Single-Sourcing vs Multisourcing: An Empirical Analysis of Large IT Outsourcing Arrangements

Abstract

As the IT services landscape matures, clients are increasingly adopting multisourcing arrangements that involve multiple vendors. While a large body of IS literature addresses issues of whether or not to outsource (to a single vendor), what types of contracts to use, and how to achieve optimal relational governance, little is known about the antecedents and consequents of the single vs multisourcing decision. Moreover, while conceptual and analytical models of single-sourcing vs multisourcing have been developed, there is no empirical IS research using a large-scale dataset with rigorous econometric analysis that examines the antecedents and consequents of multisourcing in the IT context. This paper fills this void, using the transaction cost economic (TCE) lens and a dataset of 49,057 large IT outsourcing arrangements that spans multiple industries and dates back 25 years. We find that there is a curvilinear relationship between number of IT services in an IT outsourcing arrangement and the likelihood of multisourcing. This relationship increases as the number of IT services increases to up to five services, and then decreases. For managers who plan to multisource IT outsourcing arrangements, this research provides guidance to minimize exchange hazards through a better understanding of the relationship between sourcing choice, client IT outsourcing capabilities, the competitiveness of the vendor landscape, and the number of IT services in an IT outsourcing arrangement. We provide empirical evidence that the choice between single sourcing and multisourcing is material to the performance of outsourcing contracts as an incorrect sourcing choice is likely to result in negative contract outcomes.

Keywords: IT Outsourcing, Single-sourcing, Multisourcing, Sourcing Choice, Misalignment, Dynamic Panel Model, XGBoost.

1. Introduction

A large body of research in the IT outsourcing area (Dibbern et al. 2004, Oshri et al. 2015, Kotlarsky et al. 2018) examines questions such as when and what IT services work clients outsource (Lacity and Hirschheim 1993; Grover and Teng 1993; Loh and Venkatraman 1992a, 1992b), how to contract for outsourcing (Aron et al. 2008, Gopal and Koka 2010, Han et al. 2011, Koh et al. 2004, Susarla et al. 2010, Susarla 2012), and how to manage the client-vendor relationship (Kirsch 2004; Kishore et al. 2003; Levina 2005; Levina and Vaast 2005, 2008; Choudhury and Sabherwal 2003; Bandopadhyay and Pathak 2007; Gopal and Gao 2009; Sabherwal 1999; Mani et al. 2012; Sia et al. 2008; Su et al. 2016; Vaidyanathan et al. 2012). However, this body of research largely focuses on the dyadic client-vendor relationships where a client outsources to just one IT vendor, commonly referred to as single-sourcing. Increasingly, clients are entering into IT outsourcing arrangements with not just one vendor, but instead with a multitude of vendors (Cohen and Young 2006, Bapna et al. 2010, Karamouzis 2011, Anderson and Parker 2013, Bala et al. 2014, Mishra et al. 2015, Oshri et al. 2019), which is commonly referred to as multisourcing.

Though academic research on IT outsourcing has largely focused on single-sourcing, the trend toward multisourcing is not surprising. As prior research suggests (e.g., Levina and Ross 2003), clients outsource IT work to take advantage of economy of scale and specialization of IT vendors. As the size and complexity of outsourced IT work increases and involves different IT services (e.g., application management, network management, systems integration, datacenter outsourcing, desktop outsourcing, IT helpdesk, etc.), it is likely that one IT vendor does not possess the economy of scale and specialization in all of the different services involved in an outsourced arrangement. Thus, multisourcing provides the benefits of best-of-breed vendors and facilitates exploratory learning (Koo et al. 2017). In this way, when an IT outsourcing deal involves more IT services, clients may involve multiple vendors in the arrangement (Bapna et al. 2010, 2013a; Anderson and Parker 2013; Bhattacharya et al. 2018).

Involving multiple vendors in an IT outsourcing arrangement may increase competition between vendors and mitigate operational and strategic risks (Richardson 1993, Lacity and Willcocks 1998, Aron et al. 2005, Levina and Su 2008, Aubert et al. 2016). For example, involving multiple vendors may reduce vendor lock-in and hold-up costs. When these vendors are distributed globally there is also the potential to reduce labor costs and increase efficiency by executing the work round-the-clock (Gokpinar et al. 2013). However, involving multiple vendors in one IT outsourcing arrangement reduces a vendor's incentive to make client-specific investments and requires clients to develop capabilities for monitoring and coordinating multiple vendors and integrating their deliverables (Clemons et al. 1993, Bakos and Brynjolfsson 1993, Levina and Su 2008, Anderson and Parker 2013, Tripathy and Eppinger 2013, Bala et al. 2014, Hao et al. 2016, Mishra and Sinha 2016). Nevertheless, if a client has IT outsourcing capabilities—if it can specify requirement specifications and performance goals to be met by different vendors and monitor, coordinate, and integrate the deliverables from different vendors (Bapna et al. 2013a, Mishra and Sinha 2016, Oshri et al. 2019)—then a client can take advantage of specialization in the IT industry by using multiple vendors and itself act as the chief integrator.

The ability and opportunities to multisource in this way are contingent on the availability and presence of different vendors with distinctive capabilities. Hence, the number of services in an IT outsourcing arrangement, the IT outsourcing capabilities of the client, and the availability of distinctive vendors with required capabilities are likely to determine the optimal sourcing choice. The question of whether to outsource or not is often examined using the transaction cost framework as a tradeoff between the exchange hazards faced in terms of the monitoring, coordination, and integration cost incurred by the client versus the benefits from the scale and specialization of the market vendor (Loh and Venkatraman 1992a, Ang and Straub 1998). However, how the transaction cost perspective extends to the single-sourcing vs multisourcing decision has not been studied in prior research. In this research, we extend the transaction cost perspective and position the choice between single-sourcing and multisourcing as an examination of the interplay between the client's IT outsourcing capabilities to manage the exchange hazards and the availability of specialized capabilities in the market as the number of services in an IT outsourcing arrangement increases.

Using a dataset of 49,057 large IT outsourcing arrangements (average size of about $58 million) from 1989 to 2014 through fixed effect panel logit and dynamic panel logit models we present four key findings. First, we find that as the number of services in an IT outsourcing arrangement increases up to about five, the likelihood of multisourcing increases, however, beyond five IT services, the increased coordination costs exceed the benefits of specialization and single-sourcing is again the preferred alternative. Second, if the client develops IT outsourcing capabilities, the client has a broader range of sourcing choices available to outsource IT work, as the coordination and integration capabilities of the client open opportunities to take advantage of the economy of specialization and multisource vendors. Third, we find that an increase in vendor specialization and competition increases the probability of finding specialty vendors for different services, which enhances the opportunity to multisource. Finally, we test our multisourcing theory using 1,588 contracts with known contract outcomes and find that misalignment in sourcing choice leads to contract failure. This test provides evidence that the single vs multisourcing choice is important for the success of the IT outsourcing contract, and that a suboptimal sourcing choice can result in contract cancellation or renegotiation.

The theoretical contribution of the study is to extend the transaction cost framework used to make the insourcing vs outsourcing decision to the single-sourcing vs multisourcing decision. We find that as the number of different services in an IT outsourcing arrangement increases up to a point, as a client's IT outsourcing capability to manage exchange hazards increases, and when competition/capabilities in the IT services market increases, the likelihood of multisourcing increases compared to single-sourcing.

The remainder of the paper is organized as follows: The second section situates the paper in the context of the IT outsourcing literature. Section three details the theory and hypothesis development for the antecedents and consequences of sourcing choice, section four describes the data and variables, section five describes the empirical approaches and presents the econometric models and results, section six discusses the robustness tests, and section seven examines the implications of the findings.

2. Literature Review

We use the framework from Kotlarsky et al. (2018) to highlight how this work is positioned in the overall landscape of IS research in the IT outsourcing area. Table 1 summarizes the body of IS literature and pinpoints a critical gap in the understanding of the antecedents and consequents of multisourcing, which we fill with this paper. As evident from Table 1, the vast majority of the IS literature has focused on the insourcing vs outsourcing decision and has covered topics ranging from making the sourcing choice (Loh and Venkatraman 1992b, Slaughter and Ang 1996, Ang and Straub 1998, Lee et al. 2004) to designing the outsourcing contracts (Gopal and Konduru 2008, Walden 2005, Dey et al. 2010, Fitoussi and Gurbaxani 2012) and managing the outsourcing relationship (Sabherwal 1999, Choudhury and Sabherwal 2003, Koh et al. 2004, Levina and Vaast 2008). We further nuance the differences across various key papers in each section by focusing on their key research question, theoretical perspective, and methodology used. The IS literature focusing on single-sourcing vs multisourcing is sparse, and most of it falls under managing the outsourcing relationship (Levina and Su 2008, Wiener and Saunders 2014, Aubert et al. 2016, Plugge and Bouwman 2018, Lioliou et al. 2019). All of these are in-depth case studies that focus on the question of how to manage multisourcing arrangements. We argue that prior to managing a relationship there is the question of selecting the right type of outsourcing relationship. That issue is the focus of this paper.

Su and Levina (2011) argue that while multisourcing is a new area of research in IT outsourcing, it has been extensively studied in manufacturing, thus there emerges a need to map and integrate existing knowledge from manufacturing to IT outsourcing; for instance, the automotive industry has also seen a move towards managing multiple vendor relationships (Ahmadjian and Lincoln 2001). This governance form facilitates faster knowledge sharing within the organization via vendors' knowledge-sharing networks, leading to increased firm profit (Dyer and Hatch 2004). Along the same lines, Japanese automakers use a hybrid organizational form called parallel sourcing to achieve high vendor performance while still preserving the relationship and commitment benefits of single sourcing (Richardson 1993).

Our work relates to the operations management literature that has examined the single-sourcing vs multisourcing issue from a supply-chain risk-management perspective (Aydin et al. 2011, Narasimhan and Talluri 2009, Pournader et al. 2020, Tomlin and Yimin 2005, Wang et al. 2010, Yang et al. 2012). This literature focuses on understanding which vendors to choose, selecting the optimal number of vendors, and understanding how to divide IT-enabled services among multiple vendors (Ang et al. 2017, Anupindi and Akella 1993, Bimpikis et al. 2019, Dada et al. 2007, Federgruen and Yang 2008, Hu and Kostamis 2015); however, the primary methodology employed in this literature is analytical modeling and there is a dearth of empirical analyses studying the antecedents and outcomes of multisourcing.

We position the current research paper in the area of making the single-sourcing vs multisourcing IT outsourcing decision. Extant research in this area is limited to Bhattacharya et al. (2018), who use analytical modelling and a game theoretic approach to find a client's optimal sourcing strategy; Angst et al. (2017), who use institutional theory and data on US hospitals to study why hospitals are trending towards single-sourcing; and Handley et al. (2022), who use a knowledge-based framework to understand trend towards IT multisourcing.

We address the single-sourcing vs multisourcing question using an extensive multi-industry dataset on large IT outsourcing arrangements to examine how the number of services in an IT outsourcing deal, a client's IT outsourcing capabilities to manage exchange hazards, and the availability of distinctive vendor capabilities interact to influence the single-sourcing vs multisourcing choice. Further, we extend our analysis to also examine the consequences of an incorrect sourcing choice. By providing data-driven insights into both the antecedents and consequents of the multisourcing (or not) decision, we fill a significant gap in the ITO literature, as identified in Table 1.

