markets causes discrimination between hogs and between hog sellers (Rosen, 2002).

In this way, our analysis of hog procurement contracts is expected to help enrich our understanding of the "exact nature of difficulties associated with economic coordination" and the "rules and decision-making structure that frame agents' behavior" (Brousseau

and Glachant, 2002). However, our research does not consider how the contracts are actually executed, or in other words, the contract performance dimension. Finally, the research has not studied the role of production knowledge on organizational choice or design. Future research in these two directions is definitely promising.

Chapter 5

EMPIRICAL ANALYSIS ON PORK PACKERS' CHOICE OF NON-SPOT MARKETS FOR SLAUGHTER HOG PROCUREMENT

1. Introduction

This chapter empirically examines factors influencing pork packers' choice of contracts or internal production shunning spot markets to procure slaughter hogs. Unlike the most TCE empirical literature focusing on choice between procurement through market transactions in general and through in-house production (see Klein, 2005; Yvrande-Billon and Saussier, 2005 for surveys of the literature), this research looks at the choice between spot markets and non-spot markets. Recognizing the fact that a number of large pork packers and even individual pork packing plants concurrently use multiple organization forms including spot markets, contracts, and vertical integration, the research investigates factors affecting the share of spot markets in their organizational form portfolio rather than dichotomous choice between spot markets and contracts or markets and in-house production.⁷⁶

It constructs three testable hypotheses. One is based on the theory of asset specificity, one on measurement difficulty or contractual externality, and one on the concept of product specificity to a buyer developed in Chapter 3. The hypotheses are based on the analysis of long-term hog procurement contract documents presented in

⁷⁶ One may find literature on concurrent sourcing (Harrigan, 1986; Parmigiani, 2007). However, this research' focus is not on concurrent sourcing itself but on the comparative analysis of spot markets and non-spot markets in terms of organizational capabilities and costs. As a reference, survey results from pork packers who simultaneously use multiple organizational forms indicate that enhancing flexibility in hog procurement quantity management is a major reason (Muth, 2007). Therefore, this research explores factors influencing choice to non-spot market organizational forms before pork packers consider the flexibility.

Chapter 4.⁷⁷ In particular, temporal specificity hypothesis is derived from looking at the attributes of assets to process slaughter hogs and the structure of upstream markets for hog transaction while measurement difficulty and product specificity hypotheses are based on consideration of the attributes of hog quality specific to a pork plant which is derived from its product differentiation activities in downstream consumer pork product markets. I conduct econometric analysis to test the hypotheses using original survey data collected from managers in pork packing plants.

The results of the multiple regression analyses show that the data support measurement difficulty and product specificity explanations for pork packers' choice of non-spot market organizational forms to procure slaughter hogs. Given pork packers' simultaneous use of alternative organizational forms, the results imply that the share of spot markets in pork packers' organizational form portfolio is negatively influenced by their concern about the difficult-to-measure quality attributes and intertemporally consistent quality attributes of slaughter hogs. In other words, spot markets that govern instantaneous exchange may not suffice for exchanges of products whose attributes involve the difficulties in measurement and providing marginal prices for the production of the attributes. Furthermore, the empirical results suggest that pork packers' hog procurement practices are influenced by their market strategic positions in the downstream consumer markets, from which demand for distinct packages of attributes of hogs is derived.

The chapter is organized as follows. The following section presents three hypotheses and third one discusses measurement of variables. And then fourth section describes data

⁷⁷ It should be noted that long-term hog procurement contracts have governed the vast majority of the U.S. slaughter hog transaction since mid-1990s as described in Chapter 4.

collection including survey sample design, survey administration procedures, and data preparation procedures. The fifth section discusses model specification and statistical methods and the sixth one reports an analysis of estimation results. Conclusions follow.

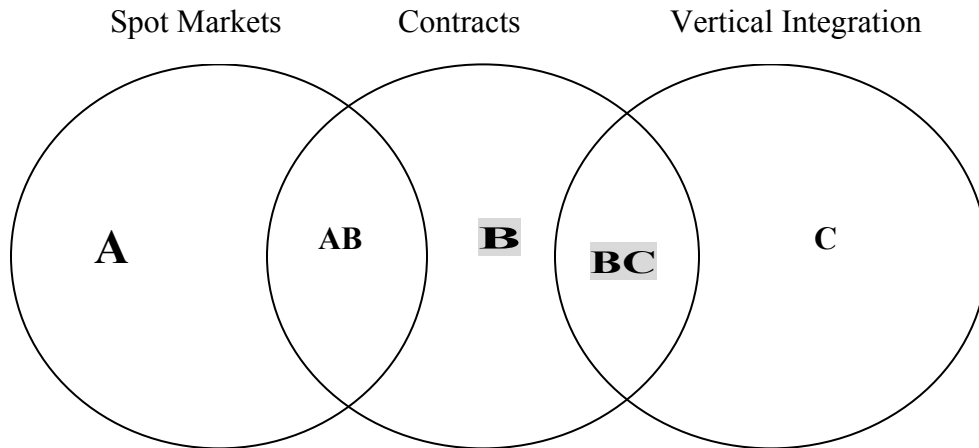
2. Hypotheses

As discussed in the previous chapters, the existing theories informing the choice between spot markets and contracts or vertical integration include TCE and measurement difficulty explanations. This research has also proposed product specificity to a buyer as an alternative explanation. While there might be other explanations, this research focus on factors influencing transition from spot markets to contracts or in-house production limits the relevant theories to generate testable hypotheses. Figure 5-1 illustrates the objectives of this empirical study. Based on Williamson (1996)'s argument that there are three generic types of governance structures including spot markets, hybrids, and vertical integrations (hierarchies), the relationship among the three governance structures can be described by the diagram.

In the diagram, spot markets and vertical integrations are located at the opposite poles and contracts in between. The diagram also shows that there are common grounds between alternative organization forms as well as their own distinctive organizational capabilities, assuming organizational capabilities and costs of the three governance structures can be characterized by multiple dimensions. Using the diagram, it may be said that this study focuses on comparison between A and B+BC while most TCE make-or-buy decision literature distinguishes between AB+B and C. Given this research focus, the

hypotheses are more associated with the distinctions between A and B+BC and therefore, potential factors influencing the choice between B and C are less emphasized.⁷⁸

Figure 5-1: Empirical Research Focus



2.1 Temporal Specificity Hypothesis

The slaughter hog transactions between pork packers and hog producers feature temporal specificity. Unlike most manufacturing operations, it is inefficient for pork packers to hold a buffer inventory of live hogs to absorb fluctuations and permit work to continue at the hog slaughter stage when problems in certain hog production units arise, due to the extremely high cost of maintenance of live animals ready to slaughter.

Alternatively, an inventory of carcasses is feasible but costly and limited due to meat

⁷⁸ One may consider choice between spot markets and contracts comparing between A and B rather than between A and B+BC isolating BC from this research design, which was originally intended by this research but has not been adopted due to limitations of the data available at the US pork industry.

quality concern. Therefore, the non-storability of live hogs requires pork packers and hog suppliers to coordinate the product flow in a timely manner given the sequential nature of hog production and processing. Buyers who do not secure an appropriate quantity of hogs for slaughter in time could suffer from idle operation of the slaughter plant.

TCE suggests that temporal specificity grows with the costs of buyers' switching from an extant hog supplier to alternative hog suppliers at the last minute, increasing probability of hold up by suppliers (Masten, et al, 1991; Pirrong, 1993; Nickerson and Silverman, 2003; Arrunada, et al., 2004). The pork industry literature points out that the temporal specificity tends to increase with two factors: slaughter plants technology and market thinness. First, modern, high-speed packing plants, especially those adopting a double-shift technology are more exposed to higher temporal specificity than those adopting a single-shift technology because they have sharply sloped short-run average cost curves (Hayenga, 1998, Martinez, 1999). The claim parallels survey results that producers and packers use long-term contracts or vertical integration to reduce uncertainty in quantity flow. Additionally, delivery schedules specified in long-term hog procurement contracts have been attributed to hold-up concerns. Second, it is also assumed that the switching costs tend to increase with hog supply quantity concentration among a small number of sellers. Martinez (1999; 15) claims that a processor that locates in a geographic region with few hog producers would be subject to opportunistic behavior by the producers.

Therefore, two hypotheses related to temporal specificity are generated.

Hypothesis 1-1: A pork packing plant that adopts double shift technology is more likely to increase the share of long-term contracts or in-house production in its organizational form portfolio.

Hypothesis 1-2: The more concentrated market share of large hog sellers surrounding a pork packing plant is more likely to reduce the share of spot markets in its organizational form portfolio.

2.2 Measurement Difficulty Hypothesis

Increasing consumer demand for meat characteristics associated with hog quality attributes that are difficult to measure have created another challenge for pork packers' transactions for slaughter hogs. Hog quality attributes such as meat color, marbling, and tenderness are not impossible to measure, but they are costly to measure on an individual hog basis in high-speed slaughter lines. Furthermore, the measurement of the quality attributes post-slaughtering involves potential moral hazard issues since quality outcomes result from a sort of team-production among the economic agents in the production, transportation, and slaughtering stage of the value chain. Therefore, it is virtually impractical for packers to implement pecuniary incentives based on objective performance measurement of individual hogs. To make things worse, providing incentives for measurable quality attributes such as leanness and size may adversely influence the outcome of the difficult-to-measure quality attributes hog producers have strong incentives to invest in the outcome of the former attribute at the sacrifice of that of the latter attribute, particularly when selecting genetics and feeding programs. This

challenge is not likely to be resolved through spot market organization because it features instantaneous and anonymously disconnected exchange.

