Social Capital, Reputation and Contract Design in Buyer-Supplier Networks

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Abstract

Prior research on inter-firm contracting has identified the ideal governance mode to be either Formal' or 'Relational' governance modes. However, both streams of literature rely on stringent assumptions about the cost of breaching contractual obligations and the mechanism of enforcement. We propose an embeddedness-based governance logic by examining an inter-organizational network of exchange partners. The buyer-seller network acts as a conduit for market actors to exchange information about exchange opportunities as well as the actual services traded, providing a mechanism for community enforcement. A firm's social capital in the network could assuage concerns about opportunism whereby a firm can maintain a reputation for performance. A firm's position in the network also acts as a signal of its ability and quality to agents beyond the dyad. We analyze a large dataset of public information technology (IT) outsourcing announcements using multi-way cluster-robust and network auto-regression techniques. We examine the impact of firms' position in the inter-organizational network on an important contract design element, the duration of contracts. We find that a network position whereby a firm is associated with central trading partners is likely to predict longer contract duration. We find that this relationship holds even after controlling for a number of alternate causal explanations. Implications for practitioners and research are discussed.

Keywords: Social Capital, Reputation, IT Outsourcing, Contract Design

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INTRODUCTION

A rich tradition of inquiry in economics and strategy debates the scale and scope of the firm. The rise of vertical de-integration and outsourcing of complex products and services (Linder et al. 2003, Miozzo and Grimshaw 2005) calls for a renewed assessment of these questions. High technology industries, in particular, are increasingly characterized by a braiding of explicit and implicit obligations enmeshed within a formal structure of exchange, in a manner that can be described neither as arm's length arrangements nor relational contracting (Gilson et al. 2009). Such networked structures (Powell 1990) are a marked departure from the fundamental transformation predicted by transaction cost economics (Williamson 1985), wherein bilateral trading partners insulate themselves from competition ex post by relying on small numbers bargaining. Such networked patterns of interaction also serve as a contrast to studies of relational governance that examine inter-firm processes that promote trust (Gulati and Singh 1998, MacNeil 1978, Poppo and Zenger 2002, Ring and Van de Ven 1992).

One area where the theories of the firm have been particularly tested is that of IT services. A recent estimate predicts that the market for Information Technology Outsourcing (IT) outsourcing was expected to reach $180 billion in 2010 (Forrester 2010). The average contract size of the top 100 outsourcing deals of 2005 was about $700 million (International Data Corp. 2006). Despite the growth of this phenomenon, however, observers have highlighted that IT outsourcing is rife with contractual disputes and premature cancellations (DiamondCluster 2006; Goolsby and Whitlow 2004) and substantial risk of opportunism (Ang and Beath 1993). IT is characterized by uncertainty and complexity (Barthélemy and Quélin 2006) and asset specificity (Poppo and Zenger 2002), rendering it difficult not only to specify the requirements ex-ante (Banerjee and Duflo 2000) but also to verify the output ex post (Whang 1992). As a result,

formal contracts are limited in their ability to protect parties from rent appropriation, as evidenced by the termination of several high profile contracts (Silwa 2005). While repeated relationships are prevalent in this market (Kalnins and Mayer 2004), the overall pattern of exchange relationships exhibits considerable breadth and diversity in the range of services outsourced (Forrester 2010), suggesting that the embedded structure of exchange could have a considerable impact on the modes of economic organization.

We propose a novel approach to inferring social capital of a firm from the inter-organizational network constructed from publicly observable sourcing relationships in the market for IT services. Social capital is defined as the 'sum of resources that accrue to a firm by virtue of possessing a durable network of inter-firm relationships' (Bourdieu and Wacquant 1992: 119). Building upon prior work that examines the impact of embeddedness on the terms of trade (DiMaggio and Louch 1998, Uzzi 1996, Uzzi 1999, Uzzi and Gillespie 2002), we examine whether social capital could impact the design of contracting arrangements. The dependent variable we consider is the duration of a contract. While the cost of designing and negotiating complex contracts make longer-term contracts desirable, they carry the risk of holdup engendered by contract incompleteness in the presence of specific investments (e.g., Klein, Crawford and Alchian 1978)[1]. The social capital of client firms could mitigate the potential for ex post opportunism associated with longer duration contracts while vendor firms with greater stock of social capital could receive a reputational premium in terms of longer contract duration.

Considering the embeddedness of economic actors impacts our understanding of inter-firm contracts in the following manner. First, given the inherent uncertainty in assessing the

[1] Throughout this paper, we refer to firms outsourcing their services as clients and the service providers as vendors.

likelihood of a successful outcome in outsourced IT services, there is considerable asymmetric information between clients and vendors. The network serves an informational role that influences perception about the quality of market participants to potential trading partners, thus providing a role in ex post enforcement of contractual obligations (Podolny 2005, Raub and Weesie 1990, Robinson and Stuart 2006). By transmitting difficult-to-obtain performance information about market agents, the network rewards cooperative behavior and sanctions deviations, strengthening contract enforcement (e.g., Robinson and Stuart 2006). Such enforcement could be particularly valuable in IT sourcing, where formal contracts offer limited protection against ex post opportunism (Susarla, Subramanyam and Karhade 2010).

Second, social capital is valuable also as an indicator of future behavior of market agents. While prior work emphasizes the benefits of embeddedness in providing access to competencies and resources (Uzzi and Gillespie 2002), less recognized is the role of networks in ensuring that contractual obligations are self-enforcing (e.g., Raub and Weesie 1990). A fundamental challenge in market arrangements is the difficulty of assuring that contractual obligations will be actually met (Klein and Leffler 1981). A buyer-seller network enables transmission of reputational information about a focal actor to the overall market. When the cost of lost social capital outweighs the short-term benefits of deviating from cooperative behavior, as posited in models of reputation (Diamond 1989, Gibbons and Murphy 1992, Raub and Weesie 1990), vendors in advantageous network positions risk a greater loss of social capital in breaching contracting obligations (e.g., Gulati, Nohria and Zaheer 2000). We therefore consider the impact of advantageous structural positions, which accrue from deliberate actions taken by vendors (e.g., Gulati and Gargiulo 1999), on the market arrangements that they enter into.

Third, we consider the role of a network as a "prism" in transmitting information to actors beyond the dyad (Podolny 2001). The network implicitly assigns and maintains status of market participants (Phillips and Zuckerman 2001, Zuckerman 1999), which substantially impacts the structure of market arrangements by differentiating producers from their competitors (Podolny 1993). The network can serve an important purpose in stratifying vendors by their perceived trustworthiness and reliability, which is especially important in procurement of customized and idiosyncratic IT services, where it can be difficult to compare service providers.

We construct an inter-organizational network based on the relationship of *who contracts with whom for IT outsourcing services*. Public announcement of outsourced IT services typically contain the names of the client and the service provider, the value and duration of the agreement and a brief description of the service outsourced, allowing us to construct a buyer-seller network of trading relationships and to compute the social capital of every firm in this network. To the best of our knowledge, this work is the first attempt at creating a network in outsourced IT enabled services. Firms in the industry occupy the nodes of such a network, while the existence of a contract forms the tie that connects these nodes. Our dataset is rich and unique, in that it comprises of 2400 public announcements of such IT outsourcing arrangements over the period 1994-2004. This data is then augmented with firms' financial measures from Compustat.

An empirical challenge in examining the impact of social capital is that firms undertake sourcing decisions not in isolation but are actively influenced by, and in turn attempt to influence, industry conventions, norms and decisions of other firms (e.g., Gulati and Gargiulo 1999, Krackhardt 1992, Young 1996). To examine the endogenous development of a firm's social capital that is observable from beyond the set of trading partners that a firm has encountered, we consider a network auto-regressive model (Butts 2008) that captures the explicit

correlation between the contract parameters with that of the contracts in the network neighborhood, defined as contracts that share the same client firm or vendor firm. We also conduct a multi-way clustered error-robust estimation (Cameron, Gelbach and Miller forthcoming) that accounts for correlated errors due to repetition of client and vendor firms in the data. We find that contract duration is significantly associated with greater social capital of the vendors while for client firms the type of social capital matters. Second, we find a positive and significant network neighborhood effect, suggesting that firms may be economizing on contracting costs by contracts taking into account the structure of prior contractual arrangements.

