IT OUTSOURCING: GROWTH, CHOICE, AND INFORMATION ASYMMETRY

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Dedication

To my family for their unconditional love

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Chapter 1: Introduction

Worldwide IT outsourcing is currently valued at 991 billion dollars per annum (Gartner 2012). The significant growth in the outsourcing business is attributed to its role in cost savings and strategic risk reduction allowing enterprises to focus on their core competencies. In spite of the volume of IT outsourcing, industry reports suggest that over fifty percent of the IT outsourcing contracts are renegotiated or cancelled. (Gartner 2010, Computer Weekly 2012). According to these reports while vendor's lack flexibly and provide poor customer service, client's hidden costs in outsourcing contracts lead to contract failure. Further, there exists natural tension in an outsourcing relationship as clients seek a service at lower than the in-house cost and the vendors wants to maximize their profits. Given this natural tension between the client and the vendor, the IT outsourcing vendor must be selected carefully and the outsourcing contract must be designed assiduously.

Chapter 2 of the thesis acknowledges the presence of information asymmetry in IT outsourcing markets and posits insight on the question: **"How to choose IT outsourcing vendor in presence of information asymmetry between clients and vendors?"** Clients have uncertainty about vendors' capabilities and vendors' have uncertainty about client's requirements. This makes the selection of vendors and contracting for IT outsourcing projects especially challenging. In this chapter we answer this question and present evidence that third party advisors, with their knowledge of client requirements and the vendor landscape, mitigate the information asymmetry in the IT outsourcing market and lead to better matching that benefits clients as well as vendors.

Chapter 3 of the thesis acknowledges that as the size of outsourced IT projects increases, it is likely that one IT vendor does not possess the economy of scale and specialization in all components of the outsourced project. Thus, as outsourced IT projects become larger, clients may involve multiple vendors in a project. This chapter posits insight on the question: "**How many vendors should be involved in an IT outsourcing contract?"** In other words, which form of outsourcing clients should choose: (i) Single-Sourcing, where the client outsources to one primary vendor, (ii) Single-Sourcing with subcontracting, where the primary vendor involves other/secondary vendors in the project, or (iii) Multi-Sourcing, where the client outsources to multiple primary vendors.

While Chapters 2 and 3 focuses on studying IT outsourcing from the point of view of clients, Chapter 4 aims at understanding outsourcing from vendor's point of view. This chapter posits insight on the question **"What capabilities should vendor develop in order to get selected for IT outsourcing contracts?"** It examines how the diversity in the type of projects executed by vendors helps them to develop their capabilities and grow their business.

Chapter 5 discusses the implications of the findings, conclusion and future work.

Chapter 2: IT Outsourcing and the Impact of Advisors on Clients and Vendors

2.1 Introduction

IT outsourcing is a very large industry. Gartner's 2012 analysis sized the worldwide IT services market at 991 billion dollars per annum. The three largest US based IT services firms, IBM Global Business Services, Accenture, and HP Enterprise Services, together have revenue of over 100 Billion dollars per year. Similarly, the three largest offshore firms in this industry, Infosys, TCS, and Wipro have annual revenue of over 15 Billion dollars. In spite of the volume of IT outsourcing, the outcome of IT outsourcing contracts have been less than stellar. Gartner (2010) reports that 55% of the IT infrastructure outsourcing contracts are renegotiated. Similarly Computer Weekly (2012) reports that 44% of the IT outsourcing contracts are renegotiated. Other industry studies also indicate that a very large proportion of outsourcing contracts are cancelled (Infosys, 2011).

Industry reports commonly blame poor customer service, lack of flexibility on the part of the vendor, and hidden costs, for clients' inability to achieve the goals of outsourcing initiatives (Craig and Willmort, 2005; McDougall, 2006). Poor service, lack of flexibility, and hidden costs, can be attributed to the tension that exists in a typical outsourcing relationship where the client seeks a service at lower than the in-house cost and the vendor who wants to maximize its profits (Tadelis, 2007). Given this natural tension between the client and the vendor, the IT outsourcing vendor must be selected carefully and the outsourcing contract must be designed assiduously. However, there is significant information asymmetry in the IT outsourcing market that makes the selection of vendors and contracting for IT projects especially challenging. For instance, clients' may understand their requirements but face significant uncertainty about the capabilities of different vendors to meet their requirements. Similarly, vendors may have an understanding about their capabilities, but face significant information asymmetry about the requirements, intentions and motivations of different (potential) clients. If the vendor does not have the capabilities to satisfy client's requirements it may lead to cancellation or renegotiation of the contract.

Different tools and devices may be used to mitigate the information asymmetries in the IT outsourcing market. For example, prior relationship with a vendor, and experience and reputation of a vendor may mitigate a client's information asymmetry about a vendor's capabilities. The vendor location/distance may also reduce information asymmetry. For example, US-based clients may have lower information asymmetry about US-based vendors compared to overseas vendors. Similarly, third party certification of vendors e.g., CMM ratings (Gopal and Gao, 2009; Gao et. al., 2010) may mitigate the information asymmetry on the client side. CMM ratings signal to (potential) clients the maturity of a vendor's software development process, thereby providing information about the vendor's software development capabilities. The IT outsourcing literature has examined how vendors can use devices such as prior relationship with clients, vendors' experience and reputation, vendors' location, service diversification, and

CMM certification to signal quality and reduce information asymmetry (Gao et al. 2010; Gopal and Gao, 2009).

The information asymmetry between vendors' capabilities and clients' requirements and the difficulties in defining the scope and performance of outsourced work, gives rise to opportunities for specialist third party advisors to intermediate between clients and vendors. Third party advisors, such as TPI, Everest and NeoIT often help with the contracting process and set up outsourcing engagements by matching clients' needs with vendors' capabilities. Advisors create value by lowering search costs in the presence of information asymmetry between clients and vendors (e.g., Bailey and Bakos, 1997). Third party advisors use their knowledge of the vendor space to match client requirements with vendor capabilities, help to design appropriate outsourcing contracts and get the best deal available in the market for both clients and vendors. Even when advisors work on the behalf of the client, their goal is to find the most capable vendor that can provide the highest value to their client. In such cases, advisors help their clients directly and help the vendor indirectly. If third party advisors, by virtue of their market knowledge, are able to match clients with the right vendors and design appropriate contracts, then advisors can help vendors secure more outsourcing contracts and help clients and vendors achieve more positive contracting outcomes. This chapter examines the role of advisors in mitigating the information asymmetry in IT outsourcing engagements. Specifically, this chapter investigates the impact of third party advisors on vendors' revenues and contract outcomes.

Our analysis using 753 large IT outsourcing contracts from 1989-2009 suggests that the presence of advisor acts as a tool to reduce information asymmetry between clients and vendors and benefits both clients and vendors. The presence of advisor is associated with higher annual revenues for vendors. Furthermore, the presence of advisors is associated with higher likelihood of contract extension and expansion. The remainder of the chapter is organized as follows. The second section provides an overview of the IT outsourcing literature, the third section provides the conceptual background; section four discusses data and measures; section five discusses econometric model and results; section six discusses robustness analysis and section seven discusses the implications of the findings and conclusion.

2.2 Literature Review

The literature has analyzed IT outsourcing from three complementary perspectives: (i) drivers of outsourcing (Lacity and Hirscheim 1993b; Grover and Teng 1993; Loh and Venkatraman 1992), (ii) contracting for IT outsourcing services, and (iii) drivers of outsourcing success (Grover et al. 1996; Lee and Kim 1999; McFarlan and Nolan 1995). The first stream suggests that outsourcing allows clients to focus on their core competencies and strategic differentiators, and utilize vendors' expertise and economies of scale for valuable commodities (Lacity et al. 1995, Lichtenstein 2004, Levina and Ross 2003). Tanriverdi et al (2007) suggest that outsourcing choices are governed by the modular characteristics of the processes and their underlying IT infrastructure. Thus for tightly coupled processes which cannot be detached from their underlying IT infrastructure, domestic outsourcing is chosen. However, for modular processes which can be detached from their underlying IT infrastructure and performed in remote locations, offshore outsourcing is chosen.

The second stream of research focuses on contracting for IT outsourcing services. Grossman and Hart (1986) argue that bounded rationality of agents leads to incomplete contracts. A large body of IT outsourcing literature (Han and Nault, 2011; Koh et al. 2004; Susarla et al. 2010, 2012) recognizes the difficulties in writing complete contracts and suggests that IT outsourcing contracts are inevitably incomplete. In many cases the agency issues in IT outsourcing contracts arise due to information asymmetry between clients and vendors. While clients lack the ability to judge vendors' capabilities, vendors too lack the ability to signal their capabilities to clients (Spence 1973; Gopal and Gao, 2009). The literature has examined how vendors could use devices such as their experience and reputation, prior relationship with clients, their location/distance from the client, and their CMM rating to signal quality (Gao et al. 2010; Gopal and Gao, 2009). In this regard, this chapter examines the role of third party advisors in mitigating this information asymmetry and matching clients' requirements with vendors' capabilities.

Contract type determines how risk is shared between clients and vendors (Lacity and Hirschheim 1993a). Vendors' profits are higher (and risks are less) in time and material contracts than in fixed price contracts (Gopal et al. 2003; Ethiraj et al. 2005). Thus, it is likely for vendors to prefer time and material contracts compared to fixed price contracts. However, fixed price contracts allow vendors to benefit from information asymmetries and any private information regarding their capabilities or domain knowledge (unknown to clients) and realize information rents (Bajari and Tadelis 2001, Banerjee and Duflo 2000). In essence, vendors get the benefit of information asymmetries in fixed price contracts and risk protection in time and material contracts (Lacity and Hirschheim 1993a), and for larger/riskier projects vendors trade off risk protection with information rents (Gopal and Sivaramakrishnan, 2008).

Prior research has also examined the influence of client, vendor and project characteristics, on the choice of contract type (Chen and Bharadwaj, 2009). Gopal et al (2003) argue that larger clients (or clients with higher bargaining power and promise of future business) are more likely to sign fixed price contracts. They also suggest that client's with prior IT outsourcing experience and more experienced MIS departments are more likely to sign fixed price contracts. Focusing on project characteristics, Bajari and Tadelis (2001) suggest that larger, longer, and more complex projects that have greater requirement uncertainty are more likely to be time and material contracts. Similarly, Gopal et al (2003) find that projects that are more complex and mission critical are associated with time and material contracts. Focusing on prior client and vendor relationship on a project, Mani et al (2012) contend that prior cooperative association on a project serves as a channel for better/easier information exchange and is associated with fixed price contracts. With regard to vendor characteristics, Banerjee and Duflo (2000) find that vendor reputation is associated with time and material contracts. However, if there is more competition in the IT services market, the client is more likely to sign fixed price contracts. Third party advisors, with their knowledge of project and client characteristics and their understanding of vendor capabilities can help in designing appropriate contracts that are more likely to lead to a positive contract outcome for the client and the vendor.

The third stream of IT outsourcing literature focuses on drivers of outsourcing success. Classical principal agent theory (Grossman and Hart 1983) argues that performance metrics (to measure and reward vendor's performance) should be assigned only to those contract objectives that are measurable, leaving aside hard to measure objectives such as service quality. Such a framework is not suitable for actual observed IT outsourcing contracts (Garen 1994; Lacity et. al 1995). Fitoussi and Gurbaxani (2012) argue that performance metrics affects vendor's performance and ultimately the outcome of the contract. They also show empirically that in a multitask outsourcing contact, with a mix of tangible and non-tangible objectives, incentive for the measurable objectives (such as reducing cost) decreases when additional objectives are less measurable (such as quality). Further, they suggest that multiple performance metrics can be used to improve measurement of non-tangible objectives but as the number of performance metrics increases satisfactory outcome decreases.

This stream of research also examines the impact of and the balance between formal/structural controls such as reporting arrangements and penalty clauses, and informal controls such as trust and interpersonal relationships, for project success (Kirsch 2004; Levina and Vaast 2005; Levina 2005; Choudhury and Sabherwal 2003; Gopal and Gao 2009). Sabherwal (1999) argues that both structural and informal controls are vital for performance of contacts. Further, the balance between formal and informal control improves outcomes and too much focus on either can hurt performance. Third party advisors, being involved in the selection of the vendor have the incentive to remain engaged on the project as it gets underway and use their social capital with the client and vendor to oversee a positive contract outcome. They bring an alternative, objective and independent voice to monitoring a client vendor relationship. Thus, third party advisors, with their prior relationship with the client and/or the vendor are able to bring a more balanced and longer term perspective to a project that goes beyond the success and returns from the current project, and thus can contribute to contract success. However, extant literature has yet to systematically study the impact of third party advisors in the context of IT outsourcing. In this research we bridge this gap and examine the impact of advisor on vendor and contract performance.

2.3 Conceptual Background

There is information asymmetry in the IT outsourcing market between clients' requirements and vendors' capabilities. This makes the selection of vendors and contracting for IT projects especially challenging. For instance, clients' may understand their requirements but face significant uncertainty about the capabilities of different vendors to meet their requirements. Similarly, vendors may have an understanding about their capabilities, but face significant information asymmetry about the requirements, intentions and motivations of different (potential) clients.

Given the information asymmetry between client requirements and vendor capabilities, and the difficulties in defining the scope and performance of outsourced work, specialist third party advisors, such as TPI, Everest and NeoIT are sometimes used in setting up outsourcing engagements. Third party advisors offer a variety of services to clients. They help match clients' requirements with vendors with appropriate capabilities. Given the global nature of the IT vendor landscape, third party advisors with knowledge of the IT outsourcing market can match clients' specific requirements with vendors with the right capabilities to meet those requirements (Bailey and Bakos, 1997, Chan 1983). Vashistha and Vashistha (2006) describe what an advisor may do to match a client's requirements with a vendor with appropriate capabilities. For example, an advisor may visit an offshore vendor to assess a vendor's capabilities (beyond what can be judged by process-oriented quality management system certifications). These efforts are also intended to discover information about vendor's domain knowledge, technological capabilities, business continuity plans (e.g., disaster recovery and data privacy), human capital development and attrition management strategies, management skills (e.g., ability to manage geographically apart projects or projects of varying size), financial stability, and flexibility in service level agreements and pricing models. It is clear that these search and evaluation activities are costly. If these activities were costless, then clients themselves could perform these activities to evaluate every vendor, and then select the optimal vendor. Thus, as the cost of search and evaluation increases, so does the importance of advisors. The importance of advisors also increases with the global sourcing of IT services with clients and vendors that are often thousands of miles apart.