Since independent contracting parties have strong incentives to maximize their own profit even at the cost of the other parties, suboptimal outcomes may take place in terms of joint-surplus maximization (Holmstrom and Milgrom, 1991, 1994; Holmstrom, 1999).⁷⁹ Pork packers that value the less-contractible quality attributes, therefore, are likely to shun spot markets and instead adopt contracts through which they create instruments to lessen potential contractual externality. As noted in Chapter 4, the selection of genetics and nutrition programs and designing of production facilities which affect meat quality attributes of hogs are contracted between pork packers and producers. One step further, contract growers under production contracts are subject to the contractor's decision with regard to the selection of inputs for hog production. Obviously, wage workers for hog production under managerial control have little incentive to engage in the contractual externality because they are not residual claimants. Therefore, spot markets are different from long-term contracts, production contracts, or vertical integration in that the former does not allow for pork packers to interfere with the decision space of hog producers with regard to input use.

Hog carcasses are used to create a variety of meat products, ranging from processed meats, to frozen boxed meats, to fresh pork cuts, each of which has different consumer quality characteristics. Previous research suggests that fresh pork cuts are the most sensitive to meat quality attributes of hogs that are difficult to measure at the time of

⁷⁹ This contractual externality proposition under a setting of multi-task and measurement difficulty of one task has been supported by evidence from gasoline retailing sector (Slade, 1996), franchising (Brickley, 1999; Lafontaine and Shaw, 2005), and trucking industry (Baker and Hubbard, 2003). To my best knowledge, it is first that the proposition is empirically tested in firms' choice of organizational form for input procurement in upstream markets.

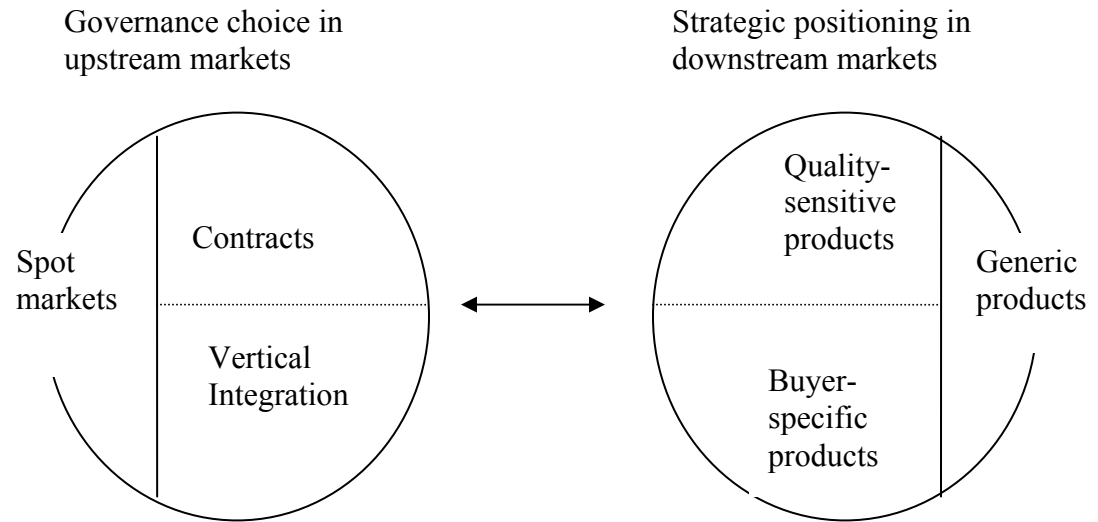
exchange (Miller, et al., 1999; Smith, 1999; Martinez and Zering; 2004; Muth, et al., 2005). A pork packer who heavily relies on a high portion of fresh pork branded product, therefore, is more vulnerable to be hurt from variation of meat quality attributes of hogs slaughtered than others that market case-ready frozen products, boxed fresh or frozen products, and processed product because marginal negative effects of the variation on the packer's potential benefit are substantially higher than otherwise.

Hypothesis 2: A pork packing plant that markets case-ready fresh pork products is more likely to enlarge the share of contracts or in-house production in its organizational form portfolio.

This measurement difficulty hypothesis and the product specificity hypothesis described below are based on supply chain approach to organizational form choice (James, et al.2007; Sykuta, 2008) and consistent with argument that firms' market strategic position affects the choice (Nickerson, 1997). In fact, this approach has been emphasized by Coase (1972).⁸⁰ A pork packer's choice of organization form in the upstream hog markets is influenced by its strategic positioning activities in the downstream pork product consumer markets in terms of product differentiation. On the other hand, the activities in the downstream markets are constrained by the packer's organizational strategic activities in the upstream markets (see Figure 5-2).

⁸⁰ "Furthermore, the costs of organizing an activity within any given firm depend on what other activities it is engaged in. A given set of activities will facilitate the carrying out of some activities, but hinder the performance of others. It is these relationships which determine the actual organization of industry (Coase, 1972: 63)."

Figure 5-2: Supply Chain Approach to Organization Form Choice in the Pork Industry



2.3 Product Specificity Hypothesis

A long-term contract may be required for pork packers when the incentive price for certain measurable hog quality attributes posted by individual packers does not meet the producers' calculation of first order condition for production of the quality attributes of hogs which should be constantly marketed. This suboptimality may take place when the factors influencing the marginal costs of the quality attributes are volatile at the same time as the quality incentive price is rigid. If a contract can be structured to help redress the suboptimality, pork packers would be likely to offer the contract to producers.

The advantage of long-term contracts can be realized when pork packers want to procure intertemporally consistent quality hogs. Achieving consistency in hog quality has been one of the greatest challenges in repeated transactions of slaughter hogs, pork cuts, and processed pork products. Packers, processors and retailers all ranked lack of uniformity in live hogs, carcasses, and retail cuts with regard to size and backfat as the

most important quality issue facing the industry (NPPC, Pork Quality Audit, April 1994). From pork packers' standpoint, consistency has to do with variances within a group of hogs delivered from a seller, across hog sellers, and over time.

Given the volatile nature of the unit price of slaughter hogs and the feed price, intertemporal variance in certain quality attributes cannot be controlled only by static quality incentive prices built in carcass merit programs. The concern arises from the erosion effects of volatility in market prices of a base hog and feed prices on the incentives (premiums and discounts based on carcass weights and percent lean) since changes in the market price of a base hog or in the price of feed will change the net return function for hog producers given a 3-week marketing horizon within which hog producers determine the timing to market hogs. Depending on the nature of the quality price matrix and the relative magnitude of market price fluctuations, producers may no longer have an incentive to deliver the desired quality hog.

Figure 5-3-A, B, and 5-4 illustrate the case described above. Given any quality pricing structure, changes in the market price of a base hog or in the price of feed (or other variable inputs) will change the net return function for producers. Figure 5-3-A shows that a high productivity-producer's optimal decision on the timing to market tends to result in marketing a hog of overweight for a pork packer when the base price of a slaughter hog is increasing at the marketing time horizon. In contrast, a low productivity-producer's optimal decision may bring about delivering a hog of underweight for a pork packer when the base price of hogs is decreasing or the feed price is increasing at the marketing time horizon (see Figure 5-3-B). Both Figure 5-3-A and 5-3-B cases result in

deviation from target range of carcass weights valuable to a downstream firm. The consequential effects on the distribution of carcass weights are expressed in Figure 5-4.

Therefore, upstream firms' optimal decision under the volatility of feed and base-hog prices may result in an insufficient supply quantity of hogs of target quality. We label this deviation as the erosion effects of price volatility. Intuitively, we can conclude on a proposition: The higher a pork packer's hog quality specificity, the larger the erosion effects are likely to be. The proposition entails that a pork packer with a narrower target range of carcass weights is more likely to get hurt from the erosion effects.

The erosion effects can be resolved by vertical integration where managers in pork packing firms exert control on production and marketing time decision in the hog production. The erosion effects may also be reduced through long-term hog procurement contracts. The observed provisions of the long-term hog procurement contracts include setting intertemporal target quality, providing contract premium, and enforcing intertemporal target quality performance. In addition, it is found that contract base-hog pricing structures observed in some long-term contracts also help producers to make a decision on intertemporally consistent hog weights. The former indirectly contributes to inducing hog producers to adjust their decision on timing to market to pork packers' expectation while the latter directly influences the price variables comprising first order condition for the producers' decision. We expect that long-term contracts increase the density of desired hogs relative to the volatile price environment and come up with the product specificity-related hypothesis.

Hypothesis 3: The proportion of spot market transactions used by a pork packing plant is negatively influenced by hog quality specificity to the plant.

Figure 5-3: Erosion Effects of Price Volatility of Base Hog and Feed on Quality Incentives