This paper makes multiple contributions to the literature. Studies of relational governance have primarily examined dyadic measures of prior interaction (Dyer and Singh 1998, Poppo and Zenger 2002) or learning to contract (Mayer and Argyres 2004). This work represents an attempt at positioning economic incentives within the larger context of the networked structure of interactions in understanding the design of buyer-supplier relationships. We conceptualize social capital as a non-price mechanism that assures that contractual obligations are upheld by transacting parties. While the role of social capital in fostering innovative capabilities and inter-firm learning has been extensively analyzed (Phelps 2010; Shan, Walker and Kogut 1994; Stuart 2000; Uzzi and Gillespie 2002), we examine the process by which the social capital of market agents influences inter-firm contractual arrangements. Prior research has not considered the path dependent effect of prior exchange relationships that firms are embedded in. An exception is Argyres and Liebeskind (1999) who analyze the constraints placed by prior governance choices on outsourcing arrangements. By analyzing a network autoregressive component of contractual choices, our work yields insight into the diffusion of conventions and norms within a market.

The balance of the paper is structured as follows: the next section discusses the relevant literature, builds theory, and proposes testable hypotheses. We then elaborate the data and measures followed by the estimation approach. The subsequent sections present the results, limitations, and conclusions respectively.

THEORY AND HYPOTHESES

Social Capital, Reputation and Inter-Firm Contracting

Inter-firm contracting arrangements have been analyzed from multiple theoretical perspectives that each posits a distinct set of contracting hazards and solutions. These streams of literature rely upon a different set of assumptions on the mechanisms of governance and remedies for breach. When specific investments are important to an exchange, transaction cost economics (TCE) posits that the resulting bilateral dependence (or small numbers bargaining) results in a fundamental transformation in that the market is characterized by isolated dyads of exchange partners that prefer to insulate themselves from competition ex post (Williamson 1985). By contrast, theories of relational governance assume that enforcement depends upon the self-enforcing range of reciprocal obligations (Baker, Gibbons and Murphy 2002; Brown, Falk and Fehr 2004) and that dyadic interaction patterns enhance collaborative value (Dyer and Singh 1998, Ring and Van de Ven 1994). Theories of reputation examine information transmission when the market can observe the overall outcomes, even when actions of actors are not (Gibbons and Murphy 1992). Table 1 highlights the key differences in the various theoretical traditions.

INSERT TABLE 1 ABOUT HERE

Contract Duration and Ex Post Opportunism

One of the fundamental characteristics in the outsourcing of IT services is that of uncertainty. The uncertainty about future technologies and prices of underlying inputs such as

hardware and network infrastructure (Gurbaxani 2007) and the difficulty in defining the stream of services upfront (Banerjee and Duflo 2000) limits the ease with which parties can specify performance milestones and penalties (e.g., Whang 1992). Further, given the intangibility and firm specificity of IT services (Bresnahan, Brynjolfsson and Hitt 2002), IT outsourcing contracts, even if undertaken between the same exchange partners, need not involve the repeated exchange of identical services (Mayer and Nickerson 2005). IT outsourcing also involves considerable deployment of specific investments to tailor processes to an organizational context (Poppo and Zenger 2002). Specific investments combined with contract incompleteness make contracts for IT outsourcing fraught with ex-post opportunism (Susarla et al. 2010). For this reason, failures are common, and it can be difficult to ascribe responsibility for failure to one party alone (Banerjee and Duflo 2000). Given the hazards of contract incompleteness and the likelihood of ex post opportunism, embeddedness of actors in a buyer-seller network works as a non-price mechanism impacting the design of contractual arrangements.

A substantive literature in economics supports our conceptualization of contract duration as an important contract design element (Crocker and Masten 1988; Guriev and Kvassov 2005; Joskow 1987). Long-term outsourcing deals could align incentives for vendors and clients since the former can recover their costs of initial investments and get a stake in future production. The clients could similarly benefit from vendors' relationship specific investments, lower risks of disruption of service and lower costs of renegotiation. However, given the complexity and substantial uncertainty characterizing IT (Barthélemy and Quélin 2006), incorporating explicit provisions to deter the threat of inefficient bargaining can make the contract too rigid to deal with future contingencies (Goldberg and Erikson 1987). In such a context, being locked into a longer-term contract can lead to ex post governance costs where parties seek to appropriate

quasi-rents through behavior such as mal-adaptation, haggling, set-up, and bonding costs (Dahlstrom and Nygaard 1999, Williamson 1996). Such behavior also increasing ex post monitoring costs in ensuring that the contracting obligations are being met. Anticipating acrimonious bargaining, a vendor could also under-invest in the non-contractible, client-specific investments (Klein et al. 1978). In order to avoid the challenges associated with designing and managing a long-term contract, exchange partners may choose to enter into shorter-term contracts (Guriev and Kvassov 2005).

Clients' Social Capital and Contract Design

Since contracts for outsourced IT services are invariably incomplete, ex post opportunism can take the form of mal-adaptation and evasion of contractual obligations by a vendor. From a client's perspective, being embedded in a social network could provide an informational benefit as well as conferring ability to influence market perceptions about an exchange partner. In other words, we examine whether the social capital of a client impacts (i) partner selection, and (ii) acts as a non-price governance mechanism that assures that contractual obligations are met.

Granovetter (2005) posits that in markets where it is difficult to assess quality, buyer-seller networks can mitigate asymmetric information. A buyer-seller network provides a conduit for market participants to exchange information about exchange opportunities as well as the actual services traded (Granovetter 2005). As a result, the information flow within the network makes it possible for a client to evaluate the quality of a potential exchange partner (vendor) beforehand (Phillips and Zuckerman 2001), which is especially valuable when it is difficult to either monitor the vendor's effort or design output-based compensation. A client with an expansive network position has access to a diverse pool of market information (Burt 1987), which could enhance its ability to use the information for strategic advantage. Clients occupying

central positions can gather information regarding potential trading opportunities and exchange partners (Gulati 1995) and have a more accurate understanding or cognitive map of the overall network (Krackhardt 1990). Clients embedded in a variety of transactions with multiple partners not only have a greater opportunity to compare across other market participants and exchange terms, but also have a wealth of access to private information that could lead to collaborative outcomes with potential service providers (Uzzi 1999). Scholars have characterized this informational role as search embeddedness that occurs when buyers use their "social relationships to identify and assess the reliability of potential transaction partners to whom they have no direct or close indirect social ties" (DiMaggio and Louch 1998: 620). Given their position of power, access to private information and control of the information flow in the network, clients with a greater social capital command a greater ability to demand advantageous contract terms, thus mitigating the likelihood of an exchange partner deviating from cooperative behavior. Thus, we expect that a client with a stronger network position will prefer shorter duration contracts that reduce likelihood of holdup.

Hypothesis 1a: A client's social capital in the buyer-seller network is associated with shorter contract duration.

Second, being central in its network allows a client to control the overall transmission of information in its network and as a result, it is in a better position to limit the likelihood of opportunistic behavior by the trading partner. The role of embeddedness is especially important given private ordering, which is that "most disputes, including those that under current rules could be brought to a court, are resolved by avoidance, self-help, and the like" (Williamson 2005). A network's function as a conduit of information is valuable when it is difficult to either monitor the vendor's effort or design output-based compensation. Since firms have better

information exchange partners through the network (and choose to contract with reputable partners), there is lower need for costly monitoring provisions and contingencies to mitigate ex post opportunism. Firms can thus benefit from an expansive network (Beckman et al. 2004) and leverage their embeddedness to lower the transaction costs of outsourcing. Thus the buyer-seller network structure provides a mechanism for community enforcement (Bowles and Gintis 2002) and communal sanctions, where information flowing through a community prevents the potential for opportunism (Kandori 1992)[2]. Given that firms with expansive network positions are in a better position to sanction a seller, we expect that a client's social capital increase the likelihood of longer contract duration that offer the benefits of business continuity. Thus, we hypothesize:

Hypothesis 1b: A client's social capital in the buyer-seller network is associated with longer contract duration.