Advisors thus, economize on the transaction cost of matching clients with the right vendor. Since the information about each vendor is useful for multiple clients, there are economies of scale in advisors' operations, even when the information search and evaluation cost is same for clients and advisors (Chan 1983). The advisors also have a greater incentive to invest in developing capabilities to learn about, evaluate the quality of, and monitor the performance of a vendor, than an individual client since advisors evaluate more vendors and carry out more transactions than individual clients. In addition, an advisor's incentive to report accurately on the quality of vendors stems from returns to building its own good reputation for having "market knowledge." In this way advisors are able to use their market knowledge to reduce the transaction space and match clients and vendors at lower transaction costs (Bailey and Bakos, 1997). Advisors also structure contracts between clients and vendors by specifying project deliverables and milestones to arrive at the appropriate contract, given the project, client, and vendor characteristics. Finally, advisors help clients with monitoring the vendors as the contract gets underway. Given that advisors work with clients and vendors on multiple projects they often have social capital and leverage that goes beyond individual contracts.

Prior work has examined how rating information such as CMM ratings, vendor's location, service diversification, prior relationship with the client, and reputation can mitigate information asymmetry. We argue that presence of advisor also acts as a tool to reduce information asymmetry between client and vendor. This information asymmetry reducing impact of advisors may benefit clients as well as vendors. The information asymmetry reducing impact of advisors may affect vendors in two distinct ways. First, in the presence of advisors, vendors may receive contracts from clients that they don't receive in markets with no advisors. In this way, advisors may enable vendors to receive "new matches" and increase vendors' revenues. Second, in the presence of advisors, vendors may receive larger contracts as advisors may find clients who have higher value for a vendor's capabilities. In this way advisors are able to secure "better matches" for the vendor and increase vendors' revenues. Advisors, thus, may lead to "more matches" and "better matches" for vendors. Hence we hypothesize:

H1: The presence of advisor is associated with higher revenues for vendors.

The IT outsourcing literature has examined customer satisfaction with IT outsourcing (e.g., Mani et al., 2012) and profitability of the project for the vendor (e.g., Gopal et al., 2003). However, with the exception of Susarla (2012), we are not aware of studies that specifically focus on project success. While contracting has been studied at the point of signing the contract, these large IT outsourcing contracts are not transactional, rather they are long-term relationships. Outcomes that are realized over longer time horizons are important to study in the context of complex inter-organizational multi-year relationships. In this chapter we study the outcomes of large contracts (average size ~350 Million) in the long-term.

It is expected that the likelihood of a contract success depends on a number of project client, and vendor characteristics. Controlling for project, client, and vendor characteristics, our claim is that the presence of advisor is likely to be associated with project success. Advisors, with their knowledge of the vendor landscape are able to match client requirements with vendors with capabilities to successfully execute the project. Advisors, with their knowledge of the client, vendor, and project characteristics, are also able to design appropriate contracts for the situation at hand.

The presence of advisors also affects the behavior and performance of vendors, as vendors know that in the presence of advisors it's more likely that higher quality vendors will get chosen in future. For instance, the mere presence of the advisors with knowledge of the market makes it less likely that a fly-by-night operator can be chosen. Thus, vendors are induced to offer better service and exert greater effort when the market has advisors that help clients with vendor evaluation and selection. Further, advisors also have the ability to reduce opportunistic behavior and asymmetries in the bargaining power of clients and vendors (Bailey and Bakos, 1997). A client and vendor may decide to not engage in future business with each other; however, they are likely to work with the same advisor again due to the long term market participation and reputation of advisors. Thus advisors act as a trust agent by preventing opportunistic behavior of both buyers and sellers (Bailey and Bakos, 1997). Further when the characteristics and behaviors of clients and vendors are unobservable to outside parties, advisors generate market information and provide guarantees of quality by monitoring and evaluating the behavior of clients and vendors. Thus, advisors, by better client requirement and vendor capability matching, by designing appropriate contracts that account for client/project characteristics and vendor capabilities, and by incenting client and vendor to exert greater effort and not behave opportunistically, achieve better contract outcomes.

On the other hand, if advisors fail to find vendors with capabilities to meet client's requirements, or fail to design an appropriate contract given the client, vendor, and project characteristics, advisors may be associated with contract failures. Clients often want to reduce their costs by outsourcing IT work. Thus, often one goal of advisors is to secure a good deal for the client. However, there is a fine line between securing a good deal for the client and achieving a win-win project outcome for the client and the vendor. For instance, our conversations with multiple senior executives at leading vendors suggest that "bidding wars" are often associated with deals that materialize through advisors. Furthermore, if high quality vendors are not the most cost effective vendors, they may be dissuaded from entering into the bidding process whenever advisors are involved in vendor selection. If advisors discourage high quality vendors from participating in the bidding process, advisors may have a negative impact on contract success. However, on balance, we expect that controlling for the project, client, and vendor characteristics, the presence of an advisor is likely to be positively associated with contract success. We thus hypothesize:

H2: The presence of advisor in a contract is positively associated with contract success.

2.4 Data and Measures

We primarily rely on IDC's services contract database (SCD) for our data. Additional data about CMM certifications and vendor age are obtained from public sources such as company websites. The IDC database includes over twenty two thousand large IT outsourcing contracts signed from 1989-2009. Our analysis includes seven hundred and fifty-three contracts where the outcome of the outsourcing contract i.e., whether the contract was extended, expanded, renegotiated or cancelled is indicated. We measure **Contract Outcome** as a binary variable. A contract is coded as one if it was extended or expanded and is coded as zero if it was renegotiated or cancelled. It is believed that if a project/contract is going well and the vendor is performing, the contract is likely to be extended or expanded and that is a good outcome for the client and the vendor. However, if a contract is not going well for the client and or the vendor, the contract is likely to be cancelled or renegotiated, and this is not a good outcome for the client or the vendor. It is acknowledged that in some circumstances contract renegotiation, to the extent that it accounts for a changing environment, may even be for the better Susarala(2012). Thus, to examine the robustness of the results we also run the analysis by excluding contracts that were renegotiated. We exclude contracts from the dataset if the contract status is unknown. The database indicates the name of the advisor, if an advisor was used in the contract.

Project/Contract Variables: The size of the project is measured as the dollar value of the contract **(ContractValue**). **EngagementTypeComplexity** is a categorical variable that measures the complexity of the project. This variable takes a value of three for Application Development, Business Consulting, IT consulting, and Systems Integration engagements; a value of two for Learning and Education, IT Education and Training, and Business Outsourcing; and a value of one for Deploy and Support, Contract Labor and Capacity Engagement, and Business Support Engagements. This classification follows Susarla et al (2010). **NumberofSubsegments** is the number of distinct IT tasks/activities that are involved in the outsourcing project. The presence of an advisor (**Advisor Y/N**) is a binary variable that takes the value of one, if an advisor was used in the contract. The strength of the client and vendor relationship prior to signing the contract **(ExistingRelationshipStrength)** is measured as the count of the number of different projects the client and the vendor had done, before signing the contract under consideration. **CompetitiveY/N** measures the competitive intensity of the bidding process. This is a binary variable that is coded as one if the bidding process for the contract was competitive bidding, and is coded as zero if the contract was awarded to the incumbent or if the contract was sole-sourced. The database indicates whether the contract was more like a fixed price contract (**FixedPriceY/N**) or more like a time and material contract. **Age** is the numerical age of the vendor in years at the time of signing the contract. The number of outsourcing partners (**NumberofMultisourcingPartners**) is the count of the number of primary contractors on the project.

Client Variables: The client's experience with IT outsourcing (**CustomerOutsourcingExperience**) is measured as the dollar value of all the projects outsourced by the client, before signing the contract under consideration. The resources a client can bring to a project are likely to be influenced by the size of the client. Thus, firm size measured as customer revenue (**CustomerRevenue**) is used as a proxy for the resources of the client that can brought to bear on the project.

Vendor/Advisor Variables: The capabilities, revenue and, reputation of the vendor (**VendorRevenue**) is measured as the annual dollar value of all the IT contracts signed by the vendor, in the signing year of the contract under consideration. The claim here is that vendors with lower information asymmetry about their capabilities will have higher annual value of contracts signed by the vendor. The process maturity of the vendor is assessed as the CMM rating of the vendor (**CMMRating**). Most of the clients in the data are US-based clients. The cultural and physical distance of the vendor is a binary variable that take a value of 1 for US-based vendors and a value of 0 for non-US-based vendor. **Diversity** is a measure of the different kinds of projects or tasks executed by a vendor Gao et al. 2010). It is computed every year based on the number of subsegments a vendor has worked on in that year. It is the average of **NumberofSubsegments** (which is a proxy for distinct IT tasks involved in the outsourcing project) of all the projects executed by the vendor in the year of the project under consideration. Table 1.1 presents the summary statistics and correlations between the key variables.

Control Variables: Region Dummies are used to control for the vendor population in the geographic location of the project and **Year Dummies** are used to control for number of projects in a year.

2.5 Econometric Model and Results

Hypothesis 1 predicts a positive relationship between the presence of advisor in project k ($AdvisorY/N_{k,t}$) and vendor j's revenue ($VendorRevenue_{j,t}$) in period t defined as the year in which the contract was signed. We treat advisor selection as endogenous and use a two-stage-least-squares (2SLS) model with appropriate identification as indicated below to predict vendor revenue.

(1) $AdvisorY/N_{k,t} = \beta_0 + \beta_1 CustomerOutsourcingExperience_{i,t} +$

$\beta_2 ContractValue_{k,t} + \beta_3 EngagementTypeComplexity_{k,t} +$

$\beta_4 NumberofSubsegments_{k,t} + \varepsilon_1$

(2) $VendorRevenue_{j,t} =$

$\beta_0 + \beta_1 Advisor\ Y/N_{k,t} + \beta_2 ExistingRelationshipStrength_{k,t} + \beta_3 CMM_{j,t} +$

$\beta_4 USY/N_{j,t} + \beta_5 Diversity_{j,t} + \beta_6 Age\ _{j,t} + \varepsilon_2$

Equation (1) is the advisor selection model. This model suggests that a client *i* may choose an advisor based on how experienced they are at IT outsourcing at time *t* ($CustomerOutsourcingExperience_{i,t}$), how large ($ContractValue_{k,t}$) and complex ($EngagementTypeComplexity_{k,t}$) the IT project is, and how many different tasks and activities are involved in the outsourced project ($NumberofSubsegments_{k,t}$). We expect clients to use advisors when they lack IT outsourcing experience and thus are not very familiar with the vendor landscape. We also expect clients to use advisors for large and complex projects, and projects that involve a number of distinct tasks and activities.

Equation (2) is the vendor revenue model. A vendor *j*'s revenue is a function of different devices available to reduce information asymmetry about the vendor. Thus, we predict vendor revenue based on how long the vendor has been in business ($Age\ _{j,t}$), the technological capabilities of the vendor ($Diversity_{j,t}$), the maturity of the vendor's software development process ($CMM_{j,t}$), whether the vendor is a US-based vendor ($USY/N_{j,t}$), and the strength of the client vendor prior relationship

($ExistingRelationshipStrength_{k,t}$), if any. We expect the information asymmetry about the vendor to be lower (and vendor revenue to be higher) when the vendor is older and has been in business for longer, the vendor has the experience to execute projects that include different types of tasks and activities, the vendor is a US-based vendor, and the client and vendor have worked with each other in the past such that the client is aware of the vendor's capabilities and the vendor understands the client's requirements. Most importantly, we expect the presence of advisor to be positively associated with vendor revenue, as an advisor can reduce information asymmetry about the vendor.

Results from the 2SLS model (see Table 1.2) indicate that larger contracts (**ContractValue**) and contracts with higher number of distinct IT tasks and activities (**NumberofSubsegments**) are more likely to use an advisor. The vendor revenue model indicates that the presence of advisor (**Advisor Y/N**) is associated with an increase in vendor revenues. This analysis provides support for hypothesis 1 that the presence of advisor may help the vendor by reducing information asymmetry about the vendor. Consistent with prior research (Gao et al. 2010) this analysis also indicates that CMM rating (**CMM**), location and physical and cultural distance of the vendor (**USY/N**) and task diversity (**Diversity**) are also positively associated with vendor revenue.

Hypothesis 2 predicts a positive relationship between the presence of advisor in project *k* and project outcome. We again treat advisor selection as endogenous and use a bivariate probit model (see equation (3) and (4)) to predict the project outcome. Equation (3) is the advisor selection model. It is the same model as equation (1). We expect clients to use advisors when they lack IT outsourcing experience

($CustomerOutsourcingExperience_{i,t}$) and thus are not very familiar with the vendor landscape. We also expect clients to use advisors for large ($ContractValue_{k,t}$) and complex projects ($EngagementTypeComplexity_{k,t}$), and projects that involve more number of distinct tasks and activities ($NumberofSubsegments$).

