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Ex Post Problems in Buyer–Supplier Transactions: Effects of Transaction Characteristics, Social Embeddedness, and Contractual Governance

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Abstract. This paper focuses on ex post governance of inter-firm transactions. We develop and test hypotheses on the occurrence of ex post problems like delivery delays, inferior quality, and insufficient service in buyer–supplier transactions. Our hypotheses address effects of transaction characteristics, of social embeddedness, and of contractual governance on the occurrence of problems. Other than earlier research on embeddedness effects in this field, we consider not only effects of dyadic embeddedness but also effects of network embeddedness. We test hypotheses using rich survey data on more than 1200 purchases of information technology (IT) products: hardware and software, both standard and complex. We find evidence for effects of transaction characteristics on the occurrence of problems, while our data do not support hypotheses on effects of contractual governance. Our data provide rather consistent support for hypotheses on the effects of embeddedness. Specifically, we find evidence that network embeddedness reduces problems.

Key words: buyer–supplier relations, embeddedness, ex post problems, inter-firm networks, governance, transaction cost theory

1. Introduction

This paper contributes to expanding the study of governance from ex ante features such as contracting to ex post features of contract execution. More specifically, we study the occurrence of ex post problems in buyer–supplier transactions. We thus analyze outcomes of purchasing. The importance of purchasing has grown considerably. Firms focus on core competences and consequently outsource more components. For instance, in the automotive and electronic industries, typically between 60 and 80% of the product value has been outsourced to suppliers (Schary and Skjøtt-Larsen, 2001). Also, firms face an increasing pressure to innovate, and suppliers are considered to

be critical sources of innovative product and process technology (Leiblein et al., 2002). Suppliers and their performance in terms of price, delivery, and quality are therefore critically important for buying firms (Leenders and Fearon, 1993).

Purchasing can be precarious in the sense that problems occur during and after the transaction. We focus on problems for buyers such as delivery delays, delivery of inferior quality, and insufficient service by the supplier. We study how the occurrence of problems depends on characteristics of the transaction, on the embeddedness of the transaction in ongoing relations of buyer and supplier, and on contract characteristics.

Empirical studies employing a similar perspective are scarce (Wathne and Heide, 2000; Jap and Anderson, 2003; David and Han, 2004). Available evidence often derives from studies on performance. This is not surprising, since performance can be conceived as a result of problems prevented or cured. Typically, earlier studies focus on performance of relations rather than transactions between buyers and suppliers (see Kogut, 1989; Parkhe, 1993 for examples of related work on performance of strategic alliances and joint ventures). Noordewier et al. (1990) examine purchasing performance in industrial purchasing relationships. Performance indicators are the percentage of on-time delivery and the percentage of acceptable items delivered. They find that under market uncertainty supplier performance is better if the supplier is more flexible and provides more assistance. However, supplier flexibility does not affect performance if there is no market uncertainty. Heide and Stump (1995) study performance in buyer-supplier relationships in industrial markets. They measure performance as delivery performance and adherence to specifications. They find that, given sufficient environmental uncertainty, supplier performance is better if buyer and supplier expect future business. If there is no or hardly any environmental uncertainty, expectations of future business do not matter.

Noordewier et al. (1990) as well as Heide and Stump (1995) use the occurrence of problems as indicators for (lack of) performance. Other studies relate performance not only to the occurrence or, respectively, prevention of problems, but also to their cure. For example, Poppo and Zenger (2002) study outsourcing relationships in information services. Supplier performance is measured as the buyer's overall satisfaction with the service. Their findings suggest that relational governance in combination with customized contracts improves performance. In another study on supplier performance, Kotabe et al. (2003) focus on supplier performance improvement, measured as the degree to which the buyer is able to improve own product and process design, product quality, and lead time through the relation with the supplier. They ask how relationship duration moderates the effects of knowledge transfer between buyer and supplier on supplier performance improvement.

They find that increasing relationship duration enhances the positive performance effects of complex technology transfer but not the performance effects of ordinary technical exchanges. Jap and Anderson (2003) investigate how relationship safeguards function to preserve performance in business-to-business supply relationships. Performance is measured as the overall performance (success) of the relationship, the achievement of competitive advantages, joint profit performance, and expectations of relationship continuity. They find that given a low level of opportunism in the relationship, bilateral idiosyncratic investments and interpersonal trust enhance performance. At higher levels of opportunism, goal congruence is more effective in enhancing performance. Finally, Claro et al. (2003) study business relationships of suppliers and merchant distributors. While they focus on determinants of relational governance, they also address performance implications of relational governance. They find that relational governance indicators such as joint planning and joint problem solving are associated with higher sales growth as a performance measure, but joint planning, in contrast to joint problem solving, does not lead to improved performance in the sense of higher satisfaction with outcomes of the relationship.

Our study improves on earlier research in two ways. First, from a theoretical and substantive perspective, a major new feature of our study is that our embeddedness characteristics include network embeddedness. We consider network embeddedness in the sense of ties of the buyer with other buyers of the supplier. Moreover, we analyze effects of network embeddedness in the sense of access to alternative suppliers. Our data include multiple indicators for both types of network embeddedness. Earlier research on problems and performance in buyer–supplier relations was restricted to effects of dyadic embeddedness in the sense of (characteristics of) the previous relation between buyer and supplier or expected future transactions between buyer and supplier. Gierl and Bambauer (2002) is, in a sense, an exception. However, rather than analyzing problems that occur for the buyer, their study is on how network embeddedness affects problems that occur for the supplier through buyer opportunism. Also, our data comprise more detailed measurements of network embeddedness. Incorporating effects of network embeddedness on the occurrence of problems during and after a transaction complements studies on network effects on *ex ante* governance such as the buyer's search for and selection of a supplier (e.g., Buskens et al., 2003) and network effects on contracting (e.g., Gulati, 1995; Rooks et al., 2000).

Second, from a methodological perspective, we improve on earlier research by implementing a core element of the research program of transaction cost economics, namely, to use the transaction as the basic unit of analysis (see, e.g., Williamson, 1985: chaps. 1 and 15; 1996: chap. 9). Our literature overview indicates that earlier research on *ex post* features of

governance such as the occurrence of problems and performance focuses on inter-firm relations rather than transactions: Problems and performance are typically measured at the level of the relation rather than the transaction itself. We do measure problems that occur in a focal transaction. We are therefore able to disentangle the level of the transaction, the level of the relation between buyer and supplier, and the level of the network of buyer and supplier with third parties. Moreover, we use a fine-grained measure of the occurrence of problems during and after the transaction. This measure is based on a detailed list of 11 typical problems often associated with the transactions included in our sample. For each transaction, a key informant assessed the degree to which each of these problems occurred.

In the remainder of this paper, we first develop a theoretical framework and derive hypotheses on the effects of transaction characteristics, embeddedness, and contractual governance on the occurrence of problems during and after a transaction. We then describe the data collection and variable construction. In the results section, we present outcomes of a three-stage least squares regression analysis for testing our hypotheses. A discussion and concluding remarks follow.

2. Theory and hypotheses

We explain the occurrence of problems during and after a focal transaction using two approaches from economics and sociology that yield hypotheses on how three groups of variables affect the occurrence of problems: transaction characteristics, embeddedness characteristics, and contractual ex ante governance. One approach is transaction cost theory (see Williamson, 1985 as a major contribution). Using this theory, we derive hypotheses on how transaction characteristics, namely, transaction-specific investments and behavioral uncertainty surrounding a transaction, and contractual ex ante governance affect ex post problems during contract execution.

Sociologists (see the influential programmatic statement in Granovetter, 1985) argue that transaction cost theory largely abstracts from the embeddedness of economic transactions. Transactions, however, are typically not isolated events. Rather, they are often embedded in an ongoing relation of repeated exchange between buyer and supplier. Transactions are also embedded in relations of buyer and supplier with third parties. For example, the buyer has access to and exchanges information with other clients of the supplier or the buyer has access to alternative suppliers. Embeddedness allows for non-contractual governance. Classical sociology (Durkheim, 1893: Book I, chap. 7; Weber, 1921: 409), the sociology of law (see Macaulay's seminal 1963 study and the "law and society" approach building on Macaulay's work), and more recently the new economic sociology (see

Smelser and Swedberg, 2005 for a representative overview) have provided arguments that can be used to generate hypotheses on how problems during and after a transaction depend on embeddedness.

We first outline how we use both approaches in our analysis and how these approaches relate to one another. We then derive our hypotheses.

2.1. TRANSACTION CHARACTERISTICS, EMBEDDEDNESS, GOVERNANCE, AND EX POST PROBLEMS

Our analysis aims at explaining the occurrence of problems during and after the execution of purchasing transactions. We focus on problems experienced by the buyer rather than problems experienced by the supplier. Thus, problems we address include delivery delays, delivery of inferior quality, and insufficient service by the supplier rather than, say, delayed payment by the buyer. Problems during and after a transaction result from the risks associated with the transaction. These risks include opportunistic behavior, defined by Williamson (1985: 47) as “self-interest seeking with guile.” An example is a delivery delay because the supplier serves another client first, thus violating an earlier and possibly implicit agreement with the buyer on delivery deadlines. Other risks are coordination problems, incompetence of the supplier, or unfavorable external contingencies. Firms manage risks and try to safeguard their transactions through governance. An example of a safeguard is a written contract. Other safeguards are non-contractual and include, e.g., rules and norms of informal reciprocity and conditional cooperation. Protecting transactions by means of contracts is costly. Eliminating risks completely through contracting is thus typically inefficient, if at all feasible. Likewise, even if informal reciprocity and conditional cooperation guide the behavior of the partners and mitigate opportunism, problems may emerge. For example, unfavorable external contingencies rather than opportunistic behavior of the supplier can cause a delivery delay. Consequently, governance will not preclude the occurrence of problems during and after a transaction.

