Version: Electronic Markets_RA_ 25 March_2003.doc
March 25, 2003

NON-CONTRACTIBILITY AND ASSET SPECIFICITY IN REVERSE AUCTIONS: "MOVE TO THE MIDDLE" OR "EFFICIENT MARKETS"?

Sunil Mithas (**smithas@bus.umich.edu**)
University of Michigan Business School
701, Tappan Street
Ann Arbor, MI 48109-1234
Phone: (734) 763-8290
Fax: (734) 936-0279

Joni L. Jones (**jonij@umich.edu**)
Hallman e-Business Fellow and Assistant Professor
Computer and Information Systems
University of Michigan Business School
701, Tappan Street
Ann Arbor, MI 48109-1234
Phone: (734) 764-9286
Fax: (734) 936-8716

Will Mitchell (**Will.Mitchell@duke.edu**) **
J. Rex Fuqua Professor of International Management
Fuqua School of Business, Duke University
Box 90120, Durham, NC 27708
Phone: (919) 660-7994, Fax: (919) 681-6244
Will.Mitchell@duke.edu

**Contact author for this paper

University of Michigan Business School Working Paper

Please do not cite, quote, or distribute without permission of the authors.

A research-in-progress version of this paper was presented at the International Conference on Information Systems (ICIS) held at Barcelona in December 2002. We are thankful to the senior editor, three anonymous reviewers, and ICIS attendees for comments and suggestions in improving this paper. We also appreciate help from Gautam Ahuja, Gerald Davis, Scott E. Masten, Marshall Van Alstyne and seminar participants at the University of Michigan Business School for stimulating discussions on some of the themes covered in this paper. We thank Pratik Sarna, Hoi-Ying Victoria Lau and Eli Dragolov for research assistance in survey administration and data coding. The Mary and Mike Hallman fellowship at the University of Michigan Business School provided financial support for this study.

NON-CONTRACTIBILITY AND ASSET SPECIFICITY IN REVERSE AUCTIONS: "MOVE TO THE MIDDLE" OR "EFFICIENT MARKETS"?

ABSTRACT

IT-enabled exchange in electronic markets has significant implications for buyer-supplier relationships. This paper builds on transaction cost and routine based perspectives in analyzing buyers' decisions to use reverse auctions, which are an emerging IT-enabled exchange mechanism. The study argues that buyers are less likely to adopt reverse auctions for supplier relationships with high degrees of non-contractibility. We operationalize non-contractibility in terms of six aspects: quality attributes, supplier innovativeness, information sharing, responsiveness, trust, and flexibility. The results show that non-contractibility helps explain the impact of IT on firm boundaries. This field study provides one of the first large sample tests of the widely cited 'move to market' and 'move to middle' hypotheses in the information systems literature.

Keywords: Electronic Markets, Reverse Auctions, Resource based view, Transaction cost economics.

ISRL Categories: AI0104, AI0604, AI0611, AM02, BA0205, HA07.

1.0 INTRODUCTION

Newly emerging Internet-based supply chains have created potential opportunities for many buyers and suppliers to deal with each other electronically, while at the same time posing difficult questions concerning the nature of supply relationships (El Sawy et al. 1999; Mishra et al. 2001; Monczka et al. 1998). Electronic markets create value by facilitating the search and selection of trading partners, aggregating buyers and sellers, creating spatial and temporal market liquidity, executing trades, and reducing transaction costs (Barua et al. 1997; Choudhury et al. 1998; Kambil et al. 1998; Kaplan et al. 2000; Yao et al. 2002). Studies have reported the potential for substantial transactional savings through use of reverse auctions in electronic markets, such as the supply management sites Covisint and FreeMarkets (Fox 2001; Reuters 2001). However, buyers face a dilemma in switching from existing supply relationships to reverse auctions because using such markets imperils their relationships with existing suppliers (Christiaanse et al. 2002; Dai et al. 2001). Moreover, many buyer-supplier transactions, particularly those involving non-contractible factors, may not suit the arms length nature of web-based relationships (Sambamurthy et al. 2002; Subramani 2003). Indeed, early use of reverse auctions by buyers fell far below expectations (Purchasing 2001: pS9). Several markets that began with highly optimistic projections have failed and firms have become more cautious in using electronic markets (CIOL 2001; Gonsalves et al. 2002; Hayes 2002; Jupiter Media Matrix 2001; Meehan 2001). This study helps explain the discrepancy between the promise and the reality of electronic market use by buyers.

Internet-based reverse auctions provide an effective setting to test competing theoretical predictions about firms' increasing use of market-based mechanisms to carry out key commercial activities. Information technology enabled market mechanisms such as reverse auctions allow buyers to announce purchasing requirements and select suppliers based on the bids that the suppliers offer, typically focusing on the lowest bid. In this paper, we examine the importance of non-contractible factors as a limiting factor for use of electronic markets by buyer firms. Non-contractible factors are product or supplier characteristics that buyers can observe but that third parties such as arbitrators or courts cannot easily verify. Some examples of non-contractible factors in a buyer-supplier relationship include quality attributes, supplier innovativeness, information sharing, responsiveness, trust, and flexibility. Such non-contractible factors are difficult or impossible to specify in advance.

In order to study the use of reverse auctions, we undertook an empirical study of U.S. automotive assemblers and component manufacturers. The study included discussions with executives and researchers to shape the theoretical model and provide contextual details, followed by a detailed survey of firms in the industry. The survey shows that products requiring suppliers' performance on non-contractible parameters may not suit procurement through buyer-initiated reverse auctions, at least at the current stage in the evolution of reverse auctions. Our argument rests on the premise that buyers gain competitive advantages by using non-contractible elements of relationships with their suppliers. Use of reverse auctions may endanger carefully cultivated relationships with suppliers without gaining commensurate cost savings. On the whole, for components with extensive non-contractible aspects, continued creation of relationship-specific resources such as design capability, ability to integrate disparate components, just-in-time delivery, and new product development may offset any short-term benefit achieved by switching to new suppliers through the reverse auction mechanism.

The implications of this study are important for both practice and research. From a practical perspective, buyers face a dilemma in choosing the optimum number of suppliers. While having fewer suppliers improves co-ordination and collaboration, it also creates potential for hold-up by suppliers (Klein 1996). For buyer firms, it is important to know how the use of electronic markets and, more specifically, reverse auctions, will affect the balance between collaboration benefits and hold up risks.

From a research perspective, the trend among buyers to selectively use Internet-enabled markets provides an opportunity to explore arguments about the impact of information technology on firm boundaries. We focus on two widely stated but little tested hypotheses: the 'electronic market hypothesis' (EMH) and the 'move to middle hypothesis' (MMH). The EMH (Malone et al. 1987) posited that greater use of information technology will cause a shift towards markets relative to hierarchies for economic transactions. By contrast, the MMH (Clemons et al. 1992) took the position that use of the electronic markets will lead to establishing long-term relationships with a few suppliers. 'Move to the middle' here refers to the movement from two ends of the spectrum, i.e., away from both hierarchies and markets towardthe middle territory of long-term buyer-supplier relationships. Despite calls for empirical examination of the EMH and MMH (Bakos et al. 1993b), particularly their conflicting predictions about how information technology will affect business relationships, no rigorous empirical work has tested their predictions in the context of the use of electronic markets for buyer-supplier relationships (Hess et al.

1994). The study finds support for the importance of non-contractibility that underlies the MMH, with an intriguing continuing role for the asset specificity that plays the central role in the EMH.

The paper continues as follows. Section 2 reviews the background literature and develops hypotheses. Sections 3 and 4 discuss the methodology and present the results. Section 5 outlines the implications of the study.

2.0 BACKGROUND AND HYPOTHESES

This section reviews the literature on inter-organizational relationships and electronic markets. The section concludes by developing hypotheses relating to use of electronic markets, highlighting the importance of specialized assets and non-contractible skills.

2.1 Electronic Markets and Hierarchies

Electronic markets are a type of inter-organizational system that links one or more firms to facilitate the exchange of products and services. Despite highly publicized projections of potential savings through participation in electronic markets, their initial use by buyers was slow and limited to specific product categories (Purchasing 2001). The slow start points to the need for a better understanding of the conditions under which buyers are likely to use electronic markets.

Early conceptual arguments paralleled business optimism concerning wide-spread use of electronic markets. Perhaps the most extensive argument arose in the transaction cost economics perspective. This argument suggested that information technology innovation would lead to substantially greater use of electronic markets, owing to a reduction in transaction specificity of assets underlying commercial relationships.

Transaction specificity arises when an asset has more value in a particular bilateral setting than in its next most valuable alternative usage. Transaction specific assets pose hazards to firms that invest in them or rely on them. For instance, a supplier plant located close to a buyer may create relatively more value for both the buyer and seller as long as the plant is fully utilized. However, in the event of underutilized capacity, the same plant may become a liability for a supplier if other potential customers are located far away and may place the buyer at risk of supplier hold up if there is no alternative plant.

The transaction costs literature argues that firm boundaries are determined by a trade-off between production cost advantages of outside procurement in market relationships and the transaction cost advantages of internal production within hierarchies (Ang et al. 1998; Coase 1937; Gurbaxani et al. 1991;

Klein et al. 1978; Williamson 1975). Markets and hierarchies entail different levels of production and transaction costs. Markets may offer lower production costs because of economies of scale or specialization, but these advantages come at the expense of higher transaction costs. The transaction costs arise because of dedicated investment in specialized assets. In the face of environmental uncertainty and bounded rationality of economic agents, coupled with partners' potential for opportunistic behavior, firms must be concerned about protecting the value of specialized investment (Davis et al. 1992; Williamson 1975). Firms employ a variety of safeguards to protect their specialized investments (Williamson 1985). These safeguards range from formal mechanisms such as financial or specialized investment hostages (Klein et al. 1981) to informal mechanisms such as relational trust and reputation (Dyer 1997).

Information system researchers have used the transaction cost perspective to argue that growing use of information technology may affect the mechanisms that firms choose to govern their inter-firm relationships. Malone et al. (1987) suggested that information technology reduces coordination costs because flexible manufacturing technology reduces investment in specific assets, as well as facilitating product description and reducing communication and information processing costs. Although this argument recognized that electronic hierarchies might be desirable when asset specificity is high, the principal prediction was that the overall impact of information technology would be towards increased use of market outsourcing, which became known as the electronic markets hypothesis. Malone et al. (1987: p.495) suggest that "electronic hierarchies frequently develop into biased, then unbiased markets when the products themselves are not asset specific and are easily described in standardized term". They further note "in the long run, the significant additional benefits to buyers possible from the electronic brokerage effect will drive almost all electronic markets toward being unbiased channels for products from many suppliers (p. 491)." The basic premise of the EMH was that information technology would lead to lower transaction costs both because of reduction in specialized investment in production assets and because of greater ease of inter-firm communication, which in turn would lead to greater reliance on arm's length relationships with many suppliers.

