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SOCIAL NETWORKS AND CONTRACT ENFORCEMENT IN IT OUTSOURCING

Completed Research Paper

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Abstract

Prior research on Information Technology Outsourcing has characterized the dominant governance modes as either 'Formal' or 'Relational,' which rely on stringent assumptions of either perfect foresight or about the extent to which one party can punish unilateral deviations by the other. We propose a third alternative for inter-firm contract governance. The social network capital offers a measure of reputation that can indicate to future trading partners the reduced likelihood of opportunistic behavior. The network of trading partners enables a community enforcement of contracting terms by providing safeguards that may not be offered by traditional measures. Based on a large dataset of public ITO announcements we examine the role that structural embeddedness can play in predicting contract duration. We find preliminary evidence suggesting that network position does matter in predicting contract structure over and above the traditional economic variables.

Keywords: Social Network, Reputation, IT Outsourcing, Node-level and Network-level effects
Firms have always aimed to exploit economies of scale and scope (Chandler 1990). However, advances in information technology (IT) have enabled firms to harness these capabilities from beyond the rigid boundaries of the firm (Gurbaxani and Whang 1991; Malone et al. 1987). As a result, outsourcing has evolved to be the prevailing strategy to acquire information technology services. A recent estimate predicts that the market for IT outsourcing (ITO) will reach $290 billion by 2010 (Gartner 2006) and the average contract size of the top 100 outsourcing deals of 2005 is $700 million (International Data Corp. 2006). However, industry analysts have noticed that contractual disputes and unraveled outsourcing relationships are common (DiamondCluster 2006; Goolsby and Whitlow 2004). Given the global acceptance of ITO as an important business thrust, it becomes imperative for firms undertaking ITO to gauge the potential of non-cooperative behavior by the other party.

Vendors’ organizational, financial or human capital alone need not predict a long term outsourcing relationship. Even quality certifications like “CMM-levels” have been shown to be either ineffective (Banerjee and Duflo 2000) or merely a signal of ability and not ability itself (Gopal and Gao forthcoming). Thus, directly observable indicators of non-cooperative behavior are few. Firms therefore seek ways to mitigate this risk of opportunism.

Several early papers that examined contracting in IT outsourcing advance the view that governance mechanisms ought to mitigate opportunism by being explicit, and drafting contracts as complete as possible (Hirschheim and Lacity 2000; Lacity and Hirschheim 1993; Lacity and Willcocks 1998). At the same time, several other researchers have argued that contracts being invariably incomplete mechanisms such as reputation and repeated relationships offer a more effective governance structure (Banerjee and Duflo 2000). Both streams of prior literature make stringent assumptions on what can be contractible or what can be enforceable between parties. Literature on formal contracting assumes that, ex-post, a third party is able to both observe and verify the contractual contingencies that were specified ex-ante. On the other hand, relational contracting models, while relaxing the assumption of verifiability, assume that the parties involved interact repeatedly, that contracting parties have symmetric information about the realization of outcomes, and that any potential deviations in cooperative behavior are detected and punished (Baker et al. 2002; Brown et al. 2004).

In the case of ITO both of these assumptions are strong assumptions to make. An ITO arrangement typically includes requirements that are difficult to verify and difficult to specify ex ante (Banerjee and Duflo 2000; Kalnins and Mayer 2004). This limits the extent to which formal contracts can protect parties from rent appropriation. IT outsourcing, even if undertaken with the same vendor, need not involve the repeated exchange of identical products or services, as usually assumed in relational contracting models (Baker et al. 2002). As a result IT outsourcing is the ideal platform to test the role of alternate mechanisms in contract governance.

Inter-organizational networks arise in this market from outsourcing transactions conducted across a broad spectrum of firms. The network can serve as a conduit for relational information about potential exchange partners. The reputation of a firm can therefore be a result of how the firm is positioned in a network, which influences how much information about the particular firm flows within the network. Thus this “structural embeddedness” of the firm can affect the practice and management of IT outsourcing between these firms. By definition, the structural embeddedness perspective considers firms to be more than atomistic entities unaffected by its contractual partners (Granovetter 1985). Firms are instead assumed to be considerably aware and be affected by being embedded in the network of other firms in the industry. Following Klein and Leffler (1981), we posit that reputation is an asset, and that the impact of a breach of contract is the discernible loss of value of this asset.

In this paper, we study how a firm’s reputational capital arising from its network position affects an important aspect of IT outsourcing contracts, namely contract duration. The data analyzed comes from a large dataset compiled from public announcements of IT Outsourcing contracts. Outsourcing announcements typically list the client, the service provider, the value and duration of the agreement and a brief description of the service outsourced. We build a social network of who outsources to whom and can then examine the social capital of every firm in this network. Of the contract terms, we examine the contract duration for two reasons. First, theoretical arguments for the choice of contract duration suggest both longer and shorter terms under different conditions. Hence the final choice of contract duration can be of empirical significance. Second, firms making ITO announcements appear to be comfortable

1 Capability Maturity Models range from level 1 to level 5. Achieving level 5 is seen as recognition of a vendor’s process capability and is not a measure of output quality.
revealing this information unlike other terms of the contractual agreement. This suggests that the contract duration is less likely to be a piece of information that holds value as a tool for any competitive strategy. For our purposes, this isolation from confounding strategic factors, make it easier to identify the association of social capital to contract duration. Thus our specific research question, “How is network capital associated with the contract duration in IT Outsourcing contracts.”