3. Theory And Hypothesis Development

The insourcing vs outsourcing decision in IT sourcing is often examined using a transaction cost framework (Aral et al. 2018, Loh and Venkatraman 1992a, Ang and Straub 1998, Whitten and Leidner 2006). IT vendors typically have the advantage of economy of scale and specialization, however, clients incur lower monitoring, coordination, and integration costs for insourced IT compared to when the work is outsourced. The coordination costs when working with external vendors stem from exchange hazards (Williamson 1985, Nickerson and Silverman 2003), in particular, the key transaction characteristics of asset specificity, uncertainty, and frequency (Williamson 1979, Poppo and Zenger 2002). Further, asset specificity creates lock-in and motivates firms to develop long-term relationships with fewer vendors (Aral et al. 2018, Kishore et al. 2003, Su et al. 2016). Transaction cost economics (TCE) recommend that arrangements that are highly asset specific, involve high uncertainty, and occur frequently are more suitable to insource (Sia et al. 2008), meaning that, in the TCE-based literature, as exchange hazards increase, firms are more likely to insource compared to outsourcing, but as the capability to manage exchange hazards increases, firm outsource. In other words, if the vendors' economy of scale and specialization advantage dominates, outsourcing is chosen. On the other hand, if exchange hazards increase the cost of monitoring, coordination, and integration of work of external vendors beyond the benefits of the vendor's scale and specialization, insourcing is preferred. In this paper we extend the traditional insource vs outsource trade-off to the single-source vs multisource trade-off and show that as the capability to manage exchange hazards increases, clients are more likely to multisource in comparison to single-sourcing.

Antecedents of Sourcing Choice. Relative to multisourcing, single-sourcing has the economy of scale and integration advantage. If the client outsources IT services to one vendor, the vendor can offer an integrated solution. Similarly, the client's cost of monitoring and coordination is lower when it needs to monitor and coordinate with one vendor. On the other hand, multisourcing has the advantage of economics of specialization (Koo et al. 2017); if the client chooses a specialist for each separate service in an IT outsourcing arrangement, the client receives the benefit of economy of specialization but incurs a higher monitoring, coordination, and integration cost (Anderson and Parker 2013). This cost is even higher when the client chooses vendors across different time zones and from different cultural backgrounds (Bala et al. 2014, Hao et al. 2016). Thus, the choice between single-sourcing and multisourcing is a trade-off between the economy of scale and integration of single-sourcing with the economy of specialization of multisourcing (Koo et al. 2017).

The difference between single-sourcing and multisourcing can be described in this way: a generalist IT vendor has lower average cost across a set of IT services compared to a client or a specialist IT vendor. A vendor that offers services across different areas/domains can grow in scale, realizing economies of scale through economies of scope. Such a vendor can offer clients benefits of economies of scale and integration. However, a specialist IT vendor has a lower average cost for a specific IT service compared to the client and the generalist IT vendor. A vendor that focuses in just one area of IT service can also achieve economies of scale through specialization.

3.1 The Number of Services in an IT Outsourcing Arrangement and Sourcing Choice

As IT outsourcing arrangements become larger, they are more likely to include services that require distinct capabilities that no one vendor is likely to have. As global supply markets with different specialization and cost advantages emerge, different outsourcing strategies become available (Levina and Su 2008, Anderson and Parker 2013, Mishra and Sinha 2016, Oshri et al. 2019), so a client is more likely to consider multisourcing for an IT outsourcing arrangement with many different services since the economics of specialization are likely to dominate the economy of scale and integration advantage of single-sourcing. Thus, an IT outsourcing arrangement that includes different services is more likely to be multisourced rather than single-sourced.

For a client to be able to involve multiple vendors in an IT outsourcing arrangement, the client needs to define the different IT services that can be awarded to different specialist vendors (Bhattacharya et al. 2018). Delineating the different services in a large IT outsourcing arrangement that can be executed by different vendors also reduces exposure to and reliance on any one vendor and consequently reduces risks attributable to opportunistic behavior such as shirking (deliberate underperformance), opportunistic renegotiation, and vendor lock-in (Aron et al. 2005, Aubert et al. 2016). Therefore, if an IT outsourcing arrangement includes distinct services, then the client can benefit from different vendors' specialization (Bapna et al. 2010).

On the other hand, as the number of distinct services in an IT outsourcing arrangement increases, if there is a commensurate increase in the number of vendors, the cost of monitoring, coordinating, and integrating the work of different vendors also increases exponentially (Clemons et al. 1993, Bakos and Brynjolfsson 1993, Anderson and Parker 2013, Bala et al. 2014, Hao et al. 2016, Mishra and Sinha 2016). Though there are benefits from specialization, beyond a certain number of services/vendors, the cost of monitoring, coordination, and integration is likely to outweigh the benefits of specialization, making single-sourcing the preferred sourcing choice (Clemons et al. 1993, Bakos and Brynjolfsson 1993, Bhattacharya et al. 2018). Thus, a client is likely to choose single-sourcing for an IT outsourcing arrangement with very small or very large number of services and choose multisourcing for IT outsourcing arrangements with an intermediate number of services. This leads to the following hypothesis.

H1: As the number of services in an IT outsourcing arrangement increases, the likelihood of multisourcing first increases and then decreases.

3.2 Client IT Outsourcing Capabilities and Sourcing Choice

Client IT outsourcing capabilities refer to a client's understanding of the vendor landscape and expertise, experience in requirements definition and performance measurement, and inter-vendor monitoring and coordination. Aubert et al. (2016) discuss how a client with significant IT outsourcing capabilities can get vendors with overlapping expertise and capabilities to collaborate by using clear separation of requirement definition and responsibility. Similarly, Wiener and Saunders (2014) describe how clients with significant IT outsourcing capabilities can get multiple vendors to cooperate and compete at the same time. Consequently, a client with significant IT outsourcing capabilities may be able to choose the multisourcing approach to source a large IT outsourcing deal. In contrast, a client without significant IT outsourcing capabilities in choosing specialist vendors, defining distinct IT services, and specifying requirements and performance measures will face significant exchange hazards and struggle to manage and coordinate multiple vendors (Lioliou et al. 2019). The value of IT outsourcing capabilities increases with the number of services in an IT outsourcing deal since the economy of specialization advantage of multisourcing is likely to be higher for IT outsourcing arrangements with more services. When an IT outsourcing arrangement includes distinct IT services with clearly specified requirements and performance goals it requires less information coordination to achieve integration, as defining distinct services reduces a client's coordination and integration costs and facilitates multisourcing (Langlois 2002, Cabigiosu and Camuffo 2012, Tiwana 2008). Therefore, we hypothesize that,

H2: A client with higher levels of IT outsourcing capabilities is more likely to be associated with multisourcing.

3.3 Industry Characteristics and Sourcing Choice

For a client to be able to take advantage of economies of specialization, there must be enough specialist IT vendors. IT vendors develop different capabilities by learning-by-doing (Zollo and Winter 2002, Li et al. 2010). These capabilities include marketing capability to understand customer needs, R&D capability to develop products and services that meet customer needs, and operations capability to make efficient and effective use of resources required to maintain viability and achieve growth (Zollo and Winter 2002, Li et al. 2010). As more IT vendors develop different capabilities, competition in the IT outsourcing industry increases. As competition in the IT outsourcing industry increases, clients can find specialist providers who may meet the specific needs of their distinct services more efficiently than a generalist vendor, although a multisourcing agreement may include a combination of generalist and specialist vendors. Therefore, as the competition in the IT outsourcing industry increases, one expects to see an increase in multisourcing.

From an IT-vendor perspective, when the cost advantage of being a specialist vendor outweighs the economy of scale and integration advantage of being a generalist IT vendor, one expects to see entry and growth of specialist IT vendors. In aggregate, as more IT vendors with specialized IT capabilities establish themselves in the increasingly global IT industry, competition in the IT industry increases and it is natural to expect that this competition will also increase the likelihood of multisourcing. Thus, we hypothesize that,

H3: Multisourcing is likely to increase with competition in the IT industry.

3.4 Effect of Sourcing Choice on Contract Outcome

Despite the popularity of IT outsourcing as a business strategy, firms fail to achieve successful performance outcomes from IT outsourcing (Brown and Fersht 2014, Narayanan et al. 2011). TCE recognizes coordination costs attributable to exchange hazards such as asset specificity and uncertainty as a driver of inferior outsourcing performance (Williamson 1985, Nickerson and Silverman 2003). To avoid suboptimal outcomes, firms outsource IT when vendors have economy of scale and specialization and coordination costs are low, and clients insource IT work when coordination costs with vendors are higher than the vendors' scale and specialization advantages. Deviation from this prescribed decision mode is referred to as sourcing misalignment*,* and such misalignment leads to inferior performance outcomes (Leiblein et al. 2002, Handley 2017). While some firms fail to make the appropriate sourcing decision in the first place (as firms differ in their ability to address sourcing challenges arising from exchange hazards), others experience sourcing misalignment over time based on the dynamic nature of the firm capabilities, cost structures, etc. (Handley 2017).

Industry reports suggest that firms experience value leakage of 17% to 40% of their annual contract value over the life of the contract because of sourcing misalignment (Ernst and Young 2016). Similarly, other industry reports indicate that 64% of firms bring outsourcing jobs back home after sourcing misalignment (Deloitte Consulting 2005). A few empirical studies have also examined the relationship between the degree of sourcing misalignment and performance outcomes. Argyres and Bigelow (2007) study the US auto industry, Leiblein et al. (2002) study semiconductor manufacturing, Nickerson and Silverman (2003) study the US trucking industry, and Sampson (2004) studies R&D alliances in the telecommunication equipment industry. In the IT domain, Susarla and Barua (2011) examine application service providers (ASP) and show that contract misalignment between clients and ASPs lowers the survival probability of providers in the ASP market. Similarly, Handley (2017) studies manufacturing and logistics/supply-chain process outsourcing and shows that sourcing misalignment leads to inferior outsourcing performance.

Prior research suggests principles for optimal (i.e., in-house vs outsourced) sourcing choice and indicates that suboptimal outcomes occur when deviation or misalignment from optimal sourcing choice occurs. In this study we propose sourcing misalignment as deviation from optimal single-source vs multisource choice and contend that sourcing misalignment will lead to a negative contract outcome. Specifically, using single-sourcing when multisourcing is the optimal sourcing choice may lead to a negative contract outcome. For example, using a generalist vendor to perform a set of specialized IT services may have performance implications if the chosen generalist vendor lacks the capabilities to efficiently perform all the distinct services involved in the IT outsourcing arrangement. In this case, although single-sourcing may save on coordination costs (Aubert et al. 2016), the chosen IT vendor's inability to efficiently execute all the different services in the IT outsourcing arrangement may increase holdup costs (Aubert et al. 2016) and miss opportunities for exploratory learning (Koo et al. 2017).