More recently, scholars have modified the EMH prediction, arguing that information technology innovation will cause less movement toward simple market relationships. Clemons et al. (1993b) agreed with EMH about an information technology-induced contraction in firm boundaries. However, they argued that the arm's length market outsourcing implicit in the Malone et al. (1987) framework would not

accompany such contraction. Instead, they hypothesized that firms will move toward long-term relationships with a smaller set of suppliers. The long-term relationships provide several benefits for buyers and suppliers: (1) leverage transactional economies of scale for both buyers and suppliers due to investments in IT for explicit coordination, (2) provide incentives to suppliers to make commitments to buyers, and (3) economize on buyers' search costs to cope with greater product differentiation. The authors referred to such a combination of greater outsourcing but with a reduced supplier base as the move to the middle hypothesis.

At the core of the MMH is the notion that a reduction in asset specificity and an increase in the ease of communication are not sufficient to lead to arm's length relationships. Instead, the issue of non-contractibility also arises. Analytical work by Bakos and Brynjolfsson (1993a; 1993b) provided conceptual support to the 'move to middle' hypothesis, based on the theory of incomplete contracts (Grossman et al. 1986; Hart et al. 1990). They argued that tightly coupled operations supported by IT require increased investments by suppliers in non-contractible resources that support the relationships with buyers. In order to induce suppliers to make non-contractible investments, the buyer can credibly commit not to appropriate the ex post surplus from such investments only if the buyer reduces its bargaining power by limiting its own options. In particular, suppliers are more likely to invest in non-contractible aspects of relationships if buyers restrict their options ex-ante by committing to a small supply base.

It is useful to recognize that the MMH argument took root at a time when the use of electronic data interchange (EDI) was growing. As such, it is possible that the characteristics and limitations of EDI influenced the prediction. The capital-intensive nature of EDI entailed significant investments by suppliers and they were not always willing to invest in relationship-specific investments for a particular buyer. With the advent of the Internet, however, more flexible technology may provide greater latitude in the choice between hierarchical or market governance, depending on the strategy and preferences of an organization (Steinfield et al. 1995). It is in this context that internet-enabled electronic marketplaces provide an opportunity to resolve the apparently competing predictions of EMH and MMH.

Few large-scale empirical studies have compared the MMH and EMH. Previous empirical research in inter-organizational information technology systems focused on questions relating to the use or effect of inter-organizational systems (Table 1 summarizes selected studies). Among early works, Hess

and Kemerer (1994) studied adoption of computerized loan origination systems to test the predictions of electronic market hypothesis using five detailed case studies. More recently, Dai and Kauffman (2001) assessed business models for Internet-enabled electronic markets based on several mini-cases. We undertook this study to explore the alternative predictions about the extent and suitability of use of electronic markets by buyers for products involving variation of asset specificity and non-contractibility. Our goal is to help determine which factors affect firms' sourcing choices, which in turn will help clarify how the EMH and MMH logics apply in practice.

{Table 1 about here}

If the EMH applies, then the most relevant issue that will determine whether buyers use reverse auctions is the degree of asset specificity underlying the products that buyers purchase from suppliers. In this view, buyer-supplier relationships that require general investments, involving little asset specificity, will suit reverse auctions. Those that require substantial asset specificity will not. Choudhury (1998), for instance, argued that electronic markets have limited value for transactions involving products that require specialized investment.

By contrast, if the MMH applies, then non-contractibility concerning skills that support the relationship between the buyer and supplier will also affect whether buyers use reverse auctions. Asset specificity may be a less important issue in such cases. Indeed, asset specificity is not a problem if firms can write complete contracts to govern the exchange processes, even if the relationships involve highly dedicated assets. Thus, arms length agreements such as reverse auctions would be most uncommon in cases of non-contractible skills, rather than simply asset specificity underlying products.

The notions of transaction specific assets and non-contractibility will sometimes arise in common. One may also cause the other. For example, firms may initially develop non-contractible skills for a particular trading partner and then increasingly invest in specialized assets to support product exchanges with that partner (i.e., N-C => A-S). In reverse, firms may make specialized investments that then lead them to develop non-contractible skills (i.e., A-S => N-C). In either case, the firm will end up with both transaction specific investment and non-contractible skills.

Despite potential correlation between non-contractible skills and transaction specific assets, the two concepts differ conceptually and may have independent variations. Asset specificity may not always imply non-contractibility. If buyer and supplier can contract on the contingencies that might arise in a

relationship, then even a dedicated asset can be made fully contractible and will not pose an opportunism-related hazard to the contracting parties. However, if the parties cannot write a fully contingent contract for even a general asset, then one or both the parties will be exposed to the requirements of non-contractible performance parameters.

To illustrate, consider the case of an automobile component manufacturer (called A) that buys slit and cut-to-length steel sheets from a steel service center (called B). Although, B may not have invested in any slitting or cut-to-length lines specifically for A's requirements, so that its investments all involve general assets, during the course of working together, B may gain a better understanding of A's requirements than what A could specify in a contract. In this example, B's understanding of A's operations becomes a non-contractible parameter that does not involve any asset specificity.

Where the non-contractibility argument goes beyond the transaction specificity argument is in the need for unspecifiable exchange support between the partners. Typically, non-contractibility arises when the degree of uncertainty concerning the nature of the support that the firms will need to provide each other rises to such an extent that parameters such as performance guarantees and non-compliance penalties become vague and impossible to enforce. Such issues are common in many modern supply relationships, particularly those involving products that face ongoing changes in underlying technology or in the nature of market demand.

We note further, though, that the EMH and MMH arguments concerning products and relationships may well reinforce each other. Indeed, as we noted earlier, uncertainty arises as a parameter in the transaction cost argument, along with asset specificity. The premise is that asset specificity matters only in the face of uncertainty, because one can write complete contracts for specialized assets if the future is known with certainty. Thus, to some extent, one can view non-contractibility as a relationship-based parameter in the transaction cost argument. It is entirely possible that both asset specificity and non-contractibility will influence sourcing choices.

2.2 Hypotheses

The foregoing discussion gives rise to two hypotheses, one addressing asset specificity and the other concerning non-contractibility. It is possible that both hypotheses will hold, if transaction specific assets and non-contractible skills complement each other in their influence on adoption of reverse auctions. Alternatively, one effect might dominate the other.

Hypothesis 1. The greater the asset specificity of a product, the less likely that buyers will adopt reverse auctions in electronic markets. Conversely, the more general the assets that support a transaction, the more likely that buyers will adopt reverse auctions.

Hypothesis 2. The greater the non-contractibility of a buyer-supplier relationship, the less likely that buyers will adopt reverse auctions in electronic markets. Conversely, the more that firms can contract on relationship attributes, the more likely that buyers will adopt reverse auctions.

Tests of the hypotheses will help differentiate between the EMH and the MMH. By predicting a 'move to market', EMH focuses on the assets that underlie a product exchange. EMH does not explicitly consider the non-contractible elements of inter-organizational exchanges themselves, particularly the generation and accumulation of firm-specific routines and capabilities to provide competitive advantage. We posit that analysis of how information technology affects firm boundaries and governance mechanisms must consider these aspects of a relationship, which would moderate the EMH predictions.

The role of non-contractibility becomes even more important as the service sector grows in the modern economy and to the extent information technology and flexible manufacturing technologies are progressively causing a decline in asset specificity even in the manufacturing sector (Milgrom et al. 1990). Thus, there is a need to focus on the effects of intangible and largely non-contractible aspects of underlying relationships that may or may not co-vary with transaction specific investments.

2.3 Multi-Dimensional Conceptual Attributes Of Non-Contractibility

Before moving to the empirical setting, we develop the notion of non-contractibility in more detail, treating it as a multi-dimensional concept. We draw on a range of previous work to identify non-contractible relationship characteristics that are common in many settings and are relevant for the use of reverse auctions mechanism in the automobile industry. We focus on six non-contractible characteristics, concerning quality, supplier innovativeness, information exchanges, responsiveness, trust, and flexibility. With the exception of quality, which eventually manifests itself as an attribute of a product, the other five non-contractible factors (innovativeness, information exchanges, responsiveness, trust, and flexibility) are primarily attributes of relationships without necessarily implying specific assets. We outline the conceptual background of the elements here and will describe their measurement in the empirical section.

2.3.1 Quality

Quality is a cluster of attributes that satisfy both stated and unstated needs of the customers. While some quality attributes, such as tolerances and defect rates, can be easily specified contractually, many other attributes – particularly those relating to 'fit' or relative 'customization' for a specific buyer –

typically remain unstated because of difficulty in specifying them ex ante. Even for a commodity product such as steel, buyers prefer a particular source (a steel plant) precisely for this reason even though product specifications that competing steel plants offer may be the same (Deming 1993: 140). Given that specifying all desired quality parameters is costly and in some cases even impossible (Barzel 1982), buyers are less likely to try new suppliers when quality parameters are critical for the performance of the end product or assembly.

Remaining with existing suppliers may also be explained in terms of 'satisficing' behavior on the part of a buyer as it relates to the search process. Although electronic markets allow more efficient search among supplier population to seek the best possible fit, buyers may decide not to undergo fresh search due to their 'satisficing' behavior. Satisficing behavior is also rational from an economic perspective because obtaining data on a new supplier's potential performance on quality parameters is not costless. As Klein and Leffler (1981, p.628) argue, the 'presence of positive quality-information costs favors an increase in the capital intensity of production, including the extent of long-term, illiquid contractual arrangements with suppliers of productive inputs.' Based on the above reasoning, quality is often a non-contractibility aspect of a buyer-supplier relationship.

2.3.2 Innovativeness

Buyers competing on innovation and newer technologies need to develop partnerships with selected suppliers. Such partnerships encourage suppliers to support continuous innovation and adopt newer technologies. Empirical evidence supports this argument. For example, Helper (1991) conducted a survey of supplier relations in US and Japan, finding that long term contracts as a significant determinant of adoption of technologies such as CAD/CAM and CNC machines. She argued that 'higher levels of information sharing and commitment…encourage suppliers to make investments that enable them to improve performance in …product and process innovation' (Helper 1991, p.16). Since adoption of newer technologies and creation of capacity to support innovation are discretionary investments by suppliers, these are essentially non-contractible to the extent they are not possible in an ex-ante specification into a contract. The higher the need for continuous technological upgrades and innovation, the less likely buyers will deal on a short term basis through adoption of electronic markets.