Consistent with prior literature, we define IT Outsourcing as the process of procuring information systems services from an external service provider through multi-year contractual arrangements (Gilley and Rasheed 2000; Grover and Cheon 1994; Gurbaxani 2007; Quinn and Hilmer 1994). Our dataset is rich and unique, in that it comprises of 2400 public announcements of such ITO arrangements over the period 1994-2004. From this set of contracts we create the network of client and service provider firms. We then calculate the relevant network measures. This data is then augmented with firms’ financial measures from Compustat. To the best of our knowledge, this work is the first attempt at creating a social network of IT outsourcing firms. This dataset is analyzed using two novel approaches. We use an econometric specification that rules out various alternate explanations. Confidence in our results is enhanced by using a multi-way clustered error-robust estimation. Further to account for the possibility that firms’ decision on contract duration can be related to other contracts undertaken by the contracting parties, we consider a network auto-regressive model which can capture the effects of the contracts’ neighborhood. Details of the econometric analysis are presented later in the paper.

In brief, we results show that contract duration is significantly associated with two complementary dimensions of uncertainty reduction. First, network measures that indicate vendor reputation are positively associated with longer contract duration. Second, we find a positive correlation of contract duration with the duration of neighboring contracts, where the neighborhood is defined as contracts that share the same client firm or vendor firm.

Prior literature has examined the role of reputation when reputation has been assigned exogenously. For example literature has examined reputation based on industry accepted standards like CMM or ISO (Banerjee and Duflo 2000; Gopal and Gao forthcoming) however in the context of ITO, study of reputation building has been restricted to dyadic measures of prior relationship (Dyer and Singh 1998). We believe this paper is the first to examine a firm’s endogenous development of its reputational capital that is observable from beyond the set of trading partners that the firm has encountered. As a result, our operationalization of reputational capital suggests a network-level measure in addition to a dyadic or node-level measure of reputation.

The paper is structured as follows: the next section discussed the relevant literature and builds theory. We then develop testable hypotheses and discuss alternate explanations. In the following section, we elaborate the data, how we create the social network and calculate the relevant network measures.

Theory and Hypotheses

The role of reputation

Studies of outsourcing suggest that the track record and reputation of the vendor can play an important role in the outsourcing initiative (Crocker and Reynolds 1993; Masten and Crocker 1985). Banerjee and Duflo (Banerjee and Duflo 2000) develop a signaling model of IT outsourcing where they show that because of asymmetric information, the choice between a fixed price contract and a risk-sharing contract can serve as a signal for the quality of the outsourcer. Accordingly, low reputation vendors will prefer projects that are simpler and easier to define and will pay a higher share of the overrun. Reputation of the vendor may serve to mitigate the ex-post opportunism that has characterized much of the earlier literature on contracts (Laffont and Tirole 1988). When the nature of the service requires asset specific investments, reputational concerns reduce the need for inflexible long-term provisions in contracts, as well as stringent damage measures for non-performance (Joskow 1985).

The reputation of an actor can be inferred from the firm’s position in a network. The network position can also influence how information about a particular actor flows within the network. The network can serve as a conduit for relational information about potential exchange partners. The aspect of structural embeddedness in relation to contract characteristics is different from the dyadic measures of reputation in economics literature or relational embeddedness in sociology. Such dyadic measures can be a source of relationship specificity that strengthens contracts (Brown et al. 2004) or a determinant of contract characteristics in a future transaction (Banerjee and Duflo 2000). However, the relationship can also act as signals of underlying quality of the participants to other participants in the network beyond the dyad (Podolny 2001). As a result the network does more than be a mere conduit of
information, it acts in the manner of what Podolny refers to as a ‘prism’ which provides to a third party, information pertaining to the focal dyad.

Structural embeddedness also adds to the transaction cost economics argument of ‘fundamental transformation’ or ‘small numbers bargaining’ (Uzzi 1997). If we accept the premise that that successful prior engagement introduces relationship specificity, the market for ITO would be limited to dyads of exchange partners that are locked into bilateral trading relationships. The reason for this being that when specific investments are important to an exchange, parties prefer to insulate themselves from competition ex post; preferring to continue in bilateral exchange because the value of trading together outweighs the advantages of trading with others. However, the existence of firms with multiple trading partners suggests that reputation and relational embeddedness does not completely explain the choice of partners. Looking at this from a structural embeddedness perspective, we can argue that structure provides a mechanism for preventing opportunism through communal enforcement (Kandori 1992), which allows the firm to benefit from an expansive network (Beckman et al. 2004; Uzzi 1997). In summary, we suggest that the networked nature of ITO industry provides an environment where the network could affect the nature of the contract. Specifically, the capital that the trading partner controls in the network characterized by proximity and centrality (Robinson and Stuart 2007), play an additional role in governance as measured in the duration of the initial and the renewed contract.