2.1.1. *Transaction cost theory*

The focus of transaction cost theory is on explaining ex ante contractual governance, broadly conceived, as well as on ex post problems and performance effects of contractual governance (e.g., Williamson, 1985, 1996). On the one hand, transaction cost theory asks how transaction characteristics – such as specific investments and uncertainty associated with a transaction – affect contracting. Roughly, the idea is that transaction characteristics affect the risks associated with a transaction. Contractual governance refers to ex ante measures that actors involved in an exchange use or implement in

order to mitigate risks and therefore also to improve performance. Transaction cost theory tries to explain *ex ante* governance based on the assumption that governance is subject to economizing behavior of exchange partners.

On the other hand, transaction cost theory is not at all blind for *ex post* performance effects of *ex ante* contractual governance (e.g., Williamson, 2001 argues that an explicit focus on *ex post* governance is a core advantage of transaction cost theory compared to the property rights approach). Theoretically, an underlying assumption is that contractual governance affects performance in the sense that exchange partners respond systematically to the incentives provided by contractual governance. Furthermore, transaction cost theory assumes that exchange partners anticipate on these responses when designing contracts (see Prendergast, 1999 for the same argument in another context: the design of compensation contracts by employers to align the interests of employees). More technically (e.g., Williamson, 1985: 20–22), transaction cost theory assumes that both *ex ante* transaction costs of drafting, negotiating, and safeguarding agreements as well as *ex post* transaction costs such as costs of maladaptation, haggling, and of enforcing agreements are subject to economizing.

Since contractual governance is costly, economizing on transaction costs will typically not eliminate all risks associated with the transaction so that problems are likely to occur during and after the execution of a transaction. Summarizing, based on transaction cost theory we assume that transaction characteristics affect *ex post* problems directly, for example, through incentive effects for suppliers, as well as indirectly through effects on *ex ante* contractual governance that anticipates on *ex post* performance effects.

To put our own empirical analysis in perspective, it is useful to note that there are empirical applications of transaction cost theory that focus on *ex post* features of governance. Our overview of empirical studies on performance in buyer–supplier relations includes such work. Other influential empirical work includes the study of strategic alliances and joint ventures (e.g., Kogut, 1989; Parkhe, 1993) as well as subcontracting (e.g., Lorenz, 1988). However, the bulk of empirical applications of transaction cost theory and tests of hypotheses derived from the theory addresses *ex ante* governance (see the overview by Shelanski and Klein, 1999, edited volumes such as Masten, 1996a, and particularly the survey by David and Han, 2004 that aims at a systematic quantitative assessment of the available empirical evidence for and against transaction cost theory arguments). Thus, analyzing *ex post* problems in buyer–supplier transactions potentially has a relatively strong effect on the ‘evidence/theory ratio’ (David and Han, 2004: 52–53).

2.1.2. *Governance*

Our analysis uses transaction cost theory arguments but likewise tries to refine and expand these arguments. First, transaction cost theory often focuses on markets and hierarchies as polar modes of governance, with “hybrids” (“franchising, joint ventures, and other forms of nonstandard contracting” according to Williamson 1985: 83) located in between. It has been argued (Grandori, 1997) that a more fine-grained perspective will often be preferable that accounts for the fact that the standard discrete alternative governance structures of transaction cost theory are actually configurations of more basic mechanisms. Also, one should not overlook non-contractual governance through, e.g., rules and norms of informal reciprocity and conditional cooperation. We implement a more fine-grained perspective on governance in the sense that we analyze exclusively purchase transactions. Hence, we do not analyze the make-or-buy decision but focus on market transactions. However, these transactions do not occur on ideal-typical perfect markets with price signals as a sufficient statistic. Rather, the governance of these transactions differs in the amount of effort invested in as well as in the completeness of contractual ex ante planning. Moreover, we take into account that the governance of these transactions can involve non-contractual elements.

2.1.3. *Embeddedness of transactions*

We develop hypotheses on embeddedness effects based on a distinction between dyadic embeddedness and network embeddedness on the one hand and learning and control effects through embeddedness on the other hand (see Buskens and Raub, 2002 for details). Dyadic embeddedness refers to an ongoing relation between exchange partners (note that dyadic embeddedness thus differs from Williamson’s frequency dimension that refers strictly to buyer activity in the market rather than repeated transactions between the same partners; Williamson, 1985: 72). Network embeddedness refers to their relations with third parties. We thus employ a notion of structural embeddedness that focuses on the quality and structure of ties among actors (Granovetter, 1985; Zukin and DiMaggio, 1990).

Embeddedness provides opportunities for learning about the partner and about the risks associated with a focal transaction, such as the risk of supplier incompetence and the supplier’s inclination to opportunistic behavior. Dyadic embeddedness allows for learning through own previous experience with the partner. Network embeddedness provides opportunities for learning through information on previous experiences of third parties. Embeddedness also allows for control of the partner in the sense of opportunities for future rewards (positive sanctions) as well as future punishments (negative sanctions) of the partner’s present behavior in a focal transaction. Good supplier

performance in a focal transaction can be rewarded and bad performance can be punished through the buyer's own behavior in future transactions with the supplier (control through dyadic embeddedness) as well as through involving third parties, for example, by informing other buyers on the supplier's performance in the focal transaction (control through network embeddedness). Embeddedness thus provides opportunities for "informal," non-contractual governance based on various forms of reciprocity and conditional cooperation, thus deterring opportunistic behavior (Axelrod, 1984; Taylor, 1987).

Summarizing, embeddedness characteristics will affect the risks associated with a transaction, how exchange partners economize on costly contractual governance, and will thus affect problems that occur during and after the transaction.

2.1.4. Summarizing the underlying theoretical argument

Figure 1 summarizes the basic logic of our argument. The Figure shows that governance has to be conceived as endogenous in our empirical analyses. Our hypotheses exclusively address direct effects of transaction characteristics as well as embeddedness on problems during and after a focal transaction. We do not develop hypotheses on the sum of the direct and indirect effects – through governance – of transaction characteristics and, respectively, embeddedness on ex post problems. However, in our empirical analysis we take the endogeneity of governance characteristics explicitly into account. Also, we focus in this paper on main effects of transaction characteristics, of embeddedness features, and of governance characteristics. We do not aim at deriving more complex hypotheses on interaction effects but control for possible interaction effects in exploratory regression diagnostics. Our hypotheses on governance effects exclusively address effects of contractual governance. However, in an exploratory analysis we compare the effect of contractual governance with the direct and indirect effects of embeddedness allowing for non-contractual governance. Obviously, our hypotheses tacitly include a *ceteris paribus* clause and are meant to specify effects we expect to hold while controlling for other variables in the statistical analysis.

We conceptualize transaction characteristics and embeddedness characteristics as exogenously given. This clearly involves simplifications. For

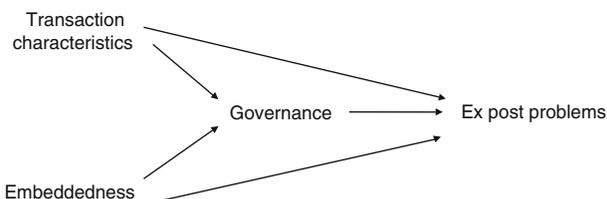


Figure 1. Types of hypothesized relations between variables.

example, buyers could choose between purchasing a standard and a tailor-made product and could thus choose between transaction characteristics. Such choices could indeed be analyzed as an ingredient of ex ante governance. In this paper, following standard versions of transaction cost theory (e.g., Williamson, 1985: chaps. 1–3), we abstract from this complication. Likewise, embeddedness characteristics need not be given. Rather, they often are – at least to some degree – choice variables: firms could establish or delete ties with other firms with an eye on the performance effects of such ties. Also, embeddedness characteristics can affect transaction characteristics. For example, after a trial period of less risky transactions and good experiences in that period, a buyer engages in more risky transactions with a supplier (e.g., Larson, 1992; Helper, 1993; Uzzi, 1996). Analyzing such effects is, however, beyond the scope of this paper.

2.1.5. Behavioral assumptions underlying transaction cost theory and embeddedness arguments

The relation between transaction cost theory and embeddedness arguments is a debated issue. One may not only argue (see above) that transaction characteristics depend – at least to some degree – on embeddedness. On a more fundamental level, it is sometimes claimed (e.g., Uzzi, 1996, 1997) that research on embeddedness effects yields findings that are hard to reconcile with assumptions on incentive-guided and basically selfish behavior that are used as the underlying behavioral model in transaction cost theory.