2.4 Impact of Vendors' Social Capital

An actor's network position influences how information about a particular actor flows within a web of trading partners (Raub and Weesie 1990), making it possible for a potential trading partner to evaluate the quality of an exchange partner beforehand (Phillips and Zuckerman 2001). A seller's social capital is an important indicator of past performance, or its ability to fulfill the terms of the exchange. It has been posited that reputation is akin to a belief that an individual will be trusted, if, in the past her actions have been trustworthy (Klein and Leffler 1981). A vendor's stock of social capital acts as a market force in assuring performance or trustworthiness. The social capital of an actor acts in a similar manner to prior theoretical

[2] Our conceptualization follows Kandori's (1992) arguments rely upon the existence of a generalized information transmission mechanism that allows members of a group to be informed about past actions of other members, rather than mechanisms such as closure (Coleman 1988) or structural holes (Burt 1992).

conceptualizations of trust, which is posited to be "a type of expectation that alleviates the fear that one's exchange partner will act opportunistically" (Bradach and Eccles 1989: 104). Thus, the social capital of a vendor offers an important ex ante safeguard to protect a transaction vulnerable to ex post opportunism. Clients will then reward a vendor with high social capital by providing favorable contract terms (McMillan and Woodruff 1999) given self-reinforcing beliefs in the overall network (e.g., MacLeod 2007). When firms obtain favorable trading terms through the embedded structure of exchange, deviations from trustworthy behavior could be costlier for a vendor with higher social capital that has incurred greater investments in upholding contractual obligations. This is similar to the information structure posited in economic models where an agent with a higher reputation accrues a greater level of future profits by continued good behavior (Diamond 1989). We therefore expect that service providers with a greater stock of social capital are likely to be awarded contracts with a longer duration. Thus:

Hypothesis 2: A Vendor's social capital within the buyer-seller network is associated with longer contract duration.

The network acts as a 'prism' (Podolny 2001), allowing a third party to make inferences about the quality of the contractual exchange (Phillips and Zuckerman 2001) or the relative quality of the market participants (Podolny 1993). In particular, we examine the role of network position of a service provider firm amongst other service providers. The type of contracting arrangements entered into, the range of services provided and the nature of exchange partners that a provider deals with can have a complex impact on its overall social capital. For instance, when a vendor signs a contract with a low status client or has accepted an assignment for a service that does not lie within its domain of expertise, it risks diluting valuable social capital. Conversely, the market could penalize a vendor with low status for trying to move out of its

existing niche. Thus, the network (market) may not necessarily reward a vendor for entering into indiscriminate contracting engagements that do not conform to the market's perceptions (Zuckerman 1999). The stock of social capital resulting from the set of exchange relationships entered into by a vendor impacts not only its market perception, but also impacts the exchange transactions it can enter into in the future. The social capital of a service provider acts as a signal of harder to imitate capabilities (Podolny, Stuart and Hannan 1996) and potential quality (Podolny 1993), providing the basis for competitive differentiation. A vendor then wants to maintain a favorable reputation amongst other providers due to the future rents accrued by a higher status. We therefore hypothesize:

Hypothesis 3: A Vendor's social capital among the network of vendors is associated with longer contract duration.

We do not examine the role of a client's network capital within the network of trading relationships within the universe of outsourcing firms. This is in line with practitioner literature that emphasizes the importance of vendors differentiating themselves from other IT vendors.

DATA AND MEASURES

Data and Dependent Variable

Our dataset is a compilation of publically announced IT Outsourcing arrangements. IT outsourcing has been defined as the process of procuring information systems services from an external service provider through multi-year contractual arrangements (Gilley and Rasheed 2000; Gurbaxani 2007, Quinn and Hilmer 1994). For the purposes of our analysis, an outsourcing arrangement refers to a multiyear relationship in which one or more vendor firms are assigned the responsibility of providing an IT service to a client firm (International Data Corp. 2006). Below is a stylized example of the process by which clients and vendors evaluate the information

available through the buyer-seller network. When contracting for outsourced IT services, the interaction between a client and a vendor typically commences when a vendor responds to a request for proposal (RFP) from the client and highlights a solution to the various business and technical specifications requested by the client firm. Vendors usually provide references to demonstrate prior experience in the nature of the work proposed. A vendor's response to a new RFP from a client is to establish credibility by including a list of its prior clients as well as the more reputable clients it has worked with. When selecting vendors, clients rely on detailed internal assessment mechanisms by ranking vendors on technical capabilities as well as their ability to provide client-specific services (Ethiraj, Kale, Krishnan and Singh 2005). A client with prior experience in contracting with vendors having higher social capital is likely to be better informed in making their contracting choices. In addition to the direct effect of the both parties trying to glean information on the status of other parties by relying on their direct ties, a client that enters into an outsourcing arrangement is also likely to evaluate vendors based on the social capital enjoyed by the vendor among vendors themselves.

Our dataset covers a large set of diverse outsourcing contract announcements across various industries, service types, regions, and sizes. A typical public announcement is of the following form: "Firm A awarded Firm B a contract worth $X for providing service S for a duration T." The dataset contains 2400 unique contracts announced between 1540 unique client firms and 373 unique vendor firms during the period 1994-2004. The data comes from two sources. One of the authors maintained a personal database of publicly announced IT outsourcing contracts. We combined this data with a similar dataset maintained by a professional industry

analyst[3] firm during the period 1999-2004. From the description of the services included in the public announcement, we independently coded the service type as any of the following service types – Legacy IT outsourcing (33%), Business Process Outsourcing (19%), Data Center Operations (4%), Network Maintenance (5%), Hardware and Software maintenance (15%), System Integration (21%) and others (2%).

Each firm's financial attributes were downloaded from Compustat, which is a commercial database of financial information on publically listed companies, and matched with the data pertaining to each contract as of the year that the contract was signed. We use the financial attributes of revenue, earnings, and number of employees during the year in which the contract was signed. Since some of the firms are not publicly listed, the number of contracts with vendor financials is 2044 and the number of contracts with client financial is 737. Summary statistics are provided in Table 2 and Table 3. Clients are generally larger firms in terms of revenue, earnings, and employees than vendors. An average client firm[4] is a $16 billion company that employs about 100,000 people, while an average vendor firm in our dataset is a $10 billion company employing about 34,000 employees. Typically, our client firms' have about 1.6 outsourcing contracts. The minimum number is 1 and the maximum number of contracts held by a client is 50. The variance in the number of contracts that a vendor has signed is greater and range from 1 to 312. On average, each vendor has about six contracts in our dataset.

INSERT TABLE 2 AND TABLE 3 ABOUT HERE

Network Construction and Measures of Social Capital

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[3] Non-disclosure agreements require us to not identify the analyst firm.
[4] The summary statistics of the clients' revenue and employees only cover publicly listed firms.

We consider three different structures of networks of firms tied together by contracts - the bipartite network, its unipartite projection, and its affiliation network. Our network evolves over the time that we study. The centrality of a node is therefore computed using only its historical ties. We create the network as of each of the 11 years and then compute all the network measures for the client and vendor as if the network was observed in the year the contract was signed. For example if Xerox signed a contract with IBM in the year 2000, then in order to measure the social capital for Xerox and IBM in the year 2000, we use that version of the network which contains only those contracts signed on or before the year 2000. Subsequently if Xerox had a contract with EDS in the year 2002, the network measures are computed as if the network were observed in the year 2002. By constructing the network in the manner, we can avoid potential reverse causation in the relationship between contract duration and social capital.

