Uncertainty and Compensation Design in Strategic Inter-Firm Contracts

DEEPA MANI, *Indian School of Business, Hyderabad*

RANJANI KRISHNAN, *Michigan State University**

*We thank workshop participants at the Indian School of Business, Michigan State University, University of Pittsburgh, Nanyang Technological University, and Temple University for their helpful comments. Corresponding Author: Broad College of Business, Michigan State University, 632 Bogue Street, Room N207, East Lansing, MI 48824, Phone: 517-353-4687, Krishnan@bus.msu.edu.

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ABSTRACT

In strategic outsourcing contracts, a substantial portion of implementation occurs at the client's premises and requires integration of effort between the vendor and the client. Compensation design in such contracts involves trade-offs between the higher (lower) incentive properties of fixed-price (cost-plus) contracts and their higher (lower) *ex ante* contracting and *ex post* adaptation costs. We explore the compensation implications of two types of uncertainty—volatility and ambiguity—which are reflected in the client's performance measures. Performance measure volatility reflects the unpredictability of changes in the future environment faced by the contracting parties, which makes it difficult to contractually specify future contingencies. Performance measure ambiguity reflects lack of consensus about the nature, drivers, and value effects of uncertainty, which makes it difficult to contractually specify responses to contingencies if and when they occur. Volatility increases the likelihood of *ex post* adaptation costs while ambiguity increases *ex ante* contracting costs; therefore, volatility and ambiguity decrease the attractiveness of FP contracts. We use accounting and market measures to calibrate volatility and ambiguity and examine their implications for compensation design and *ex post* renegotiation. Analysis of archival data for 599 strategic outsourcing contracts valued over $15 million indicates that even after controlling for task complexity and relational uncertainty, performance measure volatility and ambiguity influence contract compensation design and renegotiation likelihood. We conclude that performance measure volatility and ambiguity are important determinants of compensation design in strategic inter-firm contracts.

Data Availability: Data used in this study were obtained from the International Data Corporation's (IDC) Services Contracts Database and are available for purchase from the IDC (http://www.idc.com).

Key Words: Performance measure properties; outsourcing; transaction cost economics.

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1. Introduction

This paper examines the effect of uncertainty on two types of vendor compensation contracts most commonly observed in practice—cost-plus and fixed-price (Banerjee and Duflo 2000; Bajari and Tadelis 2001; Rogerson 2003; Gagnepain et al. 2013). In cost-plus (CP) contracts (or time and materials contracts), the client reimburses the vendor for actual cost incurred. In fixed price (FP) contracts, the client pays the vendor a fixed price that is negotiated *ex ante*. By design, in CP (FP) contracts, the client (vendor) bears all the risk of cost overruns. This differential burden of the cost risk generates contracting frictions, which are pronounced in the presence of uncertainty (Williamson 1979). By providing strong "market-like" incentives for vendor effort, FP contracts minimize the moral hazard losses that characterize cost-plus (CP) contracts. However, if unanticipated contingencies adversely affect cost flows or require design changes and adaptations, FP contracts require costly renegotiation that exposes contracting parties to losses from opportunism. To reduce the likelihood of renegotiation, FP contracts involve significant *a priori* design costs related to specification of appropriate responses to potential future states and performance benchmarks associated with each of the states (Williamson 1985).

CP contracts, in contrast, can be relatively unstructured and allow the contracting parties to make modifications if contingencies arise *ex post* (Crocker and Reynolds 1993; Bajari and Tadelis 2001). However, CP contracts increase the likelihood to the client of moral hazard and dissipation of gains from privately favorable distribution of surplus. The moral hazard risk in CP contracts arises primarily because the client bears the risk of cost overruns in the presence of asymmetry between the client and vendor on the true costs of task execution. Inter-firm compensation design therefore involves trade-offs between losses from vendor moral hazard of CP contracts on the one hand and transaction costs of *ex ante* contract design and *ex post* adaptation of FP contracts on the

other (Laffont and Tirole 1993; Bajari and Tadelis 2001). Transaction cost economics (TCE) theory posits that firms select compensation mechanisms to minimize these trade-offs and recommends that if moral hazard (contract design and adaptation) costs are more significant than contract design and adaptation (moral hazard) costs, the optimal contract is FP (CP).