In this contribution, we circumvent this issue (see Grandori, 2000 for a more detailed discussion of behavioral models underlying analyses of governance). We do so by focusing on hypotheses on embeddedness effects that can indeed be derived using behavioral assumptions like those employed in transaction cost theory. Perhaps surprisingly, this is in line with Granovetter's (1985: 505–506) often cited programmatic sketch of an embeddedness approach to economic life. Granovetter's criticism of the shortcomings of the neoclassical model of perfect markets of "atomized" actors and transactions has often been taken to imply that one had better abandon models of incentive-guided and selfish behavior in favor of more "realistic," socially inspired models of man. It has been widely overlooked that Granovetter opposes "psychological revisionism" which he characterizes as "an attempt to reform economic theory by abandoning an absolute assumption of rational decision making" (1985: 505). Rather, he suggests to maintain the rationality assumption: "[W]hile the assumption of rational action must always be problematic, it is a good working hypothesis that should not easily be abandoned. What looks to the analyst like nonrational behavior may be quite sensible when situational constraints, especially those of embeddedness are fully appreciated" (1985: 506). He argues that investments in tracing the effects of embeddedness are more promising

than investments in the modification of the rationality assumption: “My claim is that however naive that psychology [of rational choice] may be, this is not where the main difficulty lies – it is rather in the neglect of social structure” (1985: 628). It is thus not surprising that Williamson (e.g., 1996: 230–231) has accentuated the complementarities between transaction cost theory and arguments based on embeddedness.

We likewise maintain that an appropriate way of accounting for many effects of embeddedness is to derive hypotheses on such effects from assumptions on incentive-guided and selfish behavior in a context that differs from the neoclassical model of perfect markets in that transactions are embedded in ongoing relations and networks of exchange partners. We now proceed with presenting our hypotheses.

2.2. HYPOTHESES ON EFFECTS OF TRANSACTION CHARACTERISTICS

We distinguish two core transaction characteristics that are expected to have an effect on the occurrence of ex post problems in the focal transaction, namely, transaction-specific investments of the buyer as well as behavioral uncertainty of the buyer (see Williamson, 1985: chap. 3 for hypotheses on effects of these transaction characteristics on ex ante governance).

2.2.1. *Specific investments*

A core argument of transaction cost theory holds that when firms make unilateral investments that are specific to a transaction or relation, the hazard of opportunistic behavior of the partner increases. Given specific investments of buyers, they face switching costs – we will use measurements of such costs as indicators for specific investments – when exiting from the relation with a focal supplier. Consequently, even if the performance of the focal supplier is below standard, switching to an alternative supplier may not be a sensible thing to do. Therefore, switching costs related to specific investments induce incentives for supplier opportunism. While transaction cost theory predicts that unilateral specific investments of the buyer will induce investments in contractual ex ante governance to mitigate supplier opportunism, the direct effect of such specific investments on the occurrence of ex post problems will be positive.

Hypothesis 1: *Transaction-specific investments of the buyer will be positively related to the occurrence of ex post problems.*

2.2.2. *Behavioral uncertainty*

Uncertainty refers to difficulties of the buyer in observing or predicting contingencies relevant for the transaction. Williamson (1985: 56–59)

distinguishes market uncertainty that refers to unforeseen or unforeseeable external contingencies such as technological developments from “strategic” behavioral uncertainty, that is a result of information asymmetry between buyer and supplier. Here, we focus on the case such that the buyer does not have access to some private information of the supplier that can be used for strategic purposes. This is the case of supplier uncertainty in the sense of Sutcliffe and Zaheer (1998: 4): “[T]he behavioral uncertainty arising from the (strategic) actions of the exchange partner firm.” We use monitoring problems of the buyer as an indicator for the buyer’s behavioral uncertainty. Buyers face monitoring problems if they cannot easily assess, before and at the time of delivery, the quality of the product or service to be purchased. Note that such monitoring problems are clearly distinguished from ex post problems during contract execution such as delivery delays, compatibility problems, or inadequate service. Monitoring problems of the buyer imply that coordination between buyer and supplier becomes an issue. Moreover, a supplier can profit opportunistically from such monitoring problems, for example by delivering a product of inferior quality. Again, while transaction cost theory argues that behavioral uncertainty will affect contractual ex ante governance, we focus on the direct effect on the occurrence of ex post problems.

Hypothesis 2: *Behavioral uncertainty of the buyer will be positively related to the occurrence of ex post problems.*

2.3. HYPOTHESES ON EFFECTS OF EMBEDDEDNESS

Employing the distinction between dyadic embeddedness and network embeddedness and focusing on learning and control as mechanisms that become available through embeddedness, we generate hypotheses on embeddedness effects on the occurrence of ex post problems.

2.3.1. *Dyadic embeddedness: previous business*

Dyadic embeddedness includes previous as well as expected future transactions between buyer and supplier. Consider first the likely relation of *previous* transactions between buyer and supplier with supplier performance in the *focal* transaction. We focus on the satisfaction of the buyer with previous transactions with the supplier and relate buyer satisfaction to information effects and learning from previous business (Granovetter, 1985; Gulati, 1995; Lorenz, 1988). It is plausible to assume that suppliers who are more competent and less prone to opportunistic behavior will have performed better so that previous transactions with such suppliers have been associated with

fewer and less serious ex post problems. This will likely increase buyer satisfaction with previous transactions. Hence, we expect less ex post problems in the focal transaction the more satisfied the buyer has been in previous transactions with the supplier.

Hypothesis 3: *Buyer satisfaction in previous transactions with the supplier will be negatively related to the occurrence of ex post problems.*

2.3.2. Dyadic embeddedness: expected future business

According to a meanwhile common argument, joint expectations of future business provide opportunities for reciprocity and imply that firms can cooperate conditionally (Axelrod, 1984; Taylor, 1987) – control through dyadic embeddedness. If the supplier performs well in the focal transaction, the buyer can reward this during future transactions, for example, by accepting an occasional delivery of somewhat lesser quality in a future transaction. Conversely, the buyer can punish inferior supplier performance in the focal transaction in the future, for example, by not accepting deliveries of somewhat lesser quality in the future, but returning them immediately. Hence, short-term incentives for a supplier to behave opportunistically in the focal transaction are balanced by long-term costs of opportunism and by long-term benefits of cooperative behavior and good performance. We thus predict a direct effect of expected future business on the occurrence of ex post problems in the focal transaction.

Hypothesis 4: *Expected future business between buyer and supplier will be negatively related to the occurrence of ex post problems.*

2.3.3. Network embeddedness

Transactions can be not only embedded in the dyadic relation between buyer and supplier but are often also embedded in a network of relations of buyer and supplier with third parties. We distinguish two different networks: the “voice network” and the “exit network” (Blumberg, 2001; Hirschman, 1970; Rooks et al., 2000). The buyer’s voice network includes other buyers with whom the buyer can exchange information about the supplier. Their voice network enables buyers to collect information and learn about the supplier as well as to spread themselves information about the supplier to other business partners of the supplier (Kreps, 1990; Raub and Weesie, 1990). If buyers base their decision to engage in business with a supplier on the supplier’s reputation, this reputation becomes a valuable asset for the supplier. One mechanism through which the voice network affects the occurrence of ex post

problems is thus learning and supplier selection based on learning. If a buyer receives information from many third parties like other buyers about the supplier and chooses to do business with the supplier, it is plausible that the information the buyer receives about the supplier is positive in the sense that it indicates that the supplier is, at least compared to other potential suppliers, competent and less prone to opportunistic behavior. Hence, ex post problems are less likely to occur in the focal transaction with that supplier.

Another mechanism works through control and additional opportunities of the buyer to reward good performance of the supplier in the future as well as to sanction bad performance. If buyers have access to many other buyers of the supplier and can thus affect themselves the supplier's reputation, they can reward good supplier performance, for example, by recommending the supplier to other buyers. Conversely, bad performance can be sanctioned negatively by warning other buyers and thus spoiling the supplier's reputation. Assuming that the supplier is – at least to some degree – aware of the buyer's voice network, this reduces the supplier's temptation for opportunistic behavior through increased long-term benefits of abstaining from opportunism as well as through increased long-term costs of opportunism. Thus, through learning as well as through control, we expect a direct effect of the voice network on the occurrence of ex post problems in the focal transaction.

Hypothesis 5: *The size of the voice network will be negatively related to the occurrence of ex post problems.*

The exit network refers to the buyer's opportunities for purchasing the product or service from an alternative supplier. A larger exit network facilitates switching suppliers. Hence, the buyer becomes less dependent on the supplier and can more easily control the supplier by rewarding good performance in the focal transaction through future business with the supplier and threatening bad performance in the focal transaction with abstaining from future business with the supplier. Again, assuming (some) awareness of the supplier with respect to the buyer's exit network, this reduces the supplier's incentives for opportunism and is thus expected to affect the occurrence of ex post problems in the focal transaction.