Similarly, using multisourcing when single-sourcing is the optimal sourcing choice may have a negative contract outcome. For example, using multiple best-of-breed vendors without the ability to monitor, coordinate, and integrate their work may exacerbate moral hazard problems (Anderson and Parker 2013, Bala et al. 2014, Hao et al. 2016, Mishra and Sinha 2016, Bhattacharya et al. 2018). Lioliou et al. (2019) detail how the inability to specify requirements and outcome measures, as well as overdependence on informal monitoring among self-interested parties in a multisourced arrangement, led to negative outcomes. Thus, we expect sourcing misalignment (i.e., a deviation from optimal single-source vs multisource sourcing choice) to be negatively associated with contract outcome.

H4: Sourcing misalignment with respect to the sourcing choice is likely to be negatively associated with contract outcome.

4. Data And Variables

We primarily rely on IDC's services contract database (SCD) for our data. The IDC database includes more than 49,000 large IT outsourcing arrangements signed from 1989 to 2014. Out of these, 44,558 were single-sourced and 4,499 were multisourced. We use two related datasets for the analysis. **Dataset I** is used to evaluate the determinants of sourcing choice, i.e., test H1–H3, and **Dataset II** is used to examine the effect of sourcing choice misalignment, i.e., test H4.

4.1 Dataset I: Evaluating the Determinants of Sourcing Choice (H1, H2, and H3)

Dependent Variable. We measure **Sourcing Choice** as a binary variable. We distinguish between single-sourcing (when a client involves one vendor in an outsourcing arrangement, coded as 0) and multisourcing (when a client involves multiple vendors in an outsourcing arrangement, coded as 1).

Independent Variables: We examine the antecedents of the single-sourcing vs multisourcing choice. The IT outsourcing arrangement level antecedent considered includes the number of IT services in the deal. The number of services **(NumberOfServices**) is the number of distinct IT services (e.g., application management, network management, systems integration, datacenter outsourcing, desktop outsourcing, IT helpdesk, etc.) that are included in the outsourcing arrangement. The client-level antecedent is the client's IT outsourcing capabilities associated with selecting vendors, contracting out IT work, defining requirements, specifying performance goals, monitoring external vendors, and integrating the deliverables provided by different vendors. Client IT outsourcing capabilities (**CustomerOutsourcingCapabilities**) is assessed as the dollar value of all the IT outsourcing deals signed by the client before signing the current deal (Bapna et al. 2016, Mishra and Sinha 2016, Anderson et al. 2019). The industry-level antecedent is the level of competition in the IT outsourcing industry. It is expected that as the industry matures, more firms enter the industry, build specialized capabilities, and compete for market share. Thus, as an industry matures, the number of firms in the industry increases and the market share of each firm decreases. We compute industry competition (**Industry Competition**) as 1 minus the Herfindahl index in a particular year. Thus, industry competition is given as 1- $\sum_{i=1}^{N} V_i^{2}$ where V_i is the market share of vendor *i* and *N* is the number of vendors in a particular year. Industry competition increases with the number of vendors where each vendor has a smaller market share.

Control Variables. We control for the complexity of an outsourcing arrangement. Complexity arises in IT outsourcing arrangements that involve a number of parts that interact in a non-deterministic manner (Simon 1962). Application development, business consulting, IT consulting, and systems integration deals require creation of new knowledge that involves a large number of parts and uncertainty in the interconnection between the means and ends (Susarla et al. 2012). Thus, following Susarla et al. (2012), we code **EngagementTypeComplexity** as a binary variable that takes a value of 1 for complex deals that include services such as application development, business consulting, IT consulting, and systems integration, etc., and a value of 0 for simpler arrangements that include services such as learning and education, IT education and training, business outsourcing, deploy and support, contract labor and capacity engagement, and business support engagements, etc. We control for contract size using the dollar value of the contract (**ContractValue**) as its measure. We also control for client size, as larger firms may have more resources to single-source and act as the chief integrator. We use the annual revenue (**CustomerRevenue)** as a proxy for firm size. Also, based on the past relationship between client and vendor, it is expected that clients are more likely to single-source to vendors with whom they have worked in the past. We control for strength of past relationship between the client and the vendor **(ExistingRelationshipStrength)** and measure it as the count of the number of different contracts the vendor had held with the client before signing the current contract. It is also likely that certain IT services are more prone to certain sourcing strategies (Handley et al. 2022), so we use IT service dummies (such as application management, network management, systems integration, datacenter outsourcing, desktop outsourcing, hardware deploy and support, IT helpdesk, software deploy and support, hosted application management, network consulting and integration) as a control variable for that.

4.2 Dataset II: Evaluating the effect of Sourcing Choice Misalignment (H4)

To examine the implications of sourcing choice misalignment, we identify 1,588 contracts with known contract outcomes from the SCD database. We measure contract outcome **(Outcome)** as a binary variable based on the contract status information provided in SCD. Following Bapna et al. (2016), a contract is coded as 1 if it was extended or expanded and 0 if it was renegotiated or cancelled. The rationale is that if the vendor is meeting the client's expectation, the contract is likely to be extended or expanded, which is a positive outcome for the client and the vendor. However, if a contract is not meeting the client's expectations, the contract is likely to be cancelled or renegotiated, which may not be a positive outcome for the client or the vendor.[1]

Independent Variables: We compute the predicted sourcing choice from our theory of sourcing choice as defined by hypotheses 1 to 3. Mathematically, predicted sourcing choice is computed by estimating the predicted values from the fixed effect model (Model 2 in Table 4). This is the ideal sourcing choice as predicted by the theory presented in the paper. Next, actual sourcing choice is what the client has chosen. We observe this variable as the actual choice the client has made using the SCD data. At this point, sourcing choice misalignment is computed as the absolute value of the difference between the predicted and the observed sourcing choice, following Susarla and Barua (2011).

$$Sourcing\ Choice\ Misalignment = |\text{Predicted Sourcing Choice} - \text{Actual Sourcing Choice}|$$

[1] It is plausible that contract renegotiation is not a necessarily bad outcome if the client and vendor renegotiate the contract as conditions change (Susarala 2012). A robustness check with contract extension and expansion coded as positive outcome and contract cancellation coded as negative outcome also produces consistent results.

Control Variables: Contract outcome is likely to depend on contract, client, and vendor characteristics. At the contract level it is believed that larger contracts (**ContractValue)** with more services (**NumberOfServices)** that have higher complexity (**EngagementTypeComplexity)** are less likely to be successful. We also control for the strength of the client-vendor relationship prior to signing the contract **(ExistingRelationshipStrength)**. A strong prior relationship between the client and the vendor may increase the likelihood of a successful contract outcome, as a prior relationship may mean a better understanding of the client's requirements by the vendor and/or a better understanding of the vendors' capabilities by the client. The nature of the contract (fixed price or time and material) may also influence contract outcomes, as a time-and-material contract may reduce risk for the vendor side and increase vendor commitment to achieve a positive contract outcome (Gopal and Konduru 2008, Gopal and Koka 2010). We use a dummy variable (**FixedPriceY/N**) to control for contract type.

Contract outcome is also likely to be influenced by client characteristics. Larger clients (**CustomerRevenue)** with more resources may have a higher likelihood of contract success. Similarly, clients with significant IT outsourcing capabilities (**CustomerOutsourcingCapabilities)** may have developed routines to work in partnership with external vendors and thus they are more likely to achieve positive contract outcomes.

The vendor's capabilities may also influence contract outcome. For example, vendors with significant experience may have developed capabilities from learning by doing that lead to higher contract success rates. The vendor's outsourcing capabilities **(VendorOutsourcingCapabilities**) is measured as the dollar value of all the IT contracts executed by the vendor before signing the contract under consideration.

Table 2 presents the summary statistics and the correlations between the dependent (sourcing choice), independent, and control variables for 49,057 IT outsourcing arrangements in Dataset I, which is used to test H1–H3. Out of the 49,057 arrangements 4,499 (about 9.2%) are multisourced. The dataset includes more than 22,500 individual clients from 17 different industries, from government to transportation to discrete manufacturing. The average client has annual revenue of $17.1 billion and average outsourcing capability of $1.67 billion. The average contract value of these arrangements is $58.3 million. Similarly, Table 3 presents the summary statistics and the correlations between dependent (contract outcome), independent, and control variables for 1,588 contracts[2] in Dataset II, which is used to test H4.

5. Empirical Analysis

5.1. Econometric Models

We observe sourcing choice as a binary variable. There are two modes of sourcing: single-sourcing (0) and multisourcing (1). The fixed effect panel logit approach (Wooldridge 2002) is used in the analysis to predict the probabilities of the different outcomes of sourcing choice (see Table 4). Our panel is constructed by observing different IT outsourcing arrangements of the same client firm over multiple years.[3] Fixed effect panel logit controls for time invariant sources of unobserved heterogeneity. Equation 1 captures the likelihood of sourcing choice of the outsourcing arrangement signed by client *i* at time *t* on how many different IT services are involved in the IT outsourcing arrangement ($NumberOfServices_{i,t}$), the client's IT outsourcing capabilities in period *t*

[2] We also conducted a series of Kolmogorov-Smirnov tests (on key variables that are common between the sourcing choice and the outcome model) to check for any potential bias in the contract outcome sample compared to the sourcing choice sample. Results of the tests indicated that there is no difference in the distributions in the common variables across two samples.

[3] Our panel is unbalanced, which raises a potential selection bias issue in fixed effect panel models with binary responses. In order to handle this issue and to examine if there is selection bias as a result of the unbalanced panel, we conducted the Semykina and Wooldridge (2018) test. The results of this test show no evidence for selection bias due to the structure of an unbalanced panel and provides additional robustness check and consistency of our fixed effect panel models.

($CustomerOutsourcingCapabilities_{i,t}$), and the competition in the IT industry in period *t* ($IndustryCompetition_t$) along with the control variables and IT service dummies (Model 1 of Table 4).

$$(1)\ Sourcing\ Choice_{i,t} = \alpha_i + \beta_1 NumberOfServices_{i,t} + \beta_2 CustomerOutsourcingCapabilities_{i,t} + \beta_3 IndustryCompetition_t + +\beta_4 Control\ Variables_{i,t} + \varepsilon_{i,t}$$

Then, to determine whether the likelihood of multisourcing first increases and then decreases as the number of services in an IT outsourcing arrangement increases, we add a square term to the fixed effect logit model (Equation 1). The curvilinear effects of the number of services in an IT outsourcing arrangement is captured in Equation 2, which again includes IT service dummies and control variables (Model 2 of Table 4).

$$(2)\ Sourcing\ Choice_{i,t} = \alpha_i + \beta_1 NumberOfServices_{i,t} + \beta_2 CustomerOutsourcingCapabilities_{i,t} + \beta_3 IndustryCompetition_t + \beta_4[(NumberOfServices)_{i,t} * (NumberOfServices)_{i,t}] + +\beta_6 Control\ Variables_{i,t} + \varepsilon_{i,t}$$

Next, we use a logit model (Equation 3) to examine the relationship between sourcing choice misalignment ($SourcingChoiceMisalignment_{k,t}$) of contract *k* between client *i* and vendor *j* on contract outcome ($Contract\ Outcome_{k,t}$). This model controls for contract characteristics *(Contract Value, NumberOfServices, EngagementTypeComplexity, ExistingRelationshipStrength, FixedPriceY/N),* client characteristics *(CustomerRevenue, CustomerOutsourcingCapabilities),* vendor characteristics

(VendorOutsourcingCapabilities), and includes IT service dummies to capture the effect of sourcing choice misalignment on contract outcome (see Table 5).