(3) $AdvisorY/N_{k,t} =$

$\beta_0 + \beta_1 CustomerOutsourcingExperience_{i,t} + \beta_2 ContractValue_{k,t} +$

$\beta_3 EngagementTypeComplexity_{k,t} + \beta_4 NumberofSubsegments_{k,t} + \varepsilon_3$

(4) $Outcome_{k,t} =$

$\beta_0 + \beta_1 ContractValue_{k,t} + \beta_2 EngagementTypeComplexity_{k,t} +$

$\beta_3 NumberofMultisourcingPartners_{k,t} + \beta_4 AdvisorY/N_{k,t} +$

$\beta_5 CompetitiveY/$

$N_{k,t} + \beta_6 FixedPriceY/N_{k,t} +$

$\beta_7 ExistingRelationshipStrength_{k,t} + \beta_8 CustomerOutsourcingExperience_{i,t} +$

$+\beta_9 CustomerRevenue_{i,t} + +\beta_{10} VendorRevenue_{j,t} + \beta_{11} CMM_{j,t} +$

$\beta_{12} USY/N_{j,t} + \beta_{13} Diversity_{j,t} + \beta_{14} Age_{\ j,t} + \varepsilon_4$

Equation (4) is the project outcome model. This model suggests that the likelihood of a contract success depends on a number of project, client, and vendor characteristics. In this regard it is believed that larger ($ContractValue_{k,t}$) and more complex ($EngagementTypeComplexity_{k,t}$) projects are less likely to be successful. Similarly, if a project has a large number of vendors involved in the project

($NumberofMultisourcingPartners_{k,t}$) then the project is less likely to be successful. On the other hand, prior relationship between the client and the vendor ($ExistingRelationshipStrength_{k,t}$) gives the vendor a better understanding of what the new project entails and is likely to be associated with contract success. However, if the project contract had been won after a competitive bidding process ($CompetitiveY/N_{k,t}$), it is likely that the competitive bidding process may have reduced a vendor's profit margin, thereby negatively affecting the particular project's likelihood of success. Similarly, vendors face less risk in Time and Material contracts, so a Fixed Price ($FixedPriceY/N_{k,t}$) contract is less likely to be successful.

Project success is likely to be influenced by client characteristics. Larger clients ($CustomerRevenue_{i,t}$) may have more resources to devote to projects that may increase the likelihood of project success. Similarly, client's with significant IT outsourcing experience ($CustomerOutsourcingExperience_{i,t}$) may have developed routines to contract for and monitor IT projects executed in partnership with external vendors, are likely to achieve higher rates of project success.

It is also natural to expect that vendor capabilities are likely to influence the likelihood of contract success. For example, larger vendors ($VendorRevenue_{j,t}$) may also have reputation to protect and the risk of future business loss from a contract failure that may incent them to devote more resources to a project such that it is ultimately successful. In this regard, larger vendors may have slack resources to devote to contracts until they are successful. Similarly, process maturity ($CMM_{j,t}$) of the vendor is likely to be positively associated with contract success. Likewise, the diversity of other projects that the vendor has engaged in ($Diversity_{j,t}$) signifies the technological capabilities of the vendor and is likely to be positively associated with the contract success. Finally, it is likely that physical and cultural proximity of the vendor from the client ($USY/N_{j,t}$) may influence contract success.

The key variable of interest, however, is the presence of advisor ($AdvisorY/N_{k,t}$). The test of hypothesis 2 predicts a positive relationship between the presence of an advisor and contract outcome.

Equations (3) and (4) are estimated as a bivariate probit model and the results are presented in Table 1.3. The analysis indicates that larger contracts (ContractValue) with distinct IT tasks (NumberofSubsegments) are more likely to use an advisor. Consistent with hypothesis 2, the outcome model indicates that the presence of advisor is associated with contract extension or expansion. The outcome model also indicates that projects with larger vendors (VendorRevenue) improve project outcomes. However larger (ContractValue), competitively intense (CompetitiveY/N), more complex (EngagementTypeComplexity) and projects with higher CMM rating of the vendor are more likely to get renegotiated or cancelled. Customer experience (CustomerOutsourcingExperience) is also negatively associated with contract outcome.

It is likely that advisor selection, vendor revenues, and project outcomes are determined simultaneously. Thus, we treat advisor selection, vendor revenue and contract outcome as endogenous and use a three-stage-least-squares (3SLS) model to examine the impact of advisor on vendor revenues and contract outcomes. The 3SLS procedure is used to derive the parameters of the full system because endogenous variables in some equations of the model are used as explanatory variables in other equations. In such systems of equations it is likely that the error terms across the equations are correlated. Thus, predicted or instrumented values of the endogenous variables are generated using all exogenous variables in the system. Second, a cross-equation covariance matrix is estimated. Third, the equation with the contract outcome as the dependent variable is estimated with generalized least squares using the exogenous variables as well as the estimated covariance matrix. A good example of this approach in IS research is Kurozovich et al (2008). In summary, three stage least squares combines two stage least squares and seemingly unrelated regression (SUR) to account for both endogenous regressors and cross-equation correlation of errors. The system of equations is shown below.

(5) $AdvisorY/N_{k,t} =$

$\beta_0 + \beta_1 CustomerOutsourcingExperience_{i,t} + \beta_2 ContractValue_{k,t} +$

$\beta_3 EngagementTypeComplexity_{k,t} +$

$\beta_4 NumberofMultiSourcingPartners_{\ k,t} + \varepsilon_5$

(6) $VendorRevenue_{j,t} =$

$\beta_0 + \beta_1 Advisor\ Y/N_{k,t} + \beta_2 ExistingRelationshipStrength_{k,t} + \beta_3 CMM_{j,t} +$

$\beta_4 USY/N_{j,t} + \beta_5 Diversity_{j,t} + \beta_6 Age_{\ j,t} + \varepsilon_6$

(7) $Outcome_{k,t} =$

$\beta_0 + \beta_1 ContractValue_{k,t} + \beta_2 EngagementTypeComplexity_{k,t} +$

$\beta_3 NumberofMultisourcingPartners_{k,t} + \beta_4 AdvisorY/N_{k,t} +$

$\beta_5 CompetitiveY/$

$N_{k,t}+\beta_6 FixedPriceY/N_{k,t} +$

$\beta_7 ExistingRelationshipStrength_{k,t}+\beta_8 CustomerOutsourcingExperience_{i,t} +$

$+\beta_9 CustomerRevenue_{i,t} + +\beta_{10} VendorRevenue_{j,t} + \beta_{11} CMM_{j,t} +$

$\beta_{12} USY/N_{j,t} + \beta_{13} Diversity_{j,t}+\beta_{14} Age\ _{j,t} + \varepsilon_7$

Table 1.4 presents the results of the empirical analysis. The advisor selection model (model (5)) indicates that larger contracts (ContractValue), and experienced customers (CustomerOutsourcingExperience) are positively associated with use of advisors. The vendor revenue model (model (6)) indicates that advisors are associated with increased vendor revenues. This finding is consistent with hypothesis 1. CMM rating (CMM), vendor location and physical and cultural distance of the vendor (USY/N) and task diversity (Diversity) are also positively associated with vendor revenue. The outcome model (model (7)) indicates that the presence of advisor improves project outcomes. This finding is consistent with hypothesis 2. This model also indicates that larger (ContractValue), competitive bidding (CompetitiveY/N), more complex (EngagementTypeComplexity) and projects with higher CMM rating of the vendors are more likely to get cancelled or renegotiated. Customer experience (CustomerOutsourcingExperience) is also negatively associated with contract outcome. The findings of the 3SLS analysis are broadly consistent with the findings of the 2SLS analysis to test hypothesis 1 and the bivariate probit analysis to test hypothesis 2.

2.6 Other Robustness Analyses

Renegotiation: The prior analysis considers contract extension and expansion as positive project outcomes and contract cancellation and contract renegotiation as negative project outcomes. It may be argued that contract renegotiation is not a necessarily bad outcome, if the client and vendor renegotiate the contract if technologies or client requirements change during the contract (Susarala 2012). Thus, as a robustness check we repeat the analysis discussed above by considering contract extension and expansion as positive project outcomes and contract cancellation as negative project outcome. Table 1.5 presents the 2SLS analysis to examine hypothesis 1. This analysis again suggests that the presence of advisor has a positive relationship with vendor revenues. Similarly, Table 1.6 examines hypothesis 2 using a bivariate probit analysis and suggests that the presence of advisor has a positive impact on contract outcome. Likewise, the 3SLS analysis also finds very consistent findings that the presence of advisor has a positive impact on vendor revenues and project outcomes. Overall, this analysis presents results that are very consistent with the findings of the primary analysis that treat cancellation and renegotiation as negative project outcomes.

Rare Events: In our data an advisor is used in about 5% of the contracts. The small number of contracts with advisors may (potentially) bias the results of the empirical analysis. To mitigate this concern we perform two different types of robustness analysis. First, we take an oversampling approach that is common for rare-events. We check the robustness of our analysis by taking the contracts where an advisor was used and combine it with a random selection of 100 (200) contracts where an advisor was not used.

We repeat the analysis presented in the chapter. These analyses (see table 1.8 to 1.10 and table 1.11 to 1.13 in the chapter) led to qualitatively the same results as discussed in the chapter.

Second, we use the choice based sampling method and then apply the rare event logit procedure for the rare event bias correction (King and Zeng 1999a; King and Zeng 1999b; Tomz et al. 1999). Column 1 in Table 1.14 shows the results with the basic logit procedure and column 2 shows the results with the rare event logit procedure applied to correct the bias. Results for both the models are consistent with the primary analysis presented in the chapter. These two above sets of analyses indicate that though about 5% of the contracts in the dataset used an advisor, advisors have a positive impact on contract outcome.

2.7 Discussion and Conclusion

There is a vast body of literature on IT outsourcing. However the literature has not systematically examined factors contributing to the outcomes of IT outsourcing contracts. Though prior research has examined customer satisfaction with IT outsourcing (e.g., Mani et al., 2012) and the survival and profitability of IT outsourcing vendors (e.g., Gopal et al., 2003; Susarla and Barua, 2011), with the exception of Susarla (2012), we are not aware of studies that specifically focus on contract success, outcomes that are realized over longer time horizons, and are important to study in the context of complex inter-organizational multi-year relationships.

There exist significant information asymmetries between client requirements and vendor capabilities. IT outsourcing projects are also hard to scope. This gives rise to opportunities for third party advisors to intermediate between clients and vendors. Such third parry advisors can use their knowledge of the vendor space to match client requirements with vendor capabilities and design appropriate contracts. Our empirical analysis suggests that advisors reduce information asymmetry between client and vendor. We find evidence that supports the expectation that by appropriately matching client requirement with vendor capabilities, advisors are associated with higher revenue for vendors and higher likelihood of contract success. A number of devices have been discussed in the literature about how to mitigate this information asymmetry: CMM ratings, vendor location, vendor reputation, technological diversity, etc. The key contribution of this chapter is to demonstrate the role of one more device, the presence of advisor, in mitigating this information asymmetry.

This study has certain limitations that suggest avenues for future research. The study is limited in that we don't have access to contract outcomes for all the contracts in the database. The mean contract value for the data used in this analysis is $359 million, whereas the mean contract value for the entire dataset excluding the ones used in the analysis is $71.4 million. Thus, caution may be used when extending the findings of the current analysis to small and mid-size projects. However, we find evidence that link contract value and contract failure, thus it is reasonable to assume that these high value contracts would have been under greater scrutiny at the time of signing and would have attracted higher managerial attention as compared to the average contract in the SCD data. The same factor furthers the salience of the analysis; observe that the practice of restricting attention to high stakes contracts has been prevalent in the IT outsourcing literature (Barua, Mani and Whinston 2011 restrict their attention to the 100 top IT and BPO deals over the period 1995 and 2006). At the expense of generalizability, our analysis provides a more virile petri-dish to examine an interesting phenomenon that has not examined by the prior literature.

Two of the findings of this research also raise questions for future research. The analysis for the test of hypothesis 1 suggests that CMM ratings are positively associated with vendor revenues. This is consistent with prior research that CMM ratings reduce information asymmetry about the maturity of vendors' software development methodology and thus are positively related with vendor revenues. However, when CMM rating is included in the contract outcome model, it has a negative impact on contract outcome. Though prior research suggests that CMM ratings are associated with lower error rates, CMM ratings are also associated with longer development time and effort (Harter et al, 2000). Prior research has not examined the impact of CMM ratings on overall project outcomes. However, it is plausible that a longer development time and effort may sometimes lead to contract cancellation or renegotiation. Nevertheless, this finding requires further investigation.

The test of hypothesis 2 examines the impact of project, client, and vendor characteristics on contract outcome. In all the contract outcome models, the outsourcing experience of the client has a negative impact on contract outcome. Our prior expectation was that clients with significant outsourcing experience would have developed routines to monitor projects executed in partnership with external vendors and therefore are more likely to achieve positive contract outcome. However, the results indicate that outsourcing experience of the client has a negative impact on contract outcome. One possible explanation of this finding is that since clients with more IT outsourcing experience are more likely to use an advisor (see table 1.4 and table 1.7), it is likely that clients with more IT outsourcing experience have less experience with IT projects. Thus, IT outsourcing experience has a negative relationship with contract outcome. However, this finding requires further investigation.

Chapter 3: Specialization, Integration, and Multi-sourcing: A study of Large IT Outsourcing Projects

3.1 Introduction

There is a large body of research in the IT outsourcing area (Dibbern et al. 2004). This research examines questions like when and what IT work do clients outsource, how to contract for outsourcing, and how to manage client-vendor relationships. However, this body of research largely focuses on dyadic client-vendor relationships where a client outsources one IT project to one IT vendor (this approach to IT outsourcing is referred to as single-sourcing in the rest of the chapter). However, clients are increasingly outsourcing projects to not one vendor but to a multitude of vendors (Cohen and Young, 2006; Bapna et al., 2010; Gartner 2011). This outsourcing strategy can take at least two different forms: (i) the client outsources an IT project to one primary vendor, who then in-turn involves other/secondary vendors in the project (this approach to IT outsourcing is referred to as single-sourcing with subcontracting, in the rest of the chapter), and (ii) the client outsources an IT project to multiple primary vendors (this approach to IT outsourcing is referred to as multi-sourcing in the rest of the chapter). Though academic research in the IT outsourcing area has largely focused on single-sourcing the trend toward single-sourcing with subcontracting and multi-sourcing is not very surprising. As prior research has suggested (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 of outsourced IT projects increases, it is likely that one IT vendor does not possess the economy of scale and specialization in all components of the outsourced project. Thus, as outsourced IT projects become larger, clients may involve multiple vendors in a project.

