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Contracting Efficiency and New Firm Survival in Markets Enabled by Information Technology

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Application service providers (ASP), who host and maintain information technology (IT) applications across the Internet, emerged as an innovation in the way IT services are delivered to client firms. In spite of many potential benefits of this model, ASPs experienced business failure and high rates of exit. Drawing on agency theory, we argue that the efficiency of contracting arrangements between ASPs and client organizations is an important determinant of ASP survival. We test this prediction using a unique data set combining multiple sources that allows us to track an ASP from the year of founding through the beginning of 2006. Contractual misalignment, or adopting contracts mismatched with the underlying agency costs, significantly lowers the probability of survival of service providers in the ASP marketplace. The impact of misalignment is particularly severe when coupled with adjustment costs that impede the transition to aligned contracts. To account for potential heterogeneity in ASPs' knowledge of contracting, we test for endogenous self-selection of ASPs in the relationship between contractual misalignment and survival. Our results are robust to a variety of model specifications as well as alternate explanations of survival from multiple theoretical domains.

Key words: agency theory; contractual misalignment; firm survival; propensity score matching
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1. Introduction

The widespread adoption of Internet standards, changes in software licensing models, and the proliferation of server-based computing during the 1990s paved the way for the emergence of application service providers (ASP), who host information technology (IT) applications and business processes for user organizations over the Internet. ASPs, and more broadly, providers of software-as-a-service (SaaS) and cloud computing, combine multiple capabilities and roles such as development, management, and support (Clark 2003) in contrast to traditional IT service providers.[1] ASPs have the potential to accelerate the diffusion of technological innovations by lowering the cost and reducing the time to implement new software, and by easing the burden and complexity in managing IT applications. Although industry experts initially predicted that this innovative model would transform the enterprise IT services market (Drummond 2002), many ASPs did not live up to their initial promise and exite the market.

This study is motivated by discussions in the trade and business press that attributed the failure of many ASPs to ill-designed contracts (e.g., Gomolski 2001, Koch 2000). We characterize a contract between a firm outsourcing to an ASP (henceforth referred to as the client) and an ASP as an agency relationship.[2] Given the unobservable nature of effort exerted by the ASP, the asymmetry of information and the potential divergence of interests across ASPs and clients, agency theory would predict an ideal contractual form based on the characteristics of the required service. The two main types of contracting schemes in the ASP market are fixed-price contracts, where users agree to pay a pre specified fixed price per month for the agreed length of the contract, and time and materials contracts, where ASPs bill clients based on costs. Drawing on agency theory, we compare the relative efficiency of these two contract forms along the dimensions of incentives and risk sharing. *Contractual misalignment* results when a chosen contract is mismatched with the underlying agency costs. Joskow (1991, pp. 81–82) asks: "How much do we lose by going from the best to the next best [contracting regime]?" The cost of failure to choose the right contract can be fairly severe

[1] In contrast to ASP, SaaS and cloud computing models are typically Web-native, designed to support multiple clients over the Internet.

[2] The user of IT services (the client) is the principal and the service provider (ASP) is the agent.

(Masten 1993). When clients and ASPs deploy fixed-price contracts where the service calls for ongoing investments by the ASP, or when parties use time and materials contracts for standardized application delivery, the resulting contracting arrangements are misaligned, eroding the competitive position of an ASP and possibly resulting in business failure.

In the ASP market, the growth of the Internet and developments in software licensing may have acted as the initial impetus for entrepreneurial entry or new firm creation (e.g., Schumpeter 1934). However, the extent to which young firms can take advantage of such business opportunities and thrive in the market may depend on their ability to craft appropriate contractual arrangements. Models of firm dynamics in the industrial organization literature assume that market forces select out firms in a manner akin to natural selection (Jovanovic 1982, Hopenhayn 1992), where efficient firms survive and where inefficient firms are forced to exit the market. Survivability of a new firm directly reflects its profitability and future growth potential. Firm strategies, the structure of competition within a market, and the future range of services offered to users are shaped by the forces of entry, exit, and survival.

This study demonstrates that misaligned governance choices negatively affect the survival of service providers and ultimately the menu of choices available to user organizations. Using a data set spanning multiple years that combines data from archived Internet sources, publicly available databases, and a survey of ASPs, we analyze the impact of misaligned contracting on the survival of ASPs. Each ASP is tracked from its year of founding through the beginning of 2006. Thus the data gathering method avoids problems of left censoring, which is a limitation identified in earlier studies of firm survival (Silverman et al. 1997). The cross-sectional variation in market arrangements provides the source of identification of contracting efficiency. The collapse of the Internet sector, spanning late 2001 to early 2002, acts as an exogenous shock that changed the market structure and intensified competitive pressure, offering a unique opportunity to study the antecedents of survival of IT-enabled services.

Part of the challenge in designing efficient contracts stems from the fact that most ASPs were new firms with insufficient knowledge about contracting. Most clients of ASPs were small and medium enterprises that lacked dedicated resources to manage market arrangements. Both ASPs and client firms might have had limited comprehension about the benefits from contractual relationship and misunderstood the nature of market structure and contracting costs inherent in a new model of IT service delivery, resulting in the design of inefficient contracts. Contrasting perceptions about the right business model make it challenging for both ASPs and clients to define and adhere to an industry norm. Furthermore, organizational costs faced in adjusting to efficient contracts impede ASPs from changing contract structures in response to the pressure from the external environment, which selects out inefficient firms. The impact of contractual misalignment is particularly severe on those ASPs that face greater adjustment costs. ASPs that seek clients at any cost, ignoring contracting considerations, may do so at their own peril.

Testing for the impact of misalignment on survival is complicated because of the endogeneity of contract choices when an ASP's superior knowledge of interfirm contracting, unobservable to the researcher, enhances its ability to design aligned contracts. We test for endogenous self-selection of ASPs in the relationship between contractual misalignment and survival. We need to consider whether some ASPs adopted contracts anticipating a market crash, conferring an advantage in survival. However, the exogenous and unexpected shock to the Internet sector combined with adjustment costs in fundamentally altering a business model make it difficult to support a contention that either contracts were designed for ASPs to survive the collapse of the Internet sector or that ASPs changed their business model rapidly in response to pressure from the environment. We use propensity score matching methods to analyze whether there is a systematic difference in firm survivability across contract regimes.

We also address two key alternate explanations that could explain ASP survival. First, organizational ecologists argue that new firms fail because of the liability of newness that makes it difficult to build stable interfirm linkages, such as contracting arrangements with clients (Hannan and Freeman 1989). Second, the measured impact of misalignment on survival may result from heterogeneity in the capabilities and resource endowments of ASPs, such as developing routines that lead to competitive advantage. We include a variety of controls and consider several model specifications to separate agency theoretic effects from alternate factors likely to impact firm survival.

This study contributes to the literature on the IT services industry, where prior research has emphasized factors such as network externalities (Brynjolfsson and Kemerer 1996) and scope economies (Cottrell and Nault 2004) to explain the success or failure of software products. Although IT creates the potential for new products or services, critical to their success is an understanding of the contracting costs embodied in these market structures. For instance, electronic business-to-business markets may have a detrimental effect on ongoing buyer-supplier relationships by

increasing the potential for opportunism (Jap 2007). Factors such as contract enforceability or contract misalignment may then explain the success of IT services and the diffusion and assimilation of IT-enabled innovations. This study also contributes to the literature on governance of IT services, where prior work has stressed the role of IT departments in maximizing the value of IT service delivery to the organization (Mendelson 1985). By focusing on contracting arrangements, which, in turn, determine the viability of an individual firm, this paper integrates demand-side and supply-side explanations to derive insights into the evolution of IT services outsourcing and to the emerging field of service sciences.

The balance of the paper is organized as follows. Section 2 discusses ASP contractual arrangements and service strategies, whereas §3 presents the theory and hypotheses. Section 4 discusses operationalization of measures and data collection, whereas §5 discusses the econometric approach. Section 6 discusses the results. Concluding remarks are provided in §7.

2. ASP Service Strategies and Contractual Arrangements

A contractual arrangement between a client and an ASP consists of three elements: a formal contract, a statement of work (SOW), and a service level agreement (SLA). The SLA typically defines the performance metrics and penalties to be imposed on the ASP on the dimensions of network reliability and availability, and thus provides a guarantee for the quality of service by the ASP. The SOW defines obligations in tailoring an ASP's service to client needs. In the pin-factory tradition (Azoulay and Shane 2001), we augmented the data with practitioner interviews with ASPs and actual contracts between ASPs and clients to glean more insights into the contracting process. These interviews suggest that ASP service strategies follow two distinct approaches: horizontal and vertical solutions.

Horizontal ASPs offer a fairly standardized service, whereas *vertical* solution providers combine multiple capabilities.[3] In the first case, the ASP is a licensor of applications, whereas the client rents a standard service. For example, an ASP may provide a standardized payroll processing or e-commerce application online. A vertical ASP provides a bundle of services such as systems planning and design, maintenance, customizing software to suit client requirements,[4] user support, and training. Examples of vertical service providers are an ASP that provides fully customized procurement software services to firms in the healthcare sector and an ASP that provides logistics solutions to clients in the transportation industry. ASPs therefore face distinctly different streams of revenue depending on their service strategy, either from standardized application delivery or from providing a host of individualized services.[5]

Client engagements of horizontal ASPs are generally focused on cost savings. SLAs spell out strict penalties on nonperformance, as stated in a contract:

> ASP will make every reasonable effort to monitor its network and its interconnection to other networks and provide services in accordance with the service level agreements specified.