$$(3)\ Contract\ Outcome_{k,t}$$
$$= \beta_0 + \beta_1 ContractValue_{k,t} + \beta_2 NumberOfServices_{k,t}$$
$$+ \beta_3 EngagementTypeComplexity_{k,t}$$
$$+ \beta_4 ExistingRelationshipStrength_{k,t} + \beta_5 FixedPriceY/N_{k,t}$$
$$+ \beta_6 CustomerRevenue_{i,t} + \beta_7 CustomerOutsourcingCapabilities_{i,t} + \beta_8 VendorOutsourcingCapabilities$$
$$+ \beta_9 SourcingChoiceMisalignment_{k,t} + \varepsilon_1$$

5.2 Results

Model 1 in Table 4 is used to test hypotheses H2 and H3, and Model 2 (also in Table 4) is used to test the hypothesis H1. This approach for testing the hypotheses using different models is appropriate in this case since the square term is constructed to be orthogonal to the corresponding singular term. Orthogonalization is used to avoid collinearity between the main effect and the square term (Little et al. 2006). In this approach, the indicator of the squared term is first created by multiplying the main effect construct. Next, the squared term indicator is regressed on the main effect indicator. We then retain the residual from this regression as an indicator of the squared latent variable that is orthogonal to the main effect latent variable.[4]

Results from the fixed effect model models (see Table 4, Models 1 and 2) indicate that the coefficient of the number of services is positive and significant (p value < 0.01). Further, the coefficient of the square of the number of services is negative and significant (p value < 0.01). These results suggest that as the number of services increase, the likelihood of multisourcing first increases and then

[4] Analysis without the orthogonalization of the square term also produces results that are consistent with these findings.

decreases. This finding is illustrated graphically in Figure 1, indicating that the likelihood of multisourcing increases up to five services and decreases after that. These results indicate that the benefits of specialization increase with up to about five services, which increases the likelihood of multisourcing. However, beyond five services the increase in coordination costs exceed the benefits of specialization and single-sourcing is again the preferred alternative. This analysis provides support for hypothesis H1.

These results (see Table 4, Models 1 and 2) also indicate that an increase in client IT outsourcing capabilities increases the likelihood of multisourcing (*p* value < 0.01). This finding is consistent with hypothesis H2 and implies that if the client develops IT outsourcing capabilities in vendor selection, requirements definition, and performance measurement, along with inter-vendor monitoring and coordination, the client has a broader range of sourcing choices available to outsource IT work. It is the coordination and integration capabilities of the client that open opportunities to take advantage of the economy of specialization and use multisourcing.

Next, the coefficient of industry competition is positive and significant (*p* value < 0.01) in both Models 1 and 2 in Table 4. These results suggest that increase in vendor specialization and competition increases the probability of finding specialist vendors for different services that increases the opportunity to take advantage of multisourcing. This finding supports Hypothesis 3.

Further, in both Models 1 and 2 in Table 4, our proxy for firm size (*CustomerRevenue*) is not significant, indicating that size of the firm does not affect sourcing choice, but our proxy for contract size (*ContractValue*) is positive and significant ($p < 0.01$), indicating that larger deals are more likely to be multisourced. We also acknowledge that the nature of the service may influence the sourcing choice (Susarla et al. 2012), so we control for deal complexity (*EngagementTypeComplexity*). However, the coefficient of *EngagementTypeComplexity* is not significant, suggesting that the nature and complexity of the deal does not seem to influence sourcing choice (see both Models 1 and 2 in Table 4). To stress test, we also include IT service dummies (such as such as application management, network management, systems integration, datacenter outsourcing, desktop outsourcing, IT helpdesk, etc.) in the main model (Table 4) and do not find that these services affect the sourcing choice. This result again suggests that the nature of the IT service doesn't affect the sourcing choice. And finally, our proxy for past relationship strength between the client and the vendor (*ExistingRelationshipStrength*) is negative and significant ($p < 0.1$), indicating that if there is past relationship between a client and a vendor, the client is more likely to choose single-sourcing (see Models 1 and 2 in Table 4).

Table 5 presents the analysis of the effect of sourcing choice misalignment on contract outcome. Model 1 in Table 5 indicates that contracts with larger clients and instances where there is a strong relationship between the client and vendor are more likely to be successful, whereas more complex contracts are likely to be cancelled or renegotiated. Most interestingly, we find that contracts with higher level of misaligned sourcing choice are more likely to fail (p value < 0.05). This finding supports H4 and emphasizes that sourcing choice is important for the success of the IT outsourcing contract, as a suboptimal sourcing choice can result in contract cancellation or renegotiation.

6. Robustness Tests

6.1 Endogeneity and Reverse Causality

We used fixed effect panel logit models that control for time invariant sources of unobserved heterogeneity. However, there may be time-varying client characteristics that are correlated with sourcing choice and key independent variables, raising potential unobserved heterogeneity and endogeneity concerns. Moreover, while we propose that the number of services leads to multisourcing, it is plausible that sourcing choice leads to decomposing an IT outsourcing arrangement into a set of services, raising endogeneity concerns due to reverse causality. Similarly, while we propose that increase in vendor specialization increases the probability of finding specialist vendors for different services, which increases the opportunity to take advantage of multisourcing, it is possible that the trend towards multisourcing leads to increase in vendor specialization (again, raising endogeneity concerns due to reverse causality).

To mitigate concerns with time variant sources of unobserved heterogeneity and endogeneity, we use dynamic panel logit model to study the sourcing choice decision. Dynamic panel models are a powerful tool to handle endogeneity due to reverse causality and unobserved heterogeneity, as they disentangle the dynamic interplay between independent and dependent variables over time by including lagged values of the dependent variable on the right-hand side of the estimation equation to produce unbiased and efficient estimators for endogenous variables (Blundell and Bond 1998, Bapna et al. 2013b). In particular, we used the dynamic logit model designed by Hsiao (2005) and estimated it using the *cquad* package developed by Bartolucci and Pigini (2017). In Table 6 (Models 1 and 2), we present the results of the dynamic panel logit model that correspond to Models 1 and 2 in Table 4. The estimates in both models are consistent with our main results in Table 4. Further, we find the presence of state dependence, as the p value (or t test) associated with the lagged dependent variable (lagged sourcing choice) is significant ($p < 0.01$) in both Models 1 and 2 in Table 6, thus mitigating possible concerns with unobserved heterogeneity and endogeneity.

In addition, to address concerns with reverse causality because of the number of services (multisourcing trend), we tested the sourcing choice model where we use the lagged value of number of services (industry competition) as an explanatory variable (see Table 6, Model 3 and Model 4 respectively). Our logic is that while sourcing choice may drive disaggregation of IT sourcing arrangements into distinct services (industry competition), it should not drive disaggregation of deals (industry competition) in prior years. The results in Table 6 (Models 3 and 4) are consistent with our main results in Table 4, thus mitigating the possibility of reverse causality due to number of services (industry competition).

6.2 Customer outsourcing capabilities as single-sourcing capabilities and multisourcing capabilities

In hypothesis H2 we argued that the client's IT outsourcing capabilities lead to more multisourcing. It may be argued that it is multisourcing capabilities that lead to more multisourcing. In other words, it may be useful to differentiate single-sourcing capabilities from multisourcing capabilities. Thus, in this analysis we focus on those clients (418 clients in our case) who use both single-sourcing and multisourcing. These 418 clients executed 9,076 arrangements/deals. Out of 9,076 arrangements 5,029 are single-sourced and 4,047 are multisourced, so they have single-sourcing as well as multisourcing capabilities. We calculate their single-sourcing capabilities (as dollar value of only the single-sourced IT deals executed by them before the current deal) and multisourcing capabilities (as dollar value of only the multisourced IT deals executed by them before the current deal). We cannot include single-sourcing capabilities as well as multisourcing capabilities in the same model since they are highly correlated, so Table 7 includes multisourcing capabilities and Table 8 includes single-sourcing capabilities. The coefficient of multisourcing capabilities is not significant in Table 7, but the coefficient of single-sourcing capabilities is significant in Table 8, and the results are consistent with the results of our baseline analysis in Table 4. This analysis suggests that IT outsourcing capabilities that include single-sourcing capabilities help to develop capabilities that increase multisourcing. This finding also has managerial implications for clients who plan to multisource IT outsourcing arrangements and suggests that clients should develop IT outsourcing capabilities through first engaging in single-sourcing prior to multisourcing larger IT outsourcing deals.

6.3 Imbalance in the number of single-sourced and multisourced arrangements

Sourcing Choice Analysis. Out of 49,057 arrangements in the sample, 44,558 arrangements are single-sourced and 4,499 arrangements are multisourced. This breakdown creates the issue of imbalanced data distribution across two classes (single-sourcing and multisourcing), potentially introducing biased estimates of coefficients of interest. To address the issue of data distribution across two classes we use choice-based sampling. Choice-based sampling is a stratified sampling technique. Here data are stratified on the target and a sample is taken from each stratum so that the underrepresented class is more represented in the final sample. The motivation behind this sampling scheme is to oversample underrepresented alternatives in order to improve the accuracy of econometric analysis (Manski and McFadden 1981, Imbens 1992, Imbens and Lancaster 1996). Thus, we combine the 4,499 observations with sourcing choice 1 (for multisourcing) along with a random sample of 4,499 observations with sourcing choice 0 (for single-sourcing) and repeat the fixed effect logit analysis. The results are presented in Table 9 (Models 1 and 2) and are consistent with the analysis in Table 4 (Models 1 and 2).

Outcome Sample. Out of 1,588 contracts with known outcomes, 1,555 are single-sourced and 33 are multisourced contracts. The small number of multisourced contracts may bias results in the analysis examining the effect of sourcing choice misalignment on contract outcome. To mitigate this concern, we create new matched datasets using *k*-nearest neighbor technique (*k-NN*). *k-NN* is the simplest and best known non-parametric method, meaning we don't have to assume an explicit functional form, which provides a more flexible approach (Bishop 2006). It uses the closest data points for estimation and therefore takes full advantage of local information to form highly nonlinear and adaptive decision boundaries for each data point. Corresponding to each of 33 multisourced contracts we match the top *k* (5 and 3 in our case) nearest neighbors from 1,555 single-sourced contracts. Contracts are matched using the size of the contract, the number of services, client size, client IT outsourcing capabilities, complexity of the contract, year, and client industry. Models 1 and 2 in Table 10 show the results of the logit model for 5 and 3 nearest neighbors respectively. The results are consistent with the results in Table 5 (Model 1).

6.4 Coarsened Exact Matching (on the Outcome Sample)

To reduce heterogeneity between contracts with different sourcing choice and mitigate the issue of prediction bias of our outcome logit model (Model 1 in Table 5), we treat sourcing choice misalignment as treatment and apply coarsened exact matching (CEM) procedure on the outcome sample (Bapna et al. 2016, Blackwell et al. 2009, Iacus et al. 2012). Unlike PSM (propensity score matching), CEM does not require a predetermined functional form and generates solutions that have lower estimation error and are better balanced (Bapna et al. 2016, King and Nielsen 2019). CEM coarsens a set of the observed covariates, then performs an exact match on the coarsened data and discards the unmatched data (Bapna et al. 2016, Blackwell 2009, Iacus et al. 2012). To generate a coarsened matched sample, we focus on key covariates that effect the sourcing choice misalignment, namely contract value, number of services, customer IT outsourcing capabilities, engagement type complexity, and customer revenue. Then we repeat the logit model analysis on the CEM sample (Model 1 in Table 11). The results are consistent with the primary analysis, suggesting that sourcing choice misalignment leads to contract failure.