Involving multiple vendors in a project provides clients with the benefits of specialization, increases competition between vendors and mitigates operational and strategic risks (Lacity and Willcocks, 1998; Aron, Clemons, and Reddi 2005; Levina and Su, 2008). However, involving multiple vendors in a project reduces a vendor's incentive to make client-specific investments and increases clients' cost of coordinating multiple vendors and integrating the deliverables from different vendors (Clemons, Reddi, and Row, 1993; Bakos and Brynjolfsson, 1993; Levina and Su, 2008). Thus, in selecting a governance structure for an IT outsourcing project a client trades-off between the benefits of specialization from selecting best of breed vendors with the cost of integration and the reduced incentive of each vendor to make client-specific investments. In equilibrium, if the integration cost dominates the benefits from specialization, clients may choose single-sourcing over single-sourcing with subcontracting or multi-sourcing. However, if the benefits of specialization outweigh the cost of integration, a client may choose single-sourcing with subcontracting or multi-sourcing, over single-sourcing. The difference between single-sourcing with subcontracting and multi-sourcing is that in single-sourcing with subcontracting the cost of coordinating multiple vendors and integrating their deliverables is borne by the primary vendor (who is likely compensated by the client for this) whereas in multi-sourcing the cost of coordinating multiple vendors is largely borne by the client as the client integrates the deliverables from multiple primary vendors.

The objective of this research is to explore how project (i.e., project size / contract value, and modularity/decomposability), client (i.e., client IT experience and capabilities), vendor (i.e., vendor experience and capabilities), and industry (i.e., industry maturity) characteristics influence a client's governance choice; i.e., examine how project, client, vendor, and industry characteristics influence clients' use of single sourcing, single-sourcing with subcontracting, or multi-sourcing to outsource large IT projects. Modularity is a key concept in the design and development of IT systems as well as outsourcing of IT projects (e.g., Tanriverdi et al, 2007). Thus, one key approach to outsourcing large IT projects is to decompose the project into smaller independent components where separate segments of the project could be awarded to specialist vendors (Bapna et al, 2010). If a client is able to decompose an IT project into smaller independent components and involve specialist vendors for different segments where the deliverables from different vendors can be integrated, then the client has a broader range of choices to govern an IT outsourcing project. For example, if a client is experienced in IT outsourcing and has the capabilities to coordinate and integrate different vendors, then a client can take advantage of specialization in the IT industry by using multiple primary vendors and itself acting as the chief integrator. On the other hand, if the client is not an experienced IT outsourcer and does not have the capabilities to coordinate different vendors, then in order to benefit from the specialization in the IT industry the client needs to select and experienced IT vendor as the primary contractor who can coordinate and integrate the work from different IT specialists/subcontractors. However, in all of this, for a client to be able to choose from a variety of choices to govern IT projects there need to exist specialist IT vendors with different capabilities.

These ideas are tested using the dataset of large IT outsourcing contracts from the SCD database. This database includes 22031 large IT outsourcing contracts from 1989-2009. Out of these 22031 contracts 19387 were single-sourced, 2431 were single-sourced with subcontracting, and 231 were multi-sourced. The multinomial probit analyses make four key contributions about governance of large IT projects. First, the analysis indicates that higher value projects are more likely to be single-sourced with subcontracting rather than being single-sourced or multi-sourced. On the other hand, if a project can be modularized (i.e., decomposed) then that project is more likely to be multi-sourced compared to being single sourced or single-sourced with subcontracting. Second, if a client has the experience and capabilities to coordinate and integrate the work of different IT vendors then such a client is more likely to multi-source large IT projects compared to single-sourcing large IT projects. In this case the client realizes the benefits of specialization by selecting multiple primary vendors and acting as the chief integrator. And such an experienced client is more likely to multi-source compared to single-sourcing when the project is more decomposable. Third, if the client does not have the capabilities to coordinate different vendors and integrate their work, then client can benefit from specialization in the IT industry by selecting an experienced vendor as the primary vendor who is in turn responsible for coordinating and integrating the work of different IT specialists/subcontractors. Finally, we find that as the IT outsourcing industry matures and more specialist IT vendors become available, single-sourcing with subcontracting and multi-sourcing increase relative to single-sourcing. The remainder of the chapter is organized as follows. The second section provides an overview of the theory and hypothesis; section three discusses the data and variables; section four discusses econometric model and results and section five discusses the implications of the findings and conclusion.

3.2 Theory and Hypothesis Development

There is an increasing trend towards involving more than one vendor in IT outsourcing projects (Gartner, 2011). As IT outsourcing projects become larger, they are more likely to include components that require distinct capabilities that no one vendor is likely to possess. For its $2.24 billion IT outsourcing project ABN Amro chose IBM to handle the Infrastructure, Accenture for application development, and Infosys and TCS for application support and maintenance (FinancialWire 2008). Similarly, as global supply markets with different specialization and cost advantages emerge; different outsourcing strategies become available (Levina and Su, 2008). Thus, a client is more likely to consider single-sourcing with subcontracting or multi-sourcing for larger IT projects. However, for a client to be able to involve multiple vendors in the project, the project needs to be first decomposed into separable components that can be awarded to different specialists/vendors (Tanriverdi et al., 2007). If the project is modularized into interrelated though distinct components then the client can benefit from different vendors' specialization (Bapna et al., 2010). However, as the number of distinct components in a project increases, the cost of integrating different components also increases exponentially (Clemons, Reddi, and Row, 1993; Bakos and Brynjolfsson, 1993). Though there are benefits from specialization, beyond a certain number of components, the cost of integration is likely to outweigh the benefits of specialization. Thus, a client is likely to choose a limited number of vendors to balance the costs and benefits of specialization. This leads to the following hypotheses.

H1: Higher value projects are more likely to be single-sourced with subcontracting or multi-sourced.

H1 (a): As the number of segments in a project increases, larger value projects are more likely to be single-sourced with subcontracting or multi-sourced.

H2: Modularity/Decomposability of projects is likely to be associated with single-sourcing with subcontracting or multi-sourcing.

H2 (a): As the number of segments increases, the likelihood of single-sourcing with subcontracting or multi-sourcing first increases and then decreases.

As discussed above larger projects are expected to require different capabilities, and decomposability can allow a client to benefit from specialization in the IT industry. However, as the number of components increases, the cost of integrating the components also increases exponentially (Clemons, Reddi, and Row, 1993; Bakos and Brynjolfsson, 1993). In a project involving multiple vendors a client can follow one of two different approaches to achieve integration. If a client has significant experience and capabilities with IT outsourcing then the client can itself play the role of chief integrator. In this case an experienced client may choose a few primary vendors to take advantage of vendors' specialized capabilities, and itself play the role of chief integrator. In this case the client chooses the multi-sourcing approach to govern a large IT project. It is also likely that an experienced client is more likely to choose multi-sourcing, as the value of the project increases, and as the number of segments in the project increase; as multi-sourcing enables the client to benefit from vendors' specialization, when the client's IT experience and capabilities can enable the client to mitigate the integration cost.

In a project involving multiple vendors, a client can also follow an alternative approach to achieve integration. If the client does not have significant experience with IT outsourcing the client can select a primary vendor as the chief integrator. In this case a client selects an experienced vendor who works with specialist subcontractors and also plays the role of the chief integrator (Levina and Ross, 2003). In other words, when the client does not have significant IT experience and capabilities, in order to benefit from the specialization in the IT outsourcing industry, the client chooses single-sourcing with subcontracting as the approach to govern a large IT project. It is also likely that a client is more likely to choose single-sourcing with subcontracting, as the value of the projects increases, and as the number of segments in the project increase; as single-sourcing with subcontracting enables the client to benefit from different sub-contractors' specialization, where the primary vendor's experience mitigates integration cost. Therefore, we hypothesize that,

H3: An experienced client is more likely to be associated with multi sourcing.

H3 (a): An experienced client is more likely to be associated with multi-sourcing for higher value projects.

H3 (b): An experienced client is more likely to be associated with multi-sourcing as the number of segments in the project increases.

H4: An experienced vendor is more likely to be associated with single-sourcing with subcontracting.

H4 (a): An experienced vendor is more likely to be associated with single-sourcing with subcontracting for higher value projects.

H4 (b): An experienced vendor is more likely to be associated with single-sourcing with subcontracting as the number of segments in the project increases.

Hypotheses 3 and hypotheses 4 discuss alternative mechanisms for the client to benefit from the specialization in the IT outsourcing industry. When the client has significant IT experience and capabilities, the client may choose multi-sourcing to realize the benefits of specialization and acts as its own chief integrator, and when the client does not have significant IT experience and capabilities it may select an experienced IT vendor to realize the benefits of specialization in the IT outsourcing industry. In essence hypotheses 3 and hypotheses 4 suggest that in the presence of significant client IT experience and capabilities, the client is likely to choose multi-sourcing over single-sourcing or single-sourcing with subcontracting to govern IT projects. However, if the client does not have significant IT experience and capabilities a client is likely to select an experienced IT vendor. Thus, in the presence of an experienced IT vendor a client is likely to govern an IT project using single-sourcing with subcontracting to balance the benefits of specialization and integration costs, rather than select single sourcing or multi-sourcing.

For a client to be able to divide large projects into smaller components and take advantage of economies of specialization, there have to exist specialized IT vendors. As the IT industry matures with time and as more IT vendors with specialized IT capabilities establish themselves in the IT industry, one expects to see a trend away from single-sourcing and a trend towards single-sourcing with subcontracting and multi-sourcing. Therefore we expect that the likelihood of single-sourcing with subcontracting and multi-sourcing increases with time and maturity of the IT industry. Thus, we hypothesize that,

> **H5: Single-sourcing with subcontracting and multi-sourcing is likely to increase with maturity of the IT industry.**

Figure 1.1 presents our conceptual model that link project; client and vendor; and industry context variables to different governance choices.

3.3 Data and Variables

We have used IDC's services contract database (SCD) for our analysis. This database includes over twenty two thousand large IT outsourcing contracts signed from 1989-2009. Out of these 22031 contracts 19387 were single-sourced, 2413 were single-sourced with subcontracting, and 231 were multi-sourced.

Dependent Variable: The key dependent variable is the governance choice. We measure governance choice as a categorical variable. We distinguish between three types of governance choices: (i) single sourcing, (ii) single sourcing with subcontracting and (iii) multi-sourcing (where there is more than one primary vendor on the project).

Independent Variables: We examine the relationship between project, client and vendor, and industry-level variables and governance choice. The project level variables considered include the number of segments, and project size. The number of segments is the number of distinct IT tasks/activities that are included in the outsourcing project. A test of endogenity of the number of segments in the project using the Hausman test (Wooldridge 2002) suggests that the number of segments is endogenous. Thus, we use predicted value of number of segments (Segment) in the analysis. The number of segments is predicted using the total length of the contract (LengthinMonths) and type of engagement (EngagementType). The size of the project is measured as the dollar value of the contract (ContractValue).

The client level independent variable is client's experience with IT outsourcing. Client IT experience and capabilities (CustomerExperience) is measured as the dollar value of all the IT projects outsourced by the client, before signing the contract under consideration.

The vendor level independent variable measures the vendor's experience and capabilities. The vendor's experience (VendorExperience) is measured as the dollar value of all the IT projects executed by the vendor, before signing the contract under consideration.

The industry level variable is the maturity of the IT outsourcing industry. The maturity of the IT outsourcing industry (Industry Maturity) is measured as contract signing year minus 1989.

Control Variables: The governance choice for an IT outsourcing project may be influenced by nature of the project and or client characteristics. Thus we control for the type of engagement (EngagementType). EngagementType is a binary variable that takes a value of one for Application Development, Business Consulting, IT consulting, and Systems Integration projects; and a value of zero for Learning and Education, IT Education and Training, Business Outsourcing, Deploy and Support, Contract Labor and Capacity Engagement, and Business Support Engagements. This classification follows Susarla et al (2010). Larger clients may have the draw, leverage and market power to work with multiple vendors. Thus we control for client size using the dollar value of annual revenue as a proxy for firm size (CustomerRevenue). We also use Region Dummies to control for the vendor population in the geographic location of the project and Year Dummies to control for the number of projects in a year. Table 2.1 presents the correlations between the dependent (governance choice), independent, and control variables. Given the nature of the dependent variable Table 2.1A, table 2.1B, and Table 2.1C present the correlation tables separately for the three governance choices: (i) single sourcing, (ii) single sourcing with sub-contracting, and (iii) multi-sourcing.

3.4 Econometric Models and Results

We observe governance choice as a categorical variable. There are three types of governance choices: single sourcing, single sourcing with sub-contracting, and multi-sourcing (where there is more than one primary vendor on the project). The multinomial probit approach is used in the analysis to predict the probabilities of the different possible outcomes of governance choice given the explanatory variables (x): number of Segments, ContractValue, CustomerExperience, VendorExperience, Industry Maturity, EngagementType, and CustomerRevenue. Thus the probability of governance choice P_j is given as:

$$P_j = \frac{\exp(\beta_j\ x)}{\sum_j \exp(\beta_j\ x)} \qquad for\ j = 1\ to\ 3$$

We use the residual centering approach (Lance 1988) to reduce the correlation between singular terms, square terms and the interaction terms used in table 2.2 and table 2.3 (see Model 2).

Table 2.2 presents the results of the analysis with single-sourcing as the reference and compares single-sourcing against single-sourcing with subcontracting, and compares single-sourcing with multi-sourcing. Model 1 is used to test the main hypotheses (H1, H2, H3, H4, and H5), and model 2 is used to test the moderating hypotheses (H1a, H2a, H3a, H3b, H4a, and H4b). This approach to testing the hypotheses using different models is appropriate in this case as the square and the interaction terms are constructed to be orthogonal to the corresponding singular terms.