Hypothesis 6: *The size of the exit network will be negatively related to the occurrence of ex post problems.*

2.4. HYPOTHESES ON EFFECTS OF CONTRACTUAL GOVERNANCE

Macaulay (1963) characterized contracts as a means of planning a transaction, including specifications of what has to happen under certain

contingencies, and as a means of specifying sanctions that help induce parties to perform. Contractual governance of a transaction may thus reduce problems and increase supplier performance, while contractual governance itself will be affected by transaction characteristics as well as embeddedness characteristics (see Figure 1). We distinguish between two aspects of contractual governance: the effort invested in contracting and the content of the contract, more precisely, an indicator of the completeness of the contract (a complete contract would cover explicitly and unambiguously all contingencies that might arise during and after the transaction; see, e.g., Hart, 1987). We assume that more effort invested in contracting as well as less incompleteness of the contract reduce problems due to external contingencies, reduce coordination problems while executing the transaction, and reduce the supplier's incentives for opportunistic behavior. We thus assume that more contractual planning affects ex post problems in the focal transaction. More specifically, this yields two additional hypotheses.

***Hypothesis 7:** Effort invested in contracting will be negatively related to the occurrence of ex post problems.*

***Hypothesis 8:** Completeness of the contract will be negatively related to the occurrence of ex post problems.*

3. Methods

3.1. DATA AND SAMPLE

We test our hypotheses using survey data on the purchase of IT by Dutch small and medium sized enterprises (SMEs) with 5–200 employees (see Batenburg, 1997a; b; Batenburg and Van de Rijt, 1998 for detailed information on the data). The survey was conducted in two periods. Two samples of IT-transactions have been collected in 1995. An additional sample was collected in 1998. This resulted in a data set with detailed information on 1252 IT-transactions. The data set was not collected exclusively for testing hypotheses on the occurrence of ex post problems. Rather, the aim was to collect a multi-purpose data set for testing hypotheses on how transaction characteristics, embeddedness, and other variables affect ex ante governance of transactions such as supplier selection (e.g., Buskens et al., 2003) and contractual governance (e.g., Batenburg et al., 2003; Buskens, 2002), as well as ex post governance, including conflict resolution (e.g., Rooks and Snijders, 2001).

At the time of data collection, the purchase of IT offered a suitable context and strategic research site for testing hypotheses on ex post problems. IT was rapidly developing. Rapid improvement of hardware

performance and software applications induced considerable uncertainties with respect to price and quality. Also, the market for IT-consultancy and services was characterized by high rates of firms going bankrupt as well as frequent mergers and acquisitions. Thus, the purchase of IT-products and related services often implied considerable risks associated with specific investments and long-term business relations (see, e.g., Schellekens et al., 2000). Given that IT-transactions often involved sizeable risks, problems were likely to occur.

One reason for using data on IT-purchases by SMEs was that these buyers usually lack expertise and resources for the in-house production of IT-products. This makes some of the simplifying assumptions used in our theoretical argument and in our empirical analysis less problematic. Specifically, we can more easily neglect the make or buy-decision and assume the transaction as exogenously given. This at least reduces a selection bias problem. For example, the effect of relation specific investments could be underestimated, because the more risky transactions are managed by vertical integration (Masten, 1996b: 50). Likewise, embeddedness effects could be underestimated if buyers tend to avoid risky transactions with suppliers if the transaction is not well embedded (Buskens, 2002: 156–157). In fact, according to the answers to one of the questions in the survey, less than 5% of the transactions involved IT-products that could have been produced easily by the buyer. Note also that remaining selection bias of the type sketched should work *against* our hypotheses.

The sampling frame for the 1995 survey was a business-to-business database of Dutch SMEs that contained information about the characteristics of these SMEs with respect to automation. The database is known to be far more up to date and reliable than the often used database of the Chamber of Industry and Commerce. At the time of data collection, about 80% of all Dutch SMEs with more than five employees were included in the database. The database could be considered to be representative for the Dutch population of SMEs (see Batenburg, 1997a). Three criteria were used for stratification. First, the sample was stratified according to the number of IT-specialists employed by the firm. The second stratification criterion was the strength of inter-firm relations within certain sectors of industry. Using 21 expert judgements, sectors were divided in three groups: sectors with weak, medium, and strong inter-firm relations. The third stratification criterion was the type of IT-products purchased by a firm. This criterion distinguished four groups of products: standard hardware, complex hardware, standard software, and complex software. The three stratification criteria resulted in a sampling design with 36 ($3 \times 3 \times 4$) cells.

Key informants of buying firms were first briefly interviewed by a structured Computer Assisted Telephone Interview (CATI). In the CATI-interview,

cooperation was asked from an employee responsible for automation in the firm. Most of the key informants were IT-managers of the buying firm. The CATI-interview was then used to randomly select a particular IT-investment the firm had made in the recent past, in order to define beforehand on which transaction the main questionnaire would focus. Usually, the respondents were involved themselves with and often responsible for the purchase.

Following this sampling procedure, a main sample of 547 IT-transactions was obtained. Subsequently, the data set was extended with an additional sample. This additional sample was collected in order to obtain more observations on innovative and complex IT-products. Transactions were sampled from SMEs in sectors that typically use such products. Using judgements of IT-market researchers and figures from Statistics Netherlands, five such sectors were identified (food industry, metal industry, transport equipment, wholesale trade, and road transport). The additional sample was stratified using only the criterion related to the IT-specialists in the buyer's firm. Complex transactions are assumed to be associated with more risks. Therefore, we include both samples in our analyses. Another 241 questionnaires were collected within this additional sample.

From the main sample and the additional sample, data were obtained from 788 (547 + 241) IT-buying firms. About 25% (183 out of 788) of the respondents were willing to fill out a second questionnaire regarding the purchase of a different IT-product, in most cases from a different supplier. In total, the 1995 data set thus consists of 971 (547 + 241 + 183) transactions, of which 183 are second transactions from the same buyer. Respondents were visited by a member of the research team to personally deliver the questionnaire and eventually assist the respondent in filling in the questionnaire. In about 15% (132 out of 788) of the cases, respondents were willing to participate but did not agree with a visit. Questionnaires were then sent to them by mail.

The total response rate equaled 59% in 1995 (see Batenburg, 1997b for details), a high response rate in surveys among organizations (see Kalleberg et al., 1996: chaps. 1–2) in general and specifically in survey research on ex post problems and supplier performance (see the response rates of the studies discussed in the Introduction above). Non-response analysis that was feasible through relatively extensive information on the buyer firms not agreeing to participate in the survey showed that the response group is not biased on crucial firm characteristics such as size, industry, or region. We also know from a question in the CATI-questionnaire that firms in our sample do not differ from the non-response group in their general satisfaction with IT-suppliers (see Batenburg, 1997b for details).

To improve data quality on the cases already collected and to collect data on new transactions, the participating buyer firms were contacted once again in 1998, using CATI. With respect to the transactions from the 1995 study, we wanted to find out whether new problems had come up between 1995 and 1998. Also, firms were asked to participate in a new wave of standard mail questionnaires on a new IT-purchase. This resulted in an additional set of 281 transactions. The joint data set from the 1995 and 1998 surveys thus contains information on 1252 (971 + 281) focal transactions from 788 buyers, a sizeable data set compared to earlier survey research in our field.

3.2. MEASUREMENTS

We now describe operationalizations of the theoretical variables. We first consider our dependent variable: the occurrence of ex post problems. Subsequently, we operationalize transaction characteristics, embeddedness variables, and contractual governance characteristics. We also introduce control variables. Details on the items used for constructing the variables, including Cronbach's α for each set of items, can be found in the Appendix.

3.2.1. *Ex post problems*

The occurrence of ex post problems is measured using detailed data on problems that occurred during and after the focal transaction. In the survey, questions were asked about 11 typical problems that are often associated with IT-transactions (Riesewijk and Warmerdam, 1988). Respondents could indicate for each possible problem if it occurred at all and how serious the problem was. In 72% of the transactions (902 out of 1252) at least one problem occurred at least to a certain degree. The variable EX POST PROBLEMS is derived from the scores on the questions about the occurrence of problems. EX POST PROBLEMS is constructed in such a way that a higher value on the variable indicates that more problems occurred and that problems were more serious. To examine validity, we used additional data from our survey. Buyers were asked to indicate their satisfaction with both the supplier and the product by providing a report mark between 1 and 10 (the scale used for report marks in Dutch schools) for the supplier and the product. Both satisfaction variables correlate strongly and significantly with EX POST PROBLEMS (average correlation coefficient = -0.53 ; $p < 0.001$).

3.2.2. *Transaction-specific investments*

As indicators for transaction-specific investments, we use four questions on different types of switching costs, i.e., costs for the buyer in case the buyer would have to switch to another product. This is in line with other commonly

used measures of specific investments (David and Han, 2004: 49). To check the validity of the measurement, we correlated SWITCHING COSTS with a survey variable measuring the subjectively experienced dependence of the buyer on the supplier. We find a positive and significant correlation between the variables, although the correlation is not particularly high ($r = 0.26$, $p < 0.001$).

3.2.3. Behavioral uncertainty

We use a variable MONITORING PROBLEMS as an indicator for behavioral uncertainty (see David and Han, 2004 for similar measures of uncertainty). The variable is measured using four questions that tap into the buyer's difficulties to assess the quality of the product at the time of delivery, to compare tenders, to compare the product with alternative products, and to compare the price-quality relation of potential suppliers.