In this study, we make a case that the client's performance measure properties proxy for the relative magnitude of transaction costs and moral hazard costs. We argue that transaction costs of *ex post* adaptation are increasing in the *volatility* or unpredictability of changes in the client's business environment. Volatility, reflected in factors such as rapidly changing technology, frequent price changes, or variability in product availability and support services, makes it more difficult to predict future contingencies and increases contract incompleteness (Aldrich 1979; Child 1972). Transaction costs of *ex ante* contract design on the other hand, result from *ambiguity* or causal indeterminacy and uncertain action-outcome linkages in the client's business environment. Ambiguity makes it difficult to evaluate and attain consensus on the client's business requirements, determine performance benchmarks, and render objective assessments of business tasks or functions. In turn, ambiguity increases the cost of contractually specifying performance benchmarks and mutually acceptable responses to contingencies if and when they occur (Crocker and Reynolds 1993).

FP contracts require *ex ante* consensus on contract terms, including the price, quality standards, delivery schedules, responses to uncertainty, and redistribution of surplus if circumstances change. Volatility increases the likelihood of unpredictable changes that would necessitate *ex post* renegotiation and adaptation costs. Volatility therefore lowers the desirability of FP contracts. Ambiguity reduces the ability of contracting parties to *ex ante* specify contract terms and commit to the distribution of outcomes for all potential future states, which reduces the likelihood of FP contracts. We also develop hypotheses that the fit between uncertainty and the

choice of contract will influence contract renegotiation. FP contracts are less suitable under conditions of volatility and ambiguity and are more likely to be renegotiated in such situations.

While TCE generates rich, testable propositions, data challenges stymie empirical testing; as a result, sparse archival tests exist of even the most fundamental tenets of TCE. We overcome this limitation by triangulating contract-level compensation data from large strategic outsourcing contracts with firm-level measures of volatility and ambiguity. We examine large projects that have the potential to make or break both parties. In our empirical setting, the relevant transaction involves acquiring a key strategic capability with substantial capital investments. While firms likely explore mergers and acquisitions (M&A) or equity-based alliances for such large projects, these types of organizational arrangements are not likely to be optimal under all situations. We examine projects that just fall short of equity-based alliances or complete vertical coordination through M&A. Due to the sheer size and strategic nature of these contracts, the uncertainty that is salient to the contracting environment encompasses the entire client organization rather than being narrowly limited to the transaction. While such contracts are important to the vendor, the strategic capability building is on behalf of the client, and therefore, implementation involves coordination with the client's existing resources. Further, unlike traditional outsourcing contracts, where vendors leverage scale economies to provide standardized business solutions at reduced costs of ownership, strategic outsourcing contracts are necessarily heterogeneous and idiosyncratic in their delivery. These contracts encompass a wide range of strategic purposes such as increased revenue, reduced time-to-market, or access to new capabilities, and they involve greater responsiveness to changing business needs. Indeed, in our sample of strategic outsourcing projects, the bulk of implementation occurs at the client's premises and involves creation of substantial relation-specific assets for the client. In this "cheek by jowl" implementation environment, the vendor's cost flows related to the project are closely linked with the client's business environment. Volatility and ambiguity in the client's environment, as reflected in performance measure

properties before the contract is finalized, spill over into the outsourced transaction to affect contract compensation.

Our empirical tests use data on 599 strategic outsourcing contracts implemented between 1995 and 2008. International Data Corp (https://www.idc.com/) collects data on these contracts from SEC filings and other public sources. We restrict our analysis to contracts valued above $15 million because several industry analysts use this threshold for classifying an outsourcing contract as "strategic." The value of an average contract in our sample is about 3.3 (3.8) percent of client total assets (revenue). To control for the possibly endogenous choice of compensation design, we use a two-stage Heckman regression model (Heckman 1979) that specifies the selection of compensation design in the first stage and incidence of renegotiation in the second stage. Vendor fixed effects address endogeneity concerns related to simultaneous choice of contract and vendor (Ackerberg and Botticini 2002). We use three different specifications of performance measure volatility and use factor analysis to construct an overall measure. Specifically, we use revenue-, earnings-, and equity-based measures of volatility, which are frequently used for contracting within the firm as well as by lenders and capital providers (Dechow 1994; Huang et al. 2013). We operationalize volatility using the standard deviations of revenue, net income, and market value of equity of the client for the three-year period as well as the five-year period preceding the implementation of the outsourcing contract. We use two specifications of performance measure ambiguity identified by the extant literature (Dierkens 1991; Krishnaswami and Subramaniam 1999). These include the correlation between market value of the client and its book income for the three- and five-year period preceding contract implementation, and volatility in abnormal returns surrounding earnings announcements. Our measures of volatility and ambiguity are neither extracted from the contracts, nor measured using the same time horizon as the contracts.