Model 1 suggests that compared to single sourced projects, higher valued projects are more likely to be single-sourced with subcontracting (p-value < 0.01); though compared to single-sourcing, higher valued projects are no more likely to be multi-sourced. This provides partial support for hypothesis 1 that higher valued projects are more likely to be single-sourced with subcontracting or multi-sourced. Model 1 also suggests that compared to single sourced projects, the likelihood of single-sourcing with subcontracting and multi-sourcing increases with the number of segments (p-value $<$ 0.01). This provides support for hypothesis 2 that decomposable projects are more likely to be single-sourced with subcontracting or multi-sourced. Model 1 also suggests that compared to single-sourced projects an increase in customer experience increases the likelihood of multi-sourcing (p-value < 0.01); whereas compared to single sourcing, increase in customer experience does not increase the likelihood of single-sourcing with subcontracting. These findings are consistent with hypothesis 3 that an experienced client is more likely to be associated with multi-sourcing. Model 1 also suggests that compared to single-sourced projects an increase in vendor experience does not increase the likelihood of single-sourcing with subcontracting; whereas increase in vendor experience decreases the likelihood of multi-sourcing compared to single sourcing. These findings are not consistent with hypothesis 4 that an experienced vendor is more likely to be associated with single-sourcing with subcontracting. Model 1 also suggests that compared to single-sourced projects, an increase in industry maturity increases the likelihood of single-sourcing with subcontracting ($p\text{-value} < 0.01$) and the likelihood of multi-sourcing ($p\text{-value} < 0.1$). These findings are consistent with hypothesis 5 that increase in industry maturity is more likely to be associated with single-sourcing with subcontracting and with multi-sourcing.

Model 2 in table 2.2 is used to test the moderating effects of decomposability and project size/value. The coefficient of the number of segments and contract value interaction is positive and significant for single-sourcing with subcontracting ($p\text{-value} < 0.01$) but not significant for multi-sourcing. This suggests that as the number of segments increases, compared to single sourcing, a larger valued projects is more likely to be single-sourced with subcontracting, but not more likely to be multi-sourced. This finding is illustrated graphically in Figure 1.2A. This finding provides partial support for hypothesis H1a that as the number of segments increases a larger valued project is more likely to be single-sourced with subcontracting or multi-sourced.

The coefficient of the number of segments in model 2 is not significant for single-sourcing with subcontracting but positive and significant for multi-sourcing ($p\text{-value} < 0.01$). The coefficient of the square of the number of segments is not significant for single-sourcing with subcontracting but negative and significant for multi-sourcing ($p\text{-value} < 0.05$). This suggests that as the number of segments increases, compared to single sourcing, a project is no more likely to be single-sourced with subcontracting, but compared to single-sourcing the likelihood of multi-sourcing first increases and then decreases. This finding is illustrated graphically in Figure 1.2C. This analysis provides partial support for hypothesis H2a that as the number of segments increases the likelihood of single-sourcing with subcontracting or multi-sourcing first increase and then decrease.

The coefficient of the contract value and customer experience interaction is not significant for single-sourcing with subcontracting but negative and significant for multi-sourcing ($p\text{-value} < 0.01$). This suggests that as the contract value of the project increases, compared to single sourcing, projects with more experienced clients are no more likely to be single-sourced with subcontracting; but compared to single-sourcing, an experienced client is less likely to multi-source the project. This finding is opposite of hypothesis H3a that an experienced client is more likely to multi-source projects as the value of the project increases. However, the coefficient of the number of segments and customer experience interaction is positive and significant for single-sourcing with subcontracting ($p\text{-value} < 0.01$) as well as positive and significant for multi-sourcing ($p\text{-value} < 0.01$). This suggests that as the number of segments in the project increases, compared to single sourcing, a more experienced client's project is more likely to be single-sourced with subcontracting; and compared to single-sourcing, is more likely to be multi-sourced as well. This finding is illustrated graphically in Figure 1.2B. This finding is consistent with hypothesis H3b that an experienced client is more likely to multi-source a project as the number of segments in the project increases.

The coefficient of the contract value and vendor experience interaction is not significant for single-sourcing with subcontracting or for multi-sourcing. This suggests that as the value of the project increases, compared to single sourcing, a more experienced vendor projects is no more likely to be single-sourced with subcontracting, or being multi-sourced. This finding does not support H4a that an experienced vendor is more likely to be associated with single-sourcing with subcontracting as the value of the project increases. The coefficient of the number of segments and vendor experience interaction is also not significant for single-sourcing with subcontracting or for multi-sourcing. This suggests that as the number of segments in the project increases, compared to single sourcing, a project with a more experienced vendor is no more likely to be single-sourced with subcontracting or multi-sourced. This finding is not consistent with hypothesis H4b that a project with an experienced vendor is more likely to be single-sourced with subcontracting as the number of segments in the project increases.

Table 2.2 compared single sourcing against single-sourcing with subcontracting and single sourcing with multi-sourcing. This analysis examines when a client should choose one vendor (single sourcing) or multiple vendors (single sourcing with subcontracting or multi-sourcing). Table 2.3, in contrast, compares single-sourcing with subcontracting against multi-sourcing, with single-sourcing with subcontracting as the reference. Thus, given that a client has decided to work with multiple vendors, this analysis examines when the client uses a primary vendor as the integrator, and when to itself act as the integrator. Model 1 in table 2.3 allows us to examine the main effect of contract value, decomposability (i.e., the number of segments), client experience, vendor experience, and industry maturity. Model 2, on the other hand, allow us to examine the moderating influence of contract value and project decomposability. In model 1 the negative and significant coefficient of contract value (p-value < 0.01), vendor experience (p-value < 0.05), and industry maturity (p-value < 0.05) suggests that as contract value, vendor experience, and industry maturity increase a project is less likely to be multi-sourced compared to single-sourcing with subcontracting. However, on the other hand, the positive and significant coefficient of the number of segments (p-value < 0.01) and customer experience (p-value < 0.01) suggests that as the number of segments and customer experience increase, the likelihood of multi-sourcing increases relative to single-sourcing with subcontracting.

The coefficient of the number of segments in model 2 is positive and significant (p-value < 0.01). However, the coefficient of the square of the number of segments is negative and significant (p-value < 0.05). This suggests that as the number of segments increase, compared to single-sourcing with subcontracting, the likelihood of multi-sourcing increases and then decreases. The coefficient of the number of segments and contract value interaction is negative and significant (p-value < 0.01). This suggests that as the number of segments increases, larger value projects are more likely to be single-sourced with subcontracting compared to being multi-sourced. Similarly, the coefficient of the contract value and customer experience interaction is negative and significant (p-value < 0.01). This suggests that as contract value increases, more experienced clients are less likely to multi-source projects compared to single sourcing with subcontracting. However, the coefficient of the number of segments and client experience interaction is positive and significant (p-value < 0.1). This suggests that as the number of segments increases, more experienced clients are more likely to multi-source a project compared to single-sourcing with subcontracting. Finally, the coefficients of the number of segments and vendor experience, and the contract value and vendor experience interactions are not significant. This suggests that as the number of segments or contract value increases, projects with experienced vendors are no more likely to be multi-sourced compared to single-sourcing with subcontracting.

3.5 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. As clients outsource larger projects, it becomes more and more likely that the outsourced project demands different IT specializations that no one vendor may possess. Given that one of the key rationales for outsourcing include benefiting from a vendor's scale and specialization, it is only natural to expect that as project size increases no one vendor possesses all the different specializations that one project may demand. Thus, industry reports indicate an increase in multi-sourcing (Cohen and Young, 2006). Multi-sourcing where an outsourced IT project involves multiple vendors can be governed using different approaches. For example, a client can work with one primary vendor who in turn works with multiple subcontractors. Similarly, a client may work with multiple primary vendors and itself play the role of the integrator. The objective of this research is to begin to examine the determinants of governance structure for outsourcing large IT projects. More specifically, in this research we examine the impact of key project, client, vendor, and industry level variables in choosing between single sourcing, single sourcing with subcontracting, and multi-sourcing.

At the project level, the analysis suggests that increase in contract value is associated with single-sourcing with contracting. That is larger projects (in terms of contract value) are more likely to be single-sourced with subcontracting, rather than being single-sourced or multi-sourced. However, increase in the number of segments is associated with increase in multi-sourcing (up to a point). This suggests that if the project can be decomposed/segmented, a client is more likely to multi-source a project instead of single-sourcing or single-sourcing with subcontracting. The interaction between contract value and the number of segments suggests that the value of the contract is the dominant effect as with an increase in the number of segments a large value project is more likely to be single-sourced with subcontracting rather than being single sourced or multi-sourced.

At the client level the analysis indicated that as the client’s experience with outsourcing increases a client is more likely to select multi-sourcing over single-sourcing or single-sourcing with subcontracting. The negative interaction between contract value and client experience and the positive interaction between the number of segments and client experience reinforces the findings at the project level. As contract value increases, an experienced client is less likely to use multi-sourcing; however as the number of segments increases, a more experienced client is more likely to use multi-sourcing. This suggests that if a project can be decomposed, a more experienced client is likely to govern large IT projects using the multi-sourcing approach over single sourcing or single sourcing with subcontracting.

At the vendor level, an experienced vendor is more likely to be associated with single-sourcing, or single-sourcing with subcontracting, rather than with multi-sourcing. The interaction between contract value and vendor experience and the interaction between the number of segments and vendor experience is not significant in any model. This suggests that the impact of vendor experience is orthogonal to the value of the contract or the number of segments in the project. However, industry maturity seems to increase the likelihood of single-sourcing with subcontracting as well as multi-sourcing relative to single sourcing. This is in line with the argument that as the IT outsourcing market matures and more specialist vendors establish themselves, firms have more opportunities to move away from single sourcing and take advantage of specialization by either single sourcing with subcontracting or by multi-sourcing large projects. However, when comparing single-sourcing with subcontracting against multi-sourcing it appears that industry maturity favors single-sourcing with subcontracting over multi-sourcing.

The key contribution of this research is that it demonstrates how clients outsource large IT projects. The analysis suggests that for higher value contracts clients prefer single sourcing with subcontracting over single sourcing or multi-sourcing. However, when the project can be decomposed into segments, up to a point, clients pursue multi-sourcing over single-sourcing or single sourcing with subcontracting. The second contribution of this research is that suggests that when clients are experienced in IT outsourcing, they take advantage of specialization by selecting primary vendors and themselves act as the chief integrator. However, when clients don't have significant IT outsourcing experience, they take advantage of the increasing maturity in the IT outsourcing market by selecting an experienced vendor who acts as the chief integrator and subcontract parts of the project to other specialists. Finally, the analysis indicates that as the IT industry matures and more specialists establish themselves, single-sourcing with subcontracting and multi-sourcing will become more prevalent.

Chapter 4: How do IT Service Firms Grow: Contrasting Impacts of Technical, Organizational and Industry Diversity

4.1 Introduction

How does a seven-person start-up from a small town in India grow to become a global IT service company with over hundred thousand employees (Business Today, 2013)? Prior work on IT outsourcing has largely focused on studying IT outsourcing from the point of view of clients, examining questions such as to why do firms outsource and how to contract for successful outsourcing. Few studies have examined IT outsourcing from the perspective of IT service firms (Levina and Ross, 2003). Using the foundation of the "learning by doing" literature, this research examines how small IT firms evolve and grow into large and global IT service firms. IT services firms learn from the different types of projects they execute as well as learn from their experience of working with clients from different industries. However, it is not clear how the three different dimensions of diversity - technical, organizational and industry diversity influence firm growth and success. This project examines how the diversity in the type of projects executed by IT service firms helps them to develop their capabilities and grow their business. The remainder of the chapter is organized as follows. The second section provides an overview of literature, the third section provides the theory and hypothesis; section four discusses the data and measures; section five discusses econometric model and results; section six discusses robustness check and section seven discusses the implications of the findings and conclusion.

4.2 Literature Review

Prior research has observed that firms benefit from diversity in their engagements as firms with greater experience can extract more learning than firms with less experience. This is because repeated engagements in a focal activity allow firms to learn from their experience and to store and retrieve the inferred learning for future engagements. However, Beckman and Haunschild (2002) found that experience in different industries has a different effect on learning than do other types of diversity, leading them to note a “need to better understand why some types of diversity are important and others are not.” In the same way, IT service firms may benefit differently from different dimensions of diversity. For example, technical diversity (i.e., variety in the technological dimension) may have different impact compared to organizational diversity (i.e., variety in customer) or industry diversity (i.e. variety in industry).

Firms accumulate capabilities through endogenous learning-by-doing or problem-solving experiences (Zollo & Winter, 2002). However, the understanding of how firms benefit from these diverse experiences is at a nascent stage. For example, Shamsie et al (2009) found that a replication strategy of imitating successful processes i.e., limiting diversity but specializing can enable firms to grow. Shamsie et al (2009) also found that a renewal strategy of making concerted efforts to grow in new markets i.e., increasing diversity also enables firms to grow. Similarly, Jiang et al. (2010) found that though increased diversity provided broadened resource and learning benefits, increased diversity also led to added complexity and increase in co-ordination costs. In the same way, an IT service provider can develop a diverse set of capabilities by working on different types of projects with clients from different industries (Levina & Ross, 2003). However, it is unclear if increased experiential diversity is necessarily helpful to an IT service firm to grow, and if increased technical, organizational as well as industry diversity have similar impacts. Similarly, it is unclear if small and large IT service firms benefit from technical, organizational and industry diversity in the same way. This study begins to address these related questions.

This study makes two contributions. First, we find that depth in the form of technical diversity helps an IT service firm to grow, whereas breadth in the type of engagements (industry diversity) hinders firm growth. Also, these results have a varying impact on small versus large firms. To the best of our knowledge, this is the first study that attempts to distinguish amongst the various types of IT diversity and relate them to measures of firm growth and success. Second, prior literature on firm growth has considered capabilities as given and has then attempted to explain how capabilities influence firm growth and performance (Barney, 1991). However, we have little knowledge about how firms develop these capabilities (Ethiraj, Kale, Krishnan, & Singh, 2005). Using the foundation of the learning by doing literature this study examines how firms develop and benefit from different capabilities.

4.3 Theory and Hypotheses

Technical knowledge is a combination of formal, codified scientific know-how and practice-generated, experience-based knowledge. The technical diversity of an IT service firm refers to its depth of experience with different information technologies and innovations. Such experiential diversity enriches its technical know-how. An IT service firm's technical diversity would entice its customers to use it as a one-stop shop for sourcing their multiple application needs. Technical diversity would reduce customers' search and evaluation costs since customers can transfer a firm's reputation over multiple applications (Nayyar, 1993). By working with one IT service firm, the client also reduces application incompatibility, interoperability and integration problems. Similarly, by working with one IT service firm, the client reduces learning costs for its employees by providing a common user interface for multiple applications. Thus, by increasing technical diversity, IT service firms can cross-sell applications to the same customer base at lower marketing costs.