To create the network of IT services firms we use the entire sample of 2400 contracts. We first construct a buyer-seller network where the contractual relationship is treated as a bidirectional tie with a unit tie-strength. Firms are treated as nodes while the tie that connects the nodes is the presence of a publicly announced outsourcing contract. Since no contract exists between two clients or two vendors, the network that results is called a bipartite or a two-mode network (Wasserman and Faust 1994) with the 1540 client firms comprising one mode and the 373 vendor firms comprising the other. We refer to this network in matrix notation as P with the dimensions MxN where M is 1540 and N is 373. The matrix P contains values 1 and 0 depending on whether a tie exists between client m and vendor n. We then construct a unipartite projection of the above network to represent the network of ties between vendors who have common clients. Mathematically, multiplying the matrix P with its transform gives us a 373x373 matrix of 1s and 0s where each cell takes a value 1 to represent a tie between two vendors that share a

client. Thus, this unipartite network contains 373 nodes each of which represents a unique vendors and a tie between any two vendors represents at least one common client. The bipartite structure lets us examine the industry structure as a whole while the unipartite projection allows us to isolate the ties among vendors.

The buyer-seller network is then transformed to create a network of contracts tied together by common client or vendor firms. The nodes on this network represent individual contracts and the edges represent a client or a vendor. When a client or a vendor has two contracts, an edge is placed on the graph to represent this connection between the two contracts. This network represents the flow of contracting information through the network. We use this transformation to model the autoregressive nature of our data. The visualization of the overall bipartite network is presented in Figure 1 while the unipartite projection is provided in Figure 2.

INSERT FIGURE 1 AND FIGURE 2 ABOUT HERE

In order to capture the vendors social capital we adopt four measures, namely the degree centrality (Freeman 1979), and the Eigen vector centrality (Bonacich 1972) of the vendor in both the two mode and one mode network. Degree centrality represents the number of ties possessed by a node. Degree centrality of a firm in the two-mode network captures the 'volume' of transactions that the firm has undertaken. Eigen vector centrality is similar to degree centrality except that each tie is weighted by the centrality of the node that the tie connects to(Faust 1997). The former is therefore a local measure of centrality, while the latter measures centrality at a more global level due to the iterative nature of computing the measure.

A client's experience with contracting is captured through the degree centrality and Eigen vector centrality in the two-mode network. The Eigen vector centrality measure represents centrality at a network level rather than just a node level (Faust 1997). Clients' experience in

contracting with various vendors is captured in their degree centrality in the two-mode network and their experience in contracting with vendors connected to central clients is captured in the clients two mode Eigen vector centrality. Thus for clients, the degree centrality captures the extent to which a client has been exposed to outsourcing contracting while its Eigen vector centrality captures the extent to which client firms have had experience with dealing with more central vendors. The network measures used to test the hypotheses are summarized in table 4.

INSERT TABLE 4 ABOUT HERE

Control Variables

The duration of a large outsourced IT services contract is often the result of a process of negotiation between clients and vendors, and therefore influenced by the relative bargaining power of parties, industry convention (Young 1996), and the nature of the task (Baldwin and Clark 2000) outsourced. Given the complexity of the contracting decision, we need to control for various attributes that could impact the structure of contracting arrangements besides explanations based on social capital. We first control for attributes of contracting parties. Larger client firms may undertake more outsourcing because such firms have more activities that can be outsourced. We consider earnings before interest, taxes, depreciation, and amortization (EBITDA) as measure of assets held by a client. Correspondingly, we control for vendors size in terms of number of employees.[5] It is possible that the industry that a client firm belongs to affects the scale and scope of its outsourcing arrangement, even when similar services are

[5] We considered alternate measures of firm size for both clients and the vendors such as revenue, earnings, and employees. The measures chosen in our analysis have higher correlation with contract duration than the others. By choosing the variable with the highest correlation, our estimate on the independent variable of interest becomes more conservative. Further, the goodness of fit of the model is higher when using earnings compared to revenue or number of employees, all else being equal.

outsourced. To consider the systematic difference in outsourced IT contracts across industry sectors, we include the two-digit SIC code of client firms as a dummy variable. Industry analysts also suggests that these processes have reached a level of maturity over the years (Gartner 2007). We notice that the median duration of contracts varied between 10 and 7 years prior to 1999, but seem to have stabilized at 5 years after 1999. We therefore added a binary control variable to the model, which takes a value of 1 if the contract is signed before the year 1999.

We next control for attributes of the relationship between the client and the vendor and attributes of the service outsourced. Prior interaction between parties has been demonstrated to significantly influence contract design (Ethiraj et al. 2005, Poppo and Zenger 2002). We therefore control for this aspect by including a binary variable that takes a value of 1 if the two firms have had a prior contractual agreement and 0 otherwise. Some types of services are typically outsourced for longer terms than others depending upon the nature of relationship specific investments required (Joskow 1985, Masten and Saussier 2002) and the strategic goals of the client (Susarla et al. 2010). We scrutinized the outsourcing announcement and accordingly coded seven dummy variables for the following service types: IT Outsourcing, Business Process Outsourcing, Data Center Operations, Network Maintenance, Hardware and Software Maintenance, System Development and Integration and a variable called 'Others' to capture services that are not easily classifiable as one of the other six. Each of the seven variables can take a value of 1 or 0 depending on whether the particular service is listed as being part of the outsourcing arrangement. Given the variation in contract values (TPI 2009), we include the dollar value of the contract as an additional control variable.

ESTIMATION AND RESULTS

Empirical Methods

The baseline estimation is conducted using ordinary least squares (OLS) estimation, including a vector of financial controls for clients and vendors. We estimate contract duration as a function of social capital of both clients and vendors, controlling for alternate explanations.

$$y_i = x_i\beta + u_i \text{ ------ (1)}$$

Since the network evolves over the time we study, an important issue to consider is the stability of the network. In particular, we need to examine two issues that could bias the interpretation of the results. With maturation in the market for IT services, there could be a corresponding shift in the network structure occupied by market agents (White 1981) that impacts both the design of contracts and the social capital possessed by market agents. We include a control variable, pre-1999, that denotes whether contracts were signed before 1999, which is a less mature stage of the outsourced IT services market. Second, we need to evaluate whether a few agents with considerable market power have the ability to exert significant influence on the overall structure of market arrangements. Using NodeXL, a network simulation tool, we constructed several snapshots of the overall network from 1994-2004 and examined that the network is stable even after removing the top 6 vendors (by volume). Figure 3 presents the visualizations of the market (two-mode network) with the top 6 vendors labeled. This figure therefore represents the universe of IT services contracts. Table 5 presents the correlations for the dependent and independent variables of interest. We examined the variance inflation factors (VIF) for all the variables used and established that multi-collinearity was not an issue.

INSERT TABLE 5 AND FIGURE 3 ABOUT HERE

Each observation in our data is a contract that ties a client and a vendor. Two or more contracts in the dataset can have the same clients, vendors, or both. As a result, the parameters of any one contract are likely to be *autocorrelated* with the parameters of other contracts with

which it shares clients or vendor firms. Firms also learn from their past contracts, making it likely that contracts could be correlated with other contracts with which they share a client or a vendor. Thus, two sources of edge dependence exist in our data. Ignoring this aspect of edge dependence and relying on OLS is likely to make hypothesis testing unreliable, rendering the OLS parameters inconsistent. We conducted statistical tests to assess whether the estimates are biased due to heteroskedasticity and multicollinearity, and do not find evidence of either. However, an inference of lack of heteroskedasticity from the statistical tests only implies that the error structure assumed in the test is absent. Since there is no indication suggesting the exact nature of the covariance matrix, our approach is that we do not place any *a priori* assumptions on the error structure and instead perform an estimation that does not assume independence. We use two approaches to handle observation level dependence that are discussed next.