3.2.4. Dyadic embeddedness

The survey included a question whether there were previous transactions of the buyer with the same supplier. 52% of the transactions (654 out of 1252) were transactions such that the buyer had done business previously with the supplier. For these cases, buyers were subsequently asked about satisfaction with those previous transactions. This indicator is used to construct a dummy variable SATISFACTION, indicating whether the buyer was satisfied or less than satisfied with previous business with the supplier (1 = satisfied with previous business). Thus, following Granovetter (1985: 486), our measure accounts for the content and history of the relation. A problem for the test of Hypothesis 3 is that our variable SATISFACTION is meaningful only when a common past with the supplier exists. In the analysis, we account for this problem by constructing a new variable SATISFACTION* that results from multiplying SATISFACTION with PAST, a dummy variable measuring whether or not previous business exists (1 = previous business exists). Hence, SATISFACTION* equals zero when there were no previous transactions between buyer and supplier and is equal to the value of the original variable SATISFACTION otherwise. Formally, SATISFACTION* can be interpreted as an interaction variable SATISFACTION \times PAST.

Our questionnaire included a question if the buyer expected, before the focal transaction was executed, future transactions with the supplier. Respondents could choose between five response categories (ranging from "no expectation of future transactions" to "very regular and/or very sizeable future transactions were expected"). We use the score of the buyer on this question for the construction of the variable EXPECTED FUTURE. Note that the measurement of this variable is not without problems (see Buskens,

2002: 135–136; Batenburg et al., 2003: 168). The respondent had to recall an expectation, often from a number of years ago (an average transaction took place around 1992 for the 1995 sample and around 1996/7 for the 1998 sample). The accuracy of answers to such retrospective questions on attitudes rather than behavior is likely to be doubtful (Bernard et al., 1985). However, no better measurement is available and we thus use this variable in our analyses.

3.2.5. *Network embeddedness*

The voice network refers to the buyer's opportunities for collecting and circulating information about the supplier. We employ three indicators for the voice network, one "local" and two "global" network characteristics (see Buskens, 2002: chaps. 2 and 5 for a detailed discussion). The local indicator is a characteristic of the ego-centered network of the buyer, namely, the degree of the buyer in the sense of the number of other buyers of the supplier whom the buyer in the focal transaction knows. The questionnaire includes a question directly measuring the number of those other buyers. The variable *DEGREE* is based on that question. Second, as a global network characteristic, we use an indicator for the density of contacts between firms in the buyer's sector of industry. This indicator is based on judgments of 21 experts. The experts provided estimates for 35 sectors on information exchange between the firms in a sector through business contacts as well as informal contacts between the firms. The variable *SECTOR DENSITY* is based on these judgments. As a third indicator for the voice network, we employ the answer to a survey question on the visibility of the supplier in the market. The variable *VISIBILITY* represents the score of the buyer on this question.

Note that we employ measures from different sources as indicators for the voice network, thus reducing common method variance problems with respect to one of our core variables (Podsakoff et al., 2003: 897–898; Podsakoff and Organ, 1986: 542). Note also that our global network characteristics *SECTOR DENSITY* and *VISIBILITY* indicate a supplier's "generalized reputation" (Uzzi, 1996: 680) rather than more "fine-grained information transfer" (Uzzi, 1997: 45–46) between two buyers of the same supplier that is captured by our *DEGREE* variable. One might thus conjecture that the local network characteristic has a stronger effect on the occurrence of ex post problems.

The buyer's exit network depends on the buyer's opportunities to purchase a similar product or service from an alternative supplier. The questionnaire comprised two questions that can be used as indicators for the exit network, namely, a question about the number of potential suppliers for the product and a question about the number of alternative products. The

variable EXIT NETWORK is constructed as the mean value of the two scores on these questions.

3.2.6. *Contractual governance*

Effort invested in contractual governance of the focal transaction is measured as the natural logarithm of the number of person-days invested in negotiating with the supplier and designing, drafting, and signing an agreement. The estimate provided by the respondent is used as the variable EFFORT.

The questionnaire contained a list of 24 legal and financial items that can be arranged in contracts for IT-transactions. These items were chosen in consultation with specialized lawyers and IT-experts. The list covers typical issues addressed in contracts for IT-transactions. Respondents provided information on whether each item was arranged in a written contract, only verbally, or not at all. The variable COMPLETENESS is constructed as the sum of the scores on the 24 contract items.

3.2.7. *Control variables*

To control for confounding effects of product characteristics we included two dummy variables: a dummy variable TAILOR SOFTWARE indicating whether the product includes tailor-made software (1 = yes), and a dummy variable TAILOR HARDWARE indicating whether the product includes tailor-made hardware (1 = yes). Our data set contains a relatively small number of transactions involving tailor-made hardware ($n = 30$) but a relatively high number of transactions involving tailor-made software ($n = 398$). To control for the volume of the transaction, we include the financial VOLUME of the transaction. To control for possible effects of the size of the two firms involved in the transaction, we include two size-variables in our analyses, SIZE BUYER and SIZE SUPPLIER. Since data collection took place in 1995 and in 1998, we also control for possible period effects, using a dummy variable PERIOD (1 = data collected in 1998). Table I provides an overview of our variables, including bivariate correlations.

Our dependent variable and most of our independent variables are based on responses obtained from a key respondent (an important exception being our variables representing the voice network). Therefore, a common method variance problem may be suspected to arise. To address this problem, we carried out a series of Harman's single-factor tests (see Podsakoff et al., 2003: 889 for a discussion of this approach and its limitations). We thus explored whether a single factor emerges from a factor analysis or one general factor accounting for most of the covariance among our measures. First, we included all the variables measured by means of key respondents' self-reports into a factor analysis. No general factor was apparent in the unrotated factor

Table 1. Means, standard deviations, and correlations

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1. EX POST PROBL.	18.33	7.81																	
2. SWITCH. COSTS	-0.01	1.54	.30***																
3. MONIT. PROBL.	0.03	1.66	.39***	.34***															
4. PAST	0.53	0.50	-.15***	-.13***	-.24***														
5. SATISFACTION	0.74	0.44	-.24***	-.07~	-.07~	n.a.													
6. EXPECT. FUTURE	2.89	1.32	.01	.00	-.10***	.38***	.11**												
7. DEGREE	2.31	5.30	-.04	.10***	-.04	.14***	.03	.17***											
8. SECTOR DENSITY	1.88	0.79	-.09***	-.05~	-.00	.03	.13***	.00	.07*										
9. VISIBILITY	2.91	0.86	-.06*	.08**	-.01	.17***	.04	.18***	.12***	.02									
10. EXIT NETWORK	2.70	0.97	-.23***	-.24***	-.21***	.08**	.03	-.12***	-.10***	-.01	-.07*								
11. EFFORT	1.10	0.73	.22***	.33***	.26***	-.12**	-.05	-.08**	.08**	-.04	.04	-.18***							
12. COMPLETENESS	22.43	12.35	.21***	.33***	.24***	-.11***	.00	-.02	.09**	-.05	.09***	-.18***	.33***						
13. TAIL. SOFTW.	0.32	0.47	.32***	.25***	.22***	-.11***	-.06	.02	.01	-.04	-.09***	-.19***	.21***	.21***					
14. TAIL. HARDW.	0.02	0.15	.00	.04	.03	.02	-.01	-.02	.03	-.02	.03	.06*	.09**	.08**	-.11***				
15. VOLUME	0.89	1.07	.23***	.36***	.28***	-.08**	.05	-.02	.10***	-.02	.13***	-.21***	.43***	.34***	.23***	.07*			
16. SIZE BUYER	82.64	242.50	.06~	.05~	.02	-.01	-.01	.02	.01	-.03	.09**	-.04	.15***	.06*	.04	-.01	.20***		
17. SIZE SUPPLIER	3.36	1.41	.03	.17***	.07*	.09**	-.02	.09**	.13***	.06*	.38***	-.12***	.15***	.24***	.00	.05~	.31***	.12***	
18. PERIOD	0.22	0.42	-.03	-.08**	-.19***	.16***	-.01	.14***	.21***	.01	.00	.05~	-.06*	-.06*	-.03	-.10***	-.01	.06*	

*** = $p < .001$; ** = $p < .01$; * = $p < .05$; ~ = $p < .10$

structure. Next, we restricted the factor analysis to variables like **MONITORING PROBLEMS** that are based on more subjective cognitions, excluding more objective variables like **VOLUME**, assuming that self-report bias such as due to a consistency motif would increase the likelihood of a general factor emerging in an analysis on this reduced set of variables. Again, we found no general factor in the unrotated factor structure. While this is no final proof that our measures are free of common method variance, we at least do not detect positive evidence for the presence of a common method variance problem.