6.5 XGBoost (on the Outcome Sample)

To provide further robustness analysis of our outcome logit model (Model 1 in Table 5) we use a machine-learning based model—XGBoost (eXtreme Gradient Boost by Chen and Guestrin 2016)—to compute our predicted sourcing choice variable. XGBoost is known as one of the most successful and potent prediction algorithms developed over the last few years. Unlike classical decision trees, which predict class labels, XGBoost employs boosted tree-based models, thus bootstraps several decision trees, and the final prediction is based on the sum of predictions across multiple trees. Thus, it maximizes the out-of-sample-predictive accuracy and simultaneously corrects for overfitting as well. Further, it is scalable and is shown to have advantages of both speed and performance (Chen and Guestrin 2016).

In our case, to construct the training data for our predictive model, we use only the contracts that were extended or expanded. Our assumption is that these contracts performed well and thus had the right sourcing choice. Then, we apply the XGBoost model (R software package by Chen and Guestrin 2016) to compute predictive sourcing choice using the key covariates (contract value, number of services, client IT outsourcing capabilities, engagement type complexity, and customer revenue). To prevent overfitting, we use fivefold cross validation on the training set and find the optimal hyperparameters for our XGBoost model (max depth: 4, learning rate: 0.03, and *n* estimator: 94). The other parameters were kept at their default values. In this way, we build a XGBoost model with a prediction accuracy AUC value of 0.87 (which is higher than the predictive accuracy of a logit model with AUC value of 0.74). Further, we also observe the actual sourcing choice the client has made using the SCD data. Next, we compute the sourcing choice misalignment variable, as the absolute value of the difference between the predicted sourcing choice (computed using XGBoost model) and the observed sourcing choice. Then, we repeat the logit model analysis on the contract outcome dataset, using the above computed sourcing choice misalignment variable. The results (Model 1 in Table 12) are consistent with the primary analysis, suggesting that sourcing choice misalignment leads to contract failure.

7. Discussion and Conclusion

There is a large body of research in the IT outsourcing area, however, this body of work largely focuses on dyadic client-vendor relationships. While theoretical and analytical models of single-sourcing vs multisourcing have been developed (Bhattacharya et al. 2018) and there is empirical research (Angst et al. 2017) that analyzes multisourcing trends in one industry (healthcare), there is no empirical research that examines the antecedents and consequents of multisourcing in the context of IT across multiple industries. The extant studies in multisourcing (e.g., Levina and Su 2008, Wiener and Saunders 2014, Aubert et al. 2016, Plugge and Bouwman 2018, Lioliou et al. 2019) are predominantly in-depth case studies that focus on the question of how to manage multisourcing arrangements. Our contention is that prior to managing a relationship, the client needs to first make sure to enter into the right type of outsourcing arrangement, so in this paper we focus on the determinants of the right type of outsourcing arrangement and the consequences of not entering into the correct outsourcing arrangement.

Our work builds on Bhattacharya et al. (2018), who develop a game theoretic approach to find a client's optimal sourcing strategy based on risk aversion of the vendor, coordination cost, modularity of the task, and misalignment between project revenue and verifiable performance metric. Similarly, Angst et al. (2017) find that hospitals are trending towards single-sourcing and find the key organizational characteristics, such as formal structure and internal dynamics, that predict this trend. Likewise, Handley et al. (2022) examine the effect of experiential learning on the IT multisourcing trend. We conceptualize the choice between single-sourcing and multisourcing as the interplay of two opposing forces: 1) the ability to overcome coordination challenges and capability to manage exchange hazards, and 2) risks associated with sourcing, which shrinks with IT vendor industry competition (as it reduces the chances of lock-in and opportunism) but heightens with the number of different services in an IT outsourcing arrangement. We delve into the interplay between these forces and argue that both these opposing forces are consequential to the single- vs multisourcing decision.

Theoretical Contribution and Empirical Findings. The theoretical contribution of the study extends the transaction cost framework used to make the insourcing vs outsourcing decision to the single-sourcing vs multisourcing decision. In the traditional transaction cost argument, outsourcing increases with the client's ability to manage exchange hazards and the scale and specialization advantage of IT vendors. However, multisourcing exacerbates exchange hazards faced by clients, as it involves multiple vendors to take advantage of best-of-breed vendors, as no single vendor possesses specialization in all of the different IT-enabled services involved in an arrangement. Thus, we position the choice between single-sourcing and multisourcing as examining the tradeoff between the client's ability to manage the exchange hazards (as manifested in the client's IT outsourcing capabilities) and the availability of specialized capabilities in the market (as manifested in the intensity of competition in the IT services market) as the number of services in an IT outsourcing arrangement increases. We find that as the number of services increases to up to five services, the likelihood of multisourcing increases, however, further increase in the number of services decreases the likelihood of multisourcing. Similarly, we show that as the client's ability to manage exchange hazards increases, multisourcing increases relative to single-sourcing, and as specialized capabilities become available in the IT services market, multisourcing also increases relative to single-sourcing.

The analysis suggests that if an IT outsourcing arrangement can be divided into separate services, a client is more likely to multisource. Disaggregating an IT outsourcing deal into distinct services enables clients to leverage specialized capabilities of different vendors, however, coordination cost increases with the number of services and vendors. Thus, beyond five services, the increase in coordination costs dominates the benefits of specialization and single-sourcing is preferred to multisourcing. Next, as a client's IT outsourcing capabilities increase, a client is more likely to select multisourcing over single-sourcing. This suggests that as a client's capability to manage exchange hazards and coordinate different vendors increases, the client is more likely to choose multisourcing. Moreover, as industry competition increases, the likelihood of multisourcing goes up. This is in line with the argument that as the IT services market matures and more specialist vendors establish themselves, firms have more opportunities to take advantage of specialization by multisourcing IT outsourcing arrangements that include different services. For vendors, it means that clients reward specialization. If a vendor can achieve scale economies in one service, the vendor can grow without the need to be a one-stop shop for integrated solutions. Most interestingly, we find that if the sourcing choice is misaligned with the theory discussed above, the contract is more likely to be cancelled or renegotiated. In other words, sourcing choices that are incongruent with the number of services in an IT outsourcing arrangement, the IT outsourcing capabilities of the client, or the capabilities and competition in the IT services market are more likely to be cancelled or renegotiated. This study highlights the importance of the single-sourcing vs multisourcing choice by providing evidence that the single-sourcing vs multisourcing choice has a material effect on contract outcome.

Managerial Implications. This research offers two key managerial insights for clients who want to engage in large IT outsourcing arrangements. First, the results of this study suggest that for multisourcing, clients need IT outsourcing capabilities. But how should clients build this capability? What kind of experience should they start with? Prior research on firm capabilities has shown that firms learn and grow through imitating successful strategies of other firms (Winter and Szulanski 2001, Helfat and Peteraf 2003), so it is natural to assume that clients will look at past sourcing strategies of firms that have contracted using both single-sourcing and multisourcing and follow their footsteps to develop successful sourcing strategies for themselves. To this end, the study suggests that clients who plan to multisource should develop IT outsourcing capabilities through first engaging in single-sourcing.

Next, it may be believed that the sourcing choices depend upon the nature and complexity of the services—for instance, more complex services such as systems integration may be multisourced, and less complex services such as support engagement may be single-sourced. However, we do not find sufficient evidence that service complexity effects sourcing choice. Exchange hazard risks that effect the sourcing decisions for large IT outsourcing arrangements do not arise from service complexity but rather from the number of services in an IT outsourcing arrangement. Our research suggests that with up to about five services the likelihood of multisourcing increases, and beyond five services the increase in coordination costs exceed the benefits of specialization and single-sourcing is again the preferred alternative. For large IT outsourcing arrangements (across multiple industries) we have found this to be the consistent optimal strategy between the number of services and sourcing choice, so for managers who plan to execute multisource arrangements, this research proposes mechanisms to minimize exchange hazards through better understanding of the relationship between the number of services in an IT outsourcing arrangement and sourcing choice.

Limitations and Directions for Future Research. This study has certain limitations that suggest directions for future research. In this dataset, while we know that in multisourcing arrangements multiple vendors work together to provide services to the client, we don't know the degree of the interdependence between the various services they perform. As prior research has noted, structuring a large IT outsourcing arrangement into distinct but interdependent services that can be assigned to different vendors is by itself a challenging endeavor (Gokpinar et al. 2013, Tripathy and Eppinger 2013, Mishra et al. 2015). Understanding the nature of the service interdependence may provide insight into how risk is shared by multiple vendors in the multisourcing model, however, access to such granular data continues to remain a challenge for the research community. Different vendors in a multisourcing arrangement may live in different time zones and they may differ culturally from the client. In our dataset we know the identity of the vendor(s) but not their specific location, so data limitations preclude us from examining the coordination cost implications of physical and cultural distance.

Prior research (Bapna et al. 2010) highlighted the coordination and cooperation issues that arise from multisourcing and proposed sourcing architectures such as operating-level agreements and prime-vendor models to mitigate some of the risks. More research is needed in teasing out the efficacy of these proposed solutions. Prior research (Levina and Su 2008) has also identified four archetypes of multisourcing relationships as a function of variation of breadth and depth of the multisourcing supply base: concentrated transactions, concentrated partnerships, diversified transactions, and diversified partnerships. Similarly, Wiener and Saunders (2014) define multisourcing as being mediated, direct, or direct-overlapping. Future empirical research may refine the characterization of multisourcing as described in these papers. Future research should also tackle the relationship between the degree of service interdependence, service and output verifiability, and the design of optimal compensation schemes in the context of multisourcing.

Conclusion. As clients sign large IT outsourcing deals/arrangements, it becomes more and more likely that the outsourcing arrangement demands different IT specializations that no single vendor may possess. Given that one of the key rationales for outsourcing includes benefiting from a vendor's scale and specialization, it is only natural to expect that multisourcing increases with deal size. Accordingly, industry reports and academic research indicate an increase in multisourcing (Cohen and Young 2006, Anderson and Parker 2013, Mishra et al. 2015). However, multisourcing is not without its challenges (Hao et al. 2016, Mishra and Sinha 2016, Oshri et al. 2019). Complex coordination with multiple vendors exacerbates the challenges associated with multisourcing (Whitten and Leider 2006). Through TCE framework and a data-driven approach we shed light on both the antecedents and consequents of the decision to multisource or not, yet there remain many unanswered questions about how to design, contract and manage multisourcing relationships. As the volume of multisourcing increases, we hope that this research will engender further enquiry into this important phenomenon.

References

Ahmadjian CL, Lincoln JR (2001) Keiretsu, Governance, and Learning: Case Studies in Change from the Japanese Automotive Industry. *Organization Science*. 12(6): 683–701.

Anderson EG, Jiang X, Parker GG, Tan B (2019) Systems integration and the dynamics of partial outsourcing. *Production and Operations Management*. 28(2): 319–340.

Anderson EG, Parker GG (2013) Integration in global knowledge networks. *Production and Operations Management*. 22(6): 1446–1463.