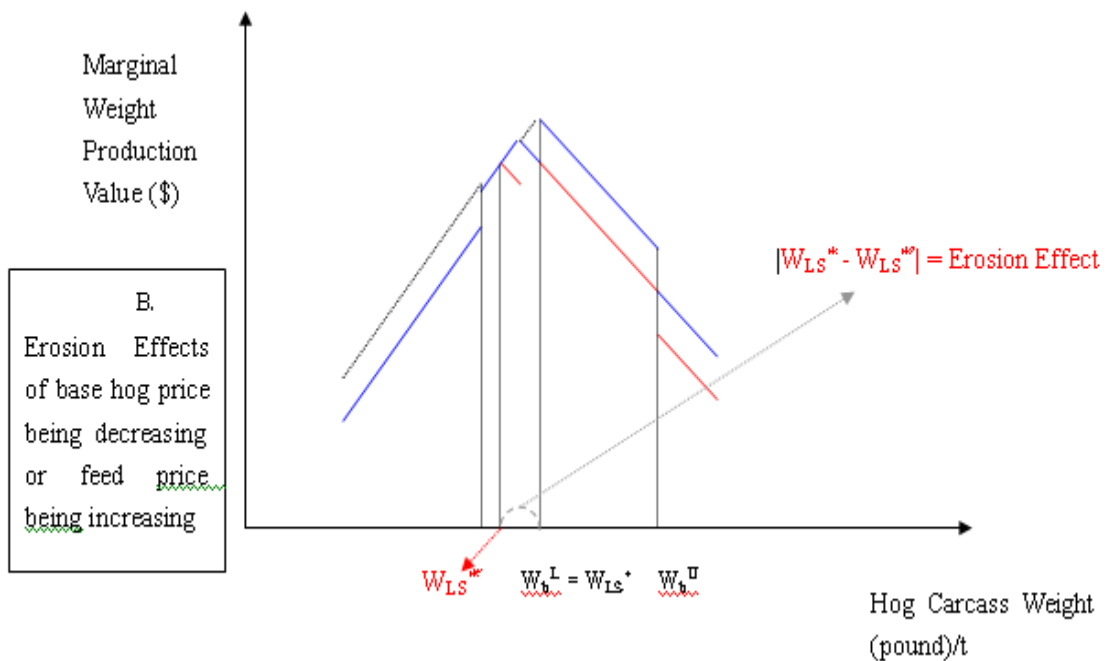
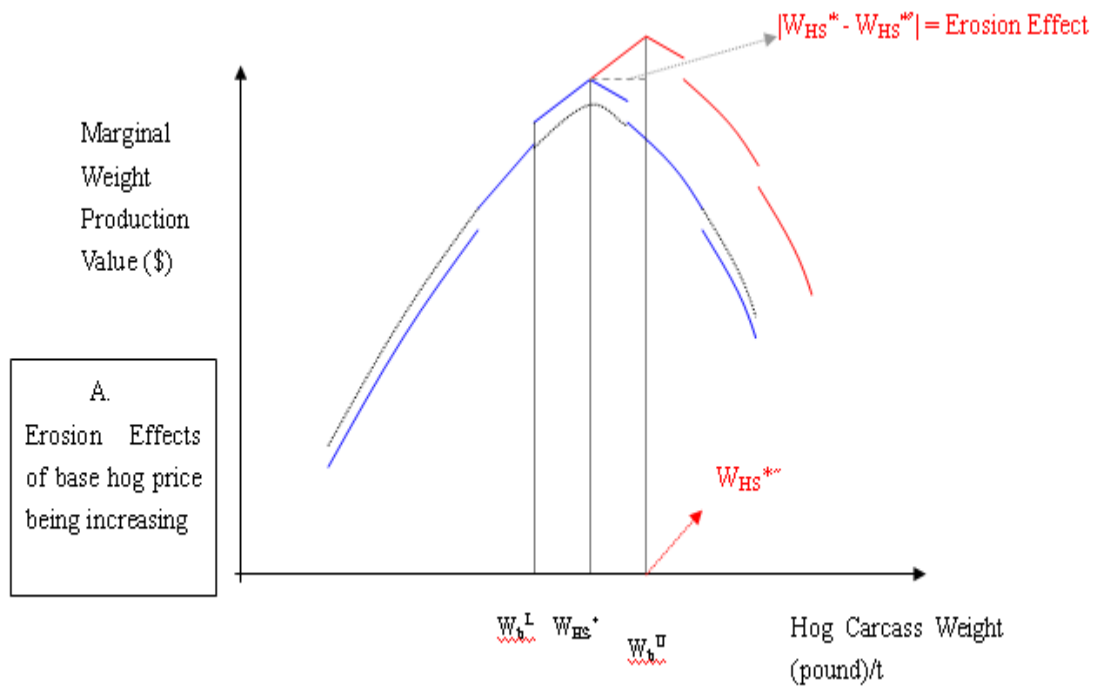
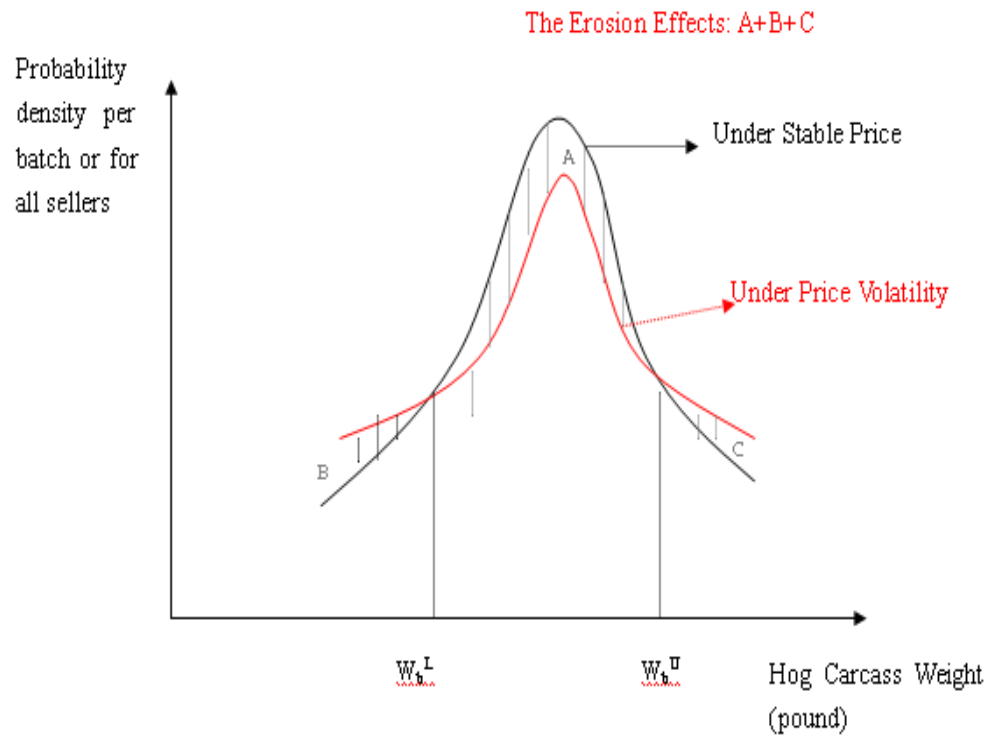


Figure 5-4: Erosion Effects on Distribution of Carcass Weights



3. Measurement of Variables

The choice of organization form

Most TCE empirical studies measure organizational form choice as a discrete event. Firms choose either to make or buy parts or equipment. Firms, however, may concurrently use alternative organization form to procure an input. Unlike most TCE empirical literature on organizational form choice, this research adopts a continuous variable for the choice, measured by shares of spot markets and non-spot markets use out of total hog procurement. It is difficult to observe pork packers' choice of organization form for marginal hog transaction. Given the nature of pork packing plant operation continuously slaughtering hogs, however, accumulated results of the choice of

organization form for a specific period of time, or a year, are observable. Therefore, the dependent variable is measured by share of spot markets in pork packing plants' organizational form portfolio, which is calculated by number of hogs procured through spot markets divided by total number of hogs procured by plant i during year t . The research adopts packing plants rather than pork packing firms as a unit of analysis since some large firms operate multiple packing plants which may have different organizational form portfolios and dissimilar characteristics associated with hog transactions each other.

Given the fact that dramatic change in organizational structure in the pork industry has been occurred since 1990s, most desirable data on the measure of the dependent variable would be one that covers the 15-20 year-span, which allows us to not only capture the dynamics of organizational form change within a pork packing plant but also control for firm specific or time specific unobserved factors that might contaminate robustness of estimation results. Furthermore, the panel data could be used to address the issue of simultaneous decision of governance choice and investment in specific assets or decision on market strategic position in downstream markets (Boener and Macher, 2002; Klein, 2005). However, the desirable data are not available from either public authorities or pork packers. Therefore, a survey is designed to collect the data on organization form portfolio. Recognizing the value of the panel data, the survey questionnaires are designed in a way that plant managers answer the questions regarding dependent variable at two-time periods.

Temporal specificity

The most desirable data on temporal specificity would be estimates of the size of the quasi-rent arising from difficulty in finding alternative hog suppliers at the last minute (Sykuta, 2008). Given the difficulty in directly measuring the magnitude of the quasi-rent, temporal specificity in this research is measured by two proxies: slaughter technology and small number bargaining condition. According to Hayenga (1998)'s analysis of cost structure differentials between double-shift versus single-shift slaughter plants, double-shift plants are more vulnerable to the seasonal and biological vagaries of spot market hog supplies than single-shift ones. He argued that when the number of hogs purchased is too small to fully employ workers for the guaranteed hours, packers often are willing to bid significantly higher prices to increase their capacity. Therefore, it is suggested that a double-shift pork packing plant is more likely to use long-term contracts or vertical integration into hog production. The survey asks the managers of packing plants whether they adopt single-shift or double-shift technology.

Another proxy for temporal specificity is considered. As a large body of transaction cost empirical literature (Leiblein, et al, 2002; Gonzalez-Diaz, et al, 2000; Ohanian, 1994; Pirrong, 1993) utilizes it, small number bargaining condition or market thinness potential may come into play in the transactions of slaughter hogs. Even though the market structure approach has been criticized as a poor proxy for temporal specificity (Sykuta, 2008), this research employs the proxy in order to construct a more comprehensive empirical model including existing propositions. As Lawrence, et al.(1997) suggested, a few large hog producers compared to a large number of small hog producers may influence the bargaining condition between the producers and pork

packers, increasing potentials of producers' opportunistic behaviors. This research quantifies small number bargaining condition by the market share of top 5% largest hog producers surrounding a pork packing plant.

Measurement difficulty

Based on existing literature regarding the positive correlation between case-ready fresh pork products and the value of meat quality attributes difficult to measure (Sander, et al., 2004; Miller, et al., 1999; Smith, 1999), the survey asks the managers of pork packing plants about the outputs including carcass, boxed fresh products, boxed frozen products, case-ready fresh products, case-ready frozen products, and processed products such as sausage, smoked or cured ham, and lunch meat. This variable takes dichotomous form, i.e., 1 if a pork packing plant sells case-ready fresh pork products, 0 otherwise.