We control for important factors noted in the literature as drivers of contract form. These include prior association between contracting parties (Anderson and Sedatole 2003; Ring and Van

de Ven 1994), task complexity (Bajari and Tadelis 2001), firm size, prior financial and market performance, and book-to-market value. Results indicate that volatility and ambiguity are negatively associated with FP contracts, consistent with our theoretical predictions. We also find that volatility increases renegotiation to a greater extent in FP contracts, relative to CP contracts. Ambiguity measured using the correlation between market value of the client and its book income is also associated with renegotiation of FP contracts. This implies that the fit between the environment, as reflected in performance measure properties, and contract compensation type influences *ex post* renegotiation likelihood.

Our research contributes to the literature in the following ways. First, as Carson et al. (2006) note, the canonical literature in TCE emphasizes not only the importance of volatility (Williamson 1985) but also ambiguity on contract choice (e.g., Alchian & Demsetz 1972). The volatility issue has received considerable empirical attention, with almost a corresponding empirical "neglect" of ambiguity (Carson et al. 2006). We use archival data to measure volatility and ambiguity, which are two different manifestations of uncertainty. Separation of these two dimensions of uncertainty allows us to distinguish between the two critical but distinct types of transaction costs—*ex ante* contract design and *ex post* adaptation costs. Second, although there is consensus in the literature that uncertainty influences optimal contract design, obtaining a measurement of uncertainty *before* contract implementation is challenging. We provide evidence that accounting signals can provide information that assists contracting parties to obtain *ex ante* estimates of uncertainty. Thus, accounting signals not only influence intra-firm compensation design (Lambert 2001), but also inter-firm contract compensation design. Third, we examine the effect of uncertainty and contract compensation fit on renegotiation of contracts and demonstrate that FP contracts in the presence of uncertainty and ambiguity are associated with greater *ex post* renegotiation. Fourth, we add to the literature that seeks to explain why in practice, a majority of inter-firm contracts are CP or FP rather than spanning a menu of contracts as predicted by

conventional contract theory. Finally, we demonstrate that in strategic contracts the uncertainty that is salient to the contracting environment encompasses the entire client organization rather than being narrowly limited to the transaction in hand, with the primary driver being contractual incompleteness, namely, the factors that are *not* in the contract.

2. Theory and hypotheses

TCE posits that the problems of economic organizations are essentially contracting problems. Solutions to these problems are functions of the type of transaction costs incurred by contracting firms. Williamson (1985) recognizes two major types of transaction costs: the *ex ante* costs of "drafting, negotiating, and safeguarding an agreement," and the *ex post* costs of maladaptation, haggling, dispute resolution, and securing commitments. An extensive body of literature uses TCE to examine the efficacy of control systems to mitigate losses from *ex post* opportunism in inter-firm contracts.[1] The premise, supported by evidence, is that organizations tailor governance and control systems to specific sources of inter-firm transaction hazards (Anderson and Dekker 2005; Williamson 1979). Contract compensation is an important form of control system. The literature uses the term "contractual completeness" to refer to the degree to which contractual compensation covers all potential contingencies that can arise and agreed forms of surplus redistribution (Crocker and Reynolds 1993; Bajari and Tadelis 2001). While in theory there exists a menu of inter-firm compensation contracts with varying degrees of completion, in practice most inter-firm contracts fall into two broad compensation categories: CP and FP (Bajari and Tadelis 2001; Chiappori and Salanié 2000; Gagnepain et al. 2013; Gopal and Sivaramakrishnan 2008; Rogerson