Ang E, Iancu DA, Swinney R (2017) Disruption risk and optimal sourcing in multitier supply networks. *Management Science*. 63(8): 2397–2419.

Ang S, Straub D (1998) Production and Transaction Economies and IS Outsourcing: A Study of the U.S. Banking Industry. *MIS Quarterly.* 22(4): 535–552.
Angst, C. M., Wowak, K. D., Handley, S. M., and Kelley, K. (2017) Antecedents of Information Systems Sourcing Strategies in U.S. Hospitals: A Longitudinal Study. *MIS Quarterly* (41:4), pp. 1129–1152.
Anupindi R, Akella R (1993) Diversification under supply uncertainty. *Management Science.* 39(8): 944–963.
Aral S, Bakos Y, Brynjolfsson E (2018) IT, Repeated Contracts, and the Number of Suppliers. *Management Science* 64(2): 592–612.
Argyres N, Bigelow L (2007) Does transaction misalignment matter for firm survival at all stages of the industry life cycle? *Management Science.* 53(8): 1332–1344.
Aron R, Bandyopadhyay S, Jayanty S, Pathak P (2008) Monitoring process quality in off-shore outsourcing: A model and findings from multi-country survey. *Journal of Operations Management.* 26(2): 303–321.
Aron R, Clemons EK, Reddi S (2005) Just right outsourcing: understanding and managing risk. *Journal of Management Information Systems.* 22(2): 37–55.
Aubert B A, Saunders C, Wiener M, Denk R, Wolfermann T (2016) How adidas Realized Benefits from a Contrary IT Multisourcing Strategy. *MIS Quarterly Executive*, 15(3): 179–194.
Aydin G, Babich V, Beil D R, Yang ZB (2011) *Handbook of integrated risk management in global supply chains* (John Wiley & Sons, New Jersey).
Bakos Y, Brynjolfsson E (1993) From vendors to partners: Information technology and incomplete contracts in buyer-supplier relationships. *Journal of Organizational Computing.* 3(3): 301–328.
Bala R, Krishnan V, Zhu W (2014) Distributed development and product line decisions. *Production and Operations Management.* 23 (6): 1057–1066.
Bandopadhyay S, Pathak P (2007) Knowledge sharing and cooperation in outsourcing projects—A game theoretic analysis. *Decision support systems.* 43(2): 349–358.
Bapna R, Barua A, Mani D, Mehra A (2010) Research Commentary---Cooperation, Coordination, and Governance in Multisourcing: An Agenda for Analytical and Empirical Research, *Information Systems Research.* 21(4): 785–795.
Bapna R, Gupta A, Ray G, Singh S (2016) Research Note—IT Outsourcing and the Impact of Advisors on Clients and Vendors. *Information Systems Research.* 27(3): 636–647.
Bapna R, Gupta A, Ray G, Singh S (2013a) Specialization, Integration, and Multisourcing: A Study of Large IT Outsourcing Projects. *Proceedings of the International Conference on Information Systems.* (ICIS, Milan), 3537–3551.
Bapna R, Langer N, Mehra A, Gopal R, Gupta A (2013b) b *Management Science.* 59(3): 641–658.
Bartolucci F, Pigini C (2017) cquad: An R and Stata package for Conditional Maximum Likelihood Estimation of Dynamic Binary Panel Data Models. *Journal of Statistical Software.* 78(7): 1–26.
Bhattacharya S, Gupta A, Hasija S (2018) Single-sourcing versus multisourcing: The roles of output verifiability on task modularity. *MIS Quarterly.* 42(4): 1171–1186.
Bimpikis K, Candogan O, Ehsani S (2019) Supply disruptions and optimal network structures. *Management Science.* 65(12): 5504–5517.
Bishop CM (2006) *Pattern Recognition and Machine Learning* (Springer Press, New York).
Blackwell M, Iacus S M, King G, Porro G (2009) CEM: Coarsened exact matching in Stata. *Stata Journal.* 9(4):524–546.
Blundell R, Bond S (1998) Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics.*87 (1): 115–143.
Brown D, Fersht P (2014) Executive report: The State of Services and Outsourcing in 2014, *KPMG and HfS Research.*
Cabigiosu A, Camuffo A (2012) Beyond the Mirroring Hypothesis: Product Modularity and Interorganizational Relations in the Air Conditioning Industry. *Organization Science.* 23(3): 597–906.

Chen T, C Guestrin (2016) Xgboost: A Scalable Tree Boosting System. *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, 785–794.Choudhury V, Sabherwal R (2003) Portfolios of control in outsourced software development projects, *Information Systems Research* 14(3): 291–314.

Clemons EK, Reddi S, Row S (1993) The impact of information technology on the organization of economic activity: The "move to the middle" hypothesis. *Journal of Management Information Systems*. 10(2): 9–35.

Cohen L, Young A (2006) *Multi-Sourcing: Moving Beyond Outsourcing to Achieve Growth and Agility*. (Harvard Business Press, Cambridge, MA).

Dada M, Petruzzi N, Schwarz L (2007) A newsvendor's procurement problem when suppliers are unreliable. *Manufacturing & Service Operations Management*. 9(1): 9–32.

Deloitte Consulting (2005) Calling a change in the outsourcing market: the realities for the world's largest organizations. https://www.worldcat.org/title/calling-a-change-in-the-outsourcing-market-the-realities-for-the-worlds-largest-organizations/oclc/60884313

Dey D, Fan M, Zhang C (2010) Design and Analysis of Contracts for Software Outsourcing, *Information Systems Research* 21(1): 93–114.

Dibbern J, Goles T, Hirschheim R, Jayatilaka B (2004) Information systems outsourcing: A survey and analysis of the literature. *ACM SIGMIS Database*. 35(4): 6–102.

Dyer JH, Hatch NW (2004) Using Supplier Networks to Learn Faster. *MIT Sloan Management Review*. 45(3): 57–63.

Ernst and Young. (2016). https://consulting.ey.com/governance-successful-outsourcing/

TFedergruen A, Yang N (2008) Selecting a portfolio of suppliers under demand and supply risks. *Operations Research*. 56(4): 916–936.

Fitoussi D, Gurbaxani V (2012) IT outsourcing contracts and performance measurement, *Information Systems Research,* 23(1): 129–143.

Gokpinar B, Hopp W, Iravani SMR (2013) In-House Globalization: The Role of Globally Distributed Design and Product Architecture on Product Development Performance. *Production and Operations Management* 22(6): 1509–1523.

Gopal A, Gao G (2009) Certification in the Indian offshore IT services industry. *Manufacturing Services Operation Management*. 11(3): 471–492.

Gopal A, Koka BR (2010) The Role of Contracts on Quality and Returns to Quality in Offshore Software Development Outsourcing. *Decision Sciences,* 41 (3): 491–516.

Gopal A, Konduru S (2008) On Vendor Preferences for Contract Types in Offshore Software Projects: The Case of Fixed Price vs. Time and Materials Contracts. *Information Systems Research*. 19(2): 202–220.

Grover V, Teng JTC (1993) The Decision to Outsource Information Systems Functions. *Journal of Systems Management*. 44(11): 34–38.

Han K, Kauffman RJ, Nault BR (2011) Returns to information technology outsourcing. *Information Systems Research*. 22(4): 824–840.

Handley SM (2017) How governance misalignment and outsourcing capability impact performance. *Production Operation Management*. 26(1): 134–155.

Handley S, Skowronski K, Thakar D (2022) The Single-Sourcing versus Multisourcing Decision in Information Technology Outsourcing. *Journal of Operations Management*. Forthcoming.

Hao X, Dawande M, Mookerjee V (2016) Optimal coordination in distributed software development. *Production and Operations Management*. 25(1): 56–76.

Helfat CE, Peteraf MA (2003) The dynamic resource based view: capability lifecycles. *Strategic Management Journal*. 24(10): 997–1010.

Hsiao C (2005) *Analysis of Panel Data* (Cambridge University Press, New York).

Hu B, Kostamis D (2015) Managing supply disruptions when sourcing from reliable and unreliable suppliers. *Production and Operations Management*. 24(5): 808–820.

Iacus S M, King G, Porro G (2012) Causal inference without balance checking: Coarsened exact matching. *Political Analysis* 20(1):1–24.

Imbens GW (1992) An efficient method of moments estimator for discrete choice models with choice-based sampling. *Econometrica*. 60(5): 1187–1214.

Imbens GW, Lancaster T (1996) Efficient estimation and stratified sampling. *Journal of Econometrics*. 74(2): 289–318.

Karamouzis F (2011) *Multisourcing Competencies Key Initiative Overview*. Gartner. https://www.gartner.com/en/documents/1745519

King G, Nielsen R (2019) Why Propensity Scores Should Not Be Used for Matching, *Political Analysis*. 27(4): 435–454.

Kirsch L J (2004) Deploying common systems globally: The dynamics of control. *Information Systems Research*. 15(4): 374–395.

Kishore R, Rao HR, Nam K, Rajagopalan S, Chaudhury A (2003) A Relationship Perspective on IT Outsourcing. *Communications of the ACM*. 46(12): 86–92.

Koh CS, Ang S, Straub DW (2004) IT Outsourcing Success: A Psychological Contract Perspective. *Information Systems Research*. 15(4): 356–373.

Koo Y, Lee J-N, Heng C S, Park J (2017) Effect of multi-vendor outsourcing on organizational learning: A social relation perspective, *Information & Management*, 54(3): 396–413.

Kotlarsky J, Oshri I, Dibben J, Mani D (2018) IS sourcing. *MIS Quarterly*, Research Curation. 1–16.

Lacity M, Hirschheim R (1993) The Information Systems Outsourcing Bandwagon. *Sloan Management Review*. 35(1): 73–86.

Lacity M, Willcocks L (1998) An empirical investigation of information technology sourcing practices: Lessons from experience. *MIS Quarterly*. 22(3): 363–408.

Langlois RN (2002) Modularity in technology and organization. *Journal of Economic Behavior and Organization*. 49(1): 19–37.

Lee JN, Miranda SM, Kim YM (2004) IT outsourcing strategies: universalistic, contingency, and configurational explanations of success. *Information Systems Research*. 15 (2): 110–131.

Leiblein MJ, Reuer JJ, Dalsace F (2002) Do make or buy decisions matter? The influence of governance on technological performance. *Strategic Management Journal*. 23(9): 817–833.

Levina N (2005) Collaborating on Multi-party Information Systems Development Projects: A Collective Reflection-in-Action View. *Information Systems Research*. 16(2): 109–130.

Levina N, Ross J (2003) From the vendor's Perspective: Exploring the value proposition in Information Technology Outsourcing. *MIS Quarterly*. 27(3): 331–364.

Levina N, Su N (2008) Global Multisourcing Strategy: The Emergence of a Supplier Portfolio in Services Offshoring. *Decision Sciences*. 39(3): 541–570.

Levina N, Vaast E (2005) The emergence of boundary spanning competence in practice: Implications for implementation and use in information systems. *MIS Quarterly*. 29(2): 335–363.

Levina, N, and Vaast, E (2008) Innovating or Doing as Told? Status Differences and Overlapping Boundaries in Offshore Collaboration, *MIS Quarterly* (32:2), pp. 307–332.