4. Results

4.1. ANALYTICAL STRATEGY

Statistical analyses are hampered because the two variables representing contractual governance of a transaction, **EFFORT** and **COMPLETENESS**, are expected not only to affect our dependent variable **EX POST PROBLEMS**, but are also expected to be themselves affected by transaction characteristics and embeddedness. Hence, **EFFORT** and **COMPLETENESS** are endogenous variables. This may cause statistical problems because effects of transaction characteristics and embeddedness on the occurrence of ex post problems cannot be separated from effects of contractual governance. Furthermore, the variables representing contractual governance and the error terms covary, thus violating a basic assumption of the classical regression model. As a consequence, least squares estimators of effects of contractual governance are inconsistent (Greene, 1997: 288, 738; see Masten, 1996b for a general discussion of such problems in empirical applications and tests of transaction cost theory). We attempt to solve these problems by employing an instrumental variables approach (Greene, 1997: 288–295, 738–759). A variable can serve as an instrument if the variable correlates with contractual governance, while not correlating with the occurrence of ex post problems (see, for example, Pindyck and Rubinfeld, 1991: chap. 7). We searched for instrumental variables by focusing on indicators from our survey for the buyer's marginal costs of contractual governance of a transaction. Such variables can be expected to have a direct effect on **EFFORT** and **COMPLETENESS**, while one would not expect a direct effect on **EX POST PROBLEMS**. We found three variables that satisfy the requirements to serve as an instrumental variable. First, we use a dummy variable that indicates whether the contract has been designed primarily by the buyer or by the supplier (**CONTRACT SUPPLIER**). If the supplier provided the contract, less effort for contractual governance is required from the buyer. A second dummy variable indicates whether the buyer firm has an in-house legal department (**LEGAL DEPARTMENT**). Finally, we use a dummy variable

indicating whether the buyer firm has employees with specific legal expertise (LEGAL EXPERTISE). The size of the tetrachoric correlations between the instruments is very small or moderate (between 0.00 and 0.36), indicating distinct measurements.

For estimation, we employ a simultaneous equation estimation using a three-stage least squares method (Greene, 1997). This method uses instrumental variables to produce consistent estimates and generalized least squares to account for correlation in the disturbances across equations. In the first stage of this procedure, a regression equation is estimated with the variables representing contractual governance as dependent variables and independent variables that include our instrumental variables as well as transaction characteristics and embeddedness characteristics. In the second stage, a consistent estimate of the covariance matrix of the equation disturbances is produced. Estimates are obtained from the residuals produced from a two-stage least squares estimation of each structural equation. In stage 3, the covariance matrix of stage 2 and the predicted values of stage 1 are then used in the regression of the occurrence of ex post problems.

It is important to note the nested structure of our data. Some buyers are included in the sample with more than one transaction. Also, some suppliers are involved in more than one transaction. A multilevel analysis with transactions nested in buyers reveals a sizeable proportion of the total variance on the level of the buyer. For the suppliers, multilevel analysis reveals no evidence for clustering of the data. We checked whether this nested structure of the data affects results by comparing the results of our three-stage least squares estimation with the results of a two-stage least squares estimation. Two-stage least squares estimation does not include stage 2 of the three-stage least squares procedure and is less efficient (Greene, 1997), but the Stata implementation (StataCorp, 2003) allows for a robust estimator of variance (Huber, 1967; Rogers, 1993). The results of the two-stage least squares estimation do not differ substantially from the three-stage least squares results.

4.2. HYPOTHESES TESTING

Table II presents the results of the three-stage least squares regression analysis. Two models are presented. Model 1 includes all variables, except for the interaction variable SATISFACTION*, which is included in Model 2. In the remainder of this section we successively discuss the results concerning effects of transaction characteristics, embeddedness, and contractual governance. We then present exploratory analyses comparing the strength of the effects of different kinds of variables and briefly discuss the effects of control variables as well as the results of regression diagnostics.

Table II. Three-stage least squares regression analysis of EX POST PROBLEMS (1205 transactions of 775 buyers)

Variable	Hypothesis	Model 1	Model 2
Transaction characteristics			
SWITCHING COSTS	+	0.110* (0.066)	0.090~ (0.060)
MONITORING PROBLEMS	+	0.275*** (0.041)	0.263*** (0.042)
Embeddedness characteristics			
PAST	?	-0.042 (0.033)	-0.045~ (0.033)
SATISFACTION*	-		-0.206*** (0.038)
EXPECTED FUTURE	-	0.054~ (0.031)	0.066* (0.032)
DEGREE	-	-0.063* (0.035)	-0.059* (0.035)
SECTOR DENSITY	-	-0.068** (0.029)	-0.055* (0.029)
VISIBILITY	-	-0.052* (0.028)	-0.054* (0.028)
EXIT NETWORK	-	-0.088** (0.034)	-0.085** (0.034)
Contractual governance			
EFFORT	-	-0.007 (0.197)	-0.060 (0.196)
COMPLETENESS	-	0.083 (0.286)	0.178 (0.289)
Control variables			
TAILOR SOFTWARE	?	0.188*** (0.043)	0.178*** (0.043)
TAILOR HARDWARE	?	0.013 (0.035)	0.009 (0.035)
VOLUME	?	0.034 (0.074)	0.051 (0.073)
SIZE BUYER	?	0.062 (0.034)	0.065~ (0.034)
SIZE SUPPLIER	?	-0.039 (0.049)	-0.058 (0.050)
PERIOD	?	0.078** (0.030)	0.069* (0.030)
CONSTANT		-0.007	-0.013
R^2		0.259	0.263

*** $p < .001$; ** $p < .01$; * $p < .05$; ~ $p < .10$; one-tailed tests. Standard errors between parentheses. All variables except the instrumented variables are standardized. R^2 is mentioned for completeness, though the measure has no statistical meaning in three-stage least squares regression (Sribney et al., 2003).

4.2.1. Transaction characteristics

In both models, the variable SWITCHING COSTS has a positive and significant effect on EX POST PROBLEMS. Hence, the results support Hypothesis 1. Hypothesis 2 states that monitoring problems will be positively related to the occurrence of ex post problems. Our data support this hypothesis: the variable MONITORING PROBLEMS has a highly significant and substantial positive effect on EX POST PROBLEMS.

4.2.2. *Dyadic embeddedness*

Our results for Model 2 clearly support Hypothesis 3: the more successful – in the sense of buyer satisfaction – previous transactions of the buyer with the supplier from the focal transaction have been, the less ex post problems occur in the focal transaction.

The variable EXPECTED FUTURE has no significant negative effect on EX POST PROBLEMS. The effect of EXPECTED FUTURE is even significantly positive, thus refuting Hypothesis 4. A possible explanation could be as follows. As described in the measurement section, our variable EXPECTED FUTURE is based on the buyer's expectation of future business with the supplier. It is conceivable that the buyer expects future business with the supplier because of one-sided dependency of the buyer on the supplier. As has been argued above, such unilateral dependency provides incentives for opportunistic behavior of the supplier and would thus increase the occurrence of ex post problems (Provan and Skinner, 1989). We can test this using a subjective assessment of the one-sided dependency of the buyer that was included as a question in the questionnaire. When including this measure of unilateral dependence in the regression model (analysis not reported here) the absolute size of the coefficient of EXPECTED FUTURE indeed drops significantly (we calculated the significance using the Stata module *suest*, see Weesie, 1999). We can also test our explanation for the refutation of Hypothesis 4 by eliminating the variables SWITCHING COSTS and EXIT NETWORK in the regression equation. Since these two variables likewise indicate unilateral dependence, we would expect that the absolute size of the coefficient of EXPECTED FUTURE would increase. We do indeed find such an increase (analysis not reported here). It thus seems that our EXPECTED FUTURE variable is not a valid measure of the buyer's opportunities for future rewards of good performance of the supplier while executing the focal transaction and for negative sanctions of current bad performance of the supplier.

4.2.3. *Network embeddedness*

We find quite some support for our hypotheses on negative effects of network embeddedness on the occurrence of ex post problems. First, consider the effects of the voice network. The effect of DEGREE is negative and significant: the more other buyers of the supplier our focal buyer knows, the less ex post problems the buyer experiences. The effect of SECTOR DENSITY is likewise negative and significant: more information exchange between firms in the industry sector of the buyer is related to less ex post problems. Finally, the effect of VISIBILITY is negative and significant: the more visible the supplier is in the market, the less ex post problems the buyer experiences.

Using the Stata implementation of Wald tests for simple and composite linear hypotheses reveals that the effects of the variables *DEGREE*, *SECTOR DENSITY*, and *VISIBILITY* simultaneously differ from zero with a high significance level ($p < 0.005$). Our results are robust in the sense that they do not depend on whether we employ measures based on reports from key respondents in our survey or independent measures based on expert judgments. Hence, our results consistently support Hypothesis 5. Note also that a Wald test provides no support for the conjecture that *DEGREE* as a fine-grained measure of information transfer has a stronger effect on *EX POST PROBLEMS* than the variables *SECTOR DENSITY* or *VISIBILITY* that indicate generalized reputation.

We find similar results for the effect of the exit network. The effect of *EXIT NETWORK* is negative and significant: the more alternative suppliers or alternative products for the buyer, the less ex post problems occur. Hypothesis 6 is thus supported by our data as well.