2.3.3 Information Exchanges

The need to exchange information as products and markets change is often a non-contractible feature of buyer-supplier relationships. The ability to adapt products and sourcing arrangements often depends on the ability of buyers and suppliers to share tacit knowledge with each other, which in turn requires either hierarchy or long-term supplier relationships. This is because the continuity of association and accumulation of firm-specific and person-specific information causes emergence of 'one single organization specific dialect' (Monteverde 1995, p.1629). Kogut and Zander (1992) observe that long term relationships facilitate future transactions within a supplier network via a learned and shared code. Evidence that firms prefer hierarchical arrangements even under relatively stable environments when firm specific routines lead to creation of valuable knowledge supports this argument (Poppo et al. 1998). Helper (1991) and Takeishi (2001) have argued that increased communication and integrated problem solving are important for improving design quality and overall performance. It is difficult to specify exchange of specific contextual knowledge and to mandate and enforce all the desirable information exchanges in a contract ex-ante, making such information exchanges a non-contractible parameter of a buyer-supplier relationship.

2.3.4 Responsiveness

The increasing demand for responsiveness to meet changing customer expectations and address heightened competition has led firms to evolve specialized governance mechanisms that resemble neither market nor hierarchy arrangements as typified in the conventional transaction cost perspective. Johnston and Lawrence (1988) provide a rich description of such hybrid mechanisms. They defined value-adding partnerships as a set of independent companies that work closely together to manage the flow of goods and services along the entire value-added chain. Value-adding partnerships arise as hybrid governance mechanisms between markets and hierarchies. Each of the companies in a value adding partnership has an incentive to stay in touch with environmental changes and be ready to react quickly, because it could lose business to other producers.

Arguably, the main strengths of responsiveness as a governance mechanism come from an understanding that each player in the value-added chain has a stake in others' success and the ability of a unit to tailor all aspects of the organization (such as personnel, plant, compensation schemes, career tracks, accounting systems and management styles) to the work to be done. These characteristics help

firms reap the positive aspects of markets as well as hierarchies while avoiding the negative aspects of both. It follows that if responsiveness is an important criterion in the relationship, buyers will be less likely to switch suppliers by using reverse auctions in electronic markets. Since responsiveness has a dynamic and contextual meaning, it is costly to specify the level of responsiveness for each contingency in a contract, thereby giving it a non-contractible character.

2.3.5 Trust

Trust between parties is a non-contractible attribute of a relationship. Moorman et al. (1992) define trust as 'the willingness to rely on an exchange partner in whom one has confidence.' Trust facilitates coordination and leads to lower transaction costs (Barzel 1982; Dyer 1997: 548; Gulati et al. 2000: 209). Several studies confirm the role of trust and coordination in cooperative relationships (Monczka et al. 1998; Smith et al. 1995). Researchers have made a distinction between structural or deterrence based trust on one hand and behavioral or knowledge based trust on the other hand (Gulati 1995; Kale et al. 2000). Barney and Hansen (1994) developed a typology of weak form, semi-strong form, and strong form trust and argued that trust can be a source of competitive advantage for firms. Clearly, it will be difficult to replace a supplier if it has been able to win the trust of buyers given that trust building occurs over a period of time and involves substantial costs. As such, buyers valuing trusting relationships with their suppliers are less likely to adopt reverse auctions.

2.3.6 Flexibility

Flexibility refers to the ability of a partner to adjust its behavior or the terms of agreement to respond to changes in the environment or to the needs of its partners (Heide et al. 1992). Flexibility is a non-contractible parameter because it is a reaction to an unexpected situation. Given bounded rationality of partners, the viability of a relationship may depend on the flexibility with which partners can modify and go beyond the terms of the contract for continued value creation. Conner and Prahalad (1996) go to the extent of suggesting that flexibility with which responsibilities can be changed on an ongoing basis in order to respond to new learning or other unexpected situations may determine the choice of organizational mode. In their view, hierarchies offer greater flexibility compared to markets because an employment contract need not be renegotiated to alter responsibilities or duties of an employee. Conner and Prahalad (1996, p.488) argue that the cost of implementing flexibility under a market contract is higher than under firm organization, such that 'firm organization is more likely to be preferred on

knowledge-based flexibility grounds, the more dynamic and uncertain is the competitive environment.' Young-Ybarra and Wiersema (1999, p.441) also have argued that 'firms may be more willing to be flexible in terms of modifying the agreement rather than causing it to fail by being unwilling to adjust' in order to protect their intangible investments such as managerial skills and technical know-how. Buyers valuing flexible suppliers are less likely to risk entering new contracts instead of negotiating more favorable contracts with their existing suppliers because of their continuing relationship. Therefore, we expect such buyers to be less likely to adopt reverse auctions for their purchasing needs.

3.0 RESEARCH METHODOLOGY

3.1 Research Setting

The U.S. automotive industry, with a market size of about $600 billion, provides an effective setting to examine the use of reverse auctions. This is because of the tremendous variation in the type of components and firm characteristics the industry encompasses.

Over the past decades, U.S. based automakers have lost market share to Japanese producers. One of the reasons for success of Japanese automakers is a close partnership between these automakers and their suppliers, many of which have set up US facilities that supply to Japanese transplant assemblers in this country (Martin et al. 1998). U.S. based automakers have also moved towards closer relationships with their suppliers and consolidations within the supply chain over the last decade bear testimony to that trend (Cusumano et al. 1991; Mudambi et al. 1998). While consolidation of the supplier base helped forge closer relationships between OEMs and their tier 1 suppliers, particularly through use of information technologies such as EDI, many suppliers stayed outside such collaborative networks because of significant set up costs and commitment that EDI technology required.

Against this backdrop of industry consolidation and supply base rationalization in the last decade, newly emerging internet-based electronic markets pose serious questions for the purchasing executives. The flexibility of newer technologies allows interconnections with a much larger global supply base promising competition induced savings. However, indiscriminate use of such technologies has the potential to nullify past efforts in consolidating the supply chain as well as any gains that may accrue by dealing with a smaller set of more familiar and perhaps trustworthy incumbent suppliers.

The unit of analysis in this research is the buyer-supplier relationship for products involving varying degrees of asset specificity and non-contractibility. We obtained data for such relationships from

firms or business units that make independent procurement decisions. Because reverse auctions are a recent phenomenon, our research questions are not amenable to archival data. Interviews and surveys of managers are the only possibilities. Following initial interviews, we chose to collect the data through a survey administered to a sample of U.S. based automotive assemblers and component manufacturers.

Development of the questionnaire proceeded in three phases. During phase one, several faculty members, doctoral students, industry executives, and survey methods consultants reviewed the questionnaire for content, wording, and understandability. Wherever applicable, we used measurement items from existing literature to develop constructs by modifying them for the specific context of this study. Early in the conceptual development of the study, one of the authors worked with a large tier-one automotive component manufacturer in developing their strategy for using reverse auctions. Interactions with purchasing executives and reverse auctions vendors during and subsequent to that engagement helped ensure the face validity of the items we subsequently developed. In phase two, we refined the questionnaire based on feedback received from our interactions with industry executives and automotive industry researchers during a major industry conference in August 2001. In phase three, we formally pre-tested the refined version of the instrument from phase two with a random sample of thirty suppliers selected from an Automobile industry database. After incorporating changes based on the responses in the pretest, we administered our instrument to firms in the automotive sector during the winter of 2002.

3.2 Variables

3.2.1 Dependent Variable

From each respondent firm, we obtained two data points about their use of reverse auctions. We asked respondents to rate the likelihood of using reverse auctions for two categories of products: commodity and specialized types of production goods. We defined production goods as those items that buyers use directly in manufacturing their end products. Examples of commodity goods are forgings, castings, steel, copper, and plastic resin, while examples of specialized goods are engineering applied polymers, engineered mold plastics, injection molded parts, and specialty chemicals. We distinguished between these two classes of goods to control for the conventional and widely prevalent explanation that commodities are more suitable for reverse auctions than specialized goods. In addition, studies in the transaction cost literature sometimes use specialized goods as an indirect measure of asset specificity of components (Masten 1984).

3.2.2 Focal Independent Variables

Asset specificity: We measured asset specificity directly through a five-item scale capturing specific equipment (Dyer 1997; Mudambi et al. 1998), labor skills (Walker et al. 1991), business processes (Zaheer et al. 1994), JIT requirements, and product customization (Bensaou et al. 1999).

Non-contractibility: We developed a new instrument to assess the non-contractibility items that we described in the previous section. The concept has received little empirical attention as a multi-dimension construct. In developing our survey instrument, we relied on prior conceptual descriptions and empirical measures of different non-contractibility elements. We verified the validity of the items through expert appraisals and discussions with key informants from buyers, suppliers, and electronic marketplace organizations. Table 2 shows the definitions of the non-contractible dimensions.

{Table 2 about here}

Quality: We used three dimensions for the quality measure: (1) manufacturing quality of the product, (2) the extent to which a product affects performance of other parts, and (3) the risk a product poses in terms of warranty liabilities.

Innovativeness: We used three items to measure innovativeness. The items are (1) the need that a supplier stay abreast of technological developments, (2) the need for continuous production innovation, and (3) the degree to which development of new technology products is critical to buyer success.

Information exchanges: We developed four items to measure information exchange variable. The items are (1) exchange of buyer's proprietary information related to products, (2) supplier's proprietary information, (3) detailed information on cost structure, and (4) participation of buyer in supplier's planning and goal setting activities

Responsiveness: We use three items to measure supplier responsiveness. The items are: (1) supplier's proactive anticipation of buyer needs, (2) supplier's responsiveness to requests, and (3) supplier keeping buyer updated on his requests.

Trust: We use three items to measure trust. The items are (1) trustworthiness, (2) honoring past promises, and (3) mutual confidence.

Flexibility: We used three items to measure flexibility. The items are the willingness of the supplier (1) to modify the contract, (2) to make necessary adjustments on a continuous basis, and (3) to go beyond the terms of contract in fulfilling buyer needs.

3.2.3 Other Measures.

We defined four other variables to address alternative and complementary influences on the use of reverse auctions.