Li S, Shang J, Slaughter SA (2010) Why Do Software Firms Fail? Capabilities, Competitive Actions, and Firm Survival in the Software Industry from 1995 to 2007. *Information Systems Research*. 21(3): 631–654.

Lioliou E, Willcocks L, Liu X (2019) Researching IT multi-sourcing and opportunistic behavior in conditions of uncertainty: A case approach, *Journal of Business Research*, 103: 387–396.

Little TD, Bovaird JA, Widaman KF (2006) On the Merits of Orthogonalizing Power and Product Terms: Implications for Modeling Interactions Among Latent Variables. *Structural Equation Modeling*. 13(4): 497–519.

Loh L, Venkatraman N (1992a) Determinants of Information Technology Outsourcing: A Cross-Sectional Analysis. *Journal of Management Information Systems*. 9(1): 7–24.
Loh L, Venkatraman N (1992b) Diffusion of Information Technology Outsourcing: Influence Sources and the Kodak Effect. *Information Systems Research*. 3(4): 334–358.
Mani D, Barua A, Whinston A (2012) An Empirical Analysis of the Contractual and Information Structures of Business Process Outsourcing Relationships. *Information Systems Research*. 23(3): 618-634.
Manski CF, McFadden D (1981) *Structural Analysis of Discrete Data with Econometric Applications* (MIT Press, Cambridge, MA).
Mishra A, Chandrasekaran A, MacCormack A (2015) Collaboration in multi-partner R&D projects: The impact of partnering scale and scope. *Journal of Operations Management*. 33(34): 1–14.
Mishra A, Sinha KK (2016) Work design and integration glitches in globally distributed technology projects. *Production and Operations Management*. 25(2): 347–369.
Narasimhan R, Talluri S (2009) Perspectives on risk management in supply chains. *Journal of Operations Management*. 27(2): 114–118.
Narayanan S, Jayaraman V, Luo Y, Swaminathan JM (2011) The antecedents of process integration in business process outsourcing and its effect on firm performance. *Journal of Operations Management*. 291(2): 3–16.
Nickerson JA, Silverman BS (2003) Why firms want to organize efficiently and what keeps them from doing so: Inappropriate governance, performance, and adaptation in a deregulated industry. *Administrative Science Quarterly*. 48(3): 433–465.
Oshri I, Dibbern J, Kotlarsky J, Krancher O (2019) An Information Processing View on Joint Vendor Performance in Multi-Sourcing: The Role of the Guardian. *Journal of Management Information Systems*. *36*(4): 1248–1283.
Oshri I, Kotlarsky J, Willcocks L (2015) *The handbook of global outsourcing and offshoring: The definitive guide to strategy and operations* (Palgrave Macmillan, London, UK).
Plugge A, Bouwman H (2018) Tensions in global IT multisourcing arrangements: Examining the barriers to attaining common value creation. *Journal of Global Information Technology Management*, 21(4): 262–281.
Poppo L, Zenger T (2002) Do formal contracts and relational governance function as substitutes or complements? *Strategic Management Journal* 23(8): 707–725.
Pournader M, Kach A, Talluri S (2020) A Review of the Existing and Emerging Topics in Supply Chain Risk Management Literature. *Decision Sciences*. Forthcoming.
Richardson J (1993) Parallel Sourcing and Supplier Performance in the Japanese Automobile Industry. *Strategic Management Journal*. 14(5): 339–350.
Sabherwal R (1999) The Role of Trust in Outsourced IS Development Projects. *Communications of the ACM*. 42(2): 80–86.
Sampson RC (2004) The cost of misaligned governance in R&D alliances. *Journal of Law Economics and Organization*. 20(2):484–526.
Semykina A, Wooldridge J (2018) Binary response panel data models with sample selection and self-selection. *Journal of Applied Econometrics*. 33(2): 179–197.
Sia SK, Koh C, Tan CX (2008) Strategic Maneuvers for Outsourcing Flexibility: An Empirical Assessment. *Decision Sciences* 39(3): 407–443.
Simon HA (1962) The architecture of complexity. *Proceedings of the American Philosophical Society*. 106(6): 467–482.
Slaughter S, Ang S (1996) Employment outsourcing in Information Systems. *Communications of the ACM*. 39(7): 47–54.
Su N, Levina N (2011) Global Multisourcing Strategy: Integrating Learning from Manufacturing into IT Service Outsourcing. *IEEE Transactions on Engineering Management*. 58(4): 717–729.
Su N, Levina N, Ross JW (2016) The Long-Tail Strategy for IT Outsourcing. *MIT Sloan Management Review*. 57(2): 81–89.

Susarla A (2012) Contractual Flexibility, Rent Seeking, and Renegotiation Design: An Empirical Analysis of Information Technology Outsourcing Contracts. *Management Science*. 58(7): 1388–1407.
Susarla A, Barua A (2011) Contracting Efficiency and New Firm Survival in Markets Enabled by Information Technology. *Information Systems Research*. 22(2): 306–324.
Susarla A, Subramanyam R, Karhade P (2010) Contractual Provisions to Mitigate Holdup: Evidence from Information Technology Outsourcing. *Information Systems Research.* 21(1): 37–55.
Tiwana A (2008) Does interfirm modularity complement ignorance? A field study of software outsourcing alliances. *Strategic Management Journal*. 29(11): 1241–1252.
Tomlin B, Yimin W (2005) On the value of mix flexibility and dual sourcing in unreliable newsvendor networks. *Manufacturing & Service Operations Management*.7(1): 37–57.
Tripathy A, Eppinger SD. (2013) Structuring Work Distribution for Global Product Development Organizations. *Production and Operations Management*. 22(6): 1557–1575.
Vaidyanathan J, Narayanan S, Luo Y, Swaminathan JM (2012) Offshoring Business Process Services and Governance Control Mechanisms: An Examination of Service Providers from India. *Production and Operations Management*. 22(2): 314–334.
Walden E A (2005) Intellectual Property Rights and Cannibalization in Information Technology Outsourcing Contracts, *MIS Quarterly* 29(4): 699–720.
Wang Y, Gilland W, Tomlin B (2010) Mitigating supply risk: Dual-sourcing or process improvement? *Manufacturing & Service Operations Management*. 12(3): 489–510.
Whitten D, Leidner D (2006) Bringing IT back: An analysis of the decision to backsource or switch vendors. *Decision Sciences.* 37(4): 605–621.
Wiener M, Saunders C (2014) Forced coopetition in IT multi-sourcing, *Journal of Strategic Information Systems,* 23(3): 210–225.
Williamson OE (1979) Transaction-cost economics: The governance of contractual relations. *Journal of Law Economics*. 22(2): 233–261.
Williamson OE (1985) *The Economic Institutions of Capitalism* (Free Press, New York).
Winter SG, Szulanski G (2001) Replication as strategy. *Organization Science*. 12(6): 339–351.
Wooldridge JM (2002) *Econometric Analysis of Cross Section and Panel Data* (MIT Press, Cambridge, MA).
Yang Z, Aydın G, Babich V, Beil DR (2012) Using a dual-sourcing option in the presence of asymmetric information about supplier reliability: Competition vs. Diversification. *Manufacturing & Service Operations Management*. 14(2): 202–217.
Zollo M, Winter S (2002) Deliberate learning and the evolution of dynamic capabilities. *Organization science*, 13(3): 339–351.

Table 1: Literature Review

Insourcing vs Outsourcing				Single-sourcing vs Multisourcing			
Making the sourcing decision				**Making the sourcing decision**			
Research Question	**Theoretical Perspective**	**Methodology**	**Key Authors**	**Research Question**	**Theoretical Perspective**	**Methodology**	**Key Authors**
Why to outsource and the determinants of outsourcing	Innovation diffusion	Empirical (data on large US firms)	Loh and Venkatraman (1992b)	Why hospitals are trending towards single-sourcing and find the organizational level antecedents that impact the rate of this trend	Institutional theory	Empirical (data on US hospitals)	Angst et al. (2017)
Determinants of insource vs outsource choice	Labor economics	Empirical (data on IS job ads)	Slaughter and Ang (1996)	Client's optimal sourcing strategy	Game theory	Mathematical modelling (principal agent framework: simultaneous move game)	Bhattacharya et al. (2018)
How to make the sourcing choice (economic determinants)	Transaction cost economics	Empirical(survey & archived data)	Ang and Straub (1998)	How the number of services in an arrangement, client's IT outsourcing capabilities and the availability of distinctive vendor capabilities interact to influence client's single-sourcing vs multisourcing choice	Transaction cost economics	Empirical (data on large IT Outsourcing Arrangements)	**Current Paper**
Configurational approach to understand impact of sourcing strategy on its success.	Residual rights theory	Empirical (survey data)	Lee et al (2004)				

Insourcing vs Outsourcing				Single-sourcing vs Multisourcing			
Designing the Outsourcing Contract				**Designing the Outsourcing Contract**			
Research Question	**Theoretical Perspective**	**Methodology**	**Key Authors**	**Research Question**	**Theoretical Perspective**	**Methodology**	**Key Authors**
Intellectual Property rights division (for software created) between client and vendor	Transaction cost economics and Property rights	Analytical modelling	Walden (2005)	Forced Coopetition as risk sharing	Strategic management Coopetition theory	Qualitative case study	Wiener and Saunders (2014)

Choice between Fixed Price and Time & Material contracts (role of various profit drivers)	Transaction cost economics	Empirical (data on offshore projects)	Gopal and Konduru (2008)	mechanism in contract design			
Performance comparison of various contract types (FP & TM)	Contract theory	Analytical modelling	Dey et al. (2010)				
Contract design and its performance measurement in IT outsourcing	Contract theory	Empirical (data on outsourcing contracts)	Fitoussi and Gurbaxani (2012)				
Insourcing vs Outsourcing				**Single-sourcing vs Multisourcing**			
Managing the Outsourcing Relationship				**Managing the Outsourcing Relationship**			
Research Question	**Theoretical Perspective**	**Methodology**	**Key Authors**	**Research Question**	**Theoretical Perspective**	**Methodology**	**Key Authors**
Role of trust in outsourced IS projects and ways to build trust between clients and vendors	Organizational trust theory	Qualitative case study	Sabherwal (1999)	Theoretical framework for multivendor management in sourcing	Organizational process and Change theory	Qualitative case study	Levina and Su (2008)
Mechanisms to design portfolio of controls in outsourced IS projects	Organizational control theory and Agency theory	Qualitative case study	Choudhury and Sabherwal (2003)	Foster and manage competition & cooperation in multisourcing	Strategic management Coopetition theory	Qualitative case study	Wiener and Saunders (2014)
Managing outsourcing relationship through phycological contracting	Phycological contracting theory	Sequential qualitative and quantitative field study	Koh et al. (2004)	To understand knowledge sharing in multisourcing between clients and vendors and design ways to remove barriers	Resource based view	Qualitative case study	Plugge and Bouwman (2018)
How to establish collaborative practices in offshored projects	Practice theory	Qualitative case study	Levina and Vaast (2008)	Understand opportunistic vendor behavior and facilitate coopetition among vendors in multisourcing	Coopetition theory and Transaction cost economics	Qualitative case study	Lioliou et al. (2019)

Table 2: Summary Statistics and Correlations for the Sourcing Choice Analysis (49,057 arrangements).