4.2.4. *Contractual governance*

Perhaps surprisingly, our results reveal no relationship between contractual governance and the occurrence of ex post problems in the sense that neither *EFFORT* nor *COMPLETENESS* has a significant effect on *EX POST PROBLEMS*. Hence, Hypotheses 7 and 8 are not supported. Of course, one could imagine that *other* features of contractual governance do affect the occurrence of ex post problems. Our data set comprises additional information on contractual governance. We were therefore able to explore this issue in some directions. First, our questionnaire elicited information on whether legal and financial issues associated with the transaction were arranged at all and, if so, only verbally or in a written contract. We could thus also check for effects of contracts that are more explicit in the sense that legal and financial issues are arranged in writing. Again, in various analyses we could not find an effect on the occurrence of ex post problems. Second, we know how much attention was drawn to each legal and financial issue during negotiations. Employing weights for legal and financial issues that account for the amount of attention does not affect our results. Finally, one could imagine that the kind of contract used would explain the absence of effects of contractual governance. More precisely, one could argue that if a standard contract is used, the number of clauses does not necessary reflect the quality of contractual governance (see Macaulay, 1963). To control for this, we included in the regression model in analyses not reported here an interaction of *COMPLETENESS* with a dummy variable indicating whether the contract was tailor-made or standard. However, this interaction is far from significant.

4.3. ADDITIONAL ANALYSES

4.3.1. *A comparative analysis of the strength of effects of embeddedness characteristics and contractual planning*

Our hypotheses predict the sign of the effects of different variables on EX POST PROBLEMS rather than the strength of those effects. An exploratory analysis of effect strengths is revealing, though. Specifically, such an analysis can contribute to a comparative assessment of contractual governance on the one hand and non-contractual governance that becomes feasible through embeddedness on the other.

While all other variables in Table II, including the dependent variable, are standardized, the instrumented variables are themselves not standardized. This complicates the comparison of the size of coefficients. To account for this complication, we carried out additional analyses. First, we performed an ordinary least squares (OLS) regression analysis of our contractual planning variables on the instruments and all the exogenous variables. We then standardized the predicted instrumented variables and used them with all other standardized exogenous variables in an OLS regression of the standardized variable EX POST PROBLEMS. This yields a standardized solution allowing for a comparison of the size of coefficients. The results of this procedure do not differ from the results based on the analysis in Table II.

First, it is useful to note that the effect of SATISFACTION* on EX POST PROBLEMS is in the same order as the effect of MONITORING PROBLEMS and larger than the effect of SWITCHING COSTS. It is thus not the case that the effects of transaction characteristics are generally larger than embeddedness effects. Second, a Wald test reveals that the combined effect of the variables representing network embeddedness does not differ significantly from the effect of SATISFACTION*. This does not support conjectures sometimes found in the literature that dyadic embeddedness effects will outperform effects of network effects, for example, because first-hand information from dyadic embeddedness is more reliable than third-party information one receives through networks (see Lorenz, 1988; Raub and Weesie, 1990; Williamson, 1996: 153–155; Buskens, 2002: 18–20 for more detailed discussions). Finally, consider a comparative assessment of the effects of contractual and non-contractual governance through embeddedness. Table II shows that contractual governance has no effect on EX POST PROBLEMS. SATISFACTION* as well as network embeddedness characteristics reduce the occurrence of ex post problems. On the other hand, expected future business is associated with more ex post problems. The effect of EXPECTED FUTURE is, however, more than outweighed by the effects of the other embeddedness variables. A Wald test shows that the combined effect of the embeddedness variables on EX POST PROBLEMS is clearly

negative, with a high significance level ($p < 0.0001$). In this sense, non-contractual governance based on embeddedness outperforms contractual governance when it comes to the prevention of ex post problems.

4.3.2. *Control variables*

Our results show that the occurrence of ex post problems decreases for tailor-made software, while tailor-made hardware has no such effect. Transaction volume also has no significant effect. While the size of the supplier has no significant effect, the size of the buyer has a significantly positive effect on EX POST PROBLEMS. The period in which the survey was conducted also has a significant effect: compared to 1995, more ex post problems occur on average in transactions on which data have been collected in 1998.

4.3.3. *Regression diagnostics*

We controlled for interaction effects between our independent variables, for effects of heteroscedasticity, for multicollinearity, and for outlier effects. An exploratory control for interaction effects shows hardly any significant effects, while our main effects remain robust. Heteroscedasticity means that residuals differ in their variance, hampering the estimation of standard errors. Using White's test reveals indeed heteroscedasticity. Employing Szroeter's (1978) Q-statistic, we find that mainly transaction characteristics induce heteroscedasticity. We modeled heteroscedasticity and found hardly any differences with the results from the three-stage least squares regression. Inspection of the bivariate correlations between the independent variables and of the (co)variance matrix of the estimated coefficients does not reveal serious problems of multicollinearity. Finally, outlier analyses reveal approximately 50 observations with a relatively large standardized residual. Deleting these cases from the analyses does not produce relevant differences in our results.

5. Discussion and conclusion

In this paper, we studied ex post features of the governance of inter-firm relations. Specifically, we studied the occurrence of ex post problems in buyer-supplier transactions. Using transaction cost theory and theory on embeddedness effects in economic exchange, we focused on effects of transaction characteristics, on effects of dyadic as well as network embeddedness of exchange, and on effects of contractual governance. We tested hypotheses using a sizeable and rich data set on the purchase of IT-products by Dutch SMEs. We found evidence for hypothesized effects of transaction characteristics as well as embeddedness. Notably, our data do not support

hypotheses on effects of contractual governance on the occurrence of ex post problems. Non-contractual governance based on embeddedness thus seems to outperform contractual governance as a mechanism of preventing problems during and after the execution of a transaction.

A distinct contribution of our study is the inclusion of effects of network embeddedness on ex post problems in the analysis. We distinguished two types of network embeddedness, namely, the buyer's network of contacts with other clients of the supplier (voice network) and the buyer's network of (alternative) suppliers (exit network). Our data provide consistent support for hypotheses on effects of network embeddedness.

Several suggestions for future research emerge from our results. Obviously, the lack of effects of various variables representing contractual governance merits attention. Puzzling evidence of the type reported here, namely, that quite some characteristics of contractual governance do not affect the occurrence of ex post problems, could inspire analyses that proceed from assumptions on various mechanisms how contractual governance can undermine "informal" bases of supplier performance such as "trust" (see, e.g., Malhotra and Murnighan, 2002 for work in this direction). An open question is then, of course, why firms engage in costly contractual governance, seemingly not anticipating on the lack of effects on the occurrence of ex post problems. Another approach would be to focus on substitution effects versus complementarities between contractual governance on the one hand and non-contractual, relational governance based on dyadic and network embeddedness on the other hand (see, e.g., Poppo and Zenger, 2002 for work in this direction).

A further problem for future research is related to effects of dyadic embeddedness and derives from the lack of empirical support for the hypothesis that expected future transactions should reduce the occurrence of ex post problems. We found some evidence that this result could be due to measurement problems. First, one would be interested in improved measurements that circumvent the problem of asking retrospective questions on expected future business. This presumably calls for prospective research designs that are, unfortunately, not easy to implement in empirical research on inter-firm relations. Second, one would be interested in measurements that allow to disentangle expectations of future business that result from one-sided dependence of the buyer on the supplier from expectations of future business that are (more) conditional on the suppliers present behavior and performance, since the prediction of negative effects of expected future business on the occurrence of ex post problems is based on the latter type of expectations.

Our results on effects of network embeddedness may also encourage more detailed studies. For example, while the effect of being embedded in an exit

network can be plausibly interpreted as a control effect of embeddedness, the effect of being embedded in a voice network can be interpreted as a learning effect as well as a control effect of embeddedness. It would thus be useful to develop and implement research designs that allow to disentangle learning and control effects (see Buskens and Raub, 2002 for such designs).

Finally, a major practical implication for purchase management follows from our findings on effects of embeddedness and specifically of network embeddedness on the occurrence of ex post problems. Typically, advice on purchase management and common benchmarking practices focus on transaction and supplier characteristics and aim at legal features of contractual governance (Leenders and Fearon, 1993). Empirically, this is reflected in strong opinions of purchasing professionals. They feel (see Tazelaar and Snijders, 2004 for a study of purchasing experts' predictions on the occurrence of ex post problems in IT-transactions) that the degree of detail of the written contract is one of the most important predictors for the occurrence of ex post problems. Conversely, purchasing professionals believe that characteristics related to network embeddedness such as the supplier's reputation (which is similar to our VISIBILITY variable) is only moderately important for predicting ex post problems, while they feel that knowing other clients of the supplier (in fact, this is our variable DEGREE) is one of the least important predictors of ex post problems. Our findings suggest, however, that buyers aiming at optimizing their purchase management should take network embeddedness explicitly into account, anticipating on the effects of network embeddedness on the occurrence of ex post problems. More than before they should recognize that enhancing own network embeddedness through contacts with other firms as well as accumulating knowledge about the supplier's network and the supplier's current and past performance within this network in an earlier stage of search and selection can help economizing on costly contractual governance and can help reducing ex post problems.

Given that network embeddedness seems to reduce ex post problems, it follows that buyers have an incentive to take their network embeddedness not as given but to actively invest in such network embeddedness. This would imply that embeddedness is no longer conceptualized as exogenous but that embeddedness characteristics are conceived as endogenous variables. Conceptualizing network embeddedness as social capital, Flap (2004) offers a theoretical perspective that combines the idea of networks providing returns to actors with a focus on how actors invest in such networks. Dutta and Jackson (2003) provide a sample of the rapidly expanding literature on formal models of strategic network formation that can be used to endogenize embeddedness. Finally, Snijders (2001) develops statistical models for the analysis of network dynamics that nicely correspond to the basic idea that

network dynamics result from instrumental behavior of actors who invest in their embeddedness.