**The role of contract duration**

Contract duration is an important decision variable for firms deciding to outsource IT. A considerable amount of prior literature has highlighted the importance of contract duration (Joskow 1985). Long term outsourcing deals are advantageous from the vendor’s viewpoint since they allow vendors to recover costs of initial investments and give them a stake in future production. The expected stream of revenue that accrues to a vendor in a long-term contract as well as anticipated cost savings provide incentives for vendors to undertake ex-ante non-contractible specific investments, such as learning the technological and business environment in the client firm. For a client the advantage is that long term contracts both minimize the risk of business disruption as well as benefit from relation-specific assets made by a vendor. Longer duration contracts also lower the costs of bargaining and friction involving contract renegotiation.

The contractual uncertainty results from exchange hazards such as post-contractual opportunism and contract incompleteness. Prior research has emphasized the difficulty of writing contracts with a complete description of the future stream of service required from the vendor (Nam et al. 1996). Given the complexity and substantial uncertainty characterizing IT, it is difficult to build provisions to deter the threat of inefficient bargaining, as the contract may become too rigid to deal with the incompleteness in describing tasks (e.g. Rogerson 1992). Therefore given the difficulty of writing and enforcing detailed contract terms to safeguard against post-contract opportunism, long-term contracts could lead to ex post adverse outcomes such as shirking and mal-adaptation (Dahlstrom and Nygaard 1999). The danger is that a vendor can under-invest in non-contractible client-specific investments or that clients could engage in acrimonious bargaining to capture appropriable quasi-rents.

Duration represents a design consideration in this paper rather than an element of risk. In the case of large ITO contracts the duration of the contract is often the end result of a process of negotiation. Often the decision of which vendor to contract with is separate from the decision of how long or short the contract should be. The contracted duration, itself, can be a function of various other aspects such as the relative bargaining power or an industry convention. Beyond a general notion of a ‘long-term’ contract or a ‘short-term’ contract, there is little evidence of what the ideal duration for a particular outsourcing arrangement is. The precision with which contractors can accurately estimate the costs and benefits of a contract term is considerably lower for longer contracts (Masten and Saussier 2000). The contract duration is therefore an expectation of how long the contract lasts and as such an important contract feature that merits deeper understanding.

**Hypotheses**

We hope to uncover the role of network based reputation mechanisms in addressing an important aspect of IT outsourcing – the challenges underlying ex post governance. Williamson posits the following ex post governance costs incurred by parties: (i) maladaptation costs incurred when parties are unable to factor in ex post contingencies; (ii) haggling costs incurred when bilateral efforts are required to correct ex post misalignment; (iii) the set up and running costs associated with the governance structures to which disputes that arise during the exchange are
referred, and (iv) bonding costs of effecting secure commitments (Williamson 1996 pg 176). While this paper shares the focus on ex post governance costs with prior TCE literature, we differ from TCE in the role of the “fundamental transformation”. Williamson posits that when specific investments are important to an exchange, parties prefer to contract repeatedly with a smaller set of trading partners because the value of trading together outweighs the advantages of trading with others. However, in the market for outsourced IT services we observe firms engaging in a variety of outsourcing arrangements with multiple trading partners. Further, as suggested by Granovetter (1985), firms are rarely atomistic market participants but embedded in a web of trading relationships. Given the practice of repeated market interactions, mechanisms that help meet the challenges of ex-post governance gain significance.

**Impact of Clients’ Reputation**

We suggest two mechanisms by which a social network plays the role of a reputation device. First, a social network provides the conduit for market participants to exchange information about exchange opportunities as well as the actual services exchanged (Granovetter 1995). The social network structure provides a mechanism for community enforcement and communal sanctions, where information flowing through a community prevents the potential for opportunism (Kandori 1992). A social network’s function as a conduit of reputation is then especially valuable when it is difficult to either monitor the vendor’s effort or when it is difficult to design output-based compensation. Thus, a buyer’s central position in a network is an indicator of its ability to sanction a seller; a client can then benefit from a large network (Beckman et al. 2004; Uzzi 1997). A buyer with a strong network position faces a lower likelihood of mal-adaptation, haggling, bonding and costs of administering contracts. This is because, while an individual firm only has local knowledge, a client who is in a strong network position, either through connections with multiple trading partners or through its structural position in the network, is able to control the overall transmission of information in the network, and thus in a better position to punish a vendor who reneges on the terms of an agreement. Following Burt (Burt 1987), a client with an expansive network position also has access to a diverse pool of market information, which could enhance its ability to use the information for strategic advantage. Thus clients with a strong network position have a greater advantage in bargaining power and in their ability to demand favorable contract terms. Since the network position of a client lowers the risk of ex post opportunism while deterring poor performance by a vendor, we expect that a client with a stronger network position will prefer shorter duration contracts. Clients embedded in a variety of transactions 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).

**Hypothesis 1:** Clients’ network capital is associated with shorter contract duration.

**Impact of Vendors’ Reputation**

A seller’s network position becomes an indicator of good performance, or its ability to fulfill the terms of the exchange. Klein and Leffler (1981) suggest that this aspect of a reputation is akin to a belief that an individual will be trusted, if, in the past her actions have been trustworthy. In this regard, the reputation of an actor acts in a similar manner to prior theoretical 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). Given the importance of asset specificity, as well as the likelihood of ex post opportunism, we expect that service providers with a greater stock of reputational capital are likely to be awarded contracts with a longer duration.