However, information on the characteristics of outputs marketed by pork packers may not be sufficient to precisely explain the relationship between measurement difficulty in hogs and the share of non-spot markets used since marginal effect of a packing plant' production of case-ready fresh pork products on the share of non-spot markets use may rely on how much percent of total pork products takes on case-ready fresh pork products among the mix of various pork products. Therefore, information on share of case-ready fresh products among total shipment in a plant may increase the accurateness of the measure for the influence of measurement difficulty hypothesis on the choice to non-spot market organizations. Given severe competition for pork product development among pork packers, however, pork packers' considerable concerns about confidentiality discouraged the inclusion of the relevant survey questions.

Hog quality specificity

The degree to which measurable quality attributes of hogs required by a pork packer is idiosyncratic may be measured with a couple of proxies: deviation of a target average carcass weight from national average carcass weights; narrowness of target range of carcass weights; and deviation of a target percent lean from national average percent lean. Among the three proxies, narrowness of target range of carcass weights is the most plausible one that might show a high correlation with the erosion effects mentioned in the previous section. Given the biological variation in hog weights per batch and for certain period of time, it is expected that a packing plant that adopts narrower range of target weights is more likely to choose long-term contracts or in-house production shunning spot markets. The survey includes questions of whether they adopt a carcass merit program for procuring slaughter hogs and of indicating target carcass weights range.

Similar to measure of measurement difficulty, information on the share of idiosyncratic hogs among total hog procurement or share of idiosyncratic pork products among total shipment in a plant may be beneficial to accurately estimate the marginal impact of the hog quality specificity on the share of non-spot markets in its organizational form portfolio. However, it has not been included in our survey due to the same reason with measurement difficulty.

Control variable

Plant size has been used as a control variable. Plant size is measured by slaughter capacity of a packing plant and is categorized with 8 intervals in our survey questionnaire. Information on economic performance of organizational form choice may be desirable to address self-selection bias arising from managers' misperception on

organizational form choice (Masten et al., 1991; Yvrande-Billon and Saussier, 2005; Sykuta, 2008). The economic performance can be measured by plant operation costs (for temporal specificity hypothesis) or revenue or hog quality performance (for measurement difficulty and hog quality specificity hypotheses). However, the data have not been obtained due to the same reason mentioned above.

Table 5-1: Definition of Variables

Dependent variable	Spot market	Number of hogs procured through spot markets divided by total number of hogs procured by plant <i>i</i> during year <i>t</i> . (SM)
Theoretical variable	Temporal specificity	Slaughter technology (ST): 1 if plant <i>i</i> uses double shift, 0 otherwise Market share of top 5% large producers surrounding plant <i>i</i> (MSLP) based on the plant manager's estimate
	Measurement difficulty	Case-ready fresh products (CRFP): 1 if plant <i>i</i> markets case-ready fresh products, 0 otherwise
	Product specificity	Target range of carcass weights (TRW): calculated by high bound minus low bound of the range and then the inverse of product specificity are calculated by dividing individual target ranges with the highest target range in our sample
Control variable	Plant size	Yearly slaughter capacity (PS): categorized with range from 1 to 8

4. Data Collection

4.1 Survey Sample Design

I obtained data to test our hypotheses through a survey. The survey questionnaire was designed to obtain data on designing of long-term hog procurement contracts as well as on organizational form choice (see Appendix 1). However, this chapter uses data on the latter only. The survey was conducted through mailing and web basis during the period of October 2007 to March 2008. I constructed a survey sample of 115 pork packing plants based on information collected from the National Pork Board (NPB), USDA Food Safety and Inspection Service (FSIS), American Meat Institute (AMI), and National Meat Association (NMA). Among the sample, 69 plants were derived from the data posted at the website of the National Pork Board. The data include the name and slaughter capacity of 69 largest pork packing plants which exceed slaughter of 25,000 heads per year as of 2004. According to “Livestock Slaughter Summary 2006,” NASS, USDA, 53 pork packing plants which slaughter over 100,000 heads per year shared 97% of total US slaughter hogs. The address information was obtained from “Lists of Plants Approved to Receive Immediate Slaughter Animals, August 2007” posted at the website of USDA FSIS. In order to meet the balance of our sample and population of pork packing plants, which includes 561 packing plants yearly slaughtering below 100,000 heads, we collected an additional sample of 46 packing plants from FSIS, AMI, and NMA.

4.2 Survey Administration Procedures and a Brief Report of the Responses

I mailed a survey questionnaire and cover letter to the manager of hog procurement department in 53 large plants and to the president of 62 small plants in late October 2007. In order to increase the response rate, I established a web survey site which was informed by the cover letter. 2 weeks after mailing the survey packet, we sent target respondents reminder postcards. On mid December, I contacted sampled plants by telephone to encourage participation. I had 7 mail survey packets undeliverable. By the early January 2008, I remailed survey packets to 108 target respondents and 2 weeks later, sent the second reminder postcards. Lastly, I mailed the third survey packets to all target respondents on late February 2008, and 1 week later, sent the third reminder postcards.

Table 5-2: Population and sample of federally inspected pork packing plants, 2006

Size group	Population		Sample
	Plants	Head	Plants
	<i>Number</i>	<i>1,000 (%)</i>	<i>Number</i>
1-999	380	124 (0.1)	0
1,000-9,999	118	322 (0.3)	0
10,000-99,999	63	2,727 (2.6)	6
100,000-499,999	20	4,817 (4.6)	6
500,000-999,999	5	3,702 (3.6)	1
1,000,000-2,499,999	15	32,566 (31.4)	4
2,500,000-3,999,999	3	10,329 (10.0)	3
4,000,000+	10	49,099 (47.4)	2
Total	614	103,689 (100.0)	22

Source: Livestock Slaughter Summary, NASS, USDA

I have obtained 25 responses from 108 eligible pork packing plants that received our survey packets. We removed 3 responses from the 25 responses due to high incompleteness, indicating a 20% response rate. I briefly report the survey responses.

Table 5-2 indicates the distribution of the size of the sample packing plants that will be utilized into our analysis. It can be said that the sample plants responded to our survey moderately represent the distribution of the medium and large scale packing plants. A potential bias associated with our sample responses should be mentioned. It may be supposed that pork packers that believe the information we ask is more confidential are more unlikely to respond to our survey. This issue may be relevant in the meat industry where competition in multiple attributes of meat quality is increasing and the source of quality differentiation partly resides in the way of hog procurement. Particularly, pork packers' concern on this issue is more closely related to the questions of product specificity than other information that we request, such as slaughter technology and an estimate of degree of producers' market concentration.⁸¹ Therefore, our sample may underrepresent the pork packers who have high correlation between organization form choice and product specificity.

Table 5-3 summarizes the information obtained from the survey. Three features deserve mention. First, the sample data involve missing cases in two independent variables. We report variable means for cases with and without data in the bottom of the table. A more detailed imputation procedure is provided in the next subsection. Second, the sample data indicate that 12 packing plants out of 22 sample respondents simultaneously use alternative organization forms while 10 plants rely on one form of organization to procure slaughter hogs.⁸² This feature of our sample is not different from

⁸¹ The concern was repeatedly identified in conversation with the industry participants during the implementation of follow-up phone calls to encourage respondents to participate in the survey. In fact, the survey was originally designed to collect data on contract design as well as contract choice. But the concern caused to reduce the number of usable responses on the questions of contract design and thereby the analysis was impracticable.

⁸² This feature of organizational structure in the pork industry may be one of the factors that

observation results of existing literature (Muth, et al., 2007). One may maintain that there would be an optimal portfolio of alternative organization forms to use. Third, unlike existing descriptions on the relation between contracts and carcass merit programs, the sample data indicate that carcass merit programs are used in spot markets by some packers and some contracts do not involve the programs.

Table 5-3: Report of Sample Data

Panel 1: 2003

ID	VII	LC1	SC1	SM1	ST1	MSLP1	CRFP1	TRW1	PS1	
1	0	0	0	100	0		0		2	
2	0	100	0	0	0	90	1	45	4	
3	0	0	0	100	0	75	0		5	
4	67.5	25	0	7.5	1	20	1	46	7	
5	35	35	0	30	0	85	1	1	6	
6	0	0	2.5	97.5	0	70	0	52	4	
7	97.5	0	0	2.5	0	40	1	40	4	
8	2.5	5	0	92.5	0	40	1	40	4	
9	2.5	47.5	2.5	47.5	1	50	1	45	6	
10	10	17.5	2.5	70	1	70	1	45	6	
11	30	27.5	2.5	30	1	60	1	45	6	
12	0	0	0	100	0	30	0	34	5	
13	0	0	0	100	0	90	1		3	
14	20	45	15	20	1	10	1	1	7	
15	0	50	0	50	0	5	1		3	
16	0	0	0	100	0	60	0		3	
17	100	0	0	0	0	90	0		6	
18	100	0	0	0	0	60	0		2	
19	0	0	0	100	0		0		3	
20	0	0	0	100	0		0		4	
21	5	40	15	20	1	20	0	44	6	
22	97.5	0	0	2.5	0	40	1	11	6	
Variables means for cases with and without data:										
					ST1	MSLP1	CRFP1	TRW1	PS1	SM1
Cases with complete data (n=13)					0.46	48.08	0.79	34.38	5.77	40
Cases missing TRW only (n=6)					0	63.33	0.33		3.67	58.33
Cases missing TRW and MSLP (n=3)					0		0		3	100

make it inappropriate to adopt a traditional empirical approach to organizational choice using a dichotomous variable (see Klein, 2004, for a survey of the literature).