Macher and Boerner (2006) note that knowledge that results from greater experience within a particular technological area, when combined with knowledge spillovers from other technological areas, significantly improves performance. Thus, the experience of a firm shapes and facilitates the firm's ability to absorb knowledge spillovers and grow. In the same way, IT service firms have a strong incentive to increase their technical diversity by executing different types of IT projects. Such technical diversity builds technological capabilities that may lead to firm growth and success. This leads to the following hypothesis.

H1: Technical diversity is likely to be associated with firm growth.

The organizational diversity of an IT service firm is its experience with different types of clients. A large organizational diversity comprises an IT service firm's experience with large number of different client firms. As an IT service firm moves beyond a homogenous client base, it requires experience of working with varied clients. Organizational diversity also enables an IT service firm to discover multiple application needs. Knowledge of customer needs and preferences is critical in deciding which applications to develop and which application attributes to emphasize. Thus, organizational experiential diversity enables IT service firms to identify and exploit opportunities for growth. This leads to the following hypothesis:

H2: Organization diversity is likely to be associated with firm growth.

Industry diversity refers to IT service firm's breadth of its experience with and expertise in dealing with clients from different industries. At low levels of industry diversity, an IT service firm would develop solutions that apply to the complexities of a specific type of industry because effective generalization from prior experience to new industry settings depends on the similarity between settings (Haleblian & Finkelstein, 1999). At low levels of industry diversity, an IT service firm might apply superficial learning and oversimplification of cause-and-effect relationships to client across industries that are inherently different but superficially similar to prior experiences. Such erroneous generalizations when trying to extract common lessons from past experience might hamper firm growth and performance (Cohen & Bacdayan, 1994). Further, the benefits that an IT service firm derives from its industry diversity may exhibit diminishing marginal returns at higher levels of industry diversity. For example, cognitive limitations may constrain the value that can be extracted from managing and integrating highly diverse projects across industries (Katila & Ahuja, 2002). This leads to the following hypothesis:

H3: Industry diversity is less likely to be associated with firm growth.

Further, the effect of various dimensions of diversities on firm growth will be related to the size of the firm. Thus, larger firms have positive impact on firm growth with technical and organizational diversity and negative impact on firm growth with industry diversity. This leads to the following hypothesis:

H4: Larger firms benefit more growth from technical and organizational diversity and less from industry diversity.

4.4 Data and Measures

Data for this study come from three sources. First, we use IDC's services contract database (SCD) for our analysis. This database includes over twenty two thousand large IT outsourcing contracts signed from 1989-2009. Second, we combine this information with measures of firm performance and a variety of control measures from the COMPUSTAT database. Finally, measures of geographical regions and global sales are obtained from the COMPUSTAT SEGMENT database. Our analysis includes 1045 firm-year observations for 300 unique firms.

Dependent Variables: The firm growth and performance measure: **Sales Turnover** is obtained from the COMPUSTAT database. **Total Global Sales** is available only on an annual basis from the SEGMENT database. We use **Annual Sales Turnover** as our dependent variable.

Independent Variables: We use the SCD dataset to obtain diversity measures that are the key independent variables of interest. Technical diversity is a measure of the diversity of the types of projects executed by the IT service firm. We calculate technical diversity as 1 minus the Herfindahl index, so that higher values reflect greater diversity (Blau, 1977).

$$\text{Technical diversity} = 1 - \sum (n_s / n)^2$$

Where n_s is the number of different types of projects executed by the firm and n is the total number of projects executed by the firm. Organizational diversity is a measure of the diversity of the clients that the IT service firm has worked with. Thus, Organizational diversity is calculated as $\{1 - \sum (c_s / c)^2\}$, where c_s is the number of different clients and c is the total number of clients firm has worked. Similarly, Industry diversity is a measure of the diversity of the industries that the IT service firm has worked in. Thus, Industry diversity is calculated as $\{1 - \sum (i_s / i)^2\}$, where i_s is the number of different types of industries of the client and i is the total number of industries the firm has work in.

Control variables: A firm's sales growth is likely to be influenced by its total assets, number of employees, R&D capabilities, and the strength of its brand. Thus, **Total Assets, Research and Development, Number of Employees** and **Advertising Expense** are used as control variables. We also use Region Dummies to control for the vendor population in the geographic location of the project and Year Dummies to control for the number of projects in a year.

4.5 Econometric Model and Results

We use a fixed effect model to estimate the effect of technical, organization and industry diversity on firm's performance. Such a model is appropriate as it controls for all time-invariant differences between the firms, so the estimated coefficients of fixed effect model cannot be biased because of omitted time-invariant characteristics. We have also done a Hausman Test (Green 2008) to decide between fixed effects or random effects and have found support for using fixed effects model. Fixed Effect models to estimate various dimensions of diversity on firm's performance, for firm 'i', contract 'j' in time period 't' are given as:

$$(1) \quad \textbf{Annual Sales Turnover}_{i,j,t}$$

$$= \beta_0 + \beta_1 TechnicalDiversity_{i,j,t} + \beta_2 OrganisationDiversity_{i,j,t}$$

$$+ \beta_3 IndustryDiversity_{i,j,t} + \beta_4 \text{Total Assets}_{i,j,t}$$

$$+ \beta_5 \text{Research and Development}_{i,j,t} + \beta_6 \text{Employees}_{i,j,t} + \beta_7 Advertising_{i,j,t} + \varepsilon_1$$

Table 3.2 presents results from analysis using annual sales turnover as the dependent variable. We find that total assets, number of employees, R&D capability, and brand/advertising strength have a positive relationship with measures of firm growth providing prima facie support for the validity of the empirical model. The analysis indicates that the main effect of technical diversity as well as organization is positive. Firms with greater technical diversity as well as organization diversity are associated with greater sales growth.. However, the main effect of industry diversity is negative. Firms with greater industry diversity are associated with lower sales turnover. This analysis provides support for Hypothesis 1, 2 and 3.

Further, we examine how firm size influences sales turnover. Firms above the median employee size are classified as **Large** firms. We have taken interactions of Large with all three dimensions of diversities. Fixed Effect models with interaction terms are given as:

$$(2)\quad \textbf{Annual Sales Turnover}_{i,j,t}$$
$$= \beta_0 + \beta_1 TechnicalDiversity_{i,j,t} + \beta_2 OrganisationDiversity_{i,j,t}$$
$$+ \beta_3 IndustryDiversity_{i,j,t} + \beta_4 \text{Total Assets}_{i,j,t}$$
$$+ \beta_5 \text{Research and Development}_{i,j,t} + \beta_6 \text{Employees}_{i,j,t} + \beta_7 Advertising_{i,j,t}$$
$$+ + \beta_8 TechnicalDiversity_{i,j,t} * Large + \beta_9 OrganisationDiversity_{i,j,t} * Large$$
$$+ \beta_{10} IndustryDiversity_{i,j,t} * Large + \varepsilon_2$$

Table 3.3 present the results of the above models. The moderation terms indicate that larger firms benefit more from organizational diversity. However large firms are worse-off from industry diversity. This analysis provides partial support for Hypothesis 4 and full support for Hypothesis 1.

4.6 Robustness Check

It is likely that technical, organizational and industry diversity are endogenous as firms may choose their diversity based on their performance aspirations or from their competitor's diversity. We have controlled for the imitation effect by first computing three nearest neighbors (Russel and Norvig 2010) of each firm based on its size, total assets and turnover. We have then computed the predicted diversity of the firm based on the average of the three nearest neighbor's diversity. Thus, as a robustness check we repeat the analysis discussed above by replacing actual diversity with predicted diversity. Tables 3.4 and 3.5 present these results. The results are consistent with our earlier analysis and suggest that firms with greater technical diversity as well as organization diversity are associated with higher growth but firms with greater industry diversity are associated with lower sales turnover. Similar to the previous analysis we again find that larger firms benefit more from organizational diversity but are worse-off from industry diversity.

4.7 Discussion and Conclusion

An IT service firm's performance is likely affected by the diversity of its experiences. We find that technical and organizational diversity has a positive impact on different measures of success. We, however, find that industry diversity has a negative relationship with different measures of firm success. This analysis suggests that while experience depth, in the form of technical and organizational diversity (only for homogenous clients) helps firm growth, breadth of experiences; in the form of industry diversity hurt growth. Quite interestingly, though large firm may benefit from organizational diversity (experience depth), large firms are especially worse-off from industry diversity (experience breadth). It is likely that larger firms have reached a point of diminishing returns where more industry diversity hurts growth. Our empirical study has begun to contribute to our understanding of how IT service firms grow. However, further analysis underway is likely to provide more refined insights about how IT service firms grow.

Our study will also contribute to the experiential learning and learning by doing literatures. Experiential learning studies tend to focus on passive spillovers based on the assumption that experiential knowledge spills over a firm's boundary and that other firms in the vicinity automatically benefit from such knowledge externalities. Learning research has also focused on repetition-based learning, which emphasizes the quantity of accumulated experience (Adler & Clark, 1991). Our contribution lies in considering the compositional heterogeneity of experience. We focus on the technical, organizational and industry diversity of IT service firms and find that these three strategies have different impacts, and that the impacts also vary based on the size of the firm. Our analysis suggests that it is important for research studying firm growth to take a fine grained, dimension specific perspective on experience. We thus begin to address questions about the development of capabilities in IT service firms (Ethiraj et al., 2005).

Chapter 5: Conclusions

We have used empirical analysis to study IT outsourcing contracts in this thesis. Chapter-2 of the thesis provides evidence that presence of advisor is associated with higher revenues for vendors and more positive contract outcomes. It also suggests that the third party advisors mitigate the information asymmetry in the IT outsourcing market and lead to better matching that benefits clients as well as vendors. In chapter 3 we have identified the relationship between project, client and vendor, and industry-level variables and client's governance choice: (i) single sourcing, (ii) single sourcing with subcontracting and (iii) multi-sourcing (where there is more than one primary vendor on the project). Chapter 4 provides evidence that different dimensions of diversity (technical, organizational and industry) in the type of projects executed by vendor effect its performance.

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Tables

Construct	Mean	Std. Dev	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Outcome	**0.787**	**0.409**	-0.09	-0.17*	-0.01	-0.12*	-0.07	0.04	-0.01	-0.03	0.06	0.01	-0.11*	0.03	0.04	0.05	-0.01
VendorAge	**31.6**	**28**	0.05	0.03	0.01	0.07	-0.08	0.04	0.02	0.06	0.08	0.07	-0.04	-0.06	0.01	0.11*	1
Diversity	**2.34**	**1.09**	0.05	-0.04	0.22*	0.09*	-0.30*	0.04	-0.12*	-0.06	0.76*	0.03	-0.04	0.22*	0.01	1	
FixedPrice Y/N	**0.39**	**0.48**	0	0.03	-0.07	-.15*	-0.05	0.09*	0.02	0	0.01	-0.06	0.02	-0.08	1		
USY/N	**0.64**	**0.47**	0.08	-0.09	0.35*	0.09	-0.05	0.11*	-0.04	-0.07	0.17*	0.08	0.15*	1			
CMMRating	**1.79**	**1.51**	0.08	0.02	0.34*	0.03	0	0.02	-0.02	-0.04	-0.03	0.04	1				
Customer Outsourcing Exp	**114m**	**466m**	0.05	-.20*	0.19*	0.12*	-0.02	0.46*	0.03	-0.02	0.07	1					
Numberof SubSegments	**2.341**	**1.423**	0.10*	-0.03	0.14*	0.14*	-.31*	0.06	-.11*	-0.03	1						
Numof Multisourcing Partners	**0.007**	**0.081**	0.08	0.06	-0.04	0	-0.01	0	0.1	1							
Customer Revenue	**22.1b**	**65.7b**	-0.01	0.05	0	0.19*	-0.02	0.03	1								
Existing Relationship Strength	**1.402**	**0.979**	-0.01	-.25*	0.08	0	0.01	1									
Engagement Type Complexity	**1.323**	**-0.554**	-0.01	0.02	-0.11	-.11*	1										
Contractvalue	**358m**	**823m**	0.12*	0.09	0.19*	1											
Vendor Revenue	**29.5b**	**49.1b**	0.01	0.03	1												
Competitive Y/N	**0.591**	**0.49**	0.03	1													
AdvisorY/N	**0.036**	**0.19**	1														

*correlation coefficients significant at the 10% level or better

Table 1.1 Summary statistics and correlations

	(1)	(2)
VARIABLES	AdvisorY/N	VendorRevenue
AdvisorY/N		0.803** (0.320)
ExistingRelationshipStrength		0.045 (0.045)
EngagementTypeComplexity	0.033 (0.038)	
ContractValue	0.109*** (0.037)	
NumberofSubsegments	0.087** (0.039)	
CustomerOutsourcingExperienc**e**	0.036 (0.036)	
USY/N		0.210*** (0.051)
CMMRating		0.246*** (0.051)
Diversity		0.148*** (0.047)
VendorAge		-0.024 (0.048)
Constant	0.001 (0.036)	-0.001 (0.044)
Observations	753	753
R-squared	0.023	-0.457

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

Table 1.2 2SLS model

	(1)	(2)
VARIABLES	AdvisorY/N	Outcome
AdvisorY/N		1.513*** (0.142)
ExistingRelationshipStrength		0.030 (0.060)
EngagementTypeComplexity	0.005 (0.179)	-0.178* (0.099)
ContractValue	0.001*** (0.001)	-0.001*** (0.001)
NumberofSubsegments	0.130*** (0.047)	
NumberofMultisourcingPartners		0.529 (0.410)
CompetitiveY/N		-0.450*** (0.109)
FixedPriceY/N		0.114 (0.097)
CustomerRevenue		0.001 (0.001)
CustomerOutsourcingExperience	0.001 (0.001)	-0.001* (0.001)
USY/N		0.161 (0.112)
CMMRating		-0.094*** (0.032)
Diversity		-0.017 (0.050)
VendorAge		-0.001 (0.002)
VendorRevenue		0.002* (0.001)
Constant	-2.281*** (0.294)	1.332*** (0.254)
Observations	753	753