Clients typically undertake responsibility to analyze the data made available from the ASP-hosted solution. Clients are also responsible for integrating the functionality from the hosted solution with their internal IT systems, as the following quote from a contract illustrates:

> The client is solely responsible for installation, operation, maintenance, use, and compatibility of equipment or software not provided (by the ASP) and the ASP does not hold responsibility thereof.

Although vertical ASPs may also achieve substantial cost savings, the emphasis in these arrangements is equally on the value delivered by the ASP. Vertical solution providers, as stated earlier, have to combine several functions, as illustrated in a quote from one of the contracts:

> The software will incorporate specific specifications provided by the client and interface with a workflow engine. ASP will also provide expert consulting and training.

Another states—

> The service will conform to its written specifications when installed and for [confidential] thereafter. The sole source of such specifications shall be written user documentation provided by the client.

The client needs to actively participate in scheduling and requirements definition, requiring greater interaction between the ASP and the client. Some clients

[3] Some applications such as a hosted enterprise system can be delivered either through a horizontal or vertical approach whereas applications such as personal productivity tools are fairly standardized. Note that both approaches still allow the clients to benefit from lower costs compared to installing applications in-house.

[4] Customization involves configuring the service to suit a client organization, as well as customizing application code for client specific needs.

[5] The language in the contracts indicates that the ASP should provide consulting, implementation, training, customization, network access, hardware management, project management, and software applications.

even designate an internal representative to communicate with the ASP and provide information about data and systems architecture. We further elaborate on the distinction between these two service strategies with qualitative evidence gathered through interviews with ASPs in the online appendix.[6]

The interviews with ASPs illustrate the challenges in contracting between clients and service providers. The ASP's obligations defined in the SOW are not always contractually enforceable, thus carrying the likelihood of shirking or under-investing in quality by the ASP.[7] Given the unobservability of the ASP's effort, one challenge is contracting is to ensure that costs are low for the client (e.g., Laffont and Tirole 1993). Another challenge is to provide incentives for exerting effort on dimensions considered valuable by the client. For instance, an ASP that expends insufficient effort in understanding the client-sided processes and business functions, or invests insufficient effort on tasks that are considered valuable by the client, concentrating instead on just cost reduction, lowers the value to be obtained by the client. An example would be that of hosted enterprise resource planning (ERP) where the ASP spends sufficient effort on traditional enterprise tasks but underestimates the complexity of idiosyncratic processes specific to a client. Providing interfaces across these applications is a nontrivial task given the variety of transactions that need to be performed.[8] When the ASP personnel do not understand the importance of viewing the interlinkages between the ERP system and other functions such as supply chain planning for which the client may rely on internal systems, clients need to bear the burden of redundant work and process inefficiencies. When ASPs and clients do understand the challenges in contracting, we should expect that client engagements that are characterized by greater service uncertainty and those that need to be customized to client needs should be governed by time and materials contracts. On the other hand, for fairly standardized application delivery where cost minimization is important, fixed-price contracts enable the ASP to leverage the benefits of a shared platform and infrastructure. Ideally, this distinction should reflect itself in the capability building process, because horizontal solution providers may need to invest in infrastructure, whereas vertical providers need to build capabilities required to tailor services to each client.

Table 1 ASPs' Service Strategies and Contract Types

Dimension of service	Characteristics of client engagements	T&M	FP
Customization	Do not provide customization	41	56
	Customize to clients' needs	39	15
Performance guarantees	Relatively less important to client engagement	43	20
	Relatively more important to client engagement	37	51
Value delivered by ASP (selfreported)	ASP focus on cost savings, reliability of service	31	44
	Domain expertise and business value delivered by ASP	49	27

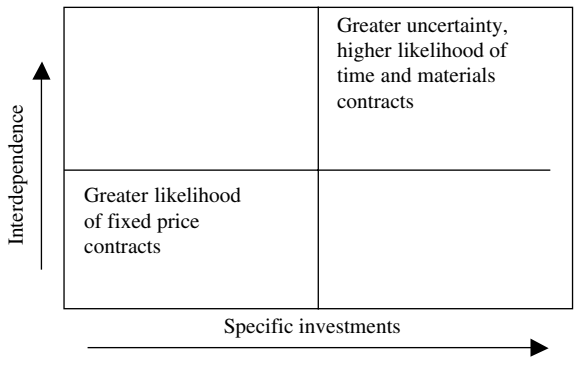
Note. T&M denotes time and materials contracts, FP denotes fixed price.

At the aggregate level, the ASP market is consistent with the aforementioned rational considerations, as evidenced by the descriptive statistics summarized in Table 1. Figure 1 illustrates the trade-offs in contracting. However, individual ASPs and their clients may have an insufficient understanding of the trade-offs involved in designing contracts. The heterogeneity in contracting alignment across ASPs results from parties adopting myopic contracts that disregard the source of value in outsourcing to ASPs and characteristics of client engagements not matched with the type of the contract. An exhaustive analysis of the qualitative data from ASPs, summarized in the online appendix, reveals some of the challenges in contracting and possible sources of contractual misalignment.

3. Theory and Hypotheses

Contracts between ASPs and clients exhibit the features of an agency relationship. First, such contracts

Figure 1 Service Offerings, Interdependence, and Customization



[6] An electronic companion to this paper is available as part of the online version that can be found at http://isr.journal.informs.org/.

[7] Although the ASP manages the services, rights to the data and intellectual property reside with the client, which implies that an ASP's incentive to exert effort depends on the pricing structure of the contract alone.

[8] There is interdependence between the ASP's service and the systems architecture in a client organization when the hosted application needs access to data from multiple functional areas from within the client organization. The ASP needs to ensure that there is no redundant data entry (Austin 2002) as well as enable data from its application to be available in the client organization for analysis (Information Technology Association of America (ITAA) 2003). It is difficult to specify the amount of transaction support and the extent of data integration at the time the contract is signed, creating ex post variability in costs borne by the ASP as well as problems in measuring output quality.

are characterized by imperfect observability of the ASP's actions. Second, there is a delegation of responsibility to an ASP in that the ASP has to make decisions about the form of service delivery, whereas it is the client that obtains value from the services provided (e.g., Geis 2007). Finally, most ASPs are heavily dependent on a steady stream of client revenues, lacking financial resources to absorb overruns, necessitating some risk sharing (e.g., Banerjee and Duflo 2000). The variation in contracting arrangements is across ASPs rather than within a single ASP, as we discuss in the online appendix, which makes it appropriate to investigate the impact of contractual misalignment on the survival of ASPs. Next, we consider the motivation for observed contracts and the implications of misalignment for the survival of ASPs.

3.1. Agency Costs and Contract Choice

According to agency theory, contracts should be structured to provide incentives to the agent to exert effort along the dimensions valuable to the client (e.g., Geis 2007), while simultaneously providing a measure of risk sharing (Allen and Lueck 1998). We consider three factors that impact the choice of contracts: (i) The level of uncertainty inherent in the stream of services required by the client. (ii) The level of interdependence between the service and the technological systems and architecture in the client organization. (iii) The extent to which there is a need for client-specific investments by the ASP.[9]

A fixed-price contract, which makes the ASP a residual claimant from cost minimizing effort (e.g., Holmstrom 1979), is a high-powered incentive contract that lowers costs for the client firm (e.g., Geis 2007). However, when it is difficult to measure the quality of the output, such as the case when there is substantial interdependence between the ASP service and the clients' systems and business functions, incentives for cost minimization could lead to deterioration in the benefit from the service (e.g., Mayer and Nickerson 2005, Tiwana and Bush 2007). At the same time, the need for making client specific investments in service delivery carries the risk of parties haggling for the share of contract surplus (Poppo and Zenger 2002). Low-powered incentives in the form of time and materials contracts could provide greater incentives to make specific investments, as the ASP does not have to commit to a division of contractual surplus before making its unobservable investment decisions.[10] Another challenge in contracting is that contracts should facilitate provide risk-sharing when uncertainty in the transacting space results in substantial variability in output (Banerjee and Duflo 2000). For instance, with a fixed-price contract, the ASP needs to bear the overruns when there are service requirements that are not anticipated at the outset. Thus, factors that increase the risk to an ASP, such as uncertainty, should also increase the need for low powered contracts (e.g., Banerjee and Duflo 2000). Thus we hypothesize as follows.

Hypothesis 1. *Greater uncertainty in service description, the need for client specific investments and interdependence between the ASP and the client are associated with time and materials contracts.*

3.2. Contractual Misalignment and Survival of ASPs

Given the inherent agency costs in the ASP model, theory suggests that contracts should be structured to economize on agency costs. Misalignment in contract structures results when parties adopt contracts that are not matched with the underlying agency costs, or the next best contract form (Joskow 1991). The qualitative evidence from ASPs provided in Table 2 and elaborated in the online appendix describes possible sources of contractual misalignment. As shown in quadrant 2 of Table 2, when there is a greater need for risk sharing or when a client engagement requires effort in learning the client's business domain and the technological infrastructure, fixed-price contracts induce the ASP to scale back effort on tasks that are valuable to end users, creating client dissatisfaction with the quality of service provided by the ASP. By contrast, when parties use time and materials contract for relatively standardized application delivery as highlighted in quadrant 4 of Table 2, the ASP has lower incentives for cost reduction, resulting in client perceptions of being overcharged. In either case, misaligned incentives between the client and the provider may adversely affect the stream of revenues and profitability of an ASP, and ultimately the viability and survival of a young firm in a new market.