Product specialization. We used the commodity and specialty product distinction as a measure of product specialization. As we noted above, this measure provides an alternative measure of asset specificity, because specialty products commonly require dedicated assets. For example, Masten (1984) used a similar distinction as a measure of asset specificity in his empirical study of aerospace production.

IS compatibility: We measure information system compatibility through eight items, by looking at both legacy investments (EDI technologies) and current web technologies (Grover 1990; Mishra et al. 2001).

Supply chain strategy: We used two items to measure a firm's approach to managing its supply chain in terms of buyer orientation. A relational orientation emphasizes developing long-term relationships with major suppliers, while a transactional approach emphasizes frequent change of suppliers to gain the better prices.

Competitive strategy: We measure the competitive strategy of a firm by measuring the extent to which the firm emphasizes competing on cost or differentiation.

We also controlled for three other possible influences. These additional variables include firm size (revenues), firm national origin (U.S. or Japan), and firm type (OEM v. component manufacturer).

Figure 1 shows our complete research model.

{Figure 1 about here}

3.3 Sample and Data Collection

We used the list of automotive industry firms operating in the U.S. from the ELM database (2001). The firms include automotive assemblers and component manufacturers. The ELM database lists more than fifteen hundred firms. Of those, 706 met our sampling criterion of more than $ 10 million sales annually, including assemblers and tier-one through tier-four component manufacturers. We mailed the surveys during the winter of 2002 in two waves. The survey package included the questionnaire, a cover letter explaining the purpose of the study and seeking the cooperation of participants, a one-dollar bill as a token of appreciation for the respondent time and effort in filling up the survey, and a business return envelope. We assured confidentiality and promised that we would report only aggregate results and not

individual responses in any publication (Phillips 1981). We sent two follow-up reminders after 2 weeks and 4 weeks of the first mailing.

In order to minimize the key informant bias, we administered the surveys to the key executive responsible for the purchasing function for the firms in our sample. Typically, such an executive will have a vantage point for providing data relevant to our study and is likely to be the most knowledgeable informant (Bagozzi et al. 1982). This approach for relying on a single most knowledgeable informant is consistent with the practice of previous research studies (Zaheer et al. 1994).

We received 152 responses in two waves of our survey administration. This response rate (22%) is reasonable and comparable to previous empirical studies using survey questionnaires of firm activities. Table 3 shows the characteristics of the respondent firms in terms of firm type (OEM v. component manufacturer), annual sales, and number of employees. There was a reasonable distribution of firm types among the respondents, with about 20% having OEM activities and the remaining being distributed among four tiers of component manufacturers (most in the first and second tiers). There also was a reasonable size distribution: about 60% had sales of less than $100 million or fewer than 500 employees, while the remainder ranged up to more than $1 billion in sales and more than 5,000 employees. In addition, 76% of the respondents were American-owned firms, while 24% had Japanese ownership.

{Table 3 about here}

3.4 Data Assessments

We examined the data to assess potential issues related to non-response bias, merging of samples from two waves of survey administration, reliability, and validity.

To check for the non-response bias, we compared number of employees and annual sales for the respondents and non-respondents. We did not find any statistically significant differences, suggesting that respondent firms form a representative sample of automotive firms in the US.

We conducted the Kolmogorov-Smirnov two-sample test on the dependent variable to check for any systematic bias in the wave 1 and wave 2 responses. A non-significant result implies that it is appropriate to treat data from two survey waves as arising from the same population. Because of its non-parametric nature, the Kolmogorov-Smirnov test does not impose distributional assumptions and is more general than the two-sample t-test. Since we did not find evidence of any systematic difference between the two samples, we merged the data obtained from two waves of questionnaire administration.

Use of multiple-item scales to measure latent constructs makes it necessary to assess the validity and reliability of scales (Anderson et al. 1988). The selection of survey items based on past research, plus our fieldwork and interactions with industry executives and researchers and pre-testing of the instrument helped ensure content validity. To assess the reliability of the scale, we calculated Cronbach's alpha for multiple scale items involving our key variables and found these to be equal to or greater than the generally recommended value of 0.70 and well above the 0.60 threshold appropriate for newly developed scales (Nunnally 1988; Nunnally et al. 1994). Table 4 shows the results of our reliability analysis.

{Table 4 about here}

Table 5 reports the descriptive statistics and correlations between constructs. The primary statistic of interest is that non-contractibility and asset specificity show substantial correlation with each other (r=0.76). Nonetheless, there is enough independent variation in the two measures to investigate their independent influences on the use of reverse auctions.

{Table 5 about here}

4.0 RESULTS

We carried out two sets of analysis, based on ordinary least squares regression and structural equation modeling.

4.1 Linear Regression Models

We first present OLS analyses as initial tests of hypotheses 1 and 2. Model 1 in Table 6 analyzes the effect of asset specificity on reverse auctions use without controlling for non-contractibility. The coefficient of asset specificity in this model is negative and significant. In addition, the coefficient for specialized products – which provides a complementary measure of specificity – is negative and highly significant. These results are consistent with previous research in transaction cost economics that found asset specificity influenced choices of market or hierarchical governance mechanisms. Because these prior studies did not control for the effect of non-contractible parameters in the inter-organizational relationships, they did not test for the effect of asset specificity in the presence of non-contractibility.

{Table 6 about here}

Model 2 of Table 6 adds non-contractibility to the analysis. The key result in this model is that non-contractibility is negative and highly significant. This result suggests that as the degree of non-contractibility increases for specialized products, buyers are less likely to use reverse auctions for

procuring such products. Moreover, the effect of asset specificity on use of reverse auctions becomes insignificant in model 2. The negative effect of specialized products (an alternative measure of asset specificity) remains significant, which lends support for the partial impact of asset specificity, although we note that there is a low correlation between specialty products and the direct measure of asset specificity (r=0.13).

Thus, the initial results offer strong support for hypothesis 2, concerning non-contractibility, and more measured support for hypothesis 1, concerning asset specificity. When the models include non-contractibility, the primary asset specificity variable loses significance, with only the specialized-products variable retaining an effect. The initial conclusion is that non-contractibility strongly influences firms' willingness to use reverse auctions, quite possibly more strongly than concerns about asset specificity.

The control variables in column 2 of Table 6 also provide useful insights. First, IS compatibility is positive and significant, implying buyers are more likely to adopt reverse auctions if they have a compatible IS infrastructure in place. This finding is of importance in predicting buyers' use of reverse auctions and may be useful for vendors in targeting their marketing campaigns. Second, buyers with a 'relationship' approach to supply chain strategy are less likely to adopt reverse auctions compared to buyers that take a 'transaction' orientation towards their suppliers. Third, we found that the nature of competitive strategy (differentiation vs. cost leadership) does not have a significant effect on reverse auctions use in our sample. Finally, we found that larger firms are more likely to use reverse auctions.

In sensitivity analyses, we added control variables for national origin (Japan or U.S.) and firm type (OEM v. component manufacturer). We found no material differences from the results here.

4.2 Structural Equation Models

While the regression results presented above provide a useful starting point, we extend the above analysis by using structural equation modeling technique. This approach has three values. First, use of structural models allows us to bring together psychometric (measurement) and econometric (structural relationship) analyses in the same framework. Second, structural models permit us to explicitly model unobserved constructs and the measurement error associated with our variables. Finally, and perhaps most importantly, structural modeling allows more fine-grained testing of the causal paths of rival explanations, in order to enhance the confidence in the observed results.

Researchers have observed the difficulty in fitting structural models with a large number of items per latent variable (Williams et al. 1986). Bagozzi and Heatherton (1994, p.43) have noted that as the number of parameters and items increases, the model 'can be unwieldy because of likely high levels of random error in typical items and the many parameters that must be estimated.' Given the large number of manifest variables and complexity of our research model, we adopted the partial aggregation approach for consolidating the manifest items of a latent variable into a smaller number of composite indicators (Bagozzi et al. 1994). For constructing each composite indicator, we used the summative scale of the constituent manifest items corresponding to the composite variable we described earlier.

We checked for normality and kurtosis of all the variables. All the variables had skewness values of less than 3 and kurtosis of less than 20, consistent with drawing the variables from a normal population (Kline 1998). Use of maximum likelihood estimation procedures is robust against non-normality even with sample sizes as low as fifty (Anderson et al. 1988).

We present our structural equation modeling results in three parts. The first part presents the results from the measurement model. The second part discusses results from estimating several structural models. The third part examines our research model and hypotheses.

Table 7 reports the measurement model, which evaluates the reliability and validity of constructs, based on confirmatory analysis. The measurement model suggests that the measures we use in this study satisfied the requirements of reliability and validity.

{Table 7 about here}

We found significant loadings of the manifest indicators on their underlying constructs in the expected direction. As Table 7 shows, the significance of factor loadings for the effect indicators provides support for convergent validity of the respective scales. The overall measurement model comprising five latent variables provided an acceptable fit (Chi-square= 394.68, df=124, RMSEA=0.08, GFI=0.87, NFI=0.94, Tucker Lewis Index or NNFI=0.95, CFI=0.96). One may note from Table 7 that the measurement model uses second order constructs for both non-contractibility and reverse auction use.

We assessed the discriminant validity among latent constructs by comparing models with the correlation among constructs constrained to one with an unconstrained model (Anderson et al. 1988). Significant improvements in the value of the chi-square statistic for the model with unconstrained correlations provided support for discriminant validity.

After assessing the measurement model, we now examine the theoretical relationships among the underlying constructs within the structural model (Figure 2a). Before focusing on individual paths, we first report the measures related to overall fit of the model.

{Figure 2a about here}

For the basic model that Figure 2a depicts, we obtained a chi-square value of 518.76 (df=210, p value<0.01). In general, an insignificant p value implies good fit. Given the dependence of p value on sample size, however, a non-zero chi-square value is often rejected even for good theoretical models.

We considered several measures that are less susceptible to sample size than the chi-square statistics. For instance, the Goodness of Fit Index (GFI) is analogous to a squared multiple correlation, i.e., it indicates the proportion of observed covariance that a model's implied co-variances explain. We obtained a GFI value of 0.87, signifying that our model explains 87% of the variance observed in the data. In addition, the Normed Fit Index (NFI) indicates the proportion in the improvement of the overall fit of the research model relative to a null (independence) model in which observed variables are assumed uncorrelated. Our model yields a NFI value of 0.92, suggesting that the proposed model is 92% better than a null model estimated with the same sample data. The values for both the GFI and NFI indicate that the model has an adequate overall fit, as do several other measures that we report in Table 8.