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

Table 1.3 Empirical Results (Bivariate Probit Model)

	(1)	(2)	(3)
VARIABLES	AdvisorY/N	VendorRevenue	Outcome
AdvisorY/N		0.517*** (0.186)	0.928** (0.457)
ExistingRelationshipStrength		0.014 (0.033)	0.032 (0.048)
EngagementTypeComplexity	0.014 (0.036)		-0.091** (0.044)
ContractValue	0.142*** (0.036)		-0.224*** (0.068)
NumberofSubsegments	0.049 (0.039)		
NumberofMultisourcingPartners			-0.037 (0.063)
CompetitiveY/N			-0.169*** (0.040)
FixedPriceY/N			0.021 (0.042)
CustomerRevenue			0.032 (0.040)
CustomerOutsourcingExperience	0.082** (0.034)		-0.106** (0.053)
USY/N		0.244*** (0.036)	0.050 (0.050)
CMMRating		0.293*** (0.037)	-0.128** (0.053)
Diversity		0.157*** (0.036)	-0.019 (0.045)
VendorAge		0.001 (0.034)	-0.021 (0.041)
Constant	0.004 (0.038)	-0.023 (0.037)	0.013 (0.042)
Observations	753	753	753
R-squared	0.021	-0.083	-0.948

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

Table 1.4 Empirical Results (3SLS Model)

	(1)	(2)
VARIABLES	AdvisorY/N	VendorRevenue
AdvisorY/N		0.617** (0.262)
ExistingRelationshipStrength		0.049 (0.041)
EngagementTypeComplexity	0.021 (0.039)	
ContractValue	0.123*** (0.040)	
NumberofSubsegments	0.094** (0.040)	
CustomerOutsourcingExperienc**e**	0.052 (0.040)	
USY/N		0.196*** (0.047)
CMMRating		0.268*** (0.044)
Diversity		0.134*** (0.043)
VendorAge		-0.016 (0.043)
Constant	0.009 (0.038)	-0.031 (0.040)
Observations	691	691
R-squared	0.029	-0.196

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

Table 1.5 Empirical Results (2SLS Model) without Renegotiation

	(1)	(2)
VARIABLES	AdvisorY/N	Outcome
AdvisorY/N		1.560*** (0.136)
ExistingRelationshipStrength		0.022 (0.062)
EngagementTypeComplexity	-0.051 (0.156)	-0.137 (0.100)
ContractValue	0.001*** (0.001)	-0.001*** (0.001)
NumberofSubsegments	0.134*** (0.048)	
NumberofMultisourcingPartners		-0.238 (0.754)
CompetitiveY/N		-0.420*** (0.113)
FixedPriceY/N		0.140 (0.100)
CustomerRevenue		0.001 (0.001)
CustomerOutsourcingExperience	0.001 (0.001)	-0.001* (0.001)
USY/N		0.158 (0.111)
CMMRating		-0.096*** (0.032)
Diversity		-0.021 (0.049)
VendorAge		0.001 (0.002)
VendorRevenue		0.002 (0.001)
Constant	-2.222*** (0.294)	1.239*** (0.258)
Observations	691	691

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

Table 1.6 Empirical Results (Bivariate Probit Model) without Renegotiation

	(1)	(2)	(3)
VARIABLES	AdvisorY/N	VendorRevenue	Outcome
AdvisorY/N		0.377* (0.204)	0.898** (0.456)
ExistingRelationshipStrength		0.015 (0.033)	0.034 (0.053)
EngagementTypeComplexity	0.009 (0.037)		-0.069 (0.044)
ContractValue	0.155*** (0.040)		-0.257*** (0.074)
NumberofSubsegments	0.056 (0.040)		
NumberofMultisourcingPartners			-0.012 (0.046)
CompetitiveY/N			-0.165*** (0.042)
FixedPriceY/N			0.034 (0.042)
CustomerRevenue			0.030 (0.039)
CustomerOutsourcingExperience	0.093** (0.037)		-0.122** (0.061)
USY/N		0.237*** (0.038)	0.039 (0.054)
CMMRating		0.300*** (0.036)	-0.119** (0.050)
Diversity		0.144*** (0.036)	-0.023 (0.046)
VendorAge		0.006 (0.034)	-0.016 (0.043)
Constant	0.011 (0.040)	-0.050 (0.036)	0.014 (0.044)
Observations	691	691	691
R-squared	0.028	0.061	-0.890

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

Table 1.7 Empirical Results (3SLS Model) without Renegotiation

	(1)	(2)
VARIABLES	AdvisorY/N	VendorRevenue
AdvisorY/N		0.007** (0.095)
ExistingRelationshipStrength		0.007 (0.057)
EngagementTypeComplexity	0.145 (0.202)	
ContractValue	0.671*** (0.201)	
NumberofSubsegments	0.417 (0.184)	
CustomerOutsourcingExperienc**e**	0.140 (0.175)	
USY/N		0.036** (0.051)
CMMRating		0.398* (0.149)
Diversity		0.060* (0.042)
VendorAge		0.024 (0.105)
Constant	0.881 (0.189)	-0.191 (0.169)
Observations	127	127
R-squared	0.138	0.309

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

Table 1.8 Empirical Results (2SLS Model) Random Selection 100 Contracts

	(1)	(2)
VARIABLES	AdvisorY/N	Outcome
AdvisorY/N		0.836** (1.447)
ExistingRelationshipStrength		0.251 (0.228)
EngagementTypeComplexity	0.168 (0.302)	0.007 (0.294)
ContractValue	0.001*** (0.001)	-0.002* (0.001)
NumberofSubsegments	0.204 (0.093)	
NumberofMultisourcingPartners		0.038 (0.093)
CompetitiveY/N		-0.207*** (0.435)
FixedPrice Y/N		0.423 (0.006)
CustomerRevenue		0.003 (0.006)
CustomerOutsourcingExperienc**e**	0.001 (0.001)	0.002 (0.067)
USY/N		-0.126 (0.327)
CMMRating		-0.367 (0.342)
Diversity		0.076 (0.156)
VendorAge		0.004 (0.007)
VendorRevenue		0.018 (0.011)
Constant	0.789 (0.590)	0.134 (0.453)
Observations	127	127

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

Table 1.9 Empirical Results (Bivariate Probit Model) Random Selection 100 Contracts

	(1)	(2)	(3)
VARIABLES	AdvisorY/N	VendorRevenue	Outcome
AdvisorY/N		0.025** (0.054)	0.503** (0.296)
ExistingRelationshipStrength		0.025 (0.050)	-0.118 (0.132)
EngagementTypeComplexity	0.128 (0.211)		-0.027** (0.113)
ContractValue	0.654*** (0.200)		-0.024** (0.150)
NumberofSubsegments	0.445 (0.186)		
NumberofMultisourcingPartners			0.208 (0.161)
CompetitiveY/N			-0.258* (0.15)
FixedPriceY/N			0.032 (0.523)
CustomerRevenue			0.032 (0.323)
CustomerOutsourcingExperience	0.199** (0.172)		0.064 (0.104)
USY/N		0.017** (0.045)	0.015 (0.132)
CMMRating		0.382*** (0.099)	0.268 (0.451)
Diversity		0.046* (0.040)	0.160 (0.131)
VendorAge		-0.003 (0.076)	0.280 (0.291)
Constant	0.892 (0.194)	-0.254 (0.102)	0.646 (0.490)
Observations	127	127	127
R-squared	0.143	0.337	-0.321

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

Table 1.10 Empirical Results (3SLS Model) Random Selection 100 Contracts

	(1)	(2)
VARIABLES	AdvisorY/N	VendorRevenue
AdvisorY/N		0.085*** (0.148)
ExistingRelationshipStrength		0.004 (0.037)
EngagementTypeComplexity	0.102 (0.128)	
ContractValue	0.328*** (0.115)	
NumberofSubsegments	0.168 (0.117)	
CustomerOutsourcingExperience	0.037 (0.089)	
USY/N		0.149*** (0.048)
CMMRating		0.368* (0.228)
Diversity		0.086** (0.037)
VendorAge		0.181 (0.090)
Constant	0.399 (0.116)	-0.012 (0.170)
Observations	227	227
R-squared	0.052	0.166

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

Table 1.11 Empirical Results (2SLS Model) Random Selection 200 Contracts

	(1)	(2)
VARIABLES	AdvisorY/N	Outcome
AdvisorY/N		1.232*** (0.198)
ExistingRelationshipStrength		0.091 (0.132)
EngagementTypeComplexity	-0.202 (0.242)	-0.077 (0.165)
ContractValue	0.003*** (0.001)	-0.005*** (0.007)
NumberofSubsegments	0.045 (0.066)	
NumberofMultisourcingPartners		0.478 (0.391)
CompetitiveY/N		-0.565*** (0.346)
FixedPriceY/N		0.006 (0.076)
CustomerRevenue		0.061 (0.003)
CustomerOutsourcingExperienc**e**	0.001 (0.001)	-0.021 (0.089)
USY/N		0.098 (0.174)
CMMRating		-0.120 (0.058)
Diversity		0.212 (0.076)
VendorAge		0.084 (0.067)
VendorRevenue		0.067 (0.059)
Constant	-1.230 (0.433)	1.056 (0.267)
Observations	227	227

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

Table 1.12 Empirical Results (Bivariate Probit Model) Random Selection 200 Contracts

	(1)	(2)	(3)
VARIABLES	AdvisorY/N	VendorRevenue	Outcome
AdvisorY/N		0.001** (0.078)	0.831** (0.595)
ExistingRelationshipStrength		0.012 (0.034)	-0.044 (0.093)
EngagementTypeComplexity	0.071 (0.135)		-0.007*** (0.183)
ContractValue	0.325*** (0.119)		-0.046* (0.149)
NumberofSubsegments	0.181 (0.123)		
NumberofMultisourcingPartners			0.247 (0.261)
CompetitiveY/N			-0.162** (0.117)
FixedPriceY/N			0.002 (0.054)
CustomerRevenue			0.049 (0.127)
CustomerOutsourcingExperience	0.039* (0.090)		0.231 (0.077)
USY/N		0.136*** (0.042)	0.076 (0.124)
CMMRating		0.257* (0.133)	0.318 (0.775)
Diversity		0.093** (0.039)	0.121 (0.078)
VendorAge		0.147 (0.075)	0.251 (0.288)
Constant	0.414 (0.124)	-0.104 (0.099)	0.593 (0.586)
Observations	227	227	227
R-squared	0.054	0.202	-1.320

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

Table 1.13 Empirical Results (3SLS Model) Random Selection 200 Contracts

VARIABLES	Outcome (Logit Model)	Outcome (Rare-events Logit model)
AdvisorY/N	0.235*** (0.253)	0.779*** (0.449)
ExistingRelationshipStrength	0.003 (0.078)	0.065 (0.128)
EngagementTypeComplexity	-0.059* (0.132)	-0.389* (0.189)
ContractValue	-0.002** (0.006)	-0.098** (0.121)
NumberofMultisourcingPartners	0.074 (0.097)	0.374 (0.328)
CompetitiveY/N	-0.891** (0.126)	-0.939*** (0.276)
FixedPrice Y/N	0.003 (0.007)	0.671 (0.891)
CustomerRevenue	0.067 (0.063)	0.891 (0.780)
CustomerOutsourcingExperienc**e**	0.034 (0.005)	0.090 (0.430)
USY/N	0.053 (0.042)	0.391 (0.224)
CMMRating	0.093 (0.050)	0.181 (0.678)
Diversity	0.007 (0.043)	0.027 (0.100)
VendorAge	0.002 (0.031)	0.008 (0.090)
VendorRevenue	0.006** (0.200)	0.008*** (0.700)
Constant	0.038 (0.033)	0.487 (0.497)
Observations	64	64
	Standard errors in parentheses	Robust Standard errors in parentheses

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

Table 1.14 Logit and Rare Event Logit Models

Table 2.1A. Summary Statistics and Correlations (Single Sourcing 19387 contracts)								
Contruct	Mean	Std. Dev	1	2	3	4	5	6
ContractValue	70.1M	385M	1					
Segment	1.352	0.333	0.563	1				
CustomerExperience	1.47B	7.42B	0.238	0.037	1			
VendorExperience	0.982B	10.4B	0.173	0.137	0.104	1		
EngagementType	0.367	0.482	-0.295	-0.812	0.009	-0.113	1	
Industry Maturity	15.638	3.250	-0.137	-0.096	0.192	-0.059	0.059	1
CustomerRevenue	20.4B	72.6B	0.294	0.112	0.345	0.053	-0.056	-0.060

Table 2.1B. Summary Statistics and Correlations (Single Sourcing Subcontracting 2413 contracts)								
Contruct	Mean	Std. Dev	1	2	3	4	5	6
ContractValue	169M	800M	1					
Segment	1.309	0.387	0.699	1				
CustomerExperience	2.15B	8.07B	0.372	0.219	1			
VendorExperience	1.44B	12.7B	0.191	0.168	0.028	1		
EngagementType	0.515	0.499	-0.475	-0.807	-0.146	-0.135	1	
Industry Maturity	16.256	2.921	-0.182	-0.134	0.133	-0.080	0.088	1
CustomerRevenue	29.3B	89.7B	0.288	0.161	0.356	0.060	-0.119	-0.080

Table 2.1C. Summary Statistics and Correlations(Multisourcing 231 contracts)								
Contruct	Mean	Std. Dev	1	2	3	4	5	6
ContractValue	98.2M	274M	1					
Segment	1.484	0.352	0.650	1				
CustomerExperience	5.83B	12.5B	0.229	0.151	1			
VendorExperience	58.9M	544M	0.072	0.153	-0.152	1		
EngagementType	0.359	0.480	-0.207	-0.659	-0.037	-0.162	1	
Industry Maturity	16.220	2.655	-0.166	-0.052	0.106	0.082	0.002	1
CustomerRevenue	51.4B	105B	0.235	0.075	0.276	-0.136	0.035	-0.095