**Hypothesis 2:** Service Providers’ network capital is associated with longer contract duration.

The above discussion examines the role of extant reputation of parties in obtaining favorable terms at the level of the dyad but not a party’s incentive to build such a reputation. The second mechanism for a social network is that a firm’s position in the network acts as a signal of the underlying quality to participants beyond the dyad. Podolny (2001) posits that the network structure serves a purpose beyond a mere conduit of information or resources between a dyad, by acting as a ‘prism’ that provides information pertaining to a focal dyad to a third party, such as the relative quality of the market participants or the market arrangements that they enter into. A service provider then wants to maintain a favorable reputation amongst other service providers due to the future rents accrued by continuing good behavior. The type of contracts signed and the nature of exchange partners that a firm deals with can have a complex impact, for instance, when a vendor that has signed a contract with a low status client or has accepted an assignment for a service that does not lie in its domain of expertise, risks diluting valuable reputational capital.
Hypothesis 3: Service Providers’ network capital among other vendors is associated with longer contract duration

Data

Our dataset is broad and unique in that it covers a large set of diverse outsourcing contract announcements covering various industries, service types, regions and sizes. It comprises of public announcements of outsourcing contracts awarded. 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. This definition is consistent with both academic research as well as industry analysts (Grover et al. 1996; International Data Corp. 2006; Lacity and Hirschheim 1993). 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.” However, not every announcement needs to have disclosed all the above elements. Often contract value, duration or the services included are not mentioned in the announcement.

The Outsourcing Organization Network

Our dataset includes announcements that were published during the period 1985 to 2005. However, due to small sample sizes for the years prior to 1994, we restrict our sample to the period 1994-2004. The number of unique contracts in the entire time period is 2400. At minimum these announcements provide the client and vendor names.

To create the network of ITO firms we use the entire sample, which provides complete information of the actors involved in the transaction. The network measures are then computed from this entire network. This dataset is then appended with firm characteristics obtained from Compustat, a company that provides public financial information on companies. Using Compustat we augment our dataset with information about the firms such as number of employees, revenue, and earnings during the year in which the contract was signed. Naturally since not all firms are publically listed in the US, our sample of contracts with clients’ industry, and financial information drops to 305 observations and contracts that contain vendors’ financials is 994. Summary statistics are provided in Table 1.

The data comes from two sources. During the time period 1994-2000, one of the authors maintained a personal database of publicly announced ITO contracts. The second half of the data (period 1999-2004) comes from a leading professional industry analysis firm whose name we are obliged to keep confidential2. As part of their routine research and analysis activity, this firm updates their database with announcements of ITO contracts that were released through various newswire services. Based on the description of the service in the announcement the authors coded the service as having the following service types – ITO (33%), BPO (19%), Data Center Operations(4%), Network Maintenance(5%), Hardware and Software maintenance(15%), System Integration(21%) and others(2%).

Table 1 Data Summary

<table>
<thead>
<tr>
<th></th>
<th>Statistics</th>
<th>Contracts</th>
<th>Duration</th>
<th>Revenue (Million)</th>
<th>Employees (1000's)</th>
<th>EBITDA (Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vendors</strong></td>
<td>Mean</td>
<td>6.45</td>
<td>4.81</td>
<td>8773.17</td>
<td>33.70</td>
<td>1508.63</td>
</tr>
<tr>
<td></td>
<td>StdDeviation</td>
<td>26.53</td>
<td>2.87</td>
<td>16701.22</td>
<td>66.29</td>
<td>3647.66</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1</td>
<td>1</td>
<td>0.29</td>
<td>0.009</td>
<td>-166.266</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>312</td>
<td>20</td>
<td>81667</td>
<td>443</td>
<td>29065</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>374</td>
<td>216</td>
<td>180</td>
<td>161</td>
<td>180</td>
</tr>
<tr>
<td><strong>Clients</strong></td>
<td>Mean</td>
<td>1.56</td>
<td>6.00</td>
<td>17177.82</td>
<td>49.41</td>
<td>3437.33</td>
</tr>
<tr>
<td></td>
<td>StdDeviation</td>
<td>2.12</td>
<td>3.04</td>
<td>35707.15</td>
<td>84.32</td>
<td>10040.02</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1</td>
<td>0.4</td>
<td>1.789</td>
<td>0.038</td>
<td>-1808</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>51</td>
<td>20</td>
<td>156911.9</td>
<td>905.77</td>
<td>118107.00</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>1544</td>
<td>1056</td>
<td>379</td>
<td>355</td>
<td>377</td>
</tr>
</tbody>
</table>

2 Contracts that had been captured in both datasets in the year 2000 have been included only once.
Actors involved in the 2400 contracts are 1544 unique client firms and 374 unique vendors. The number of contracts per vendor range from 1 to 312. On average each vendor has 6.44 contracts over the 11 years. In terms of firm characteristics, client firms, on average, earn a revenue of $18.8 billion, has an EBITDA of $2.9 billion and employs 51,300 employees. The average service provider on the other hand, earns revenues of $8.1 billion, an EBITDA of $1.2 million with 29,900 employees.