It has been posited that misaligned contractual arrangements "invite their own demise" (Williamson 1996, p. 234) whereby market forces select out those firms that adopt inefficient modes of economic organization, whereas efficient firms survive (Hannan and Freeman 1989, Jovanovic 1982). Misaligned contracts are detrimental to new firm survival for the following reasons. First, the lack of alignment in contracting arrangements lowers the efficiency with which a young firm can convert inputs, such as resource endowments and proprietary technologies, to outputs, such as a sustainable stream of revenues or new customer acquisition. This misalignment in contracting is particularly deleterious for new firms

[9] In the online appendix we provide details of tests to rule out that our results may be biased because of adverse selection.

[10] Although client-specific services by the ASP lead to greater value to a client, an ASP that anticipates that a client is unwilling to pay for overruns might scale down its costs and cut back on service quality.

Table 2 Qualitative Evidence from Interviews with ASPs on Service Strategies and Contract Types

Contract type	Sample of responses from ASPs that provide fairly standardized services	Sample of responses from ASPs whose services have greater need for specific investments and risk sharing
Fixed-price contract	Quadrant 1: Aligned contracts • We don't differentiate between different types of customers. • We sell a specific solution, so it is not any different. • We offer a stable platform and good connectivity.	Quadrant 2: Misaligned contracts • We try to meet all client needs. • We provide integration with back end systems in the client organization.
Time and materials contracts	Quadrant 4: Misaligned contracts • We sell a standard service to clients. • The cost and the technology do not differ; it does not matter who the end user is. • We market differently to large and small clients; the service itself is not different.	Quadrant 3: Aligned contracts • Our clients are small and mid-market and they have specific needs. Everything we do is custom. • We sell a service package instead of a component, so it is custom. • Our solution is on a case-by-case basis. We understand the client and customize the solution. • We have a partnership with the client to provide specific solutions. • We do specific development for clients and spend effort in understanding the client's business model.

that need a sustainable stream of revenues to invest for the future. Second, entrepreneurial ASPs that remain focused on technological innovation could fail to understand the inadequacies of their contracting arrangements with clients. Therefore misalignment adversely impacts not only the profitability of a young firm but also its prospects for future growth. Third, the competitive pressures from misaligned contracts could also be magnified by the pace of technological change and lack of accepted models in a new market (e.g., Eisenhardt and Schoonhaven 1996), making it difficult for ASPs to formulate the optimal set of contracting arrangements needed to survive. We therefore expect that ASPs that adopt aligned contracts will obtain positive reinforcement from the market whereas those that are misaligned in their contracting practices receive adverse feedback, leading to exit from the market. Thus we hypothesize as follows.

Hypothesis 2. *Misalignment between agency costs and contracts chosen leads to lower probability of survival.*

3.3. Adjustment Costs and Contractual Misalignment

Models of industry and firm dynamics maintain that firm growth and exit follow a "noisy" selection process (Jovanovic 1982, p. 649) whereby firms discover how efficient (or inefficient) they are relative to competitors. When ASPs (and clients) perceive that contracts are not aligned with agency costs, realignment to efficient governance could remedy the competitive challenges in survival. Clients and ASPs, however, face substantial costs in perceiving the impact of misalignment and in transitioning to aligned governance, adversely impacting survival. We consider two factors that could contribute to such adjustment costs. First, it has been posited that "contractual commitments of a firm tie it to specific other parties who have rights in relation to the firm" (Argyres and Liebeskind 1999, p. 52). The expenses in compensating clients for disruption of business and the associated legal fees hinder an ASP's ability to terminate inappropriately designed contracts that erode its profitability and future growth potential. Misaligned governance imposes adjustment costs on young firms, and such costs are even greater for ASPs locked into longer-term contracts with clients. Such adjustment costs because of contractual commitments enhance the selection pressure from the environment, which is detrimental to survival. Therefore, we hypothesize as follows.

Hypothesis 3A. *The impact of misalignment on survival is intensified because of the length of contracts between ASPs and clients.*

Second, the selection pressure in a new market makes it important for firms to engage in active learning about the environment (Ericson and Pakes 1995) and thereby improve the efficiency with which they transform inputs to outputs. However, market participants' bounded rationality poses limits to their ability to gather and process information about contractual contingencies (e.g., Williamson 1985). When there is substantial uncertainty in specifying the stream of services required by the client, ASPs (and clients) could face an information overload in anticipating optimal incentives to be addressed in the contract. ASPs may overestimate their ability to deal with the contracting challenges in client engagements, which deters

them from learning about the environment and incorporating contractual provisions appropriately. Such cognitive limitations act as an adjustment cost that magnifies the impact of misalignment, increasing the selection pressure from the environment. Thus:

Hypothesis 3B. *The impact of misalignment on survival is intensified because of the uncertainty in specifying service obligations of the ASP.*

4. Data and Measures

4.1. Data Collection Effort: Timeline

Each ASP was tracked from the year of founding to the beginning of 2006 as shown in Figure 1. The data collection was conducted as follows: (1) Information on founder characteristics (dating to the time each ASP was formed) was gathered from archival sources. (2) A survey was conducted in January 2001 when there was the most concentration of firms in the ASP market. (3) Data about the operational characteristics of ASPs from the first quarter of 2001 was gathered from archival sources and public databases. (4) Data on survival (as of the first quarter of 2006) or date of exit were recorded from public databases and archival sources. The shakeout of the Internet sector from late 2001 through the year 2002 onwards provides the exogenous shock needed to study the survival of ASPs. The survey provides a cross-sectional variation across ASPs that allows us to disentangle the effects of contracting from normal entry and exit. Figure 2 shows the timing of the data collection effort, whereas Figure 3 shows the entry and exit rates of all ASPs in our sample.

4.2. Creating a Measure for Survival

A binary variable *Survival* denotes whether the ASP is still operational, as evidenced by listing in industry directories by the beginning of 2006. Data about each ASP was gathered by combining information from several publicly available databases that aggregate news and press releases: ABI Informs Business and Industry, Dow Jones Interactive, Reuters, and LexisNexis. This method also allows us to obtain information on announcements of ASPs declaring bankruptcy, notices about closures as well as data on ASPs that were acquired or changed names (Azoulay and Shane 2001). The survival measure was validated by gathering data from archived Web pages of ASPs obtained from the Internet archive (http://www.archive.org), which is a nonprofit group that captures snapshots of Web pages across the Internet at weekly intervals. Wherever possible, we checked for consistency by examining Usenet groups and forums as well as postings on ASP websites announcing that they were defunct. When we could not get data through public records or industry directories, we verified if the last known telephone numbers, provided in our survey by all participants, were still operational in the first quarter of 2006 and the ASPs were still listed under the same name as in the survey.

Figure 2 Timing of the Data Collection

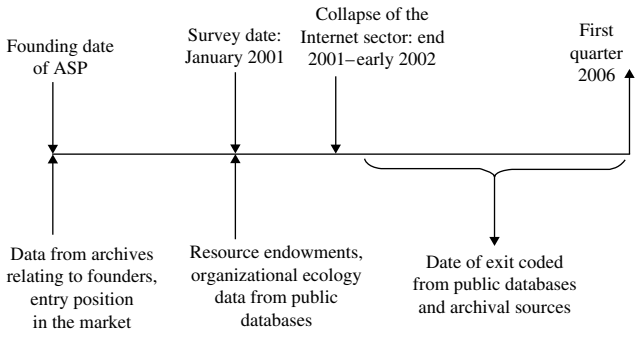
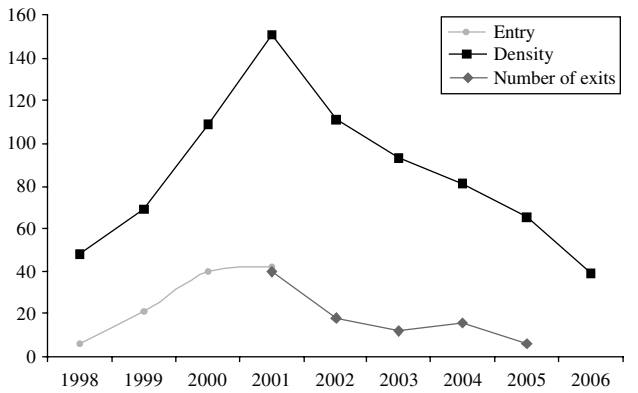


Figure 3 Entry and Exit Rates for the ASPs in this Study*



*Surviving ASPs based on figures at the beginning of the year. The survey date is January 2001.

4.3. Measure Development for Survey Items

We created a questionnaire based on interviews with managers in ASP firms and practitioner-oriented literature. The questionnaire was pretested for content, scope, and validity by multiple faculty members, doctoral students, and an initial sample of 30 ASPs identified by a consulting organization specializing in IT. A seven-point Likert scale was used for some questions whereas others involved more objective measures.