Table 8 presents results from the structural models. Column 1 shows that non-contractibility leads to less use of reverse auctions. As in the OLS analysis, asset specificity has no significant impact. Consistent with the earlier analysis, specialized products involve less reverse auction use.

{Table 8 about here}

The control variables in Table 8 are consistent with the earlier OLS results. IS compatibility increases the likelihood of reverse auction use. A relationship orientation towards supply chain strategy leads to lower use of reverse auctions. Larger firms are more likely to use reverse auctions. These results serve as a robustness check. In addition, sensitivity analyses with the national origin and firm type variables continued to produce equivalent results.

Although the proposed model in Figure 2a fits the data well, we estimated a competing model to compare its fit with the initial structural model (Anderson et al. 1988). In this model, we allowed non-contractibility to be an endogenous variable of asset specificity. This approach drew on the argument that asset specificity may cause non-contractibility, as we noted in the theory section, which in turn may

influence use of reverse auctions. If this argument holds, then the apparent insignificance of asset specificity would be an artifact of the underlying causal structure.

To consider this mediating effect of asset specificity, we introduced a unidirectional relationship between asset specificity and non-contractibility (Figure 2b). This alternative model provided comparable values of fit indices, as model 2 of Table 8 reports.

{Figure 2b about here}

As expected, asset specificity does contribute to non-contractibility, as column 2 of Table 8 reports. In turn, non-contractibility continues to have a significant negative impact on reverse auction use. Thus, the results continue to support hypothesis 2.

At the same time, though, the analysis of the alternative model highlights the importance of asset specificity as having both direct and indirect effects on the nature of a buyer-supplier relationship. That is, if we simply consider the direct effect of asset specificity, the variable appears to have little influence on reverse auction adoption. A different conclusion stands out though, when we recognize that investment in transaction specific assets to support the exchange of particular products may lead to an increase in non-contractible aspects of buyer-supplier relationships that have negative effect on reverse auction use. Thus, both asset specificity and non-contractibility influence reverse auction use and they may jointly determine the total effect of relationship parameters on reverse auction adoption.

It is possible to estimate other alternative models. However, given our primary objective of testing the hypotheses we developed in the theory section, we avoid a post-hoc search for other models.

Finally, we conducted additional exploratory analysis to check the robustness of our results. A buyer's perception of the non-contractible investments that its suppliers make might correlate with the buyer's overall satisfaction with its suppliers. If so, then buyers may be less likely to auction business for which suppliers have high buyer satisfaction ratings. We created a variable to measure buyer satisfaction with current suppliers, using three self-generated items. The items explore the extent to which current supplier performance influences the decision to use reverse auctions suppliers (Dai et al. 2000; Helper 1991). Table 9 reports the results.

{Table 9 about here}

We did not find support for the argument that buyers will avoid reverse auctions if they are satisfied with current suppliers. As Panel A of Table 9 shows, a comparison of item a and item b indicates

that buyers are likely to use reverse auctions even if they are satisfied with their incumbent suppliers. This result indicates that buyers will not limit their use of reverse auctions only to those situations in which they are not satisfied with their incumbent suppliers. The difference between item a and item b is significant at $p<0.05$ (Panel B).

Nonetheless, incumbent suppliers do not necessarily lose because of increased competition. This is because buyers will often reward loyal suppliers by continuing business with the suppliers even if they do not provide the lowest bids in the auction process (row c of Table 9). Supplier loyalty is likely to involve investment in non-contractible skills that support their buyer relationships. Thus, satisfaction with non-contractible investments made by suppliers increases buyers switching costs and makes such suppliers less vulnerable compared to the suppliers with whom buyers are relatively less satisfied.

5. DISCUSSION AND CONCLUSION

Empirical results based on a field study in the automotive industry confirm the importance of non-contractible factors as determinants of the use of reverse auctions in electronic markets by buyers. These results lend support to predictions of the move-to-middle hypothesis (MMH). The intuition behind this result is that as technologies become more ubiquitous and widely available, they may no longer give a differentiating competitive advantage to firms. Consequently, firms increasingly have to rely more on non-contractible and intangible assets to derive competitive advantage. Thus, even though information technology may have the potential to reduce the costs of external coordination, IT may not necessarily lead to substantial use of 'electronic markets' for many types of products. Our results show that even after controlling for asset specificity, buyers prefer to avoid reverse auction if they value suppliers' investments in non-contractible factors such as quality, supplier innovation, information sharing, responsiveness, trust, and flexibility. Indeed, greater use of IT may actually increase the salience of non-contractible factors and influence buyers to move towards consolidation of their supply base.

One reason why buyers are attracted towards using electronic markets is the possibility of reducing costs by finding the lowest cost suppliers for their raw inputs. However, while price plays an important role in supplier selection, non-price factors also are import. Helper (1991) provided preliminary evidence for this conclusion. One of the items in the Helper's survey related to the change in criteria that customers used to choose suppliers over a five-year period from 1983-1988. The analysis showed that: 'price went up the least, while quality increased the most to become the most important single

criterion…Engineering-R&D showed the greatest percentage increase in importance.' The results of our study build on these findings by highlighting the importance of non-price factors in reverse auction usage.

The results of this study also suggest that we need to condition our understanding of the electronic markets hypothesis (EMH). The EMH prediction suggested that the emergence of information technology would lead to greater use of arms length relationships. Indeed, this is likely to be true, in the sense that any use of reverse auctions reflects greater use of market-mediated institutions, at least to the extent that the reverse auctions substitute for activities that firms previously undertook internally or through long term inter-firm relationships. Where both asset specificity and non-contractibility are low, reverse auctions appear to be feasible.

Although we may witness some increase of market-mediated exchange, the results suggest that non-contractibility often will be an important issue, both in its own right and as an outcome of investment in transaction specific assets. Where non-contractibility arises, with or without asset specificity, reverse auctions are unlikely and the MMH appears to apply more strongly than the EMH. By augmenting the asset specificity argument with a consideration of non-contractible factors, as Dai et al. (2001) suggest, we gain a more nuanced understanding of the complexities involved in buyer-supplier relationships.

The results implying the importance of non-contractible factors echo the Hess and Kemerer's (1994) observations that: '…either the EMH will take more time to come to fruition or that the underlying phenomenon is not fully captured in the current electronic market hypothesis (p. xiv).' We believe that empirical research on identifying additional non-contractible parameters has the potential to enrich our understanding of the conditions under which predictions of electronic market hypothesis would apply.

The results have significant managerial implications. For buyers, it is important to choose carefully products for procurement through electronic market mechanisms such as reverse auctions. An indiscriminate use of electronic markets by buyers may alienate loyal suppliers and such suppliers may react by under-investing in non-contractible parameters of a relationship under the pressure to be competitive in reverse auctions. Our results are also relevant to the supplier firms. The results showing that 'satisfied' buyers are likely to continue business with their suppliers even if they are not the lowest bidders in the auction process should be reassuring to the suppliers. These findings suggest that there are payoffs from investment in non-contractible parameters and relational capital.

While our study contributes to a better understanding of how information technology embodied in reverse auctions and other electronic market mechanisms may affect firm boundaries, future research may overcome some of the limitations of this study. First, our research is based on self-reported reverse auction use behavior and the factors influencing such decisions for different categories of products. There is a need to further validate our findings by collecting detailed product and supplier characteristics archival data at the firm level that may be considered more objective. Second, we attempted to cover a large cross-section of firms in the U.S. automotive industry in order to achieve generalizability. A useful extension of this research may be to conduct an in-depth study of select group of companies that reported tremendous success and those reported complete failure. Such studies will enhance our understanding of the situational and contextual factors that are difficult to control in large-scale survey based research.

We also identify several promising areas for future research in this stream of literature. First, it would be useful to identify parameters that affect performance of reverse auctions, particularly when firms adopt reverse auctions for products that score low on non-contractible parameters. For example, some of the parameters affecting potential cost reductions through reverse auctions could be the number of participating suppliers, participation of the incumbent supplier in the auction, reserve price, and information that is available to auction participants. Second, it may be useful to investigate the drivers of cost reductions through reverse auctions, such as whether cost reductions arise from heightened competition or stem from IT enabled reduced transaction costs. Third, studies might explore whether relationship management initiatives by suppliers such as investment in business to-business customer relationship management (CRM) systems have an effect on buyers' reverse auction use. Fourth, a study of the effect of Internet-enabled electronic markets on firms' business processes, internal and external transaction costs, and procurement cycle-time would help quantify the value of electronic markets. Finally, it would be useful to explore the longitudinal causality underlying the relationship between asset specificity and non-contractibility. In the structural equation analysis, we have modeled this as a process in which asset specificity leads to non-contractibility, but the causality could arguably run the other way. A longitudinal study that teased out the paths of this relationship would be highly informative.

To conclude, this paper empirically explored the importance of product and relationship characteristics that may moderate the effect of information technology on firm boundaries and governance mechanisms. Based on field data collected from firms in the automotive industry, we found

evidence for negative association between reverse auction use and the degree of non-contractibility in the relationship. Our research empirically validates the past predictions made in the information systems literature characterized as the move to middle hypothesis. The findings of this study have implications for research in transaction cost economics to the extent that we have argued and found support for the notion of non-contractibility that appears more general notion than the concept of asset specificity that is often viewed as the locomotive of transaction cost economics. Non-contractibility becomes even more appropriate and descriptive of the underlying transactions between buyers and suppliers as the importance of intangibles and service component grows in dyadic relationships. Our findings also inform marketing research, because we have found empirical support for the importance of customer satisfaction in business-to-business settings. Our results suggest that suppliers making investments in satisfying buyers may be rewarded with continued business even if they are not the lowest bidders in the reverse auction process in electronic markets.

References

Anderson, J.C., and Gerbing, D.W. "Structural equation modeling in practice: A review and recommended two-step approach," *Psychological Bulletin* (103:3) 1988, pp 411-423.

Ang, S., and Straub, D.W. "Production and Transaction Economies and IS Outsourcing: A Study of the U.S. Banking Industry," *MIS Quarterly*:December 1998) 1998, pp 535-552.

Bagozzi, R.P., and Heatherton, T.F. "A general approach to representing multifaceted personality constructs: Application to State self-esteem," *Structural Equation Modeling* (1) 1994, pp 35-67.

Bagozzi, R.P., and Phillips, L.W. "Representing and testing organizational theories: A holistic construal," *Administrative Science Quarterly* (27) 1982, pp 459-489.