**Social Network structure**

In the network of outsourcing clients and vendors, each firm occupies a node and each edge corresponds to an ITO contract. Such a network is called a bipartite or two-mode network as clients and vendors belong to two separate groups that do not contain an edge between two of the same kind. A bipartite graph projected as a unipartite graph comprised of either all clients or all service providers and a tie in this graph would correspond to a shared trading partner. The bipartite structure lets us understand the nature of the industry structure as a whole while the latter allows us to understand the structure of firms among its own kind.

**Analysis and Results**

Our objective is to estimate the association of contract duration with the measures of network capital while simultaneously ruling out the possibility of alternate explanations. Ordinary least squares (OLS) estimation is commonly used to estimate similar models. However the nature of our data violates critical assumptions of OLS due to the fact that the observations are, by design, not independent. 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 or vendors or both. As a result, the parameters of any one contract are likely to be correlated with the parameters of other contracts with which it shares clients or vendor firms. Such a violation of the independence assumption can result in the OLS parameter estimates being inconsistent and the standard errors lower than the true standard errors.

In this paper we deal with this problem of observation level dependence using two novel approaches. In the first part, we consider the effect of correlation in the unobservable traits of contracts due to the fact that contracts are signed by clients and vendors who appear multiple times in the dataset. In the second part we consider the effect of contract parameters to be correlated to other contracts across the network due to the flow of contracting information via shared clients and vendor firms. Details of the estimation techniques follow:

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3 The Fruchterman-Reingold algorithm (Fruchterman and Reingold 1991) is a commonly used layout option in social network analysis packages since it provides an aesthetically appealing graph layout.
Estimation methodology – cluster robust inference

The residual, which captures the unobserved traits, in each observation is instead clustered by common clients and simultaneously clustered by common 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. The problem of nested clusters was easily remedied by clustering at the highest level and ignoring the effect of the second level of clusters. However until recently, there has been little help available in estimating error structures that had multiple non-nested clusters of dependence. A recently published paper by Cameron et al. (forthcoming) provides a technique to make cluster-robust inferences even in the presence of multi-way clusters with few distributional constraints placed on the error structure. A brief explanation of the method follows.

Consider the model without clustered observation: \( y_i = x_i \beta + u_i \) for contract \( i \in \{1,2, ... N\} \). Here iid assumptions require that \( \text{Cov}(e_i, e_j) = 0 \). Now extending this to the two-way non-nested cluster: \( y_{gh} = x_{gh} \beta + u_{gh} \) where observation \( i \) belongs to non-nested clusters defined by \( g \in \{1,2, ... G\} \) and \( h \in \{1,2, ... H\} \). The covariance is neither diagonal (as in an on-clustered case) nor block-diagonal (as in the one-dimensional clustered case). In the case of 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.

From Cameron et al. (forthcoming) we know that \( \hat{\beta} = X'((\hat{\Omega}^* \cdot S^G)^-1)X \) where \( S^G \) is an indicator matrix in which the \( ij \) cell takes a value of 1 if \( i^h \) and \( j^h \) contract belong to the same cluster. Cameron et al. also provide a three stage approach to compute the variance of the estimator.

Estimation methodology – Network Autoregression

As discussed, each contract is tied to other contracts due to shared vendors and clients. We refer to the set of contracts, which a particular contract is associated with, as the neighborhood of the focal contract. It is therefore likely that a particular contract’s duration is affected by the duration of the contracts in its neighborhood. Therefore, to estimate the parameters of interest, in addition to controlling for other exogenous covariates the model must account for the social endogeneity of the dependent variable on the corresponding value in its neighborhood. To explicitly capture the degree of correlation between a focal contract duration and the durations of the neighboring contracts we rely on a Network Autoregression estimation technique (Butts 2008; Doreian 1989; 1990).

The network autoregressive (AR) models are considered a sub-model of the network autoregressive moving average (Sharma 1997) and is essentially identical to the well understood spatial ARMA models (Anselin 1988). An ARMA model is essentially a standard regression model with two additional components, namely the AR and the MA components. The AR portion captures the effect of each observation on all the other observations that it is tied to. MA allows for the correlation in the error terms among the observations that are tied to one another. 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. On the other hand the MA component captures the effect of an exogenous shock on the unobservable traits on all members of the neighborhood. Both components of the network ARMA model can act individually or simultaneously and the choice of the right model is largely a function of the mechanism of interaction among the individual observations.

In our case, the mechanism of interaction is as follows. A firm that has signed multiple contracts is likely to have shared some decision parameters amongst the various contracts. Therefore, from the perspective of a focal contract, the contract parameters are likely to be 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. Therefore it is likely that a focal contract both affects and is affected by neighboring contracts, where the neighborhood is defined as the set of

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4 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](http://gelbach.eller.arizona.edu/~gelbach/ado/cgmreg.ado).