We developed several measures relating to client engagements. The *contract type* is either fixed price or time and materials. The *contract length* is the length of time the ASP agrees to provide service to the end user organization (e.g., Joskow 1987). We developed the measures for contract length on an ordinal scale as observed in actual contracts of ASPs (SIAA 2004, ITAA 2003). Following prior literature in IT outsourcing (Banerjee and Duflo 2000, Poppo and Zenger 1998), *service uncertainty* is the difficulty in precisely

defining the stream of services required from the ASP. This measure was operationalized based on discussions in the trade and business press indicating that service uncertainty results from estimating compatibility with client applications or integrating the service with clients' applications (Austin 2002), service costs (Goth 2000), and delays in rollout and technical problems (Koch 2000). We also coded a binary variable called *application type*, where applications involving higher amount of interdependence with systems in the client organization and therefore associated with greater ex post variability are coded as 1 (and 0 otherwise).

Client specific investments denote whether the vendor needs to acquire company-specific knowledge to adequately perform the outsourced task (Poppo and Zenger 1998). This measure was adapted for the ASP setting by drawing on industry and trade press that emphasizes the importance of investing in functional knowledge and client specific knowledge (ITAA 2003). The *customization* done for the client was assessed by coding the qualitative responses from the ASP indicating the amount of customization done for the client with respect to creating reports, application specific functionality, etc. *Relational norms* have been measured as sharing of information, trust, and cooperation (Anderson and Narus 1990). This measure was adapted to the ASP context based on factors highlighted in the industry and trade press such as the cooperation and partnership with clients (ITAA 2003, SIAA 2004). SLAs guarantee network and application reliability and scalability of the software. The importance of SLAs to the client engagement is assessed on three dimensions:[11] tools to prove SLA achievement (Recktenwald 2000), SLAs on network reliability (Yager 2000), and customer response time (ITAA 2003). The *expectation of continued interaction* between the parties denotes an anticipation that the relationship persists into the future (Heide and John 1990).

Several measures also assessed ASP characteristics. *Technological capabilities* reflect an ASP's advantage in service delivery, such as the ability to manage its network (Bower and Darwall 2000), provide best practices (ITAA 2003), and improved technology (Eisenmann and Pothen 2001). To control for the liability of smallness (Azoulay and Shane 2001) we control for the *firm size* of the ASP measured as the number of employees (log transformed to account for scale effects). A binary variable *specialist* measures the niche width of the ASP, which is a proxy for the degree of competition among ASPs. Based on the interviews and archived Web pages, an ASP was denoted a specialist when it targets a focused group of customers (e.g., Carroll 1985). ASPs that are generalists are likely to face a higher level of competition because they may compete for the same group of customers and face higher price pressure.

Data was collected through a telephone and mail survey by a professional organization with the expertise and contacts required for a large-scale data gathering effort. The details of the survey data gathering effort are presented in the online appendix. A total of 600 questionnaires were administered, and resulted in 167 (28%) responses. 153 responses were usable in terms of completeness of data. We checked for consistency of the survey responses with information available in archived Web pages and industry reports. Because our approach relied on getting data from a representative client engagement, as highlighted in the online appendix, we dropped two observations when we were unable to match details of the service engagement with public sources. The questionnaire and details of scale development and refinement are presented in the online appendix.

4.4. Collecting Data from Archival Sources

Each survey response was matched with data gathered from archival sources dated January 2001 and from the date of founding. Gathering data from archived sources allows us to identify company history and founder information during the early years of a firm. A founder is defined as an "individual(s) involved in actualizing the steps of organizational founding" (Nelson 2003, p. 709). Founder information and biographies were gathered using archived Web pages from the Internet Archive and ZoomInfo (www.zoominfo.com), a repository of information about companies and individuals. To control for the liability of newness, *Firm Age* was measured as the time from founding in years to January 2001. The following variables capture information at the date of founding of the ASP: (1) *Founder education* denotes whether the founder(s) has an advanced degree (Eisenhardt and Schoonhoven 1996), and (2) *prior experience* denotes the experience of the founder(s) in related industries (coded as 1 when the founder had more than eight years experience in related markets).[12]

The following variables date to January 2001: (1) *Patent* is a binary variable denoting whether the ASP holds a patent. (2) *Alliance* denotes whether the ASP has alliances with prominent IT vendors or service providers. (3) A binary variable *open standards* measures the ASP's usage of open standards. (4) A binary variable, *financial resources*, denote access

[11] Because ASPs offer SLAs, an ordinal variable to measure the presence of the SLA may not be a meaningful proxy.

[12] For instance, an entrepreneur with over 30 years experience working with IBM founded one of the ASPs.

Table 3 Variables and their Predicted Impact on Contract Choice and Survival

Contract choice estimation	Source	Prior studies from which variables were adapted	Impact on fixed-price contract
Independent variables			
Service uncertainty	Survey	Uncertainty (Poppo and Zenger 1998)	—
Application type	Survey	Self generated	—
Client-specific investments	Survey	Firm specific assets (Poppo and Zenger 1998)	—
Controls and instrument			Not applicable
Customization	Interviews with ASPs	Self generated	
Relational norms (instrument)	Survey	Partnership quality (Anderson and Narus 1990)	
Performance guarantees	Survey	Self generated	
Open standards	Archived Web pages	Architecture (Bower and Darwall 2000)	
Client importance	Archived Web pages, interviews with ASPs		
Survival estimation			**Impact on survival[a]**
Survival	Public databases	Firm survival (Azoulay and Shane 2001)	
Independent variables			
Misalignment	Calculated	Misaligned governance (Silverman et al. 1997)	—
Contract length	Survey	Contract duration (Joskow 1987)	—
Service uncertainty	Survey	Defined above	—
Controls			Not applicable
Founder education, prior experience	Archived Web pages and public databases	Prior management experience and education (Eisenhardt and Schoonhaven 1996), knowledge of founder (Shane 2003)	
Patent	Public databases	Patents (Lee et al. 2001)	
Alliances	Archived Web pages	Alliances with dominant firms	
Technological capabilities	Survey	Provider Capabilities (Ethiraj et al. 2005)	
Expectations of continuity	Survey	Continuity (Heide and John 1990)	
Specialist	Interviews and archived Web pages	Niche width (Hannan and Freeman 1989)	
Open standards	Archived Web pages	Defined above	
Financial resources	Public databases	Financial resources (Azoulay and Shane 2001)	
Age, size	Archived Web pages, survey	Liability of newness and smallness (Azoulay and Shane 2001)	

[a]Predicted sign on hazard of exit is opposite that of predicted probability of survival.

either to capital markets or venture capital funding as a proxy for financial resources of the ASP (Azoulay and Shane 2001). (5) A binary variable *client importance to the ASP* was coded as follows: (a) whether the client is a large publicly traded firm that is likely to be highly visible, (b) whether the client accounts for a majority of the sales volume, and (c) whether the ASP's marketing efforts, as reported in the interviews we conducted, depend on customer referrals. Table 3 lists the variables and the predicted impact on contract choice and survival. Table 4 presents the descriptive statistics and correlations for the variables in the study.

5. Econometric Considerations and Estimation Approach

5.1. Creating a Measure of Misalignment

The stock market collapse associated with the implosion of the dot-com market provides the exogenous shock that increases the competitive pressure on ASPs facing misaligned contracts. To ensure that there was no bias in estimation, we checked that the ASPs in our sample were incorporated prior to March 2000, which is the date associated with the peak of the stock market.[13] A probit estimation of contract choice, according to agency theoretic considerations, is presented in Table 5. Using a vector W of exogenous variables such as service uncertainty, interdependence between the ASP and the client, performance guarantees, etc., and denoting fixed-price contracts by 1 (time and material contracts are assigned 0), we estimate the probability of a contract type Pr(*Contract*) being fixed price as:

$$\Pr(Contract) = f(W). \quad (1)$$

We use several proxies for the contract execution ability of the ASP and better monitoring by the client. We control for relational norms, which measure the degree of cooperative exchange across partners

[13] March 10, 2000 was the date when the NASDAQ index peaked (Janszen 2008).