Bakos, J.Y., and Brynjolfsson, E. "From vendors to partners: Information technology and incomplete contracts in buyer-supplier relationships," *Journal of Organizational Computing* (10:2) 1993a, pp 37-53.

Bakos, J.Y., and Brynjolfsson, E. "Information technology, incentives and the optimal number of suppliers.," *Journal of Management Information Systems* (10:2) 1993b.

Barney, J.B., and Hansen, M. "Trustworthiness and Competitive Advantage.," *Strategic Management Journal* (15:Winter Special Issue) 1994, pp 175-190.

Barua, A., Ravindran, S., and Whinston, A.B. "Efficient selection of suppliers over the INternet," *Journal of Management Information Systems* (13:4) 1997, pp 117-137.

Barzel, Y."Measurement Costs and the Organization of Markets" *Journal of Law & Economics* (25) 1982, pp 27-48.

Bensaou, M., and Anderson, E. "Buyer-Supplier Relations in industrial markets: When do buyers risk making idiosyncratic investments?," *Organizational Science* (10:4) 1999, pp 460-481.

Chatfield, A.T., and Bjorn-Adersen, N. "The impact of IOS-enabled business transformation of the value chain of Japan airlines.," *Journal of Management Information Systems* (14:1) 1997, pp 13-40.

Choudhury, V., Hartzel, K.S., and Konsynski, B.R. "Uses and consequences of electronic markets: An empirical investigation in the aircraft parts industry.," *MIS Quarterly* (22:4) 1998, pp 471-507.

Christiaanse, E., and Markus, M.L. "Business-to-Business Electronic Marketplaces and the Structure of Channel Relationships," Twenty third International Conference on INformation Systems 2002, AIS, Barcelona, Spain, 2002.

CIOL "B2B exchanges that failed to deliver," *Availabe At* *http://www.ciol.com/_templates/newssections/mainsectemp.htm/01041101.asp*) 2001.

Clark, T.H., and Stoddard, D.B. "Inter-organizational Business process Redesign: Merging Technological and process innovation.," *Journal of Management Information Systems* (13:2) 1996, pp 9-28.

Clemons, E.K., Reddi, S.P., and Row, M.C. "The impact of information technology on the organization of economic activity: The 'move to the middle' hypothesis.," *Journal of Management Information Systems* (10:2) 1993b, pp 9-35.

Clemons, E.K., and Row, M. "Information technology and industrial cooperation: The changing economics of coordination and ownership.," *Journal of Management Information Systems* (9:2) 1992.

Clemons, E.K., and Row, M.C. "Limits to inter-firm coordination through information technology: Results of a field study in consumer packaged goods distribution.," *Journal of Management Information Systems* (10:1) 1993a.

Coase, R. "The Nature of the Firm," *Economica* (4:16) 1937, pp 386-405.

Conner, K.R., and Prahalad, C.K. "A resource-based theory of the firm: Knowledge versus opportunism," *Organization Science* (7:5), Sep-Oct 1996, pp 477-501.

Cusumano, M.A., and Takeishi, A. "Supplier relations and management: A Survey of Japanese, Japanese transplant and U.S. Auto Plants.," *Strategic Management Journal* (12) 1991, pp 563-588.

Dai, Q., Kauffman, R.J. "To be or not to B2B? An Evaluative Model for E-Procurement Channel Adoption.,") 2000.

Dai, Q., and Kauffman, R.J. "Business Models for Internet-Based E-Procurement Systems and B2B Electronic Markets: An Exploratory Assessment.," *IEEE Computer Society (Available At* *http://dlib2.computer.org/conferen/hicss/0981/pdf/09817004.pdf?)*) 2001.

Davis, G.F., and Powell, W.W. "Organization-environment relations," in: *Handbook of industrial and organizational psychology*, M.D. Dunnette and L.M. Hough (eds.), Consulting Psychologists Press., Palo Alto, Cal, 1992, pp. 315-375.

Deming, W.E. *Out of the crisis* Massachusetts Institute of Technology Center for Advanced Engineering Study, Cambridge, Mass., 1993, pp. xii, 507.

Dyer, J.H. "Effective inter-firm collaboration: How firms minimize transaction costs and maximize transaction value.," *Strategic Management Journal* (18:7) 1997, pp 535-556.

El Sawy, O.A., Malhotra, A., Gosain, S., and Young, K.M. "IT-Intensive Value Innovation in the Electronic Economy: Insights from Marshall Industries," *MIS Quarterly* (23:3) 1999.
Fox, P. "B2B: You can find success in private sites.," *Computerword* (35:19) 2001, pp 24-25.
Gonsalves, A., and Konicki, S. "CEO Quits As Covisint Restructures," in: *InformationWeek*, 2002.
Grossman, S., and Hart, O. "The costs and benefits of ownership: A theory of vertical and lateral integration.," *Journal of Political Economy* (4:691-717) 1986.
Grover, V. "Factors affecting adoption and implementation of customer based inter-organizational systems.," University of Pittsburgh, 1990.
Gulati, R. "Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances.," *Academy of management journal* (38:1) 1995, pp 85-112.
Gulati, R., Nohira, N., and Zaheer, A. "Strategic Networks.," *Strategic Management Journal* (21) 2000, pp 203-215.
Gurbaxani, V., and Whang, S. "The Impact of Information Systems on Organizations and Markets," *Communications of the ACM* (34:1) 1991, pp 59-73.
Hart, O., and Moore, J. "Property rights and the nature of the firm.," *Journal of Political Economy* (98:6) 1990, pp 1119-1158.
Hayes, M. "E-Business Loses Momentum," InformationWeek, 2002.
Heide, J., and John, G. "Do Norms Matter in Marketing Relationships?," *Journal of Marketing* (56:2) 1992, pp 32-44.
Helper, S. "How much has really changed between U S automakers and their suppliers?," *Sloan Management review* (32:4), Summer 1991, pp 15-27.
Hess, C.M., and Kemerer, C.F. "Computerized loan origination systems: An industry case study of the electronic markets hypothesis.," *MIS Quarterly* (18:3), Sept 1994 1994, pp 251-275.
Johnston, R., and Lawrence, P. "Beyond vertical integration: The rise of value-adding partnership.," *Harvard Business Review* (66:4), July-August 1988, pp 94-101.
Jupiter Media Matrix "B-to-B is more than Net Markets.," *Vision Report* (Volume 1), April 3, 2001 2001.
Kale, P., Singh, H., and Perlmutter, H. "Learning and Protection of Proprietary Assets in Strategic Alliances: Building Relational Capital.," *Strategic Management Journal* (21:3) 2000, pp 217-237.
Kambil, A., and Heck, E.v. "Reengineering the Dutch Flower Auctions: A Framework for Analyzing Exchange Oranizations.," *Information Systems Research* (9:1) 1998, pp 1-19.
Kaplan, S., and Sawhney, M. "E-Hubs: The new B2B Marketplaces.," *Harvard Business Review*) 2000, pp 97-103.
Klein, B. "Why hold-ups occur: The self-enforcing range of contractual relationships.," *Economic Enquiry* (34:3) 1996, pp 444-463.
Klein, B., Crawford, R.G., and Alchian, A.A. "Vertical integration, appropriate rents, and the competitive contracting process.," *Journal of Law and Economics* (21:2) 1978, pp 297-326.
Klein, B., and Leffler, K.B. "The Role of Market Forces in Assuring Contractual Performance.," *Journal of Political Economy* (89:4) 1981, pp 615-641.
Kline, R.B. *Principles and practice of structural equation modeling* The Guilford Press, New York, 1998.
Kogut, B., and Zander, U. "Knowledge of the firm, combinative capabilities and the replication of technology.," *Organization Science* (3) 1992, pp 383-397.
Kuan, K.K.Y., and Chau, P.Y.K. "A perception-based model for EDI adoption in small businesses using a technology-organization-environment framework," *Information & Management* (38:8) 2001, p 507.
Lee, H.G. "Do electronic marketplaces lower the price of goods?," *Communications of the ACM* (41:1) 1998, pp 73-80.
Malone, T.W., Yates, J., and Benjamin, I. "Electronic markets and electronic hierarchies," *Communications of the ACM* (30:6) 1987, pp 484-497.
Martin, X., Swaminathan, A., and Mitchell, W. "Organizational evolution in the interorganizational environment: Incentives and constraints on international expansion strategy," *Administrative Science Quarterly* (43:3) 1998, p 566.
Masten, S.E. "The Organization of Production: Evidence from the Aerospace Industry," *Journal of Law, Economics and Organization* (27:2) 1984, pp 1-25.
McGowan, M.K. "Extent of electronic data interchange implementation : an innovation diffusion theory perspective," 1994, pp. x, 234 leaves, bound.
Meehan, M. "In slumping B2B market, Ariba benefits from early retreat; Others take losses," *Computerword* (35:30) 2001.
Milgrom, P., and Roberts, J. "The Economics of Modern Manufacturing: Technology, Strategy and Organization.," *The American Economic Review* (80:3) 1990, pp 511-528.