Table 2.1 Summary statistics and correlations

	Sourcing Choice Model 1		Sourcing Choice Model 2	
	Subcontacting	Multisourcing	Subcontacting	Multisourcing
ContractValue	0.089*** (0.010)	0.002 (0.020)	0.103*** (0.011)	0.029 (0.027)
Segment	0.290*** (0.095)	1.040*** (0.155)	-0.128 (0.115)	1.229*** (0.227)
CustomerExperience	0.001 (0.002)	0.039*** (0.005)	0.002 (0.002)	0.037*** (0.005)
VendorExperience	-0.001 (0.003)	-0.015** (0.007)	-0.002 (0.003)	-0.021*** (0.008)
EngagementType	0.736*** (0.058)	0.630*** (0.103)	0.486*** (0.072)	0.831*** (0.129)
Industry Maturity	0.051*** (0.005)	0.021* (0.012)	0.048*** (0.006)	0.023* (0.012)
CustomerRevenue	-0.005 (0.003)	0.003 (0.008)	-0.005 (0.003)	0.002 (0.008)
Segment * Segment			-0.011 (0.117)	-0.542** (0.254)
Segment * ContractValue			0.179*** (0.025)	0.020 (0.057)
ContractValue * CustomerExperience			0.001 (0.001)	-0.007*** (0.002)
Segment * CustomerExperience			0.024*** (0.006)	0.052*** (0.015)
ContractValue * VendorExperience			0.002 (0.002)	-0.002 (0.004)
Segment * VendorExperience			0.000 (0.011)	0.044 (0.027)
Constant	-4.564*** (0.185)	-5.587*** (0.375)	-4.097*** (0.199)	-6.352*** (0.462)
Observations	22,031	22,031	22,031	22,031

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

Table 2.2 Multinomial Probit (Base Single Sourcing)

	Multisourcing Model 1	Multisourcing Model 2
ContractValue	-0.088*** (0.021)	-0.074*** (0.027)
Segment	0.750*** (0.164)	1.357*** (0.237)
CustomerExperience	0.038*** (0.005)	0.035*** (0.005)
VendorExperience	-0.014** (0.007)	-0.019** (0.008)
EngagementType	-0.106 (0.108)	0.345** (0.135)
Industry Maturity	-0.031** (0.012)	-0.025** (0.013)
CustomerRevenue	0.008 (0.008)	0.006 (0.008)
Segment * Segment		-0.530** (0.263)
Segment * ContractValue		-0.159*** (0.059)
ContractValue * CustomerExperience		-0.008*** (0.003)
Segment * CustomerExperience		0.028* (0.015)
ContractValue * VendorExperience		-0.004 (0.004)
Segment * VendorExperience		0.043 (0.028)
Constant	-1.023*** (0.392)	-2.255*** (0.478)
Observations	22,031	22,031

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

Table 2.3 Multinomial Probit (Base Subcontracting)

Table 3.1. Summary Statistics and Correlations									
Contruct	**Mean**	**Std. Dev**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Technical_Diversity	.274	.278	1						
Organizational_Diversity	.509	.348	0.05	1					
Industry_Diversity	.334	.323	0.02	0.07	1				
Advertising	62.83M	289.3M	-.06	0.09	0.1	1			
Employees	32.9 Th	65.9 Th	0.01	0.02	0.02	0.04	1		
Total_Assets	10.7B	22.6B	0.05	0.04	0.03	0.06	0.08	1	
R&D	471.6M	1185.7M	0.07	0.01	0.02	0.4	0.07	0.2	1
Turnover	8.7B	18.3B	0.01	0.02	0.05	0.08	0.06	0.07	0.3

Table 3.1 Summary statistics and correlations

	Annual_Sales_Turnover
	Model I
Technical_Diversity	0.109* (0.062)
Organizational_Diversity	0.157** (0.070)
Industry_Diversity	-0.162* (0.088)
Advertising	0.126*** (0.034)
Employees	0.266*** (0.062)
Total_Assets	0.175** (0.068)
R&D	0.240*** (0.044)
Constant	-0.056*** (0.019)
Observations	1,045

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3.2 Fixed effect model

	Annual_Sales_Turnover
	Model II
Technical_Diversity	0.053* (0.031)
Organizational_Diversity	0.025 (0.021)
Industry_Diversity	-0.006 (0.025)
Technical_Diversity* LargeFirm	0.112 (0.085)
Organizational_Diversity* LargeFirm	0.284** (0.127)
Industry_Diversity* LargeFirm	-0.344** (0.159)
Advertising	0.129*** (0.033)
Employees	0.261*** (0.061)
Total_Assets	0.167*** (0.062)
R&D	0.244*** (0.044)
Constant	-0.058*** (0.020)
Observations	1,045

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.3 Fixed effect model with moderation terms

	Annual_Sales_Turnover
	Model III
Predicted_Technical_Diversity	0.147** (0.075)
Predicted_Organizational_Diversity	0.146** (0.069)
Predicted_Industry_Diversity	-0.158* (0.095)
Advertising	0.129*** (0.033)
Employees	0.260*** (0.062)
Total_Assets	0.179** (0.070)
R&D	0.240*** (0.045)
Constant	-0.056*** (0.018)
Observations	1,045

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3.4 Fixed Effect Model with predicted diversity

	Annual_Sales_Turnover
	Model IV
Predicted_Technical_Diversity	0.058* (0.034)
Predicted_Organizational_Diversity	0.031 (0.022)
Predicted_Industry_Diversity	-0.007 (0.030)
Predicted_Technical_Diversity* LargeFirm	0.162 (0.101)
Predicted_Organizational_Diversity* LargeFirm	0.224* (0.118)
Predicted_Industry_Diversity* LargeFirm	-0.302* (0.159)
Advertising	0.133*** (0.032)
Employees	0.254*** (0.061)
Total_Assets	0.176*** (0.066)
R&D	0.244*** (0.045)
Constant	-0.057*** (0.018)
Observations	1,045

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.5 Fixed effect model with predicted diversity and moderation terms

Figures

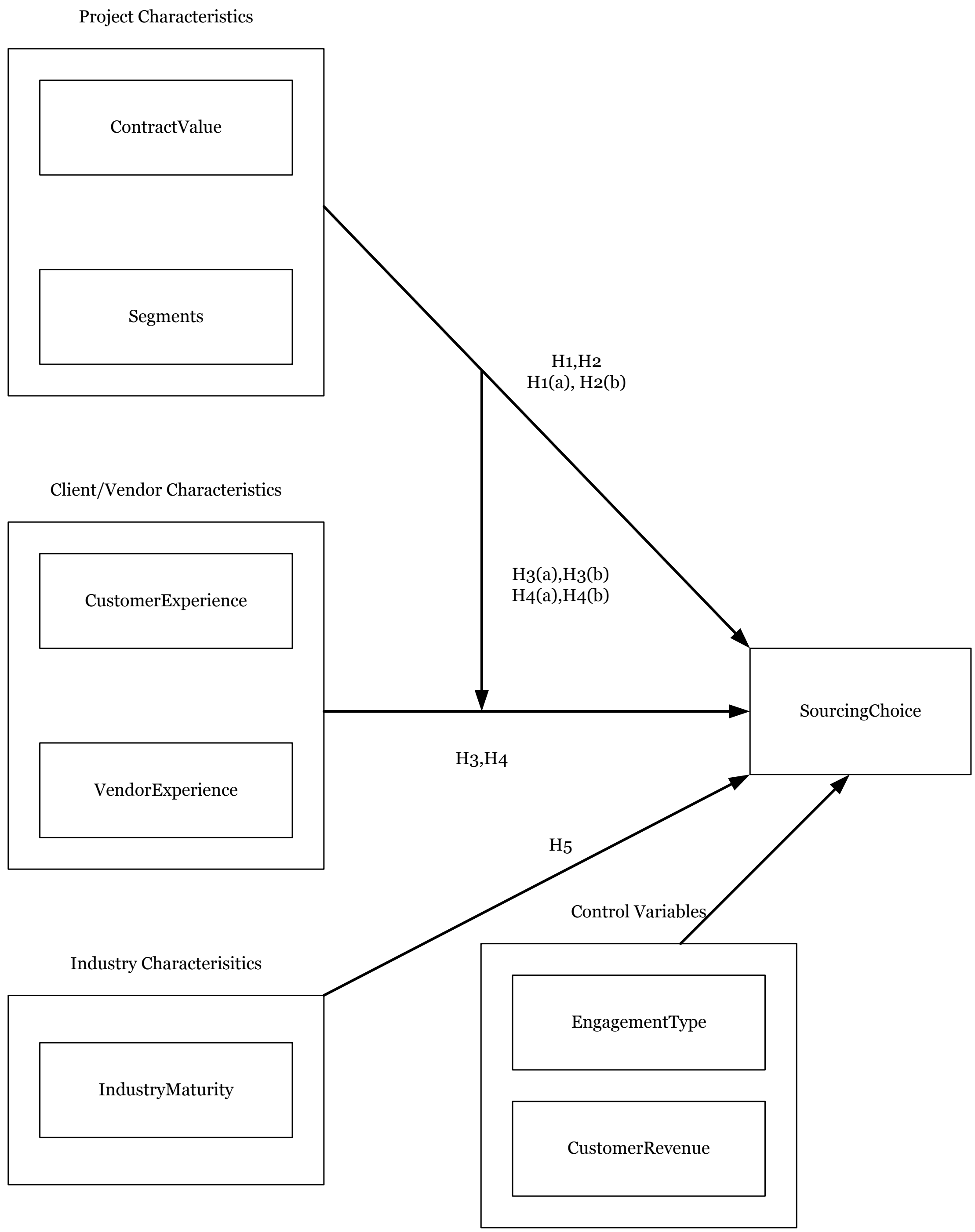

Figure 1.1 Conceptual Model and Hypotheses

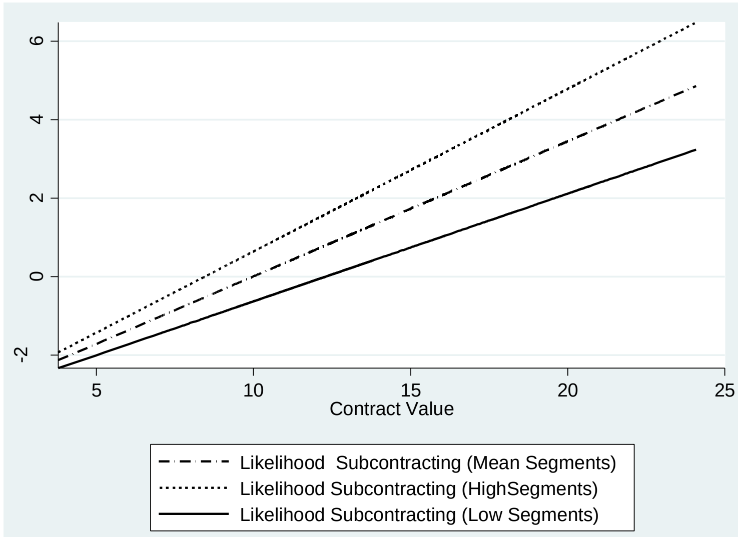

Figure 1.2a Hypothesis-1A

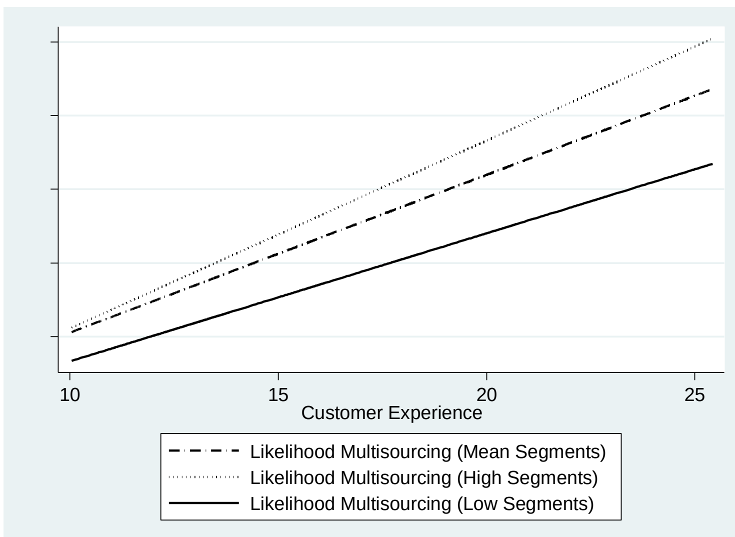

Figure 1.2b Hypothesis-3B

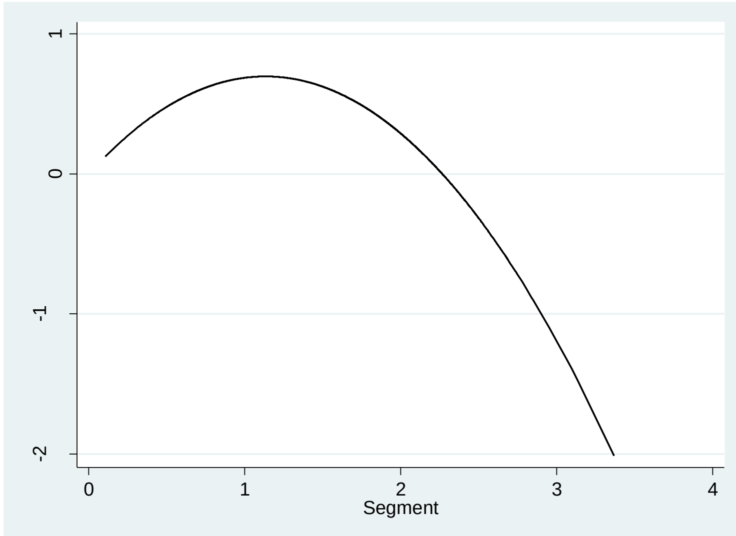

Figure 1.2c Hypothesis-2A