Panel 2: 2006

ID	VI1	LC1	SC1	SM1	ST1	MSLP1	CRFP1	TRW1	PS1	
1	0	0	10	90	0		0		3	
2	0	100	0	0	0	90	1	45	4	
3	0	0	0	100	0	90	0		4	
4	77.5	20	0	2.5	1	20	1	46	7	
5	35	35	0	30	0	95	1	1	6	
6	0	0	2.5	97.5	0	60	0	44	4	
7	97.5	0	0	2.5	0	40	1	32	4	
8	35	10	0	55	0	50	1	41	4	
9	10	17.5	2.5	70	1	60	1	52	6	
10	17.5	22.5	5	55	1	80	1	52	6	
11	35	12.5	2.5	50	1	80	1	52	6	
12	0	0	0	100	0	50	0	34	5	
13	0	0	0	100	0	90	1		3	
14	20	47.5	20	12.5	1	10	1	1	7	
15	0	50	0	50	0	5	1		3	
16	0	0	0	100	0	60	0		3	
17	100	0	0	0	0	90	1		7	
18	100	0	0	0	0	60	0		3	
19	0	0	0	100	0		0		3	
20	0	0	0	100	0		0		4	
21	5	60	20	10	1	40	0	44	6	
22	97.5	0	0	2.5	0	40	1	15	6	
Variables means for cases with and without data:										
					ST1	MSLP1	CRFP1	TRW1	PS1	SM1
Cases with complete data (n=13)					0.46	55	0.77	35.15	5.77	37.5
Cases missing TRW only (n=6)					0	65.83	0.5		3.83	58.33
Cases missing TRW and MSLP (n=3)					0		0		3.33	96.67

Table 5-4: Descriptions of Missing Data Classified by Respondents' Choice of Organization Form

		SM only		VI only	LC only	Mixed (VI+SM/LC+SM/ VI+LC+SM)
2006	No. of Sample	7		2	1	12
	No. of Missing Cases	TRW 6	MSLP 3	TRW 2		TRW 1
2003	No. of Sample	7		2	1	12
	No. of Missing Cases	TRW 6	MSLP 3	TRW 2		TRW 1

* SM indicates spot markets. SC stands for short-term contract, VI, for vertical integration, and LC, for long-term contract.

4.3 Data Preparation Procedures

Before coding the survey responses, I edited the questionnaires to resolve any data errors. It has been found that some of the survey responses include item nonresponse. Among 22 usable responses, 9 responses involve missing data in the questions of MSLP (a proxy for temporal specificity) and TRW (the proxy of product specificity), among which 3 missing data have been found in the both variables in the right hand side of the regression equation. I constructed a logical imputation procedure to impute some missing values. Traditional approaches to missing data include dropping variables or subjects with missing data or employing statistics to imputing scores that are missing (Cohen, et al., 2003). The first approach is rather impractical since the variables stained by missing data in our model are essential to the theory being tested. Before going into the second approach, we investigate the reason why the data is missing in order to make a decision on which one is more appropriate between the second or third approach.

The original survey responses include 9 missing cases in TRW variable. The 9 missing cases originate from the nature of the survey question. All 9 subjects replied that they did not use a carcass merit program where target carcass weight range is specified. The value of TRW is calculated from the target range of hog carcass weights which pork packing plants established as of the first week of May in 2003 and 2006, respectively. It has been frequently found that the target is incorporated into a carcass merit program designed by a pork packer. The carcass merit program includes incentives, premiums and discounts, through which the pork packer induces hog producers to align their decision on weights of market-ready hogs with the target set by the pork packer. Our hypothesis suggests that the narrower the target range is, the lower the effectiveness of the incentives is since the relative magnitude of premiums and discounts in carcass merit program with narrower target range are more vulnerable to volatility of feed and base-hog price. Therefore, I asked pork packers whether they used carcass merit program and then what carcass weight (or weight range) received the highest premium in their carcass-merit program.

I separate the 9 missing cases into three categories in terms of the subjects' use of organization form since the reasons that they did not use carcass merit program are different from each other. As Table 5-3 exhibits, 8 missing cases took place in the responses from packing plants which used either spot markets only (6 cases) or in-house production only (2 cases), for their procurement of slaughter hogs. The 1 missing case was found in the response from a packing plant which used both spot markets and long-term contracts. The 6 missing cases in the responses from pork packers who used spot markets only took place because they did not have a target range of hog carcass weights.

In order to estimate the 6 missing cases, we construct three alternative imputation rules and implement a sensitive analysis.

First, I estimate the 6 missing cases from the data provided by two respondents that procured slaughter hogs through spot markets only and used carcass merit programs (Imputation Rule I). I pick a larger value among the target ranges set by the two packing plants because we assume that a larger value of the target range is closer to a hypothetical value of no target range. The imputed values turn out to be 52 and 44 pounds in 2003 and 2006, respectively. The second alternative imputation rule is constructed based on selecting the largest value in our entire sample rather than the sub-sample used in the first alternative imputation rule (Imputation Rule II). The imputed values appear to be 52 and 52 pounds in 2003 and 2006, respectively. The last alternative imputation rule is established based on estimates from a large sample of carcass merit programs and sorting schedules that has been available at the USDA GIPSA Swine Contract Library website (Imputation Rule III). The carcass weight ranges after excluding the extreme weights in the 31 samples are distributed from 50 ((175-225) to 140 (110-250) pounds in 2003 and 30 (179-209) to 149 (100-249) pounds in 2006 (refer to Table 5-3). I calculate average ranges because they are most likely to be the numbers close to representing actual ranges of carcass weights excluding outliers that pork packers receive under no carcass merit program. I apply this imputation rule to the 1 missing case observed in the response from a pork packing plant which simultaneously used long-term contracts and spot markets because they did not use a carcass merit program. It may be assumed that the packing plant's choice of long-term contracts was made from other reasons.

As in the other extreme case, the 2 missing cases appeared in the responses from pork packers that entirely relied on in-house production to procure slaughter hogs because they also did not use a carcass merit program. However, the specific reason might be different. While packers that use spot markets only and do not use a carcass merit program do not much care about the variation of carcass weights, packers that adopt in-house production for all hogs and establish a target range of carcass weights do not have to create a carcass merit program since they are equipped with managerial control, and the employees in the hog production units has little incentives to take advantage of deviating from the target range. Therefore, I estimate the 2 missing cases from the data provided by two respondents that 97.5% of their slaughter hogs were procured through vertical integration but 2.5% of the hogs were purchased through spot markets and the carcass merit programs set by the packers. I obtain the estimate values of 26 and 22 pounds in 2003 and 2006, respectively, averaging the two target ranges set by the two packing plants.

After constructing the imputations, I transformed absolute values of target range of carcass weights into values to represent narrowness of them dividing each absolute value by the largest values in the sample. Therefore, a larger value of TRW indicates lower hog quality specificity. A positive sign of TRW coefficient on dependent variable of spot markets share indicates that if target carcass range becomes narrower, the share of spot markets would decrease.

Finally, three missing data in MSLP have been found in the survey responses from packers who procured slaughter hogs by only spot markets or short-term contracts in both 2003 and 2006. I scrutinized any potential reasons that the three packing plants did not

respond to the survey question. The most plausible reason for the occurrence of the missing data is that the three packers do not have sufficient information to respond to the following question: “what is your best estimate of market share of 5% largest hog producers within the geographic region surrounding your plant? Please indicate it with 10% interval.” In this case, the most frequently used imputation is to code cases with missing data at the mean value in the sample (Cohen, et al.: 442).⁸³ I plugged in the data set the mean values of MSLP, which are 53% and 58 % in 2003 and 2006, respectively. Table 5-4 and 5-5 exhibit summaries of the missing cases and imputation rules. In the next section the research analyzes the sensitivity of alternative imputation rules.

⁸³ Cohen, et al. put a caveat that the plugged mean can produce a lower standard error of the variable in question and is a source of concern when the difference between the two alternative standard errors is significant (p. 444).

Table 5-5: Alternative Imputation Rules

Portfolio of Organization Form	SM only or LC+SM		VI only
Missing Variables	TRW	MSLP	TRW
Reason of Missing	No use of carcass merit program	Lack of information	No use of carcass merit program
Imputation Rule I	The largest value out of target ranges set by two respondents that used spot markets for nearly 100% of hogs (52 and 44 pounds)	Average value of MSLP variables in the sample (53 and 58%)	Average value of target ranges set by two respondents that used in-house production for 97.5% of total hogs (26 and 22)
Imputation Rule II	The largest value out of target ranges set by total respondents (52 and 52 pounds)	Same as Imputation Rule I	Same as Imputation Rule I
Imputation Rule III	The average value of weight ranges excluding extreme small and large weights in carcass merit programs and sorting schedules observed at a larger sample provided by GIPSA (97 and 88 pounds)	Same as Imputation Rule I	Same as Imputation Rule I

5. Model Specification and Statistical Methods

With regard to the parameter space of our empirical domain, the research specifies an econometric model to estimate and test the effects of variables representing the three alternative explanations of pork packers' choice of organization form as follows:

$$\text{Share of spot markets (SM)}_{it} = \beta_0 + \beta_1 \text{ Temporal specificity (ST)}_{it} + \beta_2 \text{ Temporal specificity (MSLP)}_{it} + \beta_3 \text{ Measurement difficulty (CRFP)}_{it} + \beta_4 \text{ Product specificity (TRW)} + \beta_5 \text{ Control variable (PS)}_{it} + \varepsilon_{it}. \text{ --- (1)}$$

This model is not used to test spot markets versus long-term contracts or vertical integration or contracts versus vertical integration, but rather spot markets versus non-spot markets. Therefore, the expected results from an econometric analysis of the model using data collected from pork packers would represent what factors influence pork packers to eschew the choice of spot markets. Since the model does not distinguish between contracts versus vertical integration, the two organization forms are regarded as alternative substitutes for spot markets in our model. The model does not tell about why vertical integration instead of contracts is chosen and vice versa when spot markets is avoided but informs why spot markets are shunned as evaluated by the marginal effects of independent variables on the share of spot markets in the organizational portfolio.