Mishra, A.N., Konana, P., and Barua, A. "Determinants of Internet-based procurement: A Theoretical Framework and an Empirical Investigation.," *MSIS McCombs School of Business Working Paper*.) 2001.
Monczka, R.M., Peterson, K.J., and Handfield, R.B. "Success factors in strategic supplier alliances: The buying company perspective.," *Decision Sciences* (29:3) 1998, pp 553-577.
Monteverde, K. "Technical dialog as an incentive for vertical integration in the semi-conductor industry.," *Management Science* (41:10) 1995, pp 1624-1638.
Moorman, C., Zaltman, G., and Deshpande, R. "Relationship between providers and users of market research: The dynamics of trust within and between organizations.," *Journal of Marketing Research* (29:3) 1992, pp 314-328.
Mudambi, R., and Helper, S. "The 'Close But Adversarial' Model Of Supplier Relations In The U.S. Auto Industry.," *Strategic Management Journal* (19:8) 1998, pp 775-792.
Mukhopadhyay, T., Kekre, S., and Kalathur, S. "Business Value of Information Technology - a Study of Electronic Data Interchange," *MIS Quarterly* (19:2) 1995, pp 137-156.
Mukhopadhyay, T., Rajiv, S., and Srinivasan, K. "Information technology impact on process output and quality," *Management Science* (43:12) 1997a, pp 1645-1659.
Nidumolu, S.R. "Inter-organizational information systems and the structure and climate of seller-buyer relationships.," *Information and Management* (28:2) 1995, pp 89-105.
Nunnally, J.C. *Psychometric Theory* McGraw-Hill, Englewood Cliffs, NJ, 1988.
Nunnally, J.C., and Bernstein, I.H. *Psychometric theory*, (3rd ed.) McGraw-Hill, New York, 1994, pp. xxiv, 752.
Phillips, L.W. "Assessing measureent error in key informant reports: A methodoogical note on organizational analysis in marketing," *Journal of Marketing Research* (18) 1981, pp 395-415.
Poole, R.R. "The impact on the buyer-seller relationship of firms using electronic data interchange," 1997, pp. xi, 208.
Poppo, L., and Zenger, T. "Testing affirmative theories of the firm: Transaction cost, knowledge-based and measurement explanations for make-or-buy decisions in information services.," *Strategic Management Journal* (19) 1998, pp 853-877.
Premkumar, G., and Ramamurthy, K. "The role of inter-organizational and organizational factors on the decision mode for adoption of interorganizational systems.," *Decision Sciences* (26:3) 1995, pp 303-336.
Purchasing, B.S. "E-Procurement Strategies: The Old Economy Srikes Back,") 2001.
Reuters "eProcurement: Successful Strategies for the eMarketplace.," *Reuters Business Insight: Technology*) 2001.
Sambamurthy, V., Bharadwaj, A.S., and Grover, V. "Shaping Agility through Digital Options: Reconceptualizing the Role of IT in Contemporary Firms.," *Working Paper version Dec 2002*) 2002.
Smith, K., Carroll, S., and Ashford, S. "Intra- and Interorganizational cooperation: Towards a research agenda.," *Academy of Management Journal* (38:1) 1995, pp 7-23.
Steinfield, C., Kraut, R., and Plummer, A. "The impact of interorganizational networks on buyer-supplier relationships," *Journal of computer mediated communications* (1:3) 1995.
Subramani, M.R. "Safeguarding Investments in Asymmetric Interorganizational Relationships: Theory and Evidence," *Academy of Management Journal* (Forthcoming) 2003.
Takeishi, A. "Bridging inter- and Intra- Firm Boundaries: Management of Supplier Involvement in Automobile Product Development.," *Strategic Management Journal* (22:5) 2001, pp 403-433.
Walker, G., and Poppo, L. "Profit centers, single source suppliers, and transaction costs," *Administrative science quarterly* (36:March) 1991, pp 66-87.
Williams, L.J., and Hazer, J.T. "Antecedents and Consequences of Satisfaction and Commitment in Turnover Models: A Reanalysis Using Latent Variable Structural Equation Methods," *Journal of Applied Psychology* (71:2) 1986, p 219.
Williamson, O.E. "Markets and Hierarchies: Analysis and Antitrust Implications," in: *The Free Press*, New York, 1975.
Williamson, O.E. "The Economic Institutions of Capitalism: Firms, Markets and Relational Contracting.," in: *The Free Press*, New York, 1985.
Yao, Y., Palmer, J.W., and Dresner, M. "Impact of electronic commerce on supply chain management," Twenty third International Conference on Information Systems 2002, Barcelona, Spain, 2002.
Young-Ybarra, C., and Wiersema, M. "Strategic Flexibility in information technology alliances: The influence of transaction cost economics and social exchange theory.," *Organization Science* (10:4) 1999, pp 439-459.
Zaheer, A., and Venkatraman, N. "Determinants of Electronic Integration in the Insurance Industry: An Empirical Test.," *Management Science* (40:5) 1994, pp 549-566.

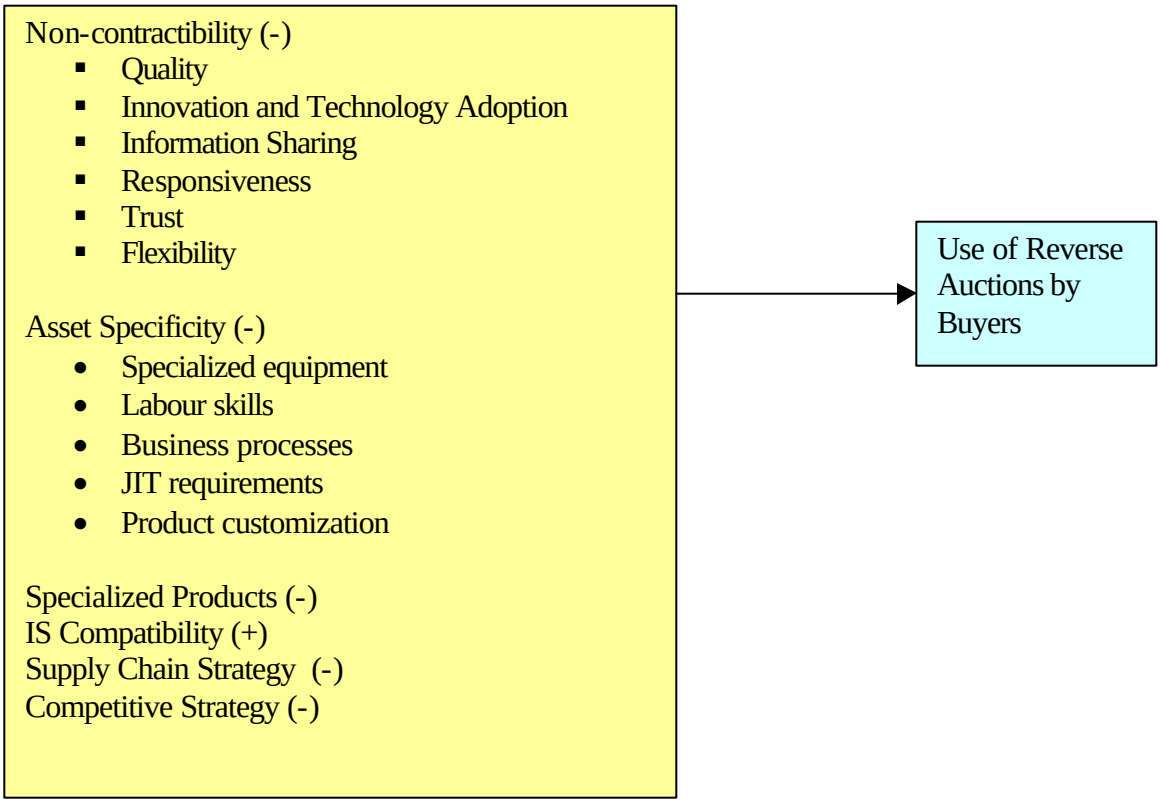

Figure 1: Conceptual Model for Reverse Auctions Use

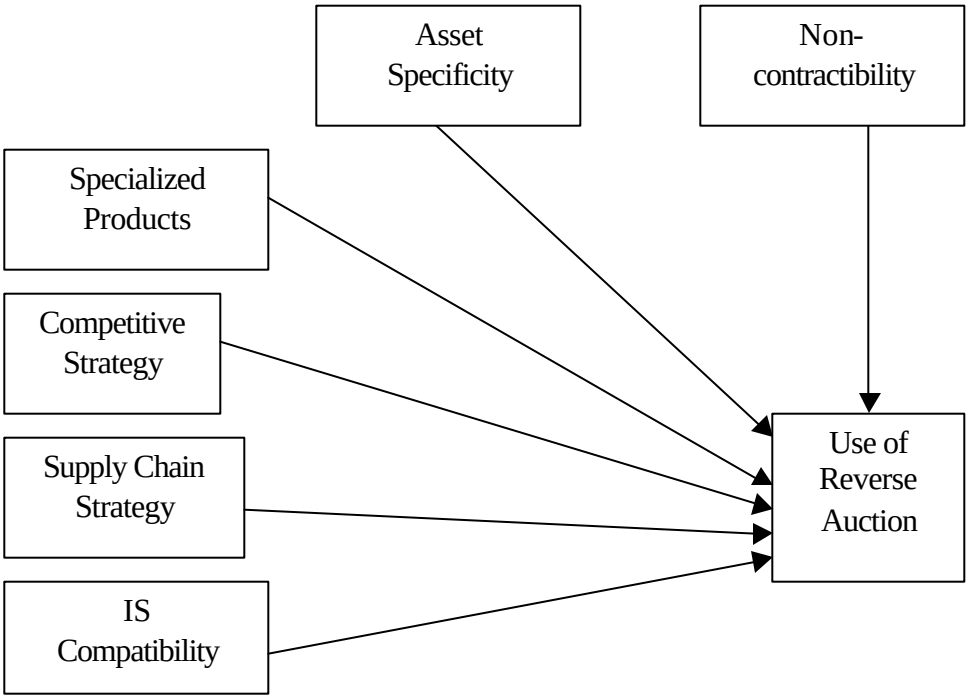

Figure 2a: Base Structural Model

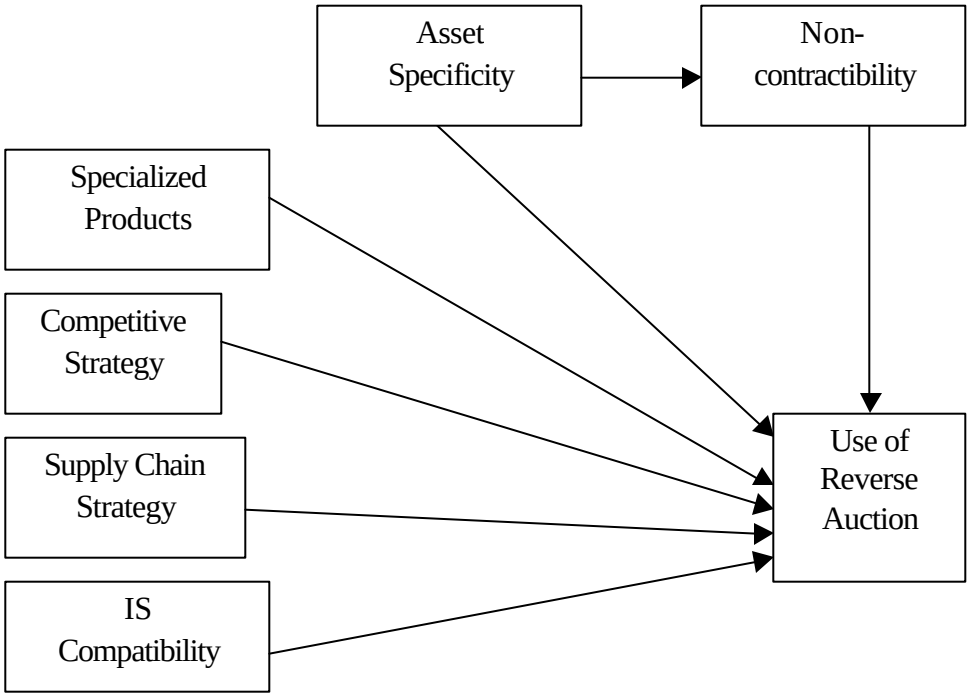

Figure 2b: Alternative Structural Model

Table 1: Empirical Studies of Information Technology and Inter-Organizational Systems