[1] These controls include incentive systems (Baiman and Rajan 2002a, b; Dekker 2004), trust-based controls (Dekker 2004; Coletti et al. 2005), management control systems (Anderson and Dekker 2005, 2010; Dekker 2004; Malhotra and Lumineau 2011), collaboration (Krishnan et al. 2011), contract extensiveness (Anderson and Dekker 2005), market controls, hierarchies, and bureaucracies (van der Meer-Kooistra and Vosselman 2000; Speklé 2001; Hakansson and Lind 2004), and collaborative contracting (Das and Teng 2001; Langfield-Smith 2008). See Anderson and Sedatole (2003), Cagilio and Ditillo (2008), and Cao and Lumineau (2015) for reviews of the literature on controls in inter-firm settings.

2003). In a costless contracting world, clients would restrict to FP contracts because, unlike CP contracts, they transfer all the risk of cost overruns to the vendor and minimize vendor moral hazard problems. However if *ex post* modifications are required that are not already priced into the FP contract, the vendor may insist on renegotiation.[2] At the renegotiation stage, the vendor frequently has private information about the cost of modification and can misrepresent this information to dissipate the client's gains from trade (Bajari and Tadelis 2001). For this reason and to reduce cost-quality trade-offs intrinsic to high-powered incentives, FP contracts are relatively more complete in that they clearly delineate the project scope and roles and responsibilities of contracting parties. Thus, FP contracts are more expensive, from both *ex ante* contract design and *ex post* adaptation perspectives.[3]

Although *ex ante* and *ex post* transaction costs are two separate constructs, archival literature has aggregated these costs under a single umbrella, and the focus has been on the general notion of the drivers of adaptation costs. However, TCE posits that contracting costs arise not only from the inability of the contracting parties to write an exhaustive contract *identifying* contingencies, but also because of their failure to reach consensus on the *responses* to these contingencies. In the next section, we make a distinction between the drivers of *ex post* adaptation costs versus the drivers of *ex ante* contracting costs and their effects on contractual compensation. *Ex post* adaption costs and *ex ante* contracting costs arise from different aspects of environmental uncertainty. *Ex post* adaptation costs are driven by volatility, that is the number of potential states of nature that can

[2] Renegotiation can facilitate monitoring by the client in a debt-contracting setting. For example, a study by Nikolaev (2016) examines debt contract renegotiation and the creditor demand for monitoring in an incomplete contracting setting. It posits that when agency conflicts and information problems are high, frequent renegotiations are likely to benefit creditors. Nikolaev (2016, page 3) posits that renegotiation is a tool used by creditors to "monitor and discipline the management *ex post*."

[3] Repeated interactions can influence the use of FP contracts. For example, Corts and Singh (2004) find that in the offshore drilling industry, repeated interaction reduces incentive problems more than it does contracting costs; as a result, in this specific industry, companies are less likely to choose a FP contract when the frequency of their interaction with a driller increases.

arise during contract implementation and would warrant renegotiation. *Ex ante* adaption costs are driven by ambiguity, that is the inability of contracting parties to agree on the probability distribution of the potential states of nature.

Ex post contracting costs and contract type

In large outsourcing projects, there are inevitable circumstances that cause unanticipated variations in cost flows. Whether or not these circumstances warrant contract renegotiation is an assessment that contracting parties have to make. In an FP contract, the vendor's revenue is fixed but costs are uncertain. Unanticipated cost variability reduces the vendor's profit and increases the likelihood of costly renegotiation of project scope or contract price. An example of uncertainty that required major *ex post* changes to the product or service design is that after the 9/11 attacks, the FAA introduced new standards for cockpit doors, such as hardened doors and locking mechanisms. Airline companies' contracts with door manufacturers had to be renegotiated to reflect the design change warranted by the change in regulation. TCE models use a *state* variable to capture volatility arising from business cycles, changes in technology, and regulation.