Multi Way Cluster Robust Estimation

Firms exhibit varying levels of sophistication in their contracting capabilities (Argyres and Mayer 2007). Two contracts across a given firm (vendor or client) may then share common characteristics depending on a firm's sophistication in designing contracting arrangements. This implies that the errors in equation (1) could be correlated among contracts of the same client and simultaneously among contracts that share vendors. The model is further complicated because the clusters are non-nested i.e. the clustering by the client dimension does not completely contain clusters by vendor firms or vice-versa. Fixed effects and random effects specifications using OLS are inappropriate to deal with interdependence across dyads or that of covariates or that of invariant characteristics across dyads (Gulati and Gargiulo 1999). To deal with the challenge of estimating error structures with multiple non-nested clusters, we utilize recent work by Cameron et al. (forthcoming) whose estimation approach imposes few distributional constraints on the error structure. Consider the model without clustered observation:

$$y_i = x_i\beta + u_i \text{ for contract } i \in \{1,2,\dots N\}, \text{ iid implies } Cov(\varepsilon i\,, \varepsilon j) = 0.$$

For the two-way non-nested cluster:

$$y_{igh} = x_{igh}\beta + u_{igh} \qquad (2)$$

Observation i belongs to non-nested clusters defined by g ∈ {1,2 ... G} and h ∈ {1,2 ... H}. The covariance is neither diagonal (as in a non-clustered case) nor block-diagonal (as in the one-dimensional clustered case). For the non-nested two-way clustered data, any two observations that belong to the same cluster regardless of the dimension of the cluster can have non-zero correlation. Therefore, off-diagonal terms of the covariance matrix can have non-zero terms. The estimate $\widehat{B} = X'(\hat{u}\hat{u}'.* S^{GH})X$ where S^{GH} is an indicator matrix in which the ij cell takes a value of 1 if i^{th} and j^{th} contract belong to the same cluster. Cameron et al. (forthcoming) deconstructs S^{GH} and estimate B in a three-stage approach to compute the variance of the estimator.[6]

Network Autoregression

We refer to the set of contracts with which a particular contract is associated as the network neighborhood of the focal contract. The Network Autoregression (AR) estimation technique (Butts 2008; Doreian 1989; Doreian 1990) allows for modeling edge dependence of this nature. Specifying a spatial correlation model controls for the flow of contracting information along the network via shared clients and vendor firms, i.e., the dependence between a contract characteristics and those in the neighborhood. The network AR model, closely related to spatial ARMA models[7] (Anselin 1988) is a standard regression model with an additional

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[6]The STATA code required to perform this estimation is available at one of the authors' webpage here http://gelbach.eller.arizona.edu/~gelbach/ado/cgmreg.ado.

[7] The endogenous relationships in the network AR models are unidirectional in that only past contracts affect future contracts. Subroutines to estimate a network ARMA model in R are available in Statnet (Handcock et al. 2004).

components, namely the autoregressive (AR) components. Essentially the AR component captures an effect of an individual observation responding to the behavior of its neighborhood and the neighborhood responding to this individual observation in return. Thus, the network AR model allows us to model the outcome variable as both a function of individual level variables and the network resonance impact. The mechanism whereby network resonance operates is as follows. A firm that has signed multiple contracts is likely to have shared some decision parameters amongst the various contracts, making it likely that contract parameters are correlated with other contracts of the same client firm. Similarly, the focal contract is also likely to share traits with other contracts serviced by the same vendor firm. Thus, it is likely that a focal contract both affects and is affected by neighboring contracts, where the neighborhood is defined as the set of contracts with which it shares a client or vendor firm.

To estimate a network AR model, we construct a network of contracts. Each node represents an outsourcing contract and the edges correspond to a common client or vendor. The corresponding adjacency matrix W, is an NxN matrix where the ij term corresponds to the number of firms that contract i and contract j have in common. Therefore each cell in the matrix can take a value of 0 if the two contracts are not connected, or 1 for one shared firm (either a common client or vendor) or a value of 2 when there exists a common client and vendor (i.e. the client and vendor sign two separate contracts at two different points in time). The adjacency matrix W multiplied by the vector of contract durations forms the AR component of the Network AR model. The X matrix contains the network variables of interest to test each hypothesis, and the control variables used to rule out alternate explanations. The model that is estimated using maximum likelihood estimation is as follows:

$$Y = WY + X\beta + u \quad (3)$$

Results

The key results from the cluster-robust estimation and the network autoregressive estimation are presented in Table 5. All the models in the table contain two variables of interest – the degree centrality and the Eigen vector centrality. We examine measures of degree centrality (expressed as a percentage) and Eigen vector centrality. Thus, it is difficult to impute a straightforward economic interpretation across different estimation models (since we look at a percentage measure and a network level measure). However, the sign and magnitude are comparable across models**.** To compare our results with a base-line we also estimated the above model using OLS with robust White sandwich estimators (White 1980). The coefficients are identical but the standard errors are lower to the ones below. In addition, we also regressed a two-mode normalized degree centrality, once again the coefficients are consistent, however normalization makes interpretation is difficult. Columns 1, 4, and 7 include financial controls for both clients and vendors while columns 2, 5, and 8 estimate the same models without client financial variables. Since the number of contracts for which client financials are available is few, the number of observations in the estimation drops substantially when client financials are included. However, the direction and significance of estimates do not change significantly in either sample. Columns 3, 6, and 9 present the results of the network Auto Regression models. These models also control for prior relationship, pre-1999 contracts and annual contract value. Table 6 presents the estimation with a full set of control variables.

INSERT TABLE 6 AND TABLE 7 ABOUT HERE

We observe that measures of client assets (EBITDA) are consistently negatively associated with contract duration while vendor size is positively associated with longer contract duration. This result seems to suggest the bargaining power dynamics in the negotiation between

clients and vendors. Vendors might prefer longer contracts that confer a steady stream of revenues while clients seek contracting arrangements that prevent locked-in. Controlling for client size reduces the explanatory power of a client's social capital. This suggests that the influence of a client's social capital on contract duration is based on bargaining power. Considering that financial measures do not exist for a large set of clients, we examined a restricted sample analysis of those firms for which financial variables do not exist. While all other relationships hold, the vendor's stock of prior contracts do not matter, suggesting that vendors' established history does not offer any incremental explanation of the determinants of contract duration. We also find that pre-1999 contracts and larger annualized contract values are associated with longer contract duration. We find that measures of prior interaction between clients and vendors do not predict a longer contract, possibly since relational interaction impacts governance by formalizing contractual contingencies (Poppo and Zenger 2002) rather than by alleviating perceptions of opportunism.

We find support for both hypotheses 1a and 1b as is seen in the estimates in columns 1, 2, and 3. The number of client's past contracts is inversely and significantly associated with duration while clients' Eigen vector centrality in the two-mode network has a positive and significant impact, controlling for clients' degree centrality. From the significant estimates in columns 5 and 6, we find support for hypothesis 2 (vendors two-mode centrality in the network of both clients and vendors). Vendors' social capital from the stock of prior contracts is significantly positively associated with duration. Being associated with central clients is further positively associated with longer duration contracts. We find evidence to support hypothesis 3 that vendors' reputation in the one mode network, i.e., a vendor who is connected to more central alters, is positively associated with contract duration. The significant estimates of the network

AR coefficients establish our contention that contract terms are likely to be correlated along the edges of the network due to common clients and vendors. Including the network effect, indeed, strengthens the significance of the estimates in columns 6 and 9, reinforcing the link between vendor centrality and longer contract duration.

DISCUSSION

We propose a novel approach to inferring social capital based on firms' contracting history. Social capital constitutes a non-price information transmission mechanism whereby potential trading partners form an opinion about a particular firm's reliability based upon observed interactions with other trading partners. The positive association of vendors' degree centrality to duration suggests that vendors who manage many contracts safeguard their social capital in an expansive network through cooperative behavior. Considering the Eigen vector centrality, the effect of a large number of trading partners is less significant compared to being associated with more central trading partners. Further, the indirect association of a vendor to another vendor, through a set of clients, indicates that vendors do not want to lose the reputational premium that accrues from high-status. Given asymmetric information and ex post opportunism inherent in exchange, the choice between a longer-term contract and a shorter contract is due to the inferred quality of the provider from its social capital. Given the need for asset specific investments, social capital could reduce the need for inflexible provisions and stringent damage measures for non-performance accompanying long-term contracts (e.g., Joskow, 1985). At the same time, we notice that for the clients, it is the quality of experience with service providers, rather than the quantity of engagement with providers that provides assurance in contracting.