5 Conceptually, the network autoregression is very similar to the widely used spatial autocorrelation technique of estimation. Spatial autocorrelation, attributed largely to Anselin (1988), is used commonly in geographic applications. Subroutines to estimate a network ARMA model in R is available in statnet, (Handcock et al. 2004)
contracts with which it shares a client or vendor firm. From prior literature on network and spatial ARMA models, we see that this mechanism corresponds closely to the application of the AR models.

To estimate a network AR model, we construct a network of contracts. Each node represents an ITO contract and the edges correspond to a common client or vendor. The corresponding adjacency matrix $W$ is an $N \times N$ 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 two contracts are not connected, or the tie can take a value of 1 for one shared firm (either a common client or vendor) or a value of 2 when the two contracts share a common client and vendor (i.e. the two client and vendor sign two separate contracts at two different points in time).

The model that is estimated using a maximum likelihood estimation is as follows:

$$ Y = WY + X\beta + u $$

Where $W$ is the adjacency matrix constructed as discussed above. The adjacency matrix $W$ multiplied by the vector of contract durations forms the AR component of the Network AR model. It is to be noted that the $X$ matrix contains the network variables of interest to test each hypothesis, and the control variables used to rule out alternate explanations. The variables that are used are presented in the next section.

**Network measures of reputational capital**

As discussed earlier the network of outsourcing clients and vendors provides a rich source of network measures that capture the essence of reputational capital. In order to understand the operationalization of the relevant network measures, it is useful to examine a stylized example of the likely process by which clients and vendors would evaluate the information available through the network.

Interaction between a client and the service provider firm for the purpose of contracting for outsourcing services typically commences with the service providers response to the RFP. In the RFP the vendor responds to the various specifications requested by the client firm. In addition to the response to the technical requirements, a vendor is often expected to provide references to demonstrate that the vendor has prior experience in the nature of the work proposed.

Over and above meeting the technical specifications, it is likely that the vendor would attempt to establish credibility by listing the various clients they have provided outsourcing services to. It is also likely that in addition to providing the list of clients contracted with, the vendor would highlight the more prestigious clients in the list. The client in its part would likely be better informed the more number of vendors it has interacted with in the past. Further, all else being the same, a client firm is likely to be better informed while making the decision to contract, if the client has had prior contracting experience with vendors of higher status than with lower status.

In addition to the direct effect of 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 reputational capital enjoyed by the vendor among vendors themselves. In other words, if client firms could observe a ranking of vendors based on how centrally located they are among the set of vendors, then it is likely that such a ranking will provide the client a reinforced sense of assurance that the vendors are less likely to behave non-opportunistically.

In order to capture the vendors reputational 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 more network. The client’s experience with contracting is captured through the degree centrality and Eigen vector centrality in the two-mode network.

A detailed discussion on the differences in the two centrality measures for a one-mode and a two-mode network is presented in (Faust 1997). Essentially, the degree centrality of a vendor in the two mode network captures the ‘volume’ of transactions that the vendor has undertaken. The Eigen vector centrality has been argued to represent popularity, status and status. This measure captures the notion that a node is more central when it is tied to nodes that are themselves more central. Thus the measure represents centrality at a network level than just a node level. From the point of view of the client, the firms experience with contracting with various vendors is captured in its degree centrality and correspondingly its experience with contracting with not just more vendors but vendors who are themselves 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 mapping of the appropriate network measures used to test the hypotheses is summarized in table 2.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Network Measure</th>
</tr>
</thead>
</table>
| H1: Service Providers’ network capital is associated with longer contract duration. | A: Vendors’ degree centrality in the two-mode network: captures the notion of the volume of outsourcing arrangements that a vendor has managed until that year due to having multiple clients  
B: Vendors’ Eigen vector centrality in the two-mode network: captures the effect that vendors are tied to clients who are themselves central in the network. |
| H2: Clients’ network capital is associated with shorter contract duration. | C: Clients’ degree centrality in the two-mode network: captures the effect of a client being tied to a larger set of vendor firms until that year  
D: Clients’ Eigen vector centrality: captures the extent of experience the client has in contracting with central vendors. |
| H3: Service Providers’ network 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. |

Literature often treats network measures ignoring the evolution of the network itself. As a result, the measures are computed as if at any point in time, the network resembled the final network structure. Clearly this approach leads to the problem that in intermediate years, contract duration is estimated on measures of network capital even before the node has accumulated that capital. In order to avoid this possible error, 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 of the contract. For example if Xerox signed a contract with IBM in the year 2000, then in order to measure the network capital for Xerox and EDS 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 IBM in the year 2002, the network measure of Xerox associated with that observation is computed as if the network was observed in the year 2002.

Alternate Explanation and Control Variables

Given the complexity of the contracting decision, various covarying parameters of the client, vendor, the nature of the service the relationship etc. can confound the association between contract duration and the network measures of interest. To systematically rule out the effect of these confounding factors, and to isolate the direct effect of the independent network variable on the contract duration we include relevant control variables in our regression models. The confounding variables can be classified under three main categories, namely attributes of the contracting parties, attributes of the relationship and attributes of the contracted service.