Table 4 Means, Standard Deviations, and Correlation Matrix

Variable	1	2	3	4	5	6	7	8	9	10
Mean	0.41	0.47	0.41	2.46	3.98	5.93	5.13	4.18	4.56	4.70
Std. dev.	0.51	0.49	0.49	1.42	2.32	1.35	1.51	2.31	2.05	1.88
Min	0	0	0	1	1	1	1	1	1	1
Max	1	1	1	5	7	7	7	7	7	7
1 Survival	1.00									
2 Contract	−0.08	1.00								
3 Misalignment	−0.27***	0.41***	1.00							
4 Length	0.02	0.08	0.00	1.00						
5 Uncertainty	−0.20***	0.00	0.04	0.07	1.00					
6 Performance guarantees	−0.02	0.02	0.06	−0.02	0.12	1.00				
7 Relational	−0.01	0.06	−0.01	−0.02	0.03	0.09	1.00			
8 Control	0.03	0.16*	−0.06	0.18**	0.16	0.13*	0.01	1.00		
9 Specific investments	0.01	0.04	0.17**	0.04	0.07	0.28**	0.22**	0.29***	1.00	
10 Technological capabilities	0.05	0.02	0.05	0.03	0.04	0.25**	0.03	0.28**	0.15*	1.00
11 Education	0.22***	−0.05	−0.05	0.09	−0.13*	−0.00	−0.08	0.01	0.02	−0.02
12 Prior experience	0.23***	−0.08	−0.02	0.08	−0.05	0.01	0.07	−0.04	−0.04	0.03
13 Age	0.27***	0.11*	0.05	0.23***	−0.09	0.06	0.10	−0.01	0.10	0.11
14 Alliance	0.28***	0.12*	0.05	−0.01	0.07	0.04	−0.02	−0.01	0.00	0.00
15 Modular	0.27***	0.01	0.08	0.09	0.05	−0.01	0.08	0.09	0.03	0.04
16 Patent	0.35***	0.02	−0.05	0.04	0.06	−0.01	0.04	0.06	0.09	0.09
17 Specialist	0.08	0.06	−0.10	0.03	0.07	−0.07	0.01	0.03	0.18**	0.03
18 Customization	0.05	0.17**	−0.08	0.23***	−0.01	0.11	0.04	−0.01	0.07	0.01
19 Size	0.06	0.02	−0.03	−0.02	0.01	−0.02	−0.08	−0.02	0.09	0.06
20 Application type	−0.05	0.06	−0.08	−0.03	0.09	−0.12	−0.07	−0.08	−0.07	0.12
21 Financial resources	0.18**	0.08	−0.15**	0.13*	−0.04	0.08	0.07	0.05	0.09	0.07

Variable	11	12	13	14	15	16	17	18	19	20	21
Mean	0.23	0.38	3.8	0.19	0.11	0.26	0.14	0.63	60	0.33	0.42
Std. dev.	0.42	0.49	4.33	0.40	0.32	0.44	0.35	0.46	45	0.50	0.40
Min	0	0	1	0	0	0	0	0	4	0	0
Max	1	1	20	1	1	1	1	1	500	1	1
1 Survival											
2 Contract											
3 Misalignment											
4 Length											
5 Uncertainty											
6 Performance guarantees											
7 Relational											
8 Control											
9 Specific investments											
10 Technological capabilities											
11 Education	1.00										
12 Prior experience	0.35***	1.00									
13 Age	0.30***	0.33***	1.00								
14 Alliance	0.22**	0.11	0.08	1.00							
15 Modular	0.24***	0.19**	0.11	0.29***	1.00						
16 Patent	0.26***	0.17**	0.35***	0.30**	0.21***	1.00					
17 Specialist	0.01	−0.12	−0.05	0.25	0.13*	0.12*	1.00				
18 Customization	0.03	−0.01	0.14**	0.02	0.04	0.16**	0.04	1.00			
19 Size	−0.02	−0.02	0.13*	0.04	0.10	−0.06	0.02	0.04	1.00		
20 Application type	−0.03	−0.12	0.02	−0.14*	−0.17**	−0.05	0.17**	0.10	0.02	1.00	
21 Financial resources	0.10	0.14*	0.16**	0.06	0.05	0.20***	−0.14**	0.03	0.20***	0.07	1.00

Notes. Number of observations = 153.

*Denotes significance at the 10% level of confidence, ** denotes significance at the 5% level of confidence, and *** denotes significance at the 1% level of confidence.

Table 5 First Stage Estimation: Probability of Fixed-Price Contract[a]

Hypothesized factors in H1	Variable	Coefficient
	Intercept	−3.46 (1.47)***
Interdependence	Application type	−0.58 (0.24)**
Uncertainty in service	Service uncertainty	−0.42 (0.16)**
Specific investments	Client specific investments	−0.12 (0.07)**
Controls	Customization	−0.96 (0.38)***
	Relational norms	−0.34 (0.10)***
	Performance guarantees	0.23 (0.14)*
	Open standards	0.22 (0.11)**
	Client importance to ASP	0.16 (0.14)

[a] Positive coefficient indicates greater likelihood of fixed-price contracts; based on two-tailed *t* tests.

* Denotes *p*-value < 10%, ** denotes *p*-value < 5% and *** denotes *p*-value < 1%.

(e.g., Jap and Anderson 2003) and act as a noncontractual mechanism to foster incentive alignment. We also control for contractual restrictions that limit the possibility that the ASP may take actions not in the client's best interest, such as service level agreements in the contract that penalize the ASP for nonperformance on service quality. Furthermore, we include as a control the use of open standards by the ASP that ease the difficulty in providing interfaces for the client and thereby reduce variability in costs to the ASP. We also control for the client's importance to an ASP, which enhances a client's bargaining power and may ensure high service quality, thus affecting the choice of contracts.

Although the ASP market may be consistent with agency theoretic arguments at an aggregate level, there may be substantial firm-level heterogeneity in the ability to design aligned contracts. Because our focus is on the impact of efficient contracting arrangements on survival, it is the firm level deviation from agency theoretic predictions that is of interest in the empirical estimation. From the first stage estimation, we calculate the predicted contract value from Equation (1), Pr(*Contract*), consistent with an agency theoretic interpretation of linearity of optimal contracts (e.g., Holmstrom 1979). Building on substantial prior literature investigating performance implications of contract choices (e.g., Silverman et al. 1997), misalignment is the divergence between the predicted and actual contract choice. Because the actual contract type is binary, misalignment lies between 0 (indicating aligned contracts), and 1 (indicating misaligned contracts), indicating the degree of divergence from efficient contracting.

$$MISALIGN = |Predicted\ Contract - Actual\ Contract|. \quad (2)$$

5.2. Estimating the Impact of Misalignment

We conduct two sets of estimations to assess the impact of contractual misalignment on survival. Hazard models estimate the probability of the stochastic event that an ASP exits the market, i.e., the probability that an ASP will not survive another year conditional on the fact that it has survived up to that year (e.g., Lancaster 1990). The Cox proportional hazard model assumes that the hazard rate, which is conditional probability of exit, is proportional to the covariates, where X is a vector of exogenous covariates that affect survival, such as the firm age and patents held by the

Table 6 Hazard Models of Firm Exit and Survival Analysis[a]

Variable	(1) Cox proportional hazard	(2) Censoring of founding date	(3) Censoring with controls	(4) Weibull specification of survival time[b]
Misalignment	0.36 (0.17)**	0.37 (0.12)***	0.38 (0.18)**	−0.39 (0.07)***
Contract length	−0.12 (0.06)**	−0.12 (0.07)*	−0.13 (0.07)**	0.10 (0.04)***
Service uncertainty	0.27 (0.09)***	0.29 (0.12)***	0.30 (0.12)***	−0.26 (0.08)***
Founder education	−0.05 (0.23)	0.06 (0.27)	0.07 (0.27)	−0.05 (0.15)
Prior experience	−0.27 (0.16)*	−0.30 (0.20)*	−0.32 (0.20)*	0.45 (0.10)***
Patent	−0.72 (0.22)***	−0.78 (0.27)***	−0.81 (0.27)***	0.63 (0.12)***
Alliances	−0.49 (0.24)***	−0.35 (0.18)**	−0.38 (0.20)**	0.34 (0.12)***
Technological capabilities	−0.06 (0.09)	0.02 (0.11)	−0.01 (0.11)	0.03 (.02)
Continuity	−0.03 (0.09)	−0.07 (0.10)	−0.07 (0.12)	0.07 (0.10)
Age	−0.53 (0.07)***	−0.45 (0.07)***	−0.45 (0.07)***	
Specialist	0.11 (0.19)	0.15 (0.20)	0.16 (0.22)	0.01 (0.04)
Open standards	−0.17 (0.10)*	−0.56 (0.30)*	−0.50 (0.30)*	−0.18 (0.05)***
Financial resources			−0.06 (0.02)*	0.04 (0.02)*
Log(Size)			−0.12 (0.10)	0.19 (0.13)
χ Square(df)	165.22 (12)***	116.63 (14)***	118.32 (14)***	

[a] *p*-values based on two-tailed tests. The hazard is the duration when a given ASP has exited the marketplace; because we are modeling the probability of exit, we expect the coefficient of misalignment to be positive.

[b] Because the Weibull model estimates survival, whereas the proportional hazard model estimates probability of exit, the signs are opposite to those of the proportional hazards model.

* Denotes *p*-value < 10%, ** denotes *p*-value < 5%, and *** denotes *p*-value < 1%.