The positive association between social capital and duration could be very significant in the context of many buyer-seller relationships in the high technology area. The social capital in a

network can act as a signal of the underlying quality and reputation of a provider, serving as a self-enforcing safeguard for implementing outcomes that cannot be enforceable by formal contracts. In other words, the 'community' of vendors and clients could penalize deviations through an implicit reputation mechanism, consistent with the idea of a communal enforcement (Kandori 1992). This dimension of social capital is particularly important given that prior literature has demonstrated that reputation mechanisms are not very effective in the IT services sector (Banerjee and Duflo 2000). Further, an agent's reputation for good behavior is not observable outside the trading relationship (Brown, Fehr and Falk 2004). Given this difficulty in observability and verifiability in a number of market transactions, buyer-seller networks provide an important mechanism of transmission of information about exchange performance.

We also consider the overall network effect when information can be transmitted beyond a firm's immediate trading partners. A client firm that undertakes an outsourcing arrangement after having entered into one in the past is likely to economize on contracting costs by designing contracts based on learning from prior contracts (Mayer and Argyres 2004), i.e., contract terms would correlate across time. It is also likely that vendors responding to RFPs would similarly learn from their past stock of contracts. A result of such a diffusion of norms within a market (e.g., Burt 1987, Krackhardt 1992, Young 1996) is that contract terms are likely to be correlated to parameters of other contract in the network neighborhood. We find strong evidence of this behavior in the significant estimates of the autoregressive coefficient.

Implications for Firms

One of the primary implications of this work is that networks could provide a means for competitive differentiation or segmentation by the overall market. Service provider firms may seek to actively differentiate themselves by entering into a pattern of exchange relationships in

an attempt to be assigned the right labels or niches by other market participants, which affects the aggregate structure of competition in the IT services market. When the network pushes vendors to specialize in different market segments, we might observe the emergence of clusters of inter-organizational networks. Another implication from this study is the role of network position in determining growth strategies and in revenue generation efforts for vendors. Given the need for substantial effort needed for acquiring and maintaining exchange relationships, it will be difficult for a vendor to enter into a variety of contracting arrangements if it has been unable to fulfill prior contractual obligations. A vendor can acquire high social capital only through a history of successful outsourcing initiatives that need substantial investment in partner specific investments and technological capabilities that are difficult to acquire and for others to imitate. Vendors could actively seek out exchange positions aimed at increasing their informational advantage and developing an intelligence web. While prior research has examined the importance of structural position to innovation (Phelps 2010, Stuart 2000), network position could also impact capability-building process. Given that the overall market could either reward or punish a vendor for a lack of conformity with network position, a vendor's efforts to improve its structural position or technological niche should build upon its initial network position. Vendors then need to scrutinize their structural position and identify a future structural position or potential role that is matched to their capabilities. Given the importance of embedded structure of ties to a firm's ability to obtain favorable exchange terms (Ethiraj et al. 2005), and given the dynamics by which the network positions constrain or empower future expansion (Podolny et al. 1996), vendors need to pursue capabilities that are aligned with their network position.

The importance of social capital for clients has implications for the depth and breadth of sourcing relationships. For instance, client could compare whether it is more advantageous to

have deeper relationships with one or two vendors or expansive relationships with a breadth of vendors that provide access to a diverse pool of available information. The costs of contract negotiation and partner selection imply that social capital could benefit clients through longer-term contracts whereby they can economize on the costs of contracting. Given the costs of maintaining a particular network position and the cost of building an expansive network, clients face a tradeoff between diversification vs. deepening of ties with exchange partners. Another issue for both literature and practice is that newer models of IT service disaggregation could affect the overall development of embedded relationships by transforming the nature of interaction between vendors and clients. The growth of modularity in products and services (Sanchez and Mahoney 1996) could shift governance towards arms-length arrangements and greater standardization in processes that are outsourced (Tanriverdi, Konana and Ge 2007). Such developments could reduce the importance of cultivating an advantageous network position.

Given the global growth of outsourcing of large and complex transactions, firms can benefit from selection strategies that allow them to leverage capabilities of specialized vendors. Vendors are similarly interested in expanding their market share and in obtaining favorable contract terms. Most of the industry rankings of vendors[8] focus on a very limited set of firms while a large majority of firms remains unranked. Further, such systems do not address the reputation of the client firms. Academic evidence on commonly used reputation metrics to rate vendors such as capability maturity models and ISO certification is also mixed (Banerjee and Duflo 2000).

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[8] Two such examples are Gartner's Magic Quadrant and The Black Book of Outsourcing. However, both reports list service providers under very narrow classification heads and as a result, it becomes difficult to compare reputational capital of vendors that offer different service offerings. A list of Gartner's Magic Quadrants, which are over a hundred, is available here http://www.gartner.com/it/products/mq/mq_ms.jsp?ref=g_key. The Black Book of Outsourcing is available here http://theblackbookofoutsourcing.com/

Another problem is that there could be considerable heterogeneity across vendors that have instituted such certification programs (Arora and Asundi 1999). As a result, there is limited academic or practitioner work that could posit a viable mechanism of reputation that can help both outsourcing firms and vendors in selecting exchange partners and in negotiating terms of trade. Vendor certification and quality ratings in high technology industries could consider the inter-organizational network context and the position of a vendor with respect to the peers.

Limitations

Our study has a few limitations. Since signing a contract does not necessarily imply successful completion of a contract, one could argue that the stock of contracts signed does not necessarily imply a healthy reputation. However, just as information on which contracts are awarded to whom propagates to other agents, it is equally likely that news of failure would resonate through the market. In fact it is this dissemination of reputational information through the network that restricts opportunistic behavior. While we do not factor in successful versus unsuccessful prior experience, we believe that firms that are central in the network are not likely to have reached that position of status given repeated unsuccessful engagements. Therefore, on average, a firm with a larger stock of prior contracts is likely to have been more successful than a firm with a less number of contracts in a comparable period. Another issue is that we do not consider the systematic pattern of tie formation in the network (e.g., Sorenson and Stuart 2001). However, we control for the pattern of ties through the network auto regression estimation.

CONCLUSIONS AND FUTURE RESEARCH

The uncertainty and the measurement difficulty associated with market arrangements pose challenges for the design and execution of contracts. First, there is considerable asymmetric information in exchange relationships where it can be difficult to assess the quality of potential

trading partners. Second, it is also important for the market to provide a mechanism by which firms can distinguish themselves from their competitors through difficult to imitate actions such as a history of successful market engagements. We take a first step in examining social capital as a measure of reputation in the context of inter-firm collaborations that involve considerable ex post transaction uncertainty and asset specificity. We examine the impact of the social capital on contract duration and find strong evidence to support our hypotheses and research framework. Social capital can play a significant role in ensuring cooperative behavior and in enhancing exchange outcomes.

This study offers a number of future research directions. Given the challenges in obtaining a reliable indicator of behavior, both academics as well as practitioners can utilize some of the methods developed in this paper to identify market segmentation strategies and develop scorecards that permit industry-wide comparisons. Given the rich literature on the nature of social capital, future work can build richer frameworks to explain contract design in the contemporary practice of outsourcing and offshoring of manufacturing and business services. Considering the role of network capital in facilitating sourcing frameworks that achieve the division of risk and responsibility across multiple participants is another agenda for future research. In future, we intend to expand upon this work by examining the degree to which relational and structural mechanisms substitute or complement each other.