Drawing on the model from Bajari and Tadelis (2001), suppose T is the number of states of nature that can occur *ex post*, $\pi_t > 0$ is the probability that state $t \in \{1, ...T\}$ occurs, $k > 0$ is the cost of specifying a state of nature, and project design occurs for each state sequentially. The probability that a project is completely specified is $\tau \in [0, 1]$. Intuitively, because of the *apriori* need to specify actions to correspond to various states of nature without renegotiation, τ is higher for FP contracts. The cost of specifying a project for S states is $d(\tau, T)$. Two conclusions emerge from TCE. First, for any given project, the more specified the project in terms of incorporating *ex post* contingencies, the higher is the contract design cost. The practical implication is that FP contracts are more expensive to design than CP contracts, and the relative costliness of FP contracts is increasing in the number of states. Second, the greater the number of states of nature T, larger the number of realized states where renegotiation of the contract could become necessary.

The empirical implication of this logic is that higher the volatility, larger the number of states of nature *T* where *ex post* renegotiation could be required. During renegotiation the client could foresee the gains from trade being dissipated by the vendor's *ex post* opportunism (Crocker and Reynolds 1993). Therefore, under conditions of higher volatility, the client will sacrifice the powerful incentive properties of an FP contract for a more flexible CP contract.

In our setting of strategic contracts, the volatility that is decision relevant is in the client's environment because it critically influences the vendor's returns from a FP project. Consider the following example. British Petroleum (BP, the client) has outsourced many of its finance and accounting (F&A) services to Accenture (the vendor) since the 1990s. By 2007, Accenture was managing BP's systems and data management, financial accounting and reporting, budgeting, accounts payable, capital budgeting, and fixed asset management. To manage the contract with BP, Accenture has over 760 employees across numerous geographic centers such as Aberdeen, Houston, Bangalore, and Shanghai. Notwithstanding the complexity of the outsourced tasks, *ex post* variability in BP's accounting performance arising from factors such as changes in the risk profile of its customers or changes in regulations that influence business processes (such as environmental regulations) also influence variability in Accenture's returns from the BP deal, if the contract were FP. The higher the variability, the higher the cost risk for Accenture and the greater the likelihood of renegotiation of an FP contract. FP contracts are akin to pure variable pay contracts where compensation is completely driven by the outcome. Just as a manager's unwillingness to accept a pure variable pay contract as well the total cost of a pure variable pay contract increases in the noise of the performance measures used in the contract (Banker and Datar 1989; Feltham and Xie 1994), a vendor would be unwilling to accept an FP contract when there is high volatility in the client's operating environment. Overall, both the client and the vendor would be less likely to prefer a FP contract when the volatility in the client's environment, as assessed at the time of contract design, is high.

HYPOTHESIS 1: *Client environment volatility is negatively associated with the likelihood of FP contracts.*

Ex ante contracting costs and contract type

In strategic contracts, the vendor's cost flows are highly dependent on the client's operating environment, and volatility can adversely affect the vendor's profit from an FP contract. Even when volatility is high, it is possible for contracting parties to use an FP contract if they can assign subjective probabilities to the relevant future events using expected utility (Savage 1954) or some other form of probabilistic sophistication (Machina and Schmeidler 1992). However, in some cases, expected utility or probabilistic sophistication methods simply cannot be applied (Abdellaoui et al. 2011). These situations are typically referred to as "ambiguous" and distinguished from other forms of uncertainty such as volatility. Ellsberg (1961, 657) defines ambiguity as a function of "the amount, type, reliability, and 'unanimity' of information giving rise to one's degree of 'confidence' in an estimate of relative likelihoods." Literature has operationalized the difference between volatility and ambiguity as the difference between decision makers' beliefs for known probabilities versus for unknown probabilities (Abdellaoui et al. 2011). In an ambiguous situation, decision makers will be unable to converge to a probability distribution and instead can only identify a set of plausible beliefs. In the context of the Bajari and Tadelis (2001) model, in an ambiguous situation, decision makers may be able to agree on the number of states of nature that can occur *ex post (T*), but they will be unable to agree on π_t, which is the probability that a particular state $t \in \{1, ...T\}$ will occur.