ASP, and contractual misalignment, β is the vector of coefficients, and $h_0(t)$ is the baseline hazard function.

$$h(t, X, \beta) = h_0(t)e^{-\beta' X}. \quad (3)$$

The results are presented in Table 6. Column 1 presents the estimates of the Cox proportional hazards model, which does not assume a specific functional form for the hazard. We examine whether there is left censoring caused by the fact that some ASPs may have been defunct even before than the observed exit from the marketplace, which may be true for ASPs who entered the market at a time when there was too much entry. In column 2 we present a proportional hazard model with censoring of founding date for the ASPs who entered the market in the year 2000. Column 3 introduces additional controls. To test the sensitivity of the model specification, we include an alternative specification using an accelerated failure time model of survival in column 4. In the survival model, the duration of survival is assumed to follow a Weibull distribution, where X is a vector of exogenous covariates that affect survival and σ is a scale factor as in (4). Because the estimates in column 4 refer to a model of survival, the signs are reversed from those in columns 1–3 that present the estimates of the proportional hazards model of exit.

$$\log T = X'\beta + \sigma\varepsilon. \quad (4)$$

We then conduct a discrete choice estimation of survival. The logit estimations modeling the probability of survival are presented in Table 7. Column 1 of Table 7 presents the baseline estimation including misalignment and organizational ecology factors. Column 2 includes a full set of control factors, whereas column 3 includes interaction effects. The association between predicted probabilities and observed responses is greater with a complete set of explanatory factors, denoting that survival is better explained through multiple factors. The impact of contracting efficiency in both models is captured through the measure of misalignment. Because the hazard model estimates exit whereas the logit models estimate survival, the coefficients in columns 1–3 of Table 6 have the opposite signs compared to those in the logit estimation in Table 7. For robustness these models were checked for consistency with a $\{0, 1\}$ coding for misalignment.

5.3. Alternate Explanations and Causal Inference

We consider two alternate explanations that may affect the relationship between contractual efficiency and ASP survival. First, because entrepreneurial ASPs are heterogeneous with respect to their resource endowments, even when contracts are misaligned, ASPs that have better resource endowments or understanding of customer expectations may improve their chances of survival by negotiating with clients to share cost overruns or managing client expectations better. The measured impact of misalignment may then reflect access to resources, capabilities and routines that confer competitive advantage. We control for several indicators of resource endowments of an ASP. *Alliances with dominant firms* provide a means for acquisition of new knowledge and resources needed to survive. Firms with strong interorganizational relationships with trading partners could also be in a better position to mobilize resources; we thus consider the *expectations of continuity* in a relationship between the ASP and its customers. The *technological capabilities* of an ASP could improve service quality and thereby allow competitive differentiation. *Patents* of the ASP offer a signal of its innovative ability (Lee et al. 2001). Because ASPs need to provide interfaces between the hosted software and the information systems in a client's organization (Bower and Darwall 2003),[14] *open standards* based on XML that ease challenges in providing integration may allow an ASP to differentiate itself from a competitor. *Prior knowledge* and *experience* allow an entrepreneur to obtain information on market development, technological change, and production processes (Shane 2003), which may be critical to survival during a firm's early years.

Second, organizational ecologists argue that younger organizations lack external legitimacy (Stinchcombe 1965). It could be the lack of external legitimacy, rather than the difference in contracting ability, could explain the variation in survival of ASPs. Because younger firms face a liability of newness we control for the *age* of the ASP. We also control for the *size* of an ASP as well as its *financial resources*, such as access to capital markets or venture capital funding, as a proxy for the liability of smallness, as in Azoulay and Shane (2001). The niche width of a new firm, or the extent to which a firm depends on its environment, is a key variable that influences survival (Hannan and Freeman 1989), as a *specialist* niche may be easier to attain for a resource starved young firm. The theory and operationalization of this measure is explained in the online appendix.

[14] Most of the applications hosted by ASPs were written for client/server or PC-based systems. To provide interfaces to clients' applications, ASPs have to either rewrite or port the applications to Web-based environments, which implies that the interfaces developed by the ASP are interdependent with the platforms, business processes and systems in the client's organizations. In contrast, Web-native ASPs, or those that have XML based architectures found it easier to provide integration with client-side information systems and provide scalable service delivery over the Internet.

Table 7 Logit and Probit Estimates of Survival[a]

	Probability of survival			Survival by contract type	
	(1) Baseline	(2) With controls	(3) With interaction terms	(4) FP	(5) T&M
Variable					
Misalign	−1.85 (0.45)***	−1.56 (0.48)***	−2.13 (0.53)***	—	—
Length		0.10 (0.12)	−0.06 (0.16)	0.02 (0.15)	−0.26 (0.19)*
Service uncertainty		−0.68 (0.23)***	−0.65 (0.26)***	−1.09 (0.37)***	−0.76 (0.26)***
Length ∗ misalignment			−0.07 (0.05)*		
Uncertainty ∗ misalignment			−0.43 (0.25)**		
Inverse mills ratio (Lambda)				−2.11 (1.83)*	1.42 (0.58)**
Controls					
Education		−0.11 (0.10)	−0.32 (0.59)	−0.12 (0.29)	−0.27 (0.53)
Prior experience		0.50 (0.40)	0.48 (0.34)*	−0.90 (0.81)	1.10 (0.51)**
Alliances		1.13 (0.55)**	1.11 (0.60)**	0.06 (0.76)	2.17 (0.81)***
Patent		2.01 (0.55)***	1.90 (0.55)***	2.40 (0.89)***	1.19 (0.73)*
Continuity		0.08 (0.23)	0.24 (0.17)*	0.01 (0.26)	0.14 (0.21)
Technological capabilities	0.19 (0.20)	0.38 (0.26)*	0.31 (0.28)	0.37 (0.29)**	0.11 (0.31)
Firm age	0.16 (0.05)***	0.02 (0.01)*	0.08 (0.04)*	0.09 (0.06)*	0.13 (0.10)*
Specialist	0.36 (0.19)*	−0.07 (0.27)	0.16 (0.36)	−0.40 (0.52)	0.07 (0.52)
Open standards	2.17 (0.48)***	1.67 (0.70)**	1.76 (0.73)***	2.39 (1.04)**	1.81 (0.77)**
Financial resources		0.49 (0.35)*	0.45 (0.29)*		
Log (size)		0.27 (0.33)	0.12 (0.11)		
Pseudo R^2	**0.36**	**0.38**	**0.47**	**0.56**	**0.47**
Association[b]	78.4	80.0	83.1	85.6	84.2

[a] Positive coefficient indicates greater likelihood of survival (p-values based on two-tailed tests).
[b] Denotes association between predicted probabilities and observed responses.
* Denotes p-value < 10%, ** denotes p-value < 5%, and *** denotes p-value < 1%.

5.4. Controlling for Endogenous Self-Selection in Contract Choices

We need to consider whether ASPs that have survived might have better knowledge and interfirm collaborative capabilities that enabled them to design contracts that are better matched with the contracting environment. An important econometric problem in this regard is that we do not observe an ASP's contracting ability, which creates a potential selection bias if ASPs with better contracting ability have an advantage in survival. To correct for endogenous self-selection, we use a variant of the switching regression model for binary outcome variables (Cameron and Heckman 1998, Aakvik et al. 2005), which is an extension of the linear switching regression model of Heckman (1990).

From the contract choice estimation in (1), which takes into account selection effects, we estimate the inverse Mills ratio, which is a correction for self-selection (Heckman 1990). We then estimate the probability of survival according to the contracting regime and correct for self-selection by incorporating the Mills ratio λ as shown in (5). The two-step maximum likelihood procedure uses an instrument for selection (contract) in the first stage that acts as the exclusion restriction necessary for identification (Maddala 1983, p. 266), i.e., when there is a variable that determines the contract choice that does not affect the outcome, survival (Aakvik et al. 2005). We use as an instrument the degree of relational norms across exchange partners that can foster incentive alignment through the development of social processes, and thereby affect the contract type chosen. We ensured that the instrument does not directly predict survival but predicts contract choice by conducting a Hausman test (Wooldridge 2002, pp. 118–122) and a Wald F-test prescribed by econometrics literature (Angrist and Krueger 1991).

$$\Pr(SURV) = \begin{cases} fn(\beta_{i1}X, \delta_{01}\lambda) & \text{if } CONTR = FP \\ fn(\beta_{i2}X, \delta_{02}\lambda) & \text{if } CONTR = T\&M. \end{cases} \quad (5)$$

Models 4 and 5 in Table 7 present the estimation for survival by contract type. The inverse Mills ratio, or the correction for self-selection, estimates the impact of choosing the right contract. The positive sign of the inverse Mills ratio indicates positive selection, which denotes that the (unobservable) contracting ability of ASPs does improve survival. For robustness we estimated a joint specification of contract choice and survival using the Heckman probit estimation in Stata, which is a maximum likelihood estimation imposing joint normality conditions on the error terms. The likelihood ratio is significant, indicating a selection effect.