Attributes of the contracting parties:

It is possible that firms’ size can affect both contract duration and the network position. Larger firms may undertake more outsourcing because there such firms have more activities that can be outsourced. Conversely firms may be large (in terms of number of employees) because they have not entered into large outsourcing arrangements. Therefore our model needs to control for firm size. Firm size can be controlled for using one of any relevant financial metrics. Based on the correlation of the financial variables to the contract duration we use client earnings
as this measure has higher correlation with contract duration than revenue or number of employees. Correspondingly, a vendor’s size may be perceived as proxy for reputation. In order to offset the possibility that client firms use this metric to decide the likelihood of vendor’s opportunistic behavior, we control for vendors size in terms of number of employees.

We control for the industry that a client firm belongs to as the scale and scope of an ITO arrangement can differ across industries even for the same service. For instance accounting systems maintenance and development for a bank need not be similar to the same service delivered to a discrete manufacturing firm. We limit the systematic difference in ITO contracting across industry sectors by including dummy variables to classify client firms according to their two digit SIC coding.

**Attributes of the relationship:**

Firms that have engaged in prior interaction are likely to base their decision on a new contracting differently from two firms that enter into an agreement for the first time. Literature commonly refers to relational governance evolving from repeated interaction. We therefore control for this aspect by including a binary variable that takes a value of 1 if the contract includes a client and a vendor who have had a prior contractual agreement and 0 otherwise.

The median contract duration for outsourcing undertaken before 1999 is 7 years while this value drops to 5 after 1999 as shown in figure 3. In order to account for this systematic change in the outsourcing industry we add a binary control variable to the model, which takes a value of 1 if the contract is signed before the year 1999.

**Attributes of the outsourced services:**

In addition to the nature of the contracting parties and their prior interactions, a significant correlation is likely to exist with the type of service outsourced and the volume of the transaction. In order to control for the nature of the outsourced service, we add seven binary dummy variables for various commonly outsourced service types. Each of the seven variables can take a value of 1 or 0 depending on whether the contract announcement lists the particular service as being part of the outsourcing arrangement. The outsourcing announcement is analyzed for the mention of any of 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.

Further, we control for the size of the transaction by including the contract value as another control variable. It is likely that the contract value and duration are correlated.

**Results**

The results from the cluster-robust estimation and the network autoregressive estimation are presented in table 3 below. Columns 1, 4, and 7 have far fewer observations that the rest due to the inclusion of clients’ financial terms. Only 305 observations consisted of US-based publically listed client firms. Columns 2, 5, and 8 contain all control variables except client size. In the network autoregression model presented in Columns 3, 6, and 9 we replace the value of the client size with 0 instead of deleting the case. In the interest of space, estimates of the various service type, industry sector, vendor employees and client earnings have now been presented.

We do not find support for hypothesis 1 as is seen in the estimates in column 2 and 3. Clients’ Eigen vector centrality in the two mode network is significant but in the direction opposite of what was anticipated. This suggests that a client associated with central vendors has the ability to sign a longer term contract. It is likely that being associated with high reputation vendors assures the firm of a partner-like relationship which outweighs the benefits of repeated arms-length contracts. From the significant estimates in columns 5 and 6 we find that hypothesis 1 which states that vendors two mode centrality affects contract duration positively is well supported. We find evidence to

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6 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.

7 To ensure that the estimation subroutine was working as expected we estimated the above model using OLS with robust White sandwich estimators (White 1980). The coefficients are similar to the ones below.
support hypothesis 3 that vendors’ reputation in the one mode network is positively associated with contract duration. In both hypotheses 2 and 3 we see that even though we control for the degree centrality, a vendor who is connected to more central alters is a significant predictor of contract duration. Due to limitations in space we do not discuss the other results pertaining to service types, industry sectors and time-frames.

**Table 3 Estimation results – Cluster-robust OLS and Network Autoregressive estimation**

<table>
<thead>
<tr>
<th>DV= Duration</th>
<th>Hypothesis-1</th>
<th>Hypothesis-2</th>
<th>Hypothesis-3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Client 2mode degree</td>
<td>-0.69</td>
<td>-0.44</td>
<td>0.17</td>
</tr>
<tr>
<td>Client 2mode Eigen vector</td>
<td>0.02</td>
<td>0.02*</td>
<td>0.06**</td>
</tr>
<tr>
<td>Vendors 2mode degree</td>
<td>0.05</td>
<td>0.04</td>
<td>0.11***</td>
</tr>
<tr>
<td>Vendors 2mode Eigen</td>
<td>0.00</td>
<td>0.01***</td>
<td>0.01*</td>
</tr>
<tr>
<td>Vendors 1mode degree</td>
<td>0.01</td>
<td>-0.01</td>
<td>0.05***</td>
</tr>
<tr>
<td>Vendors 1mode Eigen</td>
<td>0.02**</td>
<td>0.02**</td>
<td>0.02*</td>
</tr>
<tr>
<td>Prior relationship</td>
<td>0.31</td>
<td>-0.22</td>
<td>0.52**</td>
</tr>
<tr>
<td>Pre – 1999</td>
<td>0.95</td>
<td>0.97***</td>
<td>0.00***</td>
</tr>
<tr>
<td>Annual value</td>
<td>0.60***</td>
<td>0.45***</td>
<td>1.68***</td>
</tr>
<tr>
<td>Rho- AR correlation</td>
<td>0.0005***</td>
<td>0.0004**</td>
<td>0.0002*</td>
</tr>
<tr>
<td>Constant</td>
<td>3.89***</td>
<td>2.48***</td>
<td>3.59***</td>
</tr>
<tr>
<td>Observations</td>
<td>305</td>
<td>994</td>
<td>1729</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.283</td>
<td>0.185</td>
<td>0.246</td>
</tr>
</tbody>
</table>