This research adopts the most frequently used TCE empirical strategy in terms of the underlying assumptions for a reduced-form model. TCE empirical studies assume that the probability of choosing an organizational form depends on the probability that the costs of the organizational form are less than the costs of the alternatives (Williamson, 1985; Masten, 1984; Masten and Sasser, 2002). Because those two transaction costs are difficult to observe and measure, the empirical strategy resorts to a reduced-form in

which an observed organization form is explained by relevant exogenous variables as expressed in equations (2) to (4). Therefore, the logic underlying equation (1) is that the share of spot markets is influenced by the relative costs of spot markets and non-spot markets on the procurement of an incremental quantity of slaughter hogs.

$$TC^{NS} = \alpha X + e \text{ ---(2), } TC^S = \beta Z + u \text{ ----(3),}$$

$$\Pr(TC^{NS} < TC^S) = \Pr(e - u < \beta Z - \alpha X) \text{ ---(4).}$$

However, there are limitations on the reduced-form model, notably, simultaneity and self-selection bias as mentioned in the previous section. The second generation TCE empirical models have been developed to address potential self-selection bias using data on performance of firms' choice of a governance structure (see Yvrande-Billon and Saussier, 2004 for a review of the literature). The limitations to access to the data mentioned earlier preclude the advanced empirical works. Recognizing the limitations, the research attempted to address the potential issue arising from the reduced-form model using two-time period panel data as discussed below. The advantage of our estimation equation resides in that it incorporates variables representing competing theories, which is found in a few of empirical studies (Poppo and Zenger, 1998; Jacobides and Hitt, 2005).

With regard to the sample space of our empirical domain, the research employs two statistical methods that address potential issues of omitted variables and corner solution outcomes. As most of the organizational choice empirical research may suffer from potential unobserved variables which are correlated with the error term (Hamilton and Nickerson, 2003; Yvrande-Billon and Saussier, 2005), our empirical model may involve unobserved individual firm-specific factors which might be correlated with the right-hand

side variables. This kind of correlation may bias the coefficient estimates. In order to address this concern, the research designs a survey that requires plant managers to respond to the same question item at two different points of time, 2006 and 2003. This survey strategy could deal with the potential omitted variable bias issue by using first differencing estimation, a special case of the fixed effects model, which effectively controls for any time-invariant plant-specific unobserved factors in our panel data (Wooldridge, 2002: 279-285). However, it turns out that the dependent variable of share of spot market used in our sample data does not vary much across time. In this case, the first-differencing model is not practical since many zero values in right-hand side in the first-differencing transformation cause a singularity issue. The research instead adopts a dummy variable regression model which is equivalent to time-specific fixed effects model rather than firm-specific fixed effects model (Wooldridge, 2002: 272-274).

I use a doubly-censored Tobit model to estimate equation (1) rather than OLS since the dependent variable takes on fractional values and a large portion of the values are bounded to 0% and 100%. 13 observations in our sample data are corner solution outcomes on the top, 100%, and 6 observations, on the bottom, 0%. OLS estimators ignoring data censoring issues in our sample data would be biased and the t statistics are not reliable because the expected value of the dependent variable conditional on the independent variables cannot be linear and the regression variance is probably not homoskedastic (Wooldridge, 2002: 517-529).

Alternative statistical estimation methods including the fractional logit model and the sequential decision (Type II) Tobit model may be considered for our case. Fractional logit as proposed by Papke and Wooldridge (1996) may be applied to our data among

which dependent variable takes on fractional values. But it may be less appropriate for our data since the data involves the incidence of large portion of dependent variable values being corner solution outcomes and relatively small sample size (see Kieschnick and McCullough, 2003 for the discussion). The sequential decision Tobit model would be the most promising. In the Tobit II model, it is assumed that pork packing plant managers first decide whether they use non-spot markets or not, and then they decide the fraction of the procurement quantity that is contracted or insourced. In order to implement this model, data should include different explanatory variables that may affect the first-stage decisions and the second-stage decisions. I suspect that share of pork products susceptible to difficult-to-measure quality attributes and intertemporal consistent quality attributes among shipment in a pork packing plant would influence the second decision. The lack of this data prevents the adoption of the Tobit II model. Therefore, the doubly-censored Tobit I model would be the second best alternative.

The doubly-censored Tobit model has been widely used in empirical studies in organizational economics that involve fractional form of dependent variable and corner solution outcomes (see Masten, et al., 1989; Lafontaine, 1993; Nickerson and Silverman, 2003 for examples). Combining the potential concerns discussed above together, the research adopts the doubly-censored Tobit model with Huber/White heteroskedasticity robust standard error estimates including year dummy variables. The time-specific fixed effects Tobit model is specified as follows:

$$Y_{it}^* = X_{it}\beta + c_t + \varepsilon_{it}, \quad \varepsilon_{it} \sim N(0, \sigma^2) \quad \text{--- (5)}$$

$Y_{it} = 0$ if $Y_{it}^* \leq 0$; $Y_{it} = Y_{it}^*$ if $0 < Y_{it}^* < 100$; $Y_{it} = 100$ if $Y_{it}^* \geq 100$, where Y_{it}^* is the implicit, or underlying value of the dependent variable, and Y_{it} is its observed value.

6. Analysis of Estimation Results

I begin with the results of the sensitivity analysis of alternative imputation rules. As Table 5-6 exhibits, the estimation results are fairly sensitive to the three alternative imputation options. The coding target weights range values increased by the imputation option II and III not only changes the signs of coefficient estimates in plant size (PS) and market share of large producers (MSLP) variable but also increases the statistical significance of target weights range (TRW) variable. However, the different imputation rules do not much influence the coefficient and standard error estimates of slaughter technology (ST) and case-ready fresh products (CRFP) variables, which suggest that the estimates of the two variables are robust to the three alternative imputation rules. As we can see through the Table 5-6, the facts that pork packers market case-ready fresh products decrease the share of spot markets in their organizational form portfolio for procuring slaughter hogs. Narrowing target range of carcass weights also decreases the share of spot markets. Pork packers' adoption of double-shift technology decreases the choice of spot markets, but the coefficient is not statistically significant.

Given the sensitivity analysis results, it can be safe to say that the hypotheses of measurement difficulty and product specificity received statistical support from our data but the temporal specificity hypothesis representing by slaughter plant technology, one of the two proxies, is not supported by the data. In addition, another commonality among the results from applying the three imputation rules is that the coefficient estimates of the product specificity variable are statistically significant at the 10% level while the coefficient estimates of MSLP, one of the proxies for temporal specificity, are not statistically significant across the alternative imputation rules. Lastly, given the

suppression effects of coding increasing values of TRW on the estimators of some variables, it is safe to pick the imputation option I for the rest of the statistical analysis even if the imputation option III seems to be logically more reasonable.

Next, I report the results of another sensitivity analysis considering two alternative imputations of dropping all missing subjects and missing subjects of both MSLP and TRW. As Table 5-7 shows, the two alternative imputation options also influence the estimation results of the model. One of the obvious reasons is that dropping all missing subjects causes a loss of a considerable portion of the information regarding organizational choice behavior of pork packers whose organizational portfolio includes spot markets only. Comparing the estimation results of between imputation option I and imputation option IV, two major features deserve to receive attention. First, the signs of PS and MSLP are not consistent across imputation option I, IV, and V while the signs of ST, CRFP, and TRW are consistent, which is same as seen in the sensitivity analysis of imputation I, II, and III. Second, in terms of statistical significance, the coefficient estimates of PS, ST, and MSLP are not statistically significant across the three alternative imputation options, which is also similar to the sensitivity analysis results of imputation I, II, and III. In addition, it turns out that the significance level of coefficient estimates of CRFP and TRW changes across the alternative imputation options. The coefficient estimates of CRFP are statistically significant in the imputation option V but not significant in imputation option IV. Those of TRW are statistically significant at the 10% level in the imputation options I and IV.

Finally, I report the results of alternative regression models. Looking at the results of pooled OLS and dummy variable regressions, there is little difference between those two

models. Therefore, the time-specific unobserved effects have not been found to be significant in our data. As expected, it turns out that the estimate of the standard deviation of error is statistically significant at 1% level, which implies that the presence of corner solution outcomes of 44% significantly affects the regression outputs. Since the meaning of the coefficient estimates between the OLS and Tobit models is different from each other, the direct comparison of the magnitude of the estimates between those two is not practical. Two interesting features are striking. The sign of estimates of MSLP in Tobit model is opposite to that in the OLS model. One of the reasons may attribute to the fact that the magnitude of the estimates is extremely small. Second, the relative magnitudes of the standard errors of almost all of the coefficients are larger in the Tobit model as compared to the OLS model. A final finding to receive attention is that the coefficient estimates of CRFP and TRW variables are statistically significant across the alternative regression models while those of ST and MSLP variables are not statistically significant.

I summarize the overall results from the sensitivity analysis and comparison of alternative regression models. First, the coefficient estimates of plant size and market share of top 5% largest producers are not stable across alternative imputation options and alternative regression models whereas those of slaughter technology, case-ready fresh products, and target range of carcass weights are stable. Second, more interestingly, the coefficient estimates of plant size, market share of large producers, and slaughter technology are not statistically significant in all of the imputation options and alternative regression models while those of case-ready fresh products and target range of carcass weights are statistically significant except in cases where the former is imputation option

IV (dropping missing subjects of both MSLP and TRW) and the latter is imputation option V (dropping all missing subjects). Therefore, we conclude as follows.

Measurement difficulty hypothesis (H2) is supported by our survey data, which implies that pork packers positioned on downstream markets of case-ready (mostly branded) fresh products are more likely to increase the share of contracts and vertical integration in their organizational form portfolio. In addition, our survey data support the product specificity hypothesis (H3). The narrower the target carcass weights are, the lower the share of spot markets in their portfolio is. In contrast, the temporal specificity hypothesis (H1) is not supported by our data. The explanation that double-shift slaughter technology adoption and increasing market share of large producers negatively influence the share of spot markets in pork packers' portfolio of organization forms is not collaborated with our data.