Contruct	Mean	Std. Dev	1	2	3	4	5	6	7	8
1. ContractValue ($ Millions)	58.3	313M	1							
2. NumberOfServices	1.352	0.934	0.31	1						
3. CustomerOutsourcingCapabilities ($ Billions)	1.67	8.54	0.35	0.01	1					
4. EngagementTypeComplexity	0.433	0.495	-0.23	-0.32	-0.05	1				
5. CustomerRevenue ($ Billions)	17.1	251	0.27	0.06	0.24	0.18	1			
6. Industry Competition	0.562	0.032	0.13	0.05	-0.17	-0.04	0.12	1		
7. ExistingRelationshipStrength	1.38	1.34	0.15	0.09	0.31	0.05	0.11	0.09	1	
8. Sourcing Choice	0.091	0.288	0.23	0.03	0.33	0.01	-0.06	0.17	0.04	1

Table 3: Summary Statistics and Correlations for the Contract Outcome analysis (1,588 contracts).

Contruct	Mean	Std. Dev	1	2	3	4	5	6	7	8	9	10
1. ContractValue ($ Millions)	285	706	1									
2. NumberOfServices	2.276	1.548	0.28	1								
3. CustomerOutsourcingCapabilities ($ Billions)	0.79	3.96	0.19	-0.09	1							
4. VendorOutsourcingCapabilities ($ Billions)	30.2	52.5	0.25	0.16	0.13	1						
5. EngagementTypeComplexity	0.561	0.231	-0.25	-0.20	-0.01	-0.04	1					
6. CustomerRevenue ($ Billions)	18.7	55.6	0.34	0.08	0.29	0.19	-0.12	1				
7. FixedPrice(Y/N)	0.488	0.51	-0.21	-0.04	0.03	-0.01	0.08	-0.06	1			
8. ExistingRelationshipStrength	1.39	0.88	0.02	0.07	0.21	0.18	-0.13	0.08	0.08	1		
9. SourcingChoiceMisalignment	0.13	0.15	0.39	-0.02	0.32	0.11	-0.01	0.29	-0.01	0.29	1	
10. Outcome	0.77	0.41	0.30	0.09	0.02	0.05	-0.01	0.04	0.11	0.02	-0.08	1

Table 4: Fixed Effect Logit Model for the Sourcing Choice Analysis

	Model 1	Model 2
VARIABLES	Sourcing Choice	Sourcing Choice
ContractValue	0.050*** (0.136)	0.103** (0.006)
NumberOfServices	0.029*** (0.022)	0.035*** (0.133)
CustomerOutsourcingCapabilities	0.199*** (0.267)	0.026** (0.177)
EngagementTypeComplexity	0.123 (0.051)	0.191 (0.083)
CustomerRevenue	0.045 (0.028)	0.022 (0.030)
Industry Competition	0.264*** (0.186)	0.071*** (0.093)
ExistingRelationshipStrength	-0.015* (0.008)	-0.090* (0.021)
NumberOfServices * NumberOfServices		-0.271*** (0.173)
Customer Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Observations Number of Unique Customers	49,057 22,502	49,057 22,502
	χ2 = 129.32*** (7)	χ2 = 136.61***(8)

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

Table 5 : Logit Model to study the impact of Sourcing Choice Misalignment on Contract Outcome

VARIABLES	Outcome Model 1
ContractValue	0.110 (0.039)
NumberOfServices	0.190 (0.134)
CustomerOutsourcingCapabilities	0.011 (0.135)
VendorOutsourcingCapabilities	0.113 (0.175)
EngagementTypeComplexity	-0.170* (0.012)
CustomerRevenue	0.281* (0.172)
FixedPrice(Y/N)	0.102 (0.039)
ExistingRelationshipStrength	0.091* (0.029)
SourcingChoiceMisalignment	-0.121** (0.043)
Constant	0.005 (0.025)
Observations	1,588
	Pseudo R^2 =0.482

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

Table 6: Robustness Checks for Endogeneity and Reverse Causality

	Model 1 Dynamic Logit	Model 2 Dynamic Logit	Model 3 FE (using Lagged NumberOfServices)	Model 4 FE (using Lagged Industry Competition)
VARIABLES	Main Effect	Interaction Effect	Sourcing Choice	Sourcing Choice
Lagged(Sourcing Choice)	0.044*** (0.116)	0.091*** (0.103)		
ContractValue	0.252*** (0.073)	0.135** (0.262)	0.062*** (0.124)	0.015** (0.003)
NumberOfServices	0.234*** (0.136)	0.127*** (0.104)		0.022*** (0.011)
Lagged (NumberOfServices)			0.255*** (0.031)	
CustomerOutsourcingCapabilities	0.203*** (0.182)	0.166** (0.052)	0.167*** (0.158)	0.028*** (0.017)
EngagementTypeComplexity	0.052 (0.218)	0.172 (0.163)	0.291 (0.189)	0.002 (0.024)
CustomerRevenue	0.164 (0.009)	0.241 (0.199)	0.104 (0.323)	0.008 (0.003)
Industry Competition	0.155*** (0.261)	0.107** (0.031)	0.025*** (0.122)	
Lagged(Industry Competition)				0.018*** (0.043)
ExistingRelationshipStrength	-0.047* (0.022)	-0.162** (0.091)	-0.210** (0.164)	-0.008* (0.141)
NumberOfServices * NumberOfServices		-0.185*** (0.144)		
Observations	42,494	42,494	42,494	42,494
	$\chi 2$ = 191.61***(8)	$\chi 2$ = 200.31***(9)	$\chi 2$ = 144.03***(7)	$\chi 2$ = 131.57***(7)

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

Table 7: Fixed Effect Logit Model for the Sourcing Choice Analysis-Client IT Outsourcing Capabilities measured as Multisourcing Capabilities

	Model 1	Model 2
VARIABLES	Sourcing Choice	Sourcing Choice
ContractValue	0.254*** (0.176)	0.271*** (0.012)
NumberOfServices	0.026*** (0.032)	0.185** (0.066)
MultisourcingCapabilities	0.072 (0.189)	0.298 (0.006)
EngagementTypeComplexity	0.275 (0.088)	0.267 (0.019)
CustomerRevenue	0.114 (0.008)	0.322 (0.104)
Industry Competition	0.075** (0.116)	0.051*** (0.209)
ExistingRelationshipStrength	-0.171* (0.002)	-0.028** (0.243)
NumberOfServices * NumberOfServices		-0.157*** (0.181)
Customer Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Observations Number of Unique Customers	9,076 418	9,076 418
	$\chi 2$ = 118.21***(7)	$\chi 2$ = 166.32***(8)

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

Table 8: Fixed Effect Logit Model for the Sourcing Choice Analysis - Client IT Outsourcing Capabilities measured as Single-sourcing Capabilities

	Model 1	Model 2
VARIABLES	Sourcing Choice	Sourcing Choice
ContractValue	0.128*** (0.035)	0.192*** (0.181)
NumberOfServices	0.046** (0.144)	0.150** (0.276)
SinglesourcingCapabilities	0.266*** (0.227)	0.133*** (0.162)
EngagementTypeComplexity	0.038 (0.299)	0.123 (0.281)
CustomerRevenue	0.216 (0.301)	0.318 (0.001)
Industry Competition	0.214** (0.211)	0.168** (0.177)
ExistingRelationshipStrength	-0.134** (0.281)	-0.146** (0.040)
NumberOfServices * NumberOfServices		-0.233*** (0.191)
Customer Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Observations	9,076	9,076
Number of Unique Customers	418	418
	$\chi 2$ = 151.22***(7)	$\chi 2$ = 168.13***(8)

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

Table 9: Fixed Effect Logit Model for the Sourcing Choice Analysis (Choice-Based Sampling)

	Model 1 (Choice-based sampling)	Model 2 (Choice-based sampling)
VARIABLES	Sourcing Choice	Sourcing Choice
ContractValue	0.028** (0.038)	0.137*** (0.044)
NumberOfServices	0.086*** (0.283)	0.298*** (0.063)
CustomerOutsourcingCapabilities	0.117*** (0.019)	0.088** (0.091)
EngagementTypeComplexity	0.141 (0.231)	0.187 (0.096)
CustomerRevenue	0.046 (0.032)	0.310 (0.175)
Industry Competition	0.051** (0.239)	0.214** (0.139)
ExistingRelationshipStrength	-0.087** (0.388)	-0.177** (0.002)
NumberOfServices * NumberOfServices		-0.081*** (0.253)
Customer Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Observations	8,998	8,998
Number of Unique Customers	2,033	2,033
	$\chi2$ = 109.14**(7)	$\chi2$ = 145.96***(8)

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

Table 10: Logit Model to study the impact of Sourcing Choice Misalignment on Contract Outcome (Using *k*-*NN*)

VARIABLES	Model 1 Outcome (5NN)	Model 2 Outcome (3NN)
ContractValue	0.231 (0.017)	0.149 (0.169)
NumberOfServices	0.169 (0.015)	0.117 (0.127)
CustomerOutsourcingCapabilities	0.183** (0.043)	0.122*** (0.014)
VendorOutsourcingCapabilities	0.018* (0.171)	0.181*** (0.120)
EngagementTypeComplexity	-0.256* (0.137)	-0.139*** (0.071)
CustomerRevenue	0.310** (0.132)	0.361** (0.211)
FixedPrice(Y/N)	0.115 (0.182)	0.159 (0.170)
ExistingRelationshipStrength	0.276** (0.081)	0.012** (0.001)
SourcingChoiceMisalignment	-0.317** (0.133)	-0.220*** (0.007)
Constant	0.155 (0.111)	0.019 (0.036)
Observations	198	132
	Pseudo R^2 =0.516	Pseudo R^2 =0.721

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

Table 11: Logit Model (on CEM sample) to study the impact of Sourcing Choice Misalignment on Contract Outcome

VARIABLES	Model 1 Outcome
ContractValue	0.216 (0.004)
NumberOfServices	0.081 (0.115)
CustomerOutsourcingCapabilities	0.067*** (0.006)
VendorOutsourcingCapabilities	0.192** (0.181)
EngagementTypeComplexity	-0.211** (0.162)
CustomerRevenue	0.262*** (0.033)
FixedPrice(Y/N)	0.064 (0.330)
ExistingRelationshipStrength	0.088** (0.061)
SourcingChoiceMisalignment	-0.136*** (0.258)
Constant	0.037 (0.151)
Observations	1,418
	Pseudo R^2 = 0.632

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

Table 12: Logit Model to study the impact of Sourcing Choice Misalignment (computed using XGBoost) on Contract Outcome

VARIABLES	Outcome Model 1
ContractValue	0.178 (0.152)
NumberOfServices	0.127 (0.016)
CustomerOutsourcingCapabilities	0.084 (0.005)
VendorOutsourcingCapabilities	0.108 (0.112)
EngagementTypeComplexity	-0.193* (0.147)
CustomerRevenue	0.168* (0.004)
FixedPrice(Y/N)	0.185 (0.171)
ExistingRelationshipStrength	0.182* (0.163)
SourcingChoiceMisalignment	-0.233*** (0.158)
Constant	0.033 (0.019)
Observations	1,588
	Pseudo R^2 =0.523

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

Figure 1: (Hypothesis 1): As the number of services in an IT outsourcing arrangement increases, the likelihood of multisourcing first increases and then decreases.