Study	Focus
1. Chatfield et al. (1997)	Case study of Japan Airlines: Shows impact of IOS enabled value chain on business growth and profitability.
2. Kuan and Chau (2001)	EDI adoption by small businesses using technology-organization-environment framework
3. Choudhury, Hartzel and Konsynski (1998)	Case study of Aircraft parts industry: Shows mixed impact on prices and little effect on inventory levels and use of brokers.
4. Clark and Stoddard (1996)	Case study and survey in the Grocery Industry
5. Clemons and Row (1993a)	Case based study in Consumer Packaged Goods Distribution: The study points out the limitations of inter-firm coordination through information technology
6. Grover (1990)	Survey of Customer based IOS Adoption to study determinants of adoption decision and implementation success. The two most significant sets of facilitators were proactive technological orientation and internal push for the system.
7. Hess and Kemerer (1994)	Case study of computerized loan origination systems: Does not find support for the electronic markets hypothesis
8. Kambil and Eric van Heck (1998)	Case studies of Dutch flower auctions: Propose a process stakeholder framework for studying success or failure of alternative auction formats.
9. Lee (1998)	Case study of a used car marketplace (Aucnet): Shows that, contrary to popular belief, prices in electronic markets may be higher than the prices in traditional markets.
10. McGowan (1994)	Developed and tested a model to explain extent of EDI implementation through a survey. Compatibility, size, functional differentiation, training, EDI support, MIS support and customer influence explained much of the variance in the extent of EDI implementation.
11. Monczka, Peterson and Handfield (1998)	Survey research: Trust and coordination, interdependence, information quality and participation, information sharing, joint problem solving significantly related to partnership success. However, the study did not find asset specificity as an important determinant of partnership success.
12. Mukhopadhyay et al. (1995; 1997a)	Studied the effect of electronic linkages on costs, process output and quality.
13. Nidumolu (1995)	Surveyed inter-organizational information systems in insurance industry distribution chain and its impact on the structure and climate of seller-buyer relationships. Specialized IOIS were associated with increased vertical interactions and under certain conditions, a more positive transactional climate in seller-buyer relationships.
14. Premkumar and Ramamurthy (1995)	Studied the decision mode for adoption of inter-organizational systems through a survey. Competitive pressure, exercised power, internal need and top management support differentiated firms with proactive decision modes from firms with reactive decision modes.
15. Poole, Robyn R. (1997)	Studied the impact on the buyer-seller relationship of firms using electronic data interchange.

Table 2: Dimensions of Non-Contractibility

Variable Name	Definition	Adapted from
Quality	Refers to manufacturing capability, warranty implications and criticality in terms of interaction with other components in an assembly.	Cusumano and Takeishi (1991), Takeishi (2001)
Innovativeness	Supplier's track record of continuous improvement in existing products, development of new products and investment in keeping abreast with technological developments.	Helper (1991)
Information Exchanges	Exchange of proprietary information between buyer and supplier for cost reduction and involvement in planning and goal setting activities.	Cusumano and Takeishi (1991), Helper (1991), Takeishi (2001)
Responsiveness	Supplier's sensitivity and ability to respond immediately to buyer's needs and to keep buyer updated on the requests.	Johnston and Lawrence (1988)
Trust	Buyer's perception about supplier's trustworthiness, confidence in supplier and belief that supplier will honor its promises.	Johnston and Lawrence (1988)
Flexibility	Willingness of supplier to modify the contract, make necessary adjustments continuously and being responsive to buyer's requests which may be beyond the terms of contract.	Monczka et al. (1998), Young-Ybarra & Wiersema (1999)

Table 3: Characteristics of the Firms in the Sample (N=152)

	Percentage of Firms
Firm Type (a)	
OEMs	20%
Tier 1 component manufacturer	84%
Tier 2 component manufacturer	66%
Tier 3 component manufacturer	30%
Tier 4 component manufacturer	8%
Firm Size – Revenues in Million $	
Less than $100 Million	58%
More than 100 million but less than $1 Billion	30%
More than $1 Billion	12%
Firm Size – Number of Employees	
Less than 500	60%
More than 500 but less than 5000	28%
More than 5000 but less than 10000	3%
More than 10000 but less than 50000	6%
More than 50000	3%

(a) Percentage do not sum up to 100% because of multiple responses for firm type.

Table 4: Reliability Analysis of Key Variables

Variable Name	Definition	Cronbach Alpha	Valid N
Likelihood of Using Reverse Auctions	Probability of reverse auctions use by a firm or business unit	0.92* 0.92**	125 123
Non-Contractibility	Composite of quality, innovation, information exchanges, responsiveness, trust, flexibility.	0.80* 0.89**	139 128
Asset Specificity	Specialized investments in physical equipment, labor skills, business processes, JIT systems, or assets needed for customizing products.	0.65* 0.75**	140 131

* Refers to commodity products; ** Refers to specialized products

Table 5. Descriptive Statistics and Correlations Among Variables

	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Use of Reverse Auctions	1.8	5.8	3.18 (0.90)							
2. Non-Contractibility	2.5	7.0	-0.16	5.62 (0.70)						
3. Asset Specificity	1.0	7.0	-0.10	0.74*	5.30 (1.01)					
4. IS Compatibility	1.9	7.0	0.14	0.11	0.14	4.46 (1.05)				
5. Competitive Strategy	1.0	7.0	0.01	-0.05	-0.04	0.04	3.86 (0.71)			
6. Supply Chain Strategy	2.5	7.0	-0.18*	0.08	0.13	-0.03	-0.04	5.90 (0.98)		
7. Specialty Products	0	1.0	-0.11	0.01	0.13	0.00	0.00	0.00	0.5 (0.50)	
8. Revenues)	2	5	0.25*	0.00	0.08	0.33*	-0.09	-0.08	0	3.48 (0.82)

Note: Mean and SD are shown on the diagonal.
*p<0.05

Table 6. Parameter Estimates Of The Least Squares Regression Models Explaining Reverse Auctions Use *(p values are in parentheses; n=304)*

		1	2
Dependent Variable	**Parameter**	**Likelihood of RA Use**	**Likelihood of RA Use**
Intercept	β_0	3.339*** (0.000)	4.202*** (0.000)
Non-Contractibility	β_1		-0.262*** (0.007)
Asset Specificity	β_2	-0.086** (0.045)	0.049 (0.257)
Specialized Products (0=Commodities; 1=Specialized)	β_3	-0.172** (0.041)	-0.202** (0.020)
IS Compatibility	β_4	0.063 (0.110)	0.068* (0.091)
Differentiation Competitive Strategy	β_5	0.028 (0.348)	0.021 (0.383)
Relationship-Oriented Supply Chain Strategy	β_6	-0.139** (0.004)	-0.143*** (0.002)
Revenues	β_7	0.244*** (0.000)	0.229*** (0.000)
R Square		11.31%	13.07%
F Statistic		6.31*** (0.000)	6.36*** (0.000)

*** p <0.01; ** p<0.05; * p<0.10 (all one-tailed tests)

Table 7. Measurement Model: Parameter Estimates and Reliability

(t values are in parentheses)

Construct Indicators	**Parameter Estimates**
Non-Contractibility **(a)**	
Quality	1.00
Innovativeness	1.28* (9.26)
Information Exchanges	1.01* (9.32)
Responsiveness	1.00
Trust	0.77* (10.56)
Flexibility	0.93* (9.65)
Asset Specificity	
AS 1	1.00
AS 2	1.59* (5.06)
AS 3	1.71* (5.10)
AS 4	1.49* (5.09)
AS 5	0.69* (4.31)
Reverse Auction Use **(a)**	
LIK 1	1.00
LIK 2	1.17* (11.91)
LIK 3	1.09* (11.83)
LIK 4	1.00
LIK 5	1.09* (12.69)
LIK 6	0.99* (12.66)
LIK 7 (b)	0.73 (12.79) and 0.31* (9.24)

* Significant at $p<0.01$

(a) Second order construct

(b) Factorially complex item

Table 8. Parameter Estimates Of The Structural Equation Models Explaining Reverse Auctions Use *(t values are in parentheses; n=304)*

		Model 1 (Refer Figure 2a)	**Model 2 (Refer Figure 2b)**
Construct Relationship	**Parameter**	**Likelihood of RA Use**	**Likelihood of RA Use**
Non-Contractibility => RA Use	β_1	-0.58** (-2.22)	-8.29*** (-6.93)
Asset Specificity => Non-Contractibility	β_2		0.26*** (3.09)
Asset Specificity => RA Use	β_3	-0.04 (-0.39)	2.15*** (2.21)
Specialized Products => RA Use	β_4	-0.34*** (-2.22)	-0.35*** (-2.30)
IS Compatibility => RA Use	β_5	0.17*** (2.17)	0.17** (2.18)
Competitive Strategy => RA Use	β_6	0.05 (0.45)	0.05 (0.45)
Relationship Orientation to Supply Chain Strategy => RA Use	β_7	-0.25*** (-3.19)	-0.25*** (-3.19)
Revenues=> RA Use	β_8	0.36*** (3.60)	0.35*** (3.49)
Chi-Square (df)		518.76 (210)	518.56 (210)
Fit Indices			
GFI		0.87	0.87
NFI		0.92	0.92
NNFI		0.94	0.94
CFI		0.95	0.95
RMSEA		0.07	0.07

***** p<0.01; ** p<0.05; * p<0.10**

Table 9. T-tests for the effect of buyer satisfaction on reverse auction use

Panel A (survey responses)	Mean (1=Strongly disagree, 7=Strongly agree)	Standard Deviation
a. We would consider using reverse auctions **only if** we are dissatisfied with our incumbent suppliers.	3.24	1.82
b. We would consider using reverse auctions **even if** we are completely satisfied with our incumbent suppliers.	3.96	2.16
c. We are likely to reward our loyal suppliers by continuing business with them even if they are not the lowest bidders in the reverse auction.	4.68	1.70
Panel B (p-values)		
▪ p value for a two sample t test with unequal variances between item a and item b above	<0.05	
▪ p value for a two sample t test with unequal variances between item b and item c above	<0.05	