Control variables for Service type, industry sectors and firm sizes have not been shown in the interest of space

*** p<0.01, ** p<0.05, * p<0.1 Standard errors in parentheses

From the significant estimates of the network auto-regression coefficients, we infer that our expectation that contract terms would likely be correlated along the network due to common clients and vendors. Further, having controlled for this correlation the significant estimates for vendors’ centrality in columns 6 and 9 reinforce our finding that vendor centrality does in fact predict contract duration.

**Discussion**

We find that the nature of reputational capital can play different roles in mitigating ex-ante uncertainty. The structural embeddedness of a vendor, within a network of clients and vendors, offers an indication of both vendors ability and the propensity to behave less opportunistically. The fact that the vendor manages many contracts suggests that an opportunistic behavior with one client can easily be known to a large set of potential clients. Building on this observation we see that a vendors association with many clients is likely to lead to longer contract duration, we see that the vendors association to more central clients is also a significant indicator of longer contract duration.

The other channel by which vendors’ reputation carries is the meta-network provided by network of vendors that share common ties. The association of a vendor to another vendor, albeit through a set of clients, offers an indication
that the vendor belongs to a set of vendors, which if high in status, is a group in which the focal vendor may not wish to lose status in through opportunistic behavior.

A client firm that undertakes an outsourcing arrangement after having entered into one in the past is likely to economize on contracting costs by allowing contract terms to correlate across time. It is likely that vendors responding to RFPs would similarly ‘borrow’ contract terms from prior contracts. A result of such a diffusion of common drivers of contract terms is that contract terms are likely to be correlated to contract terms in the neighborhood. We find strong evidence of this behavior in the significant estimates of the autoregressive coefficient. It is therefore likely that as the industry matures, conventions of contracting terms will arise.

The arguments developed in this paper suggest a role for structural embeddedness not only in predicting characteristics of inter-firm exchange, but also for the continuation and expansion of the relationship (measured in terms of duration and value controlling for service types). Such a finding could be very significant, not only for IT outsourcing but in the context of many buyer-seller relationships in the high technology area. Social capital developed in a relationship can act as a signal of underlying quality of the participants to other participants in the network beyond the dyad. Network based reputation can then serve 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). The network dimension of reputation is particularly important given that prior literature has demonstrated that reputation mechanisms such as certification are either not very effective (Banerjee and Duflo 2000) or constitute a costly signal (Gopal and Gao forthcoming). Adding to the noisiness of vendors’ reputation as a signal of their ability is the strategic reporting of their successful outsourcing deals. Further, Brown et al. (2004) argue that an agent’s reputation for good behavior is not observable outside the trading relationship. Given this difficulty in observability and verifiability surrounding outsourcing relationships, social networks provide an important mechanism of transmission of information about exchange performance. In future we intend to expand upon this work by examining the degree to which relational and structural mechanisms substitute or complement each other. Such dyadic measures can be a source of relationship specificity that strengthens contracts (Brown et al. 2004) or a determinant of contract characteristics in a future transaction (Banerjee and Duflo 2000).

Limitations

In the current version of the study we have identified a few data limitations and a few the empirical methods. In terms of data, relying on public information has its advantages and disadvantages. While we are exempt from biases associated with respondents’ perceptions we are limited in the breadth of variables that can be studied. One could also argue that the publicly announced outsourcing arrangements are systematically different. However, we feel that vendors and clients in the industry are also recipients of the same public information and hence are likely to perform their mental calculus based on similar, if not the same, information.

Our current estimates pass the statistical tests of homoskedasticity and multicollinearity. However, passing the test of homoskedasticity 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 we adopt an approach where we do not place any a priori assumptions on the error structure and instead perform a bootstrap estimation with multiple clusters in the error covariance matrix.

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 who won a contract transpires easily through the market, it is equally likely that news of failure would resonate through the market. In fact it is precisely the fear that this news would be public that we argue restricts opportunistic behavior. Hence although we do not factor in successful as against 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 alliances is likely to have been more successful than a firm with a less number of contracts in a comparable time frame.

Conclusion

The aspect of reputation mitigating uncertainty has received some attention in the literature however to the best of our knowledge social capital as a measure of reputation in the context of ITO has yet to be examined. In the preliminary stage of this paper we find strong indication that our research framework is valid and that the
hypotheses that emerge from the framework are testable. There are various directions that this work will be extended in further papers. It is foreseeable that our data can be split by the nature of services outsourced. We are pursuing analysis to test if the reputational capital matter more for certain types of services than others, in certain industries more than others, or in different parts of the world. Given the rich literature available in sociology on the nature of social capital we envisage the development of richer theory on predicting the likelihood of contract design in the contemporary practice of Outsourcing and Offshoring.

REFERENCES

General Topics


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