Another factor that could bias the results involves potentially unobservable market perceptions about the ASP rather than (unobservable) contracting ability. Because new firms are likely to be cash strapped, investors, and clients alike may perceive an ASP to be more stable if it has access to a steady stream of revenue. For instance, ASPs that adopt fixed-price contracts may face a lower risk of clients refusing to pay for cost overruns, and therefore a comparatively more stable revenue stream. If favorable market perceptions lead to a systematic advantage in survival, survivability could be skewed in favor of one contracting regime. To address the systematic difference in survivability across different contracts, we need to compare the likelihood of survival of ASPs with the counterfactual outcome, i.e., the likelihood of survival had the ASP chosen an alternate contract. We use the estimates from the probit model of contract selection in (1) to obtain the propensity score, which is the conditional probability of receiving treatment given a vector of independent variables (e.g., Rosenbaum and Rubin 1983, 1984). The probability of treatment in our context is the probability that a client and a firm choose fixed-price contracts, which is based on agency theoretic considerations. The propensity score, or the conditional probability that a contract with vector W of observed independent covariates is assigned a contract $CONTR \in \{0, 1\}$, where 1 denotes fixed-price contracts is:

$$e(W) = \Pr(CONTR = 1 \mid W). \tag{6}$$

W and e are conditionally independent (Rosenbaum and Rubin 1983) if the treatment $CONTR$ is independent of the outcomes, conditional on W. Given the same propensity score, observations will have the same multivariate distribution for W. An important caveat is that the propensity score method should take into account the selection into a treatment regime. Conditioning on observables, we can ignore the selection into a given treatment group (Rosenbaum and Rubin 1984, Dehejia and Wahba 2002). That is, once we estimate the conditional probability of contract choice accounting for selection, we can treat contracts in the ASP market as if they were randomly assigned across ASPs. We matched observations on the propensity score from the treatment group (fixed-price contracts) with those in the control group (time and materials contracts) by ranking observations from the highest to the lowest propensity score and by grouping them into five subclasses according to the propensity score (Dehejia and Wahba 2002). Because we have a small sample, we retained four subclasses to match a comparable number of observations across the two groups.[15] Eight observations were excluded from matching. Out of 18 exogenous covariates, only 1 showed a significant difference (p value 0.05) after matching, which indicates that the matching method is valid. Once selection effects are accounted for, the average estimate of the difference in survivability across contract types is presented in Table 8.

Table 8 Distribution of Surviving ASPs According to Propensity Score Measures[a]

Causal effect	Increase in survivability with fixed-price contract
Subgroup 1	−0.16 (0.16)
Subgroup 2	−0.12 (0.06)*
Subgroup 3	−0.14 (0.09)
Subgroup 4	−0.21 (0.16)*
Average causal effect	−0.12 (0.07)*

[a] Note that we do not need to estimate a correction for self-selection when we use propensity score matching; the propensity scores account for the selection effects.
* Denotes p-value $< 10\%$.

5.5. Assessing Heterogeneity Across ASPs

Our data collection approach parallels that of Banerjee and Duflo (2000) whereby each ASP reported data about a current client engagement. Details are presented in the online appendix. Our results could be sensitive to potential bias from the heterogeneity in the service offerings of ASPs or from heterogeneity in the clients served by the ASP. We considered several checks to ensure that we control for heterogeneity in service offerings of ASPs. First, the impact of misalignment on survival may vary considerably between an ASP that primarily offers one type of service (such as a Web hosting application) governed through one type of contract, and an ASP that provides a range of services, governed through multiple types of contracts.[16] An example of the second approach was an ASP that provided an accounting application targeted at banks, where one of the clients used a fairly standardized service governed through fixed-price contracts, whereas another client engagement deployed a service that was extensively tailored to its business needs and governed through time and materials contract.

[15] Conceptually, every observation in a treatment group should be matched with an observation from the nontreatment group. We used a nearest neighbor matching with replacement technique. We verified that each subclass had a reasonable number of observations.

[16] In the first case either all client engagements are either aligned or misaligned, whereas in the second case some of the client engagements are aligned with agency costs whereas others are not.

We coded the qualitative data gathered from ASPs in January 2001 to assess whether ASPs offer a breadth of services, and checked for consistency with data collected from the Internet Archive. Out of a final sample of 151, only 31 ASPs reported heterogeneity in service offerings, perhaps because of the fact that offering multiple services may be too costly a strategy to pursue for resource strapped firms early in their life, with the result that the variation in contracting arrangements is primarily across rather than within ASPs, as we discuss in the online appendix.[17, 18] To account for heterogeneity in service strategies of ASPs, a weighted measure of misalignment was calculated by dividing the misalignment score with the number of service offerings of each ASP. The hazard models in Table 6 and the logit models in columns 1–3 of Table 7 were reestimated using the weighted measure. The estimates across both measures were consistent, indicating that our results are robust to potential heterogeneity in services.

Second, we need to consider the possibility that a misaligned contract can have a fairly detrimental impact on survival when the client in question has greater external visibility based on industry reputation or sales volume. Contract cancellations or bad publicity from such clients could substantially impede an ASP's ability to grow and acquire new customers. An important issue in this regard is the impact of external visibility of a client depending on service heterogeneity. The loss of a highly visible client may be particularly detrimental to an ASP that has invested considerable resources in offering a menu of differentiated services to a prominent client. For the 31 ASPs that offer diverse services, we obtained data about the most visible client from the following: (1) Databases that aggregate news and press releases such as Factiva, Dow Jones, and ABI Informs Trade and Industry. (2) Trade consortia such as the ASP Street. (3) SEC filings of client companies, venture capitalists that funded ASPs and filings of ASPs (small business filings).[19] The responses from the ASP survey in 2001 matched the data gathered from public sources on objective dimensions such as contract length, service offered, contract type, customization provided by the ASP, etc., which indicates a representative client engagement. For the 119 ASPs that do not offer a diverse set of services, we coded the qualitative responses on (i) the sales and marketing strategies used to target customers, and (ii) the customer expectations of the ASP's service. Nine of these ASPs report that their marketing to clients depends on targeted customer referrals, in which an endorsement by a client could be critical to the survival of the ASP. To ensure that there is no bias because of the effect of a highly visible client, these observations were dropped in estimating the hazard and logit models. The new estimates were consistent with those in Tables 6 and 7, providing evidence that the results are not biased because of a highly visible client. Additional checks are reported in the online appendix.

5.6. Checks for Robustness

In high technology industries, startups can be frequently acquired by other companies. Acquisition can be interpreted as a mixed outcome; it can represent success if it provides an ASP with visibility, access to partners and marketing resources, but may also be interpreted as an outcome of failure, when the acquisition results in the liquidation of assets held by the ASP. In our sample, 62 ASPs survived and 16 were acquired as of 2006. To examine whether the results are sensitive to the type of exit, the performance of the ASP was recoded along a three-point scale: exit, acquisition, and continued survival. An ordered logit model of survival was conducted using the recoded measure. When comparing the resulting estimates with those in column 3 of Table 7 where the dependent variable is dichotomous, the direction and significance of the coefficients do not change except that the sign for the variable for market niche (the coefficient is not significant, however). The main results are unchanged, which suggest that our results are not sensitive to the type of exit. The results are presented in the online appendix.

Two additional checks were conducted for robustness. We examine whether the timing of entry affects survival, i.e., whether there is a favorable *window of opportunity* in the ASP market. A dummy variable was coded to denote entry in the first two quarters of 1999 and included in both the hazard and the logit models. The coefficient is positive, though not statistically significant. We also examine whether ASPs derive an advantage in survival based on their location. Because geographic concentration enhances entrepreneurial activity, we need to control for economies of agglomeration. A dummy variable was coded denoting ASPs located in the Silicon Valley area, which has been identified as a *locus of innovation*. We found that location did not significantly predict survival.

6. Results and Discussion

6.1. Discussion

The probit estimation in Table 5 indicates that in a cross-sectional sample, specific investments, uncertainty, and the interdependence between the ASP and

[17] We dropped two observations when we could not confirm whether the client engagement is indeed representative.

[18] Note that offering multiple services instead of one type of service may be pursued as a competitive strategy by both horizontal and vertical ASPs.

[19] We noticed that some of the prominent clients were publicly traded companies, such as Time Warner.

the user firm are associated with time and materials contracts, supporting Hypothesis 1. At the aggregate level, observed contracts are consistent with agency theoretic arguments. However, economic actors differ in their ability to design contracts. Market participants' inability to understand the sources of agency costs imply that not all ASPs face aligned contracts. The variation in contracting arrangements across ASPs could result from an insufficient understanding of contracting costs or a misperception about the source of value from interfirm collaboration (that needs to be matched with contract forms). An ASP's competitive strength and future growth potential depends on its ability to economize on agency costs, or crafting aligned contracts.

Misalignment in contracting structures is significantly linked to the probability that an ASP will not survive, confirming Hypothesis 2. In a new market, "different resources need to be brought together to create the new product or service" (Shane and Venkatraman 2000, p. 220). Stinchcombe (1965) posits that new organizations face significant difficulties in creating standardized rules and procedures as well as building stable interfirm arrangements. Whereas a crucial difficulty faced by ASPs is the lack of knowledge of client expectations and market conditions, contractual misalignment has a significant impact after accounting for explanations from the resource based view and ecology literature.

Our results underscore the critical importance of understanding market arrangements in addition to technological capabilities of an ASP. Inappropriate contracting may cause welfare loss to the client, adversely affect the revenue stream of the ASP, potentially resulting in ASP business failure. The lack of a sustainable stream of revenues from customers also deters potential investors and venture capitalists from making endowments into a new business model and fuels the perception that the aggregate ASP market may be vulnerable to failure. When an ASP exits the marketplace when its business model is no longer viable, clients may not have enough options in the ASP market, but may fall back on traditional IT sourcing options or rely on in-house IT solutions. Survival of individual ASPs may, therefore, affect the overall competitive dynamics of the market.