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Appendix: Variable Construction

In the following, “product” refers to the focal transaction.

EX POST PROBLEMS (11-item measure): *Original questions*: These are possible problems associated with purchasing such products and with service. To what degree did you experience each of these problems? Delivery delay – exceeding of price/budget – product incomplete – product too slow/limited – deviation from agreed upon specifications – incompatibility with other IT-products – installation too quick/careless – insufficient support – service too slow/too late – updates too slow/too late – documentation incomplete/unclear. *Answer categories per item* (5-point scale): problem did not occur at all (= 1) – hardly (= 2) – to a certain degree (= 3) – to a high degree (= 4) – to a very high degree (= 5). *Variable construction*: EX POST PROBLEMS is the sum of the 11 items on problems. Cronbach’s $\alpha = .90$. Note: Using factor scores for constructing an alternative EX POST PROBLEMS-variable does not affect our results (analyses not reported here). Both constructs correlate highly ($r = 0.998$).

SWITCHING COSTS (4-item measure): *Original questions* [variable construction label]: Assume that the product had failed to function and had had to be replaced. What would have been the damage, in terms of time and money, associated with: purchasing another product [new product] – training of personnel [training] – new data entry [data entry] – idle production [idle production]. *Answer categories per item* (5-point scale): minimal (= 1) – small (= 2) – moderate (= 3) – large (= 4) – very large (= 5). *Variable construction*: SWITCHING COSTS is the main principal component of the 4 items mentioned (eigenvalue first component 2.38, second component 0.67). SWITCHING COSTS = $.52[\text{new product}] + .52[\text{training}] + .50[\text{data entry}] + .45[\text{idle production}]$. Cronbach’s $\alpha = 0.77$.

MONITORING PROBLEMS (4-item measure): *Original questions* [variable construction label]: Was it difficult for you and your employees to judge the quality of the product at the time of delivery? [quality] – Was it difficult for your firm to compare tenders? [tenders] – Was it difficult for your firm to compare the product with other products? [other products] – Was it difficult for your firm to compare the price-quality relation of potential suppliers? [price-quality]. *Answer categories per item* (5-point scale): very easy (=1) – easy (=2) – somewhat difficult (=3) – difficult (=4) – very difficult (=5). *Variable construction*: MONITORING PROBLEMS is the main principal component of the 4 items mentioned (eigenvalue first component 2.02, second component 0.53). MONITORING PROBLEMS = .41[quality] + .51[tenders] + .54[other products] + .53[price-quality]. Cronbach's $\alpha = 0.83$.

PAST (single-item measure): *Original question*: Has your firm had any kind of business relation with this supplier before the purchase of this product? *Answer categories*: no (=0) – yes (=1). *Variable construction*: PAST is a dummy variable using the score on this question.

SATISFACTION (single-item measure): *Original question*: How satisfied was your firm with previous business with the supplier? *Answer categories* (5-point scale): very unsatisfied – unsatisfied – moderately satisfied – satisfied – very satisfied. *Variable construction*: SATISFACTION is a dummy variable with 1 = satisfied or very satisfied, and 0 = very unsatisfied, unsatisfied, or moderately satisfied. Note: We constructed a dummy variable because the distribution of the answers is bimodal.

EXPECTED FUTURE (single-item measure): *Original question*: To what extent did you expect, before the purchase of this product, that your firm would continue business with this supplier? *Answer categories* (5-point scale): no business (=1) – incidental business of limited size (=2) – some business of limited size (=3) – regular and/or extensive business (=4) – very regular and/or very extensive business (=5). *Variable construction*: EXPECTED FUTURE is the score of the chosen answer category.

DEGREE (single-item measure): *Original question*: Please think about other firms that have (likely) been clients of the supplier at the time of the purchase of the product. How many of such firms did you know? *Open answer category*: number of firms. *Variable construction*: DEGREE = number of firms mentioned by respondent (with a maximum of 7 to account for outlier-effects).

SECTOR DENSITY: This variable is based on judgments of 21 experts (see Rooks, 2002: 139–142 for a detailed discussion). These experts provided estimates for 35 sectors of industry with respect to contacts and information exchange between firms in the respective sector. Sectors were defined employing the classification used by Statistics Netherlands. The experts were

asked to consider business contacts as well as informal contacts. They were also asked to consider the number of contacts as well as the frequency, intensity, and reliability of information exchange through these contacts. Based on these expert judgments, we distinguish three categories with respect to SECTOR DENSITY: weak (= 1) – medium (= 2) – strong (= 3).

VISIBILITY (single-item measure): *Original question*: How visible was the supplier in the market before the purchase of the product? Consider visibility through the media, through fairs, as well as through business with other firms you are in contact with or through business with your own clients. *Answer categories* (5-point scale): not at all visible (= 1) – hardly visible (= 2) – reasonably visible (= 3) – visible (= 4) – very visible (= 5). *Variable construction*: VISIBILITY is the score of the chosen answer category.

EXIT NETWORK (2-item measure): *Original questions*: Considering the situation before purchasing the product, how large was the number of potential suppliers? – Considering the situation before purchasing the product, how large was the number of alternatives for the product? *Answer categories per item* (5-point scale): minimal (= 1) – small (= 2) – reasonable (= 3) – large (= 4) – very large (= 5). *Variable construction*: EXIT NETWORK is the mean value of the scores on the two questions. Correlation between the scores: $r = 0.58, p < 0.001$. Cronbach's $\alpha = .74$.

EFFORT (single-item measure): *Original question*: How much time did you and your colleagues spend): on writing down the agreement and on the negotiations with the supplier of this product? *Open answer category*: number of person-days. *Variable construction*: EFFORT = natural logarithm of the number of person-days mentioned by respondent.

COMPLETENESS (24-item measure): *Original questions*. For each of the following financial and legal clauses, can you indicate how they were arranged? Price determination – price level – price changes – payment terms – sanctions on late payment – delivery time – liability supplier – force majeure – warranties supplier – quality (norms) – intellectual property (escrow) – piracy protection – restrictions on product use – non-disclosure – insurance supplier – duration service – reservation spare-parts – duration maintenance – updating – arbitration – calculation R&D costs – joint management during transaction – technical specifications – termination. *Answer categories per item* (3-point scale): not arranged at all (= 0) – only verbally arranged (= 1) – written arrangement (= 2). *Variable construction*: COMPLETENESS = sum of the scores on the 24 items. A non-parametric item response analysis for polytomous items (Mokken analysis) reveals that the contract items together form one scale. None of the items has a Loevinger's H smaller than 0.30 and the overall scale coefficient equals 0.51, which is indicative of a strong scale (see Mokken, 1970).

TAILOR SOFTWARE (3-item measure): The questionnaire included questions on what the product included. Among other things, the respondent was asked if the product included adjusted software and/or tailor made software and/or industry-specific software. **TAILOR SOFTWARE** is a dummy variable with 1 = product includes adjusted software and/or tailor made software and/or industry-specific software and 0 = otherwise.

TAILOR HARDWARE (4-item measure): The respondent was likewise asked if the product included the design of hardware. **TAILOR HARDWARE** is a dummy variable with 1 = product includes design of hardware and **TAILOR SOFTWARE** = 0, while **TAILOR HARDWARE** = 0 otherwise.

VOLUME (single-item measure): *Original question:* How much was paid to the supplier, not including later supplements? *Answer categories* (5-point scale): up to 10,000 US\$ (midpoint = 0.125) – 10,000–20,000 US\$ (midpoint = 0.375) – 20,000–50,000 US\$ (midpoint = 0.75) – 50,000–100,000 US\$ (midpoint = 1.5) – more than 100,000 US\$ (midpoint = 3.5). *Variable construction:* **VOLUME** is the midpoint of the chosen answer category, with midpoints of the price classes expressed in NLG (1 US\$ = 2.5 NLG at the time of data collection) divided by 100,000 and using an estimate for the highest category that does not have an upperbound.

SIZE BUYER (single-item measure): *Original question:* How many full-time employees were working at your firm at the time of the purchase of this product? *Open answer category:* number of full-time employees. *Variable construction:* **SIZE BUYER** = natural logarithm of the score on this question.

SIZE SUPPLIER (single-item measure): *Original question:* How many employees were working at the supplier at the time of the purchase of this product? *Answer categories* (5-point scale): less than 5 (= 1) – 5–9 (= 2) – 10–19 (= 3) – 20–49 (= 4) – 50 or more (= 5). *Variable construction:* **SIZE SUPPLIER** is the score of the chosen answer category.

PERIOD: Dummy variable with 0 = data collected in 1995 and 1 = data collected in 1998.

CONTRACT SUPPLIER: Dummy variable with 1 = contract designed by supplier and 0 = otherwise.

LEGAL DEPARTMENT: Dummy variable with 1 = buyer has an in-house legal department and 0 = otherwise.

LEGAL EXPERTISE: Dummy variable with 1 = buyer has employees with legal expertise and 0 = otherwise.

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