<Table 5-6> Sensitivity Analysis of Alternative Imputations (Dependent Variable: Spot Market Share)

	ML-Censored Normal (Tobit) (Huber/White SE)		
	Imputation option I	Imputation option II	Imputation option III
Plant size (Control)	-2.3716 (14.6713)	1.0402 (14.5238)	12.4999 (12.0351)
Slaughter technology (Temporal specificity)	-21.1753 (37.0926)	-27.1563 (35.8682)	-28.2614 (25.9413)
Market share of large producers (Temporal specificity)	-0.0055 (0.3384)	-0.0179 (0.3362)	0.0853 (0.3071)
Case-ready fresh products (Measurement difficulty)	-38.8152* (21.8335)	-36.8504* (20.6793)	-31.4099* (18.9836)
Target range of weights (Product specificity)	78.5959* (46.7592)	89.2462** (45.5498)	156.1485*** (40.5575)
Year dummy1	41.8222 (88.1055)	18.7297 (87.4190)	-58.3066 (65.9486)
Year dummy2	42.4139 (86.5027)	15.9078 (87.8464)	-29.8090 (32.9996)
Log-likelihood value	-149.04	-148.06	-141.44
Standard deviation of error	49.1488*** (7.9803)	47.8093*** (7.4465)	41.5316*** (5.8671)
N (Censored observations in parentheses)	44 (6: 13)	44 (6:13)	44 (6:13)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

(Standard Errors in parentheses)

<Table 5-7> Sensitivity Analysis of Alternative Imputations (Dependent Variable: Spot Market Share)

	ML-Censored Normal (Tobit) (Huber/White SE)		
	Drop all missing subjects (Imputation option V)	Drop missing subjects of both MSLP and NTRW (Imputation option IV)	Imputation option I
Plant size (Control)	1.2110 (12.2523)	-0.2091 (14.7360)	-2.3716 (14.6713)
Slaughter technology (Temporal specificity)	-7.4489 (27.2676)	-19.8237 (35.7174)	-21.1753 (37.0926)
Market share of large producers (Temporal specificity)	0.1987 (0.2664)	0.0339 (0.3184)	-0.0055 (0.3384)
Case-ready fresh products (Measurement difficulty)	-47.9382** (22.3364)	-26.0256 (22.1729)	-38.8152* (21.8335)
Target range of weights (Product specificity)	17.4521 (20.4822)	72.4726* (41.5746)	78.5959* (46.7592)
Year dummy1	52.8475 (67.9312)	18.7575 (87.0267)	41.8222 (88.1055)
Year dummy2	48.7593 (66.5623)	19.9392 (86.2785)	42.4139 (86.5027)
Log-likelihood value	-112.76	-140.66	-149.04
Standard deviation of error	33.5539*** (5.4080)	47.9907*** (7.6450)	49.1488*** (7.9803)
N (Censored observations in parentheses)	26 (2:2)	38 (6:8)	44 (6: 13)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

(Standard Errors in parentheses)

<Table 5-8> Comparison among Alternative Regression Models (Dependent Variable: Spot Market Share) Using Imputation Option I

	POLS (White SE)	Dummy Variable Regression (White SE)	Tobit (Huber/White SE)
Plant size (Control)	-2.2442 (7.9063)	-2.19613 (7.9970)	-2.3716 (14.6713)
Slaughter technology (Temporal specificity)	-13.4483 (21.6597)	-13.6354 (21.9686)	-21.1753 (37.0926)
Market share of large producers (Temporal specificity)	0.0953 (0.2076)	0.0904 (0.2142)	-0.0055 (0.3384)
Case-ready fresh products (Measurement difficulty)	-23.3828* (13.3062)	-23.4331* (13.4781)	-38.8152* (21.8335)
Target range of weights (Product specificity)	57.2417** (27.5978)	57.6196** (28.2944)	78.5959* (46.7592)
Year dummy1		31.5145 (50.6193)	41.8222 (88.1055)
Year dummy2		16.6378 (24.7284)	42.4139 (86.5027)
Constant	32.5462 (49.1980)		
Standard deviation of error			49.1488*** (7.9803)
N (Censored observations in parentheses)	44	44	44 (6: 13)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

(Standard Errors in parentheses)

7. Concluding Remarks

The research attempted to empirically test the two existing explanations of rapid transition from spot markets to contracts and vertical integration in the U.S. pork industry: temporal specificity and measurement difficulty. Our survey data support the latter but does not the former theory. More interestingly, the data support the product specificity hypothesis constructed based on the analysis of long-term hog procurement contract documents and the costs associated with optimal pricing. The empirical results suggest that the dramatic change in organization form in the pork industry may be better explained by the change in the downstream markets (demand side) rather than the structural change in the upstream markets (supply side). From the theoretical perspective, the pork industry case of contract and vertical integration choice is better explained by costs associated with providing appropriate incentives *ex ante* rather than *ex post* safeguard function against opportunism.

The empirical findings are well collaborated with the main findings in the analysis of hog procurement contract documents described in previous chapter. Pork packers' choice of long-term contracts can be better explained by the organizational capabilities of the contracts to create contractual instruments for intertemporal quality consistency under volatile production costs of consistency in hog weights and allowing contracting for decision rights under measurement difficulty of hog quality. Considering the fact that long-term contracts are the vast majority of organizational forms for transactions of slaughter hogs, the empirical evidence supporting the measurement difficulty and product specificity hypotheses suggests that the analysis of contract documents is essential for an empirical study of contract choice.

Although the empirical results of our research indicate new findings for the explanation for the costs of spot markets, the research is subject to a number of limitations. Like most transaction cost empirical studies, we do not directly test Williamsonian transaction cost theory, contractual externality theory, and the relationship between adjustment costs of quality price and product specificity. Particularly, our findings cannot rule out the importance of potential unobserved Williamsonian transaction costs. More importantly, data limitations, particularly lack of data on pork packers' market strategic positioning in the downstream markets may reduce the power of the regression results. In addition, the combination of a relatively small size of sample data and missing data in two variables makes the results less robust. Given the relatively small size of the relevant plant population, obtaining data on a long time period panel for even a small number of pork packers or conducting an in-depth case study would be promising for further studies.

Chapter 6 CONCLUSION

This dissertation offers two major theoretical arguments for characteristics of spot markets vis-à-vis contracts and the relation between product differentiation strategy in downstream markets and the transition from spot markets to contracts in upstream markets. It discusses how the production of differentiated products is organized more effectively through contracts than through spot markets. The first argument is concerning characteristics of the two organization forms. In particular, instantaneous and anonymously disconnected exchange characteristics of spot markets are based on the existence of pre-defined, or generic, products. One of the remarkable competences of the spot market system is in the savings on the economic individual's decision making costs by taking advantage of the least cost form of communication with others in a market system.

However, increasing divergence between the individual buyers' definitions and values of a product and the commonly perceived or generic definition of the product reduces the advantage of spot markets. Individual buyers' needs to procure idiosyncratic products require communication with potential sellers to transmit information concerning the buyers' definition of the products before sellers enter into production, since otherwise suboptimal products or a suboptimal quantity of the desired products would result. The wants for *ex ante* communication may be better fulfilled through deferred exchange, a fundamental characteristic of contract transactions. A contract therefore provides a platform for bilateral planning of the production and exchange for idiosyncratic products, which is less accessible through spot markets governing instantaneous exchange.

Second, this research develops the concept of product specificity and explains its interaction effects with influential factors offered by existing contract theories on the choice to contract. Drawing from Lancaster's (1966) and Rosen's (1974) definition of goods as package of characteristics and the existing literature on diversified quality attributes of food products, this research proposes three types of product specificity: new attributes, unique composition of extant attributes, and intertemporal consistency in the unique package of quality attributes. The driving forces of buyer-specific products on the transition from spot markets to contracts in upstream markets would be intensified when the buyer-specific attributes of products involve measurement errors, difficult-to-measure attributes, costs associated with pricing for the attributes, perishability of the products, and the buyers' investment in brand name capital in downstream consumer markets.

In this regard, this dissertation provides an analytical framework to extend existing theories of contracts into the context of the agro-food sector where the transition from spot markets to contracts has been recently widespread. In general, the influence of existing explanations on the choice to contract would increase when buyer-specific products are incorporated into the concerns offered by the existing theories. The research uses the analytical framework and stylized facts based on the existing contracts to illustrate four representative examples recently experiencing the transition: identity-preserved grains, tobacco, hogs, and French beef. Although each case exhibits different types of product specificity and other concerns, product specificity is commonly found in the four examples.

The product specificity analytical framework is applied to a more comprehensive analysis of contract forms in the US pork industry. The analysis results show long-term

hog procurement contracts are designed in ways to save costs associated with procuring intertemporally consistent carcass qualities and reducing hog growers' incentive distortion arising from difficult-to-measure meat quality attributes including marbling, muscle color, and meat tenderness. Specifically, the observed provisions of the long-term hog procurement contracts include setting intertemporal target qualities, providing contract premiums, and enforcing intertemporal target quality performance. In addition, I find that contract base-hog pricing structures observed in some long-term contracts also help producers make decisions on intertemporally consistent hog weights. The second set of contract clauses deal with potential adverse outcomes of difficult-to-measure hog quality attributes, including contractual restrictions by packers on hog producers' decision rights over hog production practices.

More interestingly, the research finds that pork packers in the contracts target a different package of hog attributes and offer dissimilar incentive prices for the targets. Based on these findings, this research generates testable hypotheses regarding product specificity and measurement difficulty explanations for contracts. The research predicts that the more packer-specific hog attributes are, the less likely spot markets will be used. Concerning measurement difficulty, it also expects that a pork packer that markets case-ready fresh pork products is more likely to choose long-term contracts or in-house production since the products' sale is more vulnerable to difficult-to-measure meat quality attributes. For more comprehensive empirical tests of existing theories of contracts, the research constructs asset specificity hypothesis, using proxies including slaughter plant technological configurations and hog supply quantity concentration on small number of sellers.