APPENDIX

Table 1: A Comparison of Different Theoretical Traditions

	Transaction Cost Economics	Relational Governance	Market Reputation	Social Capital
Observable/ Verifiable Outcomes	Complete contract, Outcomes verifiable by third party	Incomplete contracts, outcomes observable by both parties	Contract outcomes observable by the market	Embeddedness of agents in the network is observable by others
Cost of breaching contract	Monetary damages awarded to the harmed party	Loss of future rents	Loss of reputation in the market	Loss of social Capital maintained through the network
Contract Enforcement mechanism	Dispute resolution mechanisms and breach conditions specified in contract	Self-enforcement of contract	Loss of future sales	Network sanctions and stratifies agents

Table 2: Data Summary-Firm Characteristics

	Statistics	Contracts	Duration	Revenue ($million)	Employees (1000's)	EBITDA ($million)
VENDORS	Mean	6.4	4.9	9194	33.9	1537
	StdDeviation	26.5	2.6	17842	64.2	3942
	Min	1	1	0.29	0.009	-166
	Median	1	5	1410	9.5	121
	Max	312	20	89649	430	30400
	N	373	251	182	169	182
CLIENTS	Mean	1.6	6.0	16746	99.99	3289
	StdDeviation	2.1	2.8	35060	101.1	9238
	Min	1	0.4	1.8	0.03	-1808
	Median	1	5	5378	67	797
	Max	50	20	476319	443	118107

Table 3: Data Summary-Contract Characteristics

Statistics	Count	Mean	Standard Deviation	Type
Duration	1729	6.05	3.03	Continuous
Annual Value	1253	63.1	192.1	Continuous
Pre-1999	2400	0.15	0.37	Binary dummy
Prior contract	2400	0.16	0.36	Binary dummy
ITO	2400	0.34	0.47	Binary dummy
BPO	2400	0.19	0.39	Binary dummy
Data Center	2400	0.05	0.21	Binary dummy
Network Mgmt	2400	0.05	0.22	Binary dummy
Hardware /Software Maintenance	2400	0.15	0.35	Binary dummy
System Integration	2400	0.21	0.41	Binary dummy
Others	2400	0.02	0.14	Binary dummy

Note: The two graphs below were created using the Fruchterman-Reingold algorithm (Fruchterman and Reingold 1991), which is a commonly used layout option in social network analysis packages since it provides an aesthetically appealing graph layout. The two graphs were created using Frucheterman-Reingold algorithm with the nodes sized by Eigen vector centrality

Figure 1: Bipartite Graph of the entire network (The big 5 vendors are labelled)

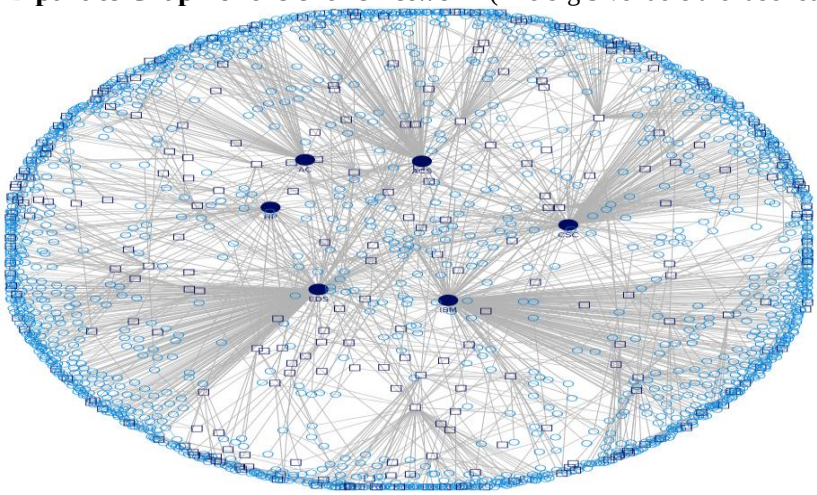

Figure 2: Unipartite Graph of the vendor firms

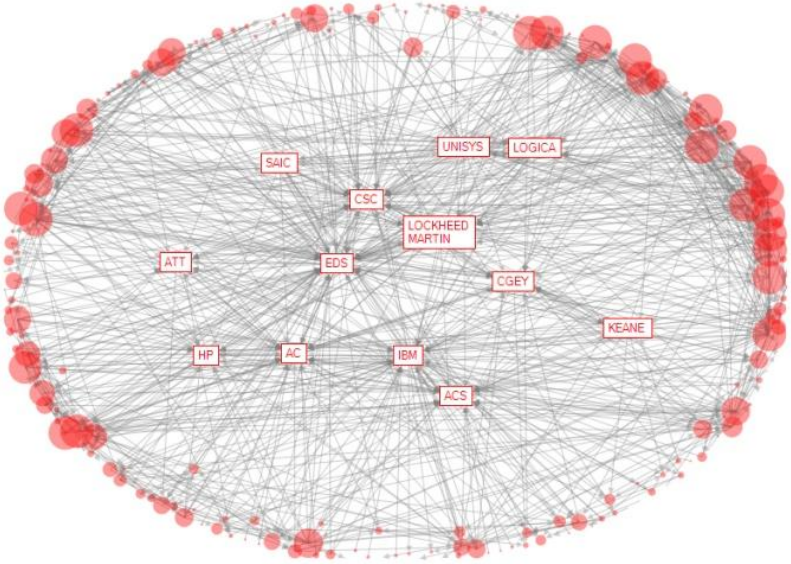

Table 4: Measures of Social Capital

Hypothesis	Network Measures
H1a: Clients' social capital is associated with shorter contract duration.	A: Clients' degree centrality in the two-mode network: captures the notion of the volume of outsourcing arrangements that a client has managed until that year due to having multiple vendors
H1b: Clients' social capital is associated with longer contract duration.	B: Clients' Eigen vector centrality in the two-mode network: captures the effect that clients are tied to vendors who are themselves central in the network.
H2: Vendors' social capital is associated with longer contract duration.	C: Vendors' degree centrality in the two-mode network: captures the effect of a vendor being tied to a larger set of clients until that year D: Vendors' Eigen vector centrality: captures the extent of experience the vendor has in contracting with central clients
H3: Vendors' social capital among other vendors is associated with longer contract duration	E: Vendors' degree centrality in the one-mode network: captures the notion of the focal vendor being tied to a number of vendors through shared clients. F: Vendors' Eigen vector centrality in the one-mode network of vendors: captures the notion of status or influence of vendors due to being indirectly tied to other vendors who are themselves central.

Table 5: Correlation Table for Independent Variables

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Duration	(1)	1								
Clients' 2 mode Deg	(2)	-0.06	1							
Client 2-mode Eigen	(3)	0.09	0.101*	1						
Vendors 2-mode Deg	(4)	0.15*	0.066	0.002	1					
Vendor 2-mode Eigen	(5)	0.19*	-0.057	0.72***	0.16*	1				
Vendor´s 1-mode Degree	(6)	0.16*	0.101*	0.16*	0.93***	0.32***	1			
Vendor's 1-mode Eigen	(7)	0.22*	0.08*	0.44***	0.65***	0.58***	0.81*	1		
Vendor Assets	(8)	0.22*	-0.03	0.06	0.28*	0.14*	0.21*	0.14*	1	
Client Assets	(9)	-0.07	0.31**	0.12*	0.11	0.00	0.13*	0.10*	0.05	1

Figure 3: IT Services Market from 1994-2004 without Top Vendors (left) and Including the Top 6 Vendors (right)