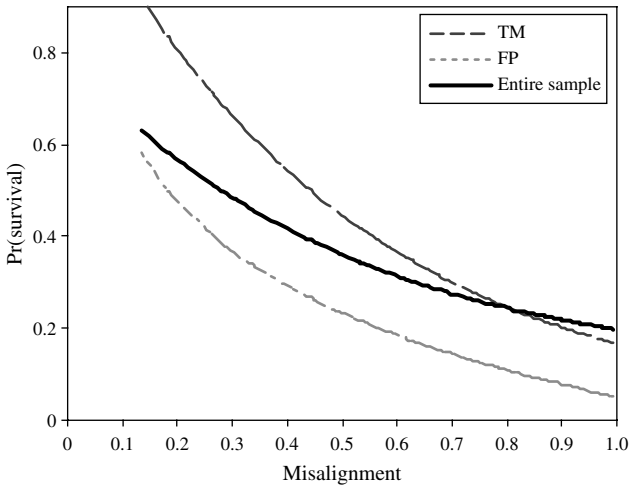
The results also highlight the importance of adjustment costs and uncertainty. As shown in Table 7, we find that the interaction effects of contract length with misalignment and uncertainty with misalignment significantly lower the probability of survival, confirming Hypotheses 3A and 3B. ASPs that are locked into a longer term contract with clients and those that experience greater uncertainty in the stream of services face greater likelihood of business failure when they ignore contracting considerations. Organizational costs and institutional features in contracting create a barrier in transitioning to aligned contract structures. Given the considerable legal costs of arbitration and damage payments to clients, altering business models and payment terms is far from easy for ASPs, and the impact of misalignment may then persist even when ASPs realize that their governance choices are not aligned. Models of firm dynamics (Jovanovic 1982, Hopenhayn 1992) posit that entrepreneurs do not know their true ability beforehand, and that market forces select out those firms that are inefficient. The impact of both uncertainty and contract length is to act as an adjustment cost that lowers the relative efficiency of an ASP, interfering with the process of learning whereby an entrepreneurial ASP can understand market processes and acquire the ability to design aligned contracts. The relatively shorter time between the emergence of ASPs and an exogenous industry shock caused by the shakeout of Internet firms could be another impediment to ASPs learning about the environment and perceiving the impact of contractual misalignment, adversely affecting the survivability of ASPs.

Unobservable selection could bias our results if (unobservable) contracting ability of an ASP improves survivability. To control for self-selection, we estimate an endogenous switching model for binary outcomes that accounts for the systematic difference in survival across contract choices. In Table 7, the Inverse Mills ratio, which captures the impact of choosing the right contract, indicates positive selection for time and materials contracts, denoting that choosing fixed price instead of time and materials contracts will result in reduced likelihood of survival. The divergence of incentives between ASPs and clients because of misaligned contracting is worse when fixed-price contracts are employed for service offerings that are more appropriately governed through time and materials contracts. Figure 4 presents the predicted probability of survival according to contract type.

Conditional on the selection of contracts, the propensity score matching presented in Table 8 allows for a comparison of survivability across the two contract forms. The propensity score method balances out the association between contract choices and survival that is independent of factors that influence the choice of the contracting regime. We find that ASPs obtain only a slight advantage in survival when using time and materials contracts, indicating that unobservable market perceptions about an ASP are less likely to significantly bias our results.

The results are consistent with arguments from the resource based view and population ecology literature on new firm survival. Founder education is not significant, whereas prior experience of the founder

Figure 4 Predicted Probability of Survival with Misalignment*



* As misalignment approaches zero, the predicted probability of survival tends to 1, thus the discontinuity.

has a significant impact on survival. Entrepreneurial firms with limited resources can improve their competitive position through stronger relationships with clients and alliances with prominent firms. We find that firm age is significantly associated with a higher probability of survival, suggesting that the liability of newness leads to organizational mortality. A specialist niche is significantly associated with survival, which is explained by the fact that firms occupying a broader niche (i.e., generalist firms) need to draw on a wider range of resources that is harder to attain for young firms. Generalists may also face a stronger competitive environment.

6.2. Implications for Literature and Practice

One reason the ASP model is attractive for user organizations is that it can ease the burden in managing complex IT infrastructure and accelerate the assimilation of productivity enhancing improvements in software. However, the extent to which entrepreneurial ASPs can take advantage of such business opportunities may depend on their ability to craft the appropriate contractual arrangements. In the early years of the business model, it is critical for the ASPs to have a reliable stream of revenues. When clients dispute the costs charged by ASPs, or when ASPs are unable to recover the cost of providing service, an ASP that does not have a sustainable source of revenue is forced out of the marketplace. Even when ASPs are comparable in their technological capabilities, there can be considerable difference in the way they deal with the challenges in interorganizational contracting. A narrow focus on the technological aspects, rather than communication and interfirm coordination skills necessary for a service-centric model, may have been detrimental to many early ASPs. This paper underscores that developing expertise in governance mechanisms and their implementation is important for young firms exploring Internet-enabled business models.

As the ASP model has evolved to encompass end-to-end IT service delivery orchestrated through service oriented architectures and IT-enabled services such as business process outsourcing, misalignment problems observed in the ASP market may be indicative of the challenges faced in crafting the right contractual arrangements to enable outsourcing of complex business relationships. When time and materials contracts are viable, it is possible to have a highly differentiated market structure, with ASPs differentiated along product offerings, and where a few firms can occupy specialized niches. When fixed-price contracts are relatively more viable, the resultant industry structure could favor consolidation and concentration of firms as a result of economies of scale. Our emphasis on contracting arrangements as determinants of industry structure is a contrast with prior literature that has highlighted explanations based on scope economies or installed base.

Prior literature suggests that IT service providers need to adopt enforcement mechanisms and processes that are appropriate to the structure of incentives offered in a governance mode (Ethiraj et al. 2005). When firms are selected out on the basis of contracting efficiency, we would expect that over time investments in capabilities would be streamlined to suit an ASP's service strategy, which, in turn, should be dictated by the exigencies of contracting arrangements with clients. Horizontal solution providers need to invest in infrastructural capabilities, which enable them to leverage economics of scale in deploying a standardized solution to several clients, which could be classified as *product innovations*. Vertical solution providers, on the other hand, need to build capabilities required to deliver a service tailored to each client that enables both clients and ASPs to benefit from the cost plus style of contracting, or capabilities geared toward developing customer satisfaction, which constitute *process innovations*. Because providers face significant trade-offs in the capability building process, understanding the distinction between different types of value created by the model of service is critical to the development of job roles and the creation of human capital for young firms seeking to exploit technology-enabled business models.

6.3. Limitations

In this paper, we examine the impact of contracting alignment on survival when an exogenous industry shock increases competitive pressure on firms in a new market. One of the limitations of this approach is that it does not allow us to infer the dynamics

of firm learning after the crash in the Internet sector, leaving open the possibility that firms could have survived because they and their clients unknowingly chose the right contracts. If ASPs differ in their ability to perceive and respond to environmental threats, then those ASPs that are better at learning about the environment will experience greater success with client engagements, leading to greater survivability. Although the results in this study will be unchanged because of firm level heterogeneity in learning, some of the impact of misalignment on future competitive conditions will be exacerbated when firms are unable to learn effectively. Whereas we do not find any systematic relationship between newness of firms and misalignment, the stock of knowledge possessed with respect to contracting arrangements, and perfected through learning routines, may be a valuable source of competitive advantage for new firms that are resource constrained. A longitudinal study of IT service providers learning to contract in a new market, instead of the approach adopted in this paper, could yield greater insight into factors that make new firms particularly vulnerable to failures of contract alignment and in selecting the right service strategies. Another limitation in this study is that we do not consider whether contract enforcement or contractual alignment might occur through alternate mechanisms other than agency theoretic factors, which could result in firm level heterogeneity in the relationship between contractual misalignment and survival.

7. Conclusions and Future Research

Prior literature has often highlighted the importance of entrepreneurs exploiting opportunities enabled by technology to create new firms (Schumpeter 1934). Models of firm dynamics posit that new firms discover their true productivity only after entry, and that market forces select out inefficient firms (Jovanovic 1982, Hopenhayn 1992). This study suggests that a strong focus on interfirm contractual arrangements, rather than a firm's ability to exploit opportunities enabled by technology, or the efficiency in internal operations, favored firms in the emerging market for application services. Williamson posited "if economic organization is formidably complex, which it is, and if economic agents are subject to very real cognitive limits, which they are, then failures of alignment will occur routinely" (Williamson 1991, p. 78). Our results are robust to alternate explanations that it is the liability of newness or a firm's resource endowment that drives success.

Evolutionary theory suggests that boundedly rational entrepreneurs discover profit-maximizing opportunities only through trial and error. The lack of accepted business models in a new market makes it difficult for entrepreneurial firms to formulate the optimal set of rules needed to survive. Relying on heuristics and biases could also make entrepreneurs prone to overconfidence in estimating their ability to deal with competitive conditions (e.g., Simon 1959). Such biases are displayed not only by entrepreneurs but also by individual consumers in making choices about new technology. The role of judgment biases in the diffusion and adoption of IT-enabled innovations is a question for future research.

Theories of social networks posit that market agents derive information and status from their position in a social network structure. New firms with a greater stock of social capital may be more capable of forming stronger linkages with clients, and thereby play a leading role in the dictating the trajectory of network externalities and dominant standards. Social network based explanations to analyze the dynamics of IT-enabled business models is another related topic for future research.

8. Electronic Companion

An electronic companion to this paper is available as part of the online version that can be found at http://isr.journal.informs.org/.

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