In the presence of ambiguity, differences of opinion are likely among contracting parties about the effect of changes in the environment on the project, and the appropriate actions that the client and the vendor should take to avoid value dissipation. Ambiguity drives: (1) information asymmetry between the firm and the market about firm value, (2) disagreement among market participants about the importance of environmental variables for future performance, and (3)

equivocality about cause-effect relationships between variables, courses of action, and their potential effects (Daft and Macintosh 1981; Krishnan et al. 2016). When ambiguity is particularly severe, contracting parties may be unable to commit to contractual terms, which are critical to FP contracts. A risk in FP contracts is that the vendor may decide to cut costs by compromising on quality. Therefore, FP contracts need stringent performance benchmarks, especially for quality and delivery. When there is ambiguity about cause and effect, sustainable value indicators, and performance drivers, contracting parties may not be able agree on these benchmarks. Instead, it may be more optimal for the firms to negotiate targets as and when events unfold and parties obtain more information. Thus, when there is higher ambiguity in the client's operating environment, *ex ante* contracting costs are higher. The client has to sacrifice the superior incentive properties of FP contracts in favor of the relatively more incomplete CP contracts, leading to the following hypothesis.

HYPOTHESIS 2: *Client environment ambiguity is negatively associated with the likelihood of FP contracts.*

Contract fit and renegotiation

The previous discussions emphasize the importance of the fit between the characteristics of the contracting environment and contractual compensation. We next examine the implications of a lack of fit between the contract type and environmental characteristics on the likelihood of *ex post* renegotiation. Considerable analytical research has examined how contracts are renegotiated over time. However, as Gagnepain et al. (2013) note, the empirical literature on contract renegotiation is lagging in both volume and scope. In volatile and ambiguous environments, contracting parties are unlikely to successfully identify all the contingencies that could potentially arise or agree on satisfactory redistribution of surplus when unexpected contingencies arise. Contract renegotiation occurs under two major conditions. The first condition is when a contingency that is not specifically covered by the contract arises. The second condition is when parties are unable to

agree on how the existing contract document can be modified so that contract performance can continue as planned. For the vendor, renegotiation could reduce unanticipated losses. Additionally, it offers an opportunity to capitalize any information advantage that the vendor obtained during the process of implementation. For the client, renegotiation could be the only mechanism to safeguard project continuation. Further, it could spur additional vendor efforts to reduce costs such that efficiency gains from renegotiation exceed transaction costs including vendor hold-up rents.

Renegotiation can occur in CP as well as FP contracts. In a CP contract, renegotiation occurs when task adaptations are so severe that the transaction is no longer recognizable based on the current contract. From a legal perspective, courts have to be able to ascertain that the parties are implementing the transaction at issue, rather than one that is outside the realm of that transaction (Schwartz and Watson 2004). CP contracts can also be renegotiated if the client believes that the vendor has been recklessly cost ineffective and can prove such recklessness in court. Similar reasons prompt renegotiation in FP contracts, except that smaller adaptations can lead to FP renegotiation. FP contracts can include a price adjustment mechanism whereby prices can adjust to verifiable future states (such as inflation or consumer price index). However, the fixed price cannot be set such that it adjusts to unverifiable states, or to any fluctuations in the vendor's cost realizations (Crocker and Reynolds 1993). The underlying logic is that parties have reached *ex ante* agreement about the distribution of future costs and have incorporated this distribution into the contract price. *Ex post* adjustments based on parameters that are highly variable or costly to measure are problematic in FP contracts, because by definition these contracts are inflexible and not designed to be adaptable. For example, Townsend (1979) shows that when it is excessively costly to verify a firm's profit, the firm will not incorporate profit-based variables in the contract. In situations of ambiguity and volatility, FP contracts are unlikely to effectively identify potential responses to unforeseen conditions in a manner that is satisfactory to both parties

(Carson et al. 2006). We posit that in volatile and ambiguous environments, FP contracts are associated with higher renegotiation.

HYPOTHESIS 3A: *Under conditions of volatility, FP contracts are positively associated with renegotiation*.

HYPOTHESIS 3B: *Under conditions of ambiguity, FP contracts are positively associated with renegotiation.*

Task complexity, trust, and contract type

The empirical tests control for the effects of task complexity and trust. It is well recognized in the contracting literature that task complexity introduces contracting problems and increases contract incompleteness. In complex tasks, there is a higher risk of departures from planned courses of action, with attendant adverse consequences on the vendor's cash flows. Prior research suggests that incentives are muted when tasks are complex (Prendergast 1999); therefore complex tasks are more likely to be kept in-house and monitored using control mechanisms such as input monitoring (Bai et al. 2010). Given that task complexity increases the likelihood of *ex post* design changes and incompleteness of project design at the time of contract negotiation, task complexity reduces the likelihood of an FP contract. Another factor that influences contract form is trust (Gulati 1995; Ring and Van de Ven 1994), which serves as an informal or social control system (Dekker 2004), and a "self-enforcing safeguard" (Dyer 1996; Dyer and Singh, 1998). Crocker and Reynolds (1993) argue that trust reduces the likelihood of provider opportunism, encouraging the adoption of less complete CP contracts. We draw on previous literature to construct the variables related to task complexity and trust. The following section discusses the data, variables, and methods.

3. Empirical Analysis

Data and measures

The analyses use data on 599 outsourcing initiatives implemented between 1995 and 2008. Given our emphasis on aggregate financial and market performance measures, we include only large, strategic contracts that are financially material and whose financial impact is more likely to be

detected and valued by the market. Consistent with prior outsourcing research (Bloch et al. 2011; Nagpal et al. 2014), we use the threshold value of $15 million to define outsourcing activity as strategic and consequently include in the analyses. Our focus on large outsourcing contracts also reduces the probability of confounding events; clients are less likely to engage in other important strategic initiatives or sign large contracts immediately prior to the outsourcing initiative. We end the sample in 2008 to allow for the contracts in our sample to be completed. Live contracts would confound the analysis if contract renegotiation occurred outside the sample time frame.

Our data set draws on multiple sources. Information on the outsourcing initiatives and their governing contracts is obtained from International Data Corporation's (IDC) proprietary services contracts database. IDC tracks outsourcing contracts implemented by firms worldwide through a variety of public sources, including but not limited to SEC filings, media releases, analyst reports, and industry reports. They capture the first public announcement of the event under the announcement date and the contract start date as the signing date. Where relevant contract information (price, length, etc.) is not available, IDC records the parameter as missing. Our sample comprises firms without missing data on announcement and signing dates. In the Appendix, we detail a sample outsourcing contract between General Motors Corporation (client) and EDS (vendor). In this contract, General Motors entrusted EDS with a variety of services, including (i) infrastructure (mainframe, super-computing, midrange and distributed computing hardware and software, voice, data and video communications services and networks, end-user hardware, and replacement), (ii) IT services (participating in planning infrastructure, development, implementation and maintenance, infrastructure integration, monitoring), (iii) applications software for business planning, financial, human resource management, sales, service marketing, engineering, purchasing, product control and logistics, production/manufacturing, materials management and legal, (iv) helpdesk support, (v) timesharing services, (v) data management, and (vi) disaster recovery and business continuity. The filing identifies the contract as variable price

(i.e., CP). We use Lexis-Nexis and the Dow Jones News Retrieval Service to verify and supplement IDC information on announcement and signing dates, Center for Research on Security Prices (CRSP) files to compute abnormal stock returns, and Compustat files to help assess firm characteristics and estimate measures of operating performance.

The final sample satisfies two requirements. First, the client is publicly traded on a major US stock exchange. Second, information on the contract and attributes of the outsourced task and relational environment are available. Data for all the variables are available for 481 observations, for tests of hypotheses 1 and 2.[4] Due to missing observations for some of the variables in the renegotiated contracts, our sample size for the test of hypothesis 3 is 324 observations. The average lifetime contract value in our sample is $356 million. A comparison with Gartner's analysis, which pegs the average annual value of an outsourcing contract as $189 million as of 2008,[5] emphasizes the strategic import of our sample contracts. The aggregate contract value of $212 billion represents nearly 49 percent of the total outsourcing contracts engaged by corporations during the sample period. The average contract in our sample represents 3.3 percent of total assets and 3.8 percent of revenue of the client.

Variables

Compensation type

The dependent variable, *CONTRACT*, takes the value of one (zero) if the contract is FP (CP). FP contracts stipulate a payment amount, and in many cases a disbursement schedule for specific services. CP contracts pay the vendor based on actual cost of providing the deliverables.