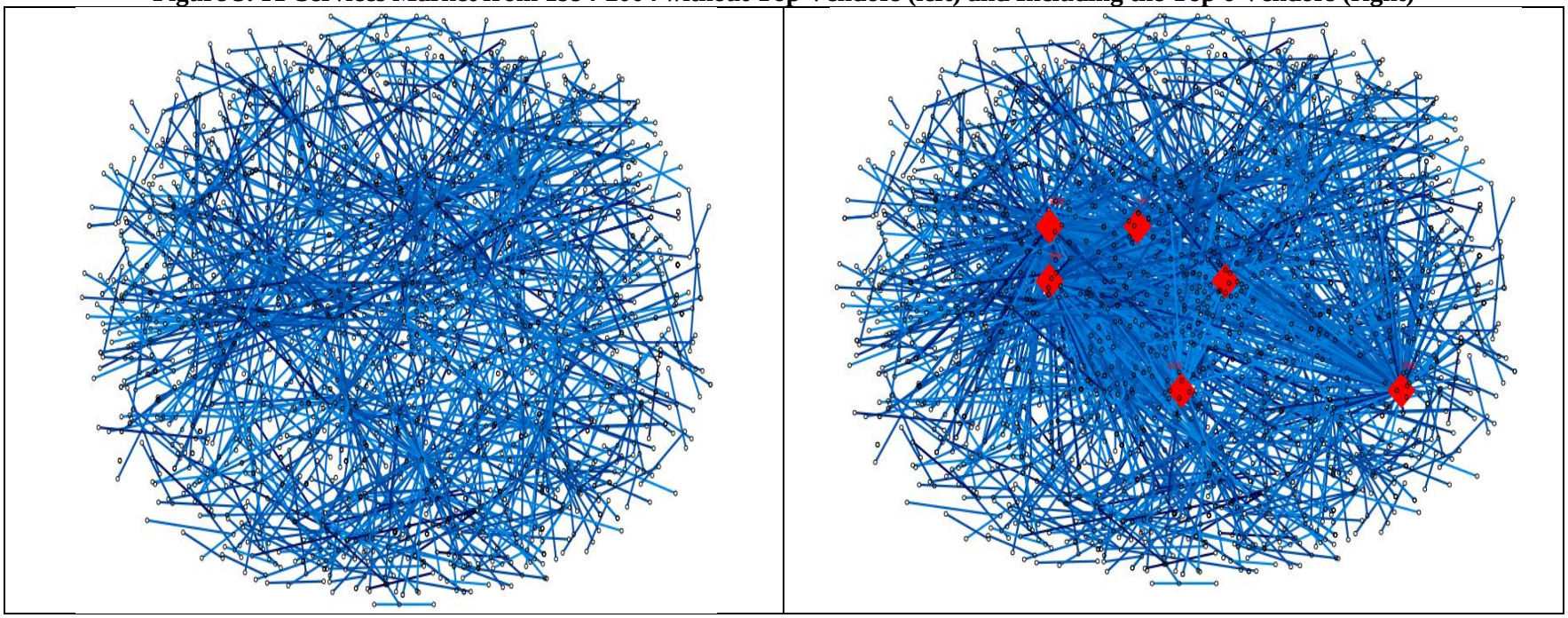

Table 6: Estimation results for MWCR-OLS and Network AR estimation

*** p<0.01, ** p<0.05, * p<0.1 Standard errors not reported

Duration	Hypothesis-1			Hypothesis-2			Hypothesis-3		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	MWCR	MWCR w/o financial controls	AR	MWCR	MWCR w/o financial controls	AR	MWCR	MWCR w/o financial controls	AR
Clients' 2mode Degree	-0.06	-0.05***	0.17						
Clients' 2mode Eigen vector	0.03	0.05*	0.06**						
Vendors' 2 mode Deg				0.01***	0.00*	0.11***			
Vendors 2mode Eigen				0.01**	0.01***	0.01*			
Vendors 1mode Degree							0.02	0.00	0.05***
Vendors 1mode Eigen							0.02*	0.02**	0.02*
Prior relationship	0.35	0.03	0.52**	0.02	-0.28	0.49**	0.01	-0.30	0.43*
Pre – 1999	0.28	0.60*	0.00***	0.74**	0.76***	(0.00)***	0.63	0.83**	0.00***
Log (Annual value)	0.58***	0.53***	1.68***	0.48***	0.48***	(1.30)***	0.53***	0.48***	1.99***
Rho- AR correlation			0.0005***			0.0004**			0.0002*
Vendor Assets ($m)	2.28	9.07*		0.61	7.41*		2.16	9.36**	
Client Assets ($m)	-1.42***			-1.90***			-1.95***		
Constant	3.28***	3.33***		3.10***	3.16***		3.46***	2.95***	
Observations	348	1015	1729	348	1015	1729	363	1048	1729
R-squared	0.253	0.185	0.246	0.288	0.197	0.269	0.271	0.195	0.266

Table 7: Detailed Estimation results for Multiway Cluster Robust Regression including control variables

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

VARIABLES/ DV= Duration	(1)	(2)	(3)	(4)	(5)	(6)
Client´s 2 mode Degree	-0.06(0.067)	-0.05(0.016) ***				
Client 2mode Eigen	0.03(0.036)	0.05(0.029)*				

Vendors 2 mode Degree			0.01(0.002)***	0.00(0.002)*		
Vendor 2mode Eigen			0.01(0.004)**	0.01(0.003)***		
Vendor´s 1mode Degree					0.02(0.026)	0.00(0.016)
Vendor's 1mode Eigen					0.02(0.009)*	0.02(0.007)**
Control Variables						
Vendor Assets	2.28(7.604)	9.07(4.980)*	0.61(5.989)	7.41(4.098)*	2.16(5.650)	9.36(4.318)**
Client Assets	-1.42(0.39)***		-1.90(0.56)***		-1.95(0.580)***	
Prior Relationship	0.35(0.562)	0.03(0.286)	0.02(0.513)	-0.28(0.287)	0.01(0.493)	-0.30(0.291)
Pre/1999	0.28(0.322)	0.60(0.314)*	0.74(0.303)**	0.76(0.235)***	0.63(0.398)	0.83(0.337)**
ITO	0.56(0.466)	1.35(0.256)***	0.40(0.424)	1.30(0.256)***	0.63(0.484)	1.39(0.271)***
BPO	1.85(0.592)***	1.62(0.554)***	1.86(0.575)***	1.59(0.550)***	1.77(0.564)***	1.61(0.547)***
DCO	2.65(1.025)***	1.54(0.395)***	2.55(0.984)***	1.49(0.388)***	2.49(0.895)***	1.63(0.359)***
NM	1.07(0.466)**	-0.04(0.253)	1.21(0.391)***	0.06(0.273)	1.28(0.433)***	-0.00(0.252)
HWSW	-0.03(0.428)	0.48(0.301)	-0.11(0.378)	0.43(0.279)	-0.11(0.416)	0.40(0.280)
SD&SI	0.42(0.429)	1.03(0.307)***	0.43(0.410)	0.99(0.301)***	0.42(0.451)	1.00(0.294)***
Others	0.94(1.787)	0.60(0.881)	1.05(1.787)	0.59(0.905)	1.28(1.609)	0.56(0.827)
SIC-Mining	0.81(1.058)	-0.21(0.879)	0.91(1.055)	-0.05(0.901)	1.14(1.063)	0.19(0.950)
SIC-Construction	-0.06(0.631)	-1.06(0.303)***	-0.33(0.516)	-1.13(0.208)***	-0.29(0.559)	-1.08(0.21)***
SIC-Mfg	1.24(0.516)**	0.39(0.355)	1.21(0.540)**	0.50(0.365)	1.06(0.513)**	0.38(0.353)
SIC-TCU	0.62(0.450)	-0.01(0.280)	0.58(0.460)	0.07(0.261)	0.85(0.464)*	0.33(0.338)
SIC-Wholesale	4.02(0.298)***	3.12(0.538)***	3.78(0.353)***	3.05(0.560)***	3.97(0.284)***	3.20(0.480)***
SIC-Retail	-0.06(0.754)	-0.71(0.504)	-0.13(0.708)	-0.60(0.463)	-0.03(0.690)	-0.50(0.435)
SIC-Finance	0.98(0.525)*	-0.05(0.445)	0.98(0.494)**	0.03(0.415)	1.01(0.452)**	0.05(0.418)
SIC-Services	0.61(0.505)	-0.35(0.410)	0.62(0.457)	-0.25(0.391)	0.42(0.533)	-0.40(0.444)
logannualvalue	0.60(0.131)***	0.53(0.099)***	0.50(0.145)***	0.48(0.104)***	0.54(0.140)***	0.48(0.105)***
Vendor Assets	2.28(7.604)	9.07(4.980)*	0.61(5.989)	7.41(4.098)*	2.16(5.650)	9.36(4.318)**
Client Assets	-1.42(0.39)***		-1.90(0.56)***		-1.95(0.580)***	
Constant	3.03(0.658)***	3.33(0.370)***	2.81(0.585)***	3.16(0.330)***	2.54(0.665)***	2.95(0.360)***
Observations	348	1,015	348	1,015	363	1,048
R-squared	0.253	0.185	0.288	0.197	0.271	0.195

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