The primary data generated from a survey of pork packers support the product specificity and measurement difficulty predictions but do not support the temporal specificity explanation that is most often suggested in the literature. The empirical results suggest that the dramatic change in organization form in the pork industry may be better explained by looking at attributes of hogs to be exchanged rather than attributes of assets required for the transactions. Thus, it is conjectured that hog transactions do not involve considerable difference in quasi-rents between contracts and spot markets. In fact, most large hog processors or packing plants concurrently use multiple organization forms including spot markets, short-term or long-term contracts, and in-house production, to procure hogs, and many large producers transact with multiple buyers and simultaneously employ contracts and spot markets. This feature of the pork industry case is distinctive from the cases that most transaction cost empirical literature has employed, in which trading parties rely exclusively on an alternative organization form and there are few secondary markets at hand.

From the organizational perspective, long-term contracts provide higher flexibility in creating appropriate incentive instruments and allocations of decision rights than do spot markets. In this fashion, this dissertation helps expand the existing literature on contracts, illuminating the choice between spot markets and contracts and revealing an empirical case different from existing TCE empirical studies. The empirical results also imply that processors' procurement practices in upstream markets are largely influenced by the processors' market strategic positions or product differentiation activities in downstream consumer markets. Therefore, the empirical analysis of hog procurement contracting conducted based on an analytical framework of product specificity may be

applied to other commodities in the agro-food sector. In this way, this dissertation contributes to the existing literature on agro-food industrial organization, providing the theoretical arguments and plausible empirical analysis on how the production and exchange of buyer-specific products are organized.

Although the evidence presented by this research collaborates with the argument, the research is not immune to limitations and room remains for considerable refinement and extension of the empirical work. First, due to the nature of the disentangled and rearranged contract data posted at USDA GIPSA, the analysis of hog procurement contracts is limited. Disclosure of the original contract documents would allow a more systematic analysis of contract design. Second, the small number of observations from the pork packing plant survey and failure to obtain relevant information limits the robustness of the econometric results. Third, more importantly, empirical analysis on the economic performance effects of incentive instruments provided by hog procurement contracts would be promising. Finally, given the research's focus on the choice between spot markets and contracts, the contract performance issues are largely ignored. Demanded is an examination on how long-term hog procurement contracts are implemented and adapted under uncertain market and behavioral environments. An approach to both hog growers and pork producers would be beneficial.

**APPENDIX 1:
HOG PROCUREMENT CONTRACTS SURVEY QUESTIONNAIRE**

Consent: By completing this survey, you hereby consent to the confidential use of the data as described in the solicitation letter. Your participation is strictly voluntary and you may abstain or terminate the survey at any time. Thank you for your participation!

A. Characteristics of Packing Plant Operations

1) Below are the items to describe the characteristics of packing plant operations. Please check all that describe your plant's operations during the years 2003 and 2006, respectively.

Processing Plant Operations	2003	2006
Slaughter		
Custom Slaughter		
Kosher Slaughter		
Halal Slaughter		
Single shift technology		
Double shift technology		
Carcass		
Cutting		
Boxed fresh products		
Box frozen products		
Case-ready fresh products		
Case-ready frozen products		
Processed products (sausage, smoked or cured ham, lunch meat)		

2) How many slaughter hogs did your packing plant procure during the years 2003 and 2006?

	1- 999	1,000- 9,999	10,000- 99,999	100,000- 499,999	500,000- 999,999	1,000,000- 2,499,999	2,500,000- 3,999,999	4,000,000+
2003								
2006								

3) What was your packing plant's annual average rate of capacity utilization during the years 2003 and 2006? Please indicate it with an estimate.

- 2003: _____ % of capacity
- 2006: _____ % of capacity

- 4) Please check the geographic region of your plant among the following categories?
 ___ East (NC, SC, GA, VA, PA, MD)
 ___ Midwest (IL, IN, IA, KS, KY, MN, MO, NE, OK, SD, WI, TN, OH)
 ___ Other

B. Choice of Procurement Form

- 5) For the year 2003, please indicate what percent of your slaughter hogs were procured using each of the following types of transactions.
- a. **Spot Transactions** = negotiated purchase of hogs delivered at your plant or buying station, purchase through dealers or order buyers, or purchase at terminal or auction markets
 - b. **Short-term Contracts (ST-Ks)** = procurement contracts lasting 6 months or less
 - c. **Long-term Contracts (LT-Ks)** = procurement contracts lasting more than 6 months
 - d. **Owned** = procurement of company and affiliated firms' hogs (including production contracts).

2003 Procurement Mechanisms (% of slaughter hogs procured)

	< 5%	5-10	10-15	15-20	20-40	40-60	60-80	80-85	85-90	90-95	95%+
Spot											
ST-Ks											
LT-Ks											
Owned											
Other											

If other, please explain: _____

- 6) For the year 2006, please indicate what percent of your slaughter hogs were procured using each of the following types of transactions.

2006 Procurement Mechanisms (% of slaughter hogs procured)

	< 5%	5-10	10-15	15-20	20-40	40-60	60-80	80-85	85-90	90-95	95%+
Spot											
ST-Ks											
LT-Ks											
Owned											
Other											

If other, please explain: _____

7) If you indicated that your plant used Long-Term Contracts for either year, please indicate the nature of the base-hog pricing formula:

Base price formula based on:	Spot prices	Feed prices	Meat prices	Window	Other
2003					
2006					

C. Carcass Merit Program and Hog Quality Requirements

This section asks about carcass merit programs your plant may have used in 2003 and 2006. To control for potential seasonal differences in merit programs, please base your response on the nature of your merit programs *as of the first week of May* in the respective years.

8) Did your plant use a carcass merit program during the year 2003 *or* 2006?

Yes () → **Go to question 9**, No () → **Go to question 13**

9) What carcass weight (or weight range) received the highest premium indicated in your carcass-merit program?

- May 1. 2003: _____ pound No target ()
- May 1. 2006: _____ pound No target ()

9a) If your plant had more than one target carcass weight range, please indicate the others.

- May 1. 2003: _____ pound No target ()
- May 1. 2006: _____ pound No target ()

10) What lower bound of percent lean or backfat received the highest premium in your carcass-merit program?

- May 1. 2003: _____ No target ()
- May 1. 2006: _____ No target ()

10a) If your plant had more than one target lower bound of percent lean or backfat, please indicate the others.

- May 1. 2003: _____ No target ()
- May 1. 2006: _____ No target ()

11) What was the highest carcass merit premium? Please indicate it with the percentage of base hog price. If the premium is set by absolute value of dollar, please indicate it with both the percentage and absolute value of dollar.

- May 1, 2003: \$ _____ // _____ % of base price
- May 1, 2006: \$ _____ // _____ % of base price

12) Has the carcass-merit program changed during the past four (4) years? Yes No

12a) If "Yes", please indicate the frequency and nature of the changes

Frequency of the changes: _____ time (s)

Schedule type (character trait targets)

Adjustment rate (size and structure of premiums)

D. Long-Term Contract Premiums

13) Were you using long-term hog procurement contracts (contracts whose duration is more than 6 months) during the years 2003 or 2006?

	Yes	No
2003		
2006		

If No to both, go to question 21

14) Did long-term contracts you signed on include a contract premium (independent of the carcass merit premium schedule) to be paid to hog suppliers?

	Yes	No
2003		
2006		

If No to both, go to question 18

15) How much was the contract premium (per head) to be paid to producers under long-term contracts?

- 2003: (_____ \$)
- 2006: (_____ \$)

16) Did the contract premium vary across hog suppliers?

	Yes	No
2003		
2006		

If so, please indicate the criteria of the variation? For example, contract quantity or the past performance of suppliers, etc.

- 2003: _____
 - 2006: _____

17) Did you also pay the premium to hog suppliers when you procured slaughter hogs through spot markets?

	Yes	No
2003		
2006		

E. Enforcement for Quality Performance under Long-Term Contracts

18) How often are you supposed to provide hog producers under long-term contracts with a report of their quality performance? Please check the most appropriate frequency.

	Never	Weekly	Monthly	Quarterly	Annually
2003					
2006					

19) How much of a penalty (per head of hog) did the contracts call for when hog suppliers failed to meet target quality ranges in your long-term contracts?

- 2003: _____ \$
 - 2006: _____ \$

F. Allocation of Decision Rights over Hog Production Practices

20) In your long-term contracts, which level of decision rights over hog production practices were assigned to you and hog producers? Please check all that are relevant for your case.

Contract stipulated...	2003	2006
Contractor's exclusive decision on the use of specific genetics		
Contractor's exclusive decision on the use of specific nutrition program		
Both parties mutually agree on use of specific genetics and nutrition program		
Contractor recommends the use of specific genetics and nutrition program		
Producer's exclusive decision on the use of specific genetics and nutrition program		
No terms address choice of genetics or nutrition programs		

G. Questions regarding Hog Market Environments Surrounding the Packing Plant

21) Think about the population of hog producers in the geographic region surrounding your plant. Now consider the producers that would represent the top 5% in terms of hog production. What is your best estimate of the market share these 5% largest hog producers represent? Please estimate to the nearest 10% interval, for example, 80%, 70%, 60%, and etc.

- May 1, 2003: _____%
- May 1, 2006: _____%

22) What percent of hogs slaughtered in your plant came from 10% largest contract suppliers? Please indicate it with 10% interval, for example, 80%, 70%, 60%, and etc.

- 2003: _____%
- 2006: _____%

H. Follow up participation

The following is completely optional and will not affect the use of your previous responses. If you would be willing to respond to follow-up questions or if you would like to receive a copy of the research report summary, please provide your name, company name, phone number and/or email address. Contact information will be kept strictly confidential and will not be included in any published reports or summaries.

Name: _____

Company: _____

Phone: _____ Email: _____

Best time/day of week to follow up: _____

Please send me a copy of the final report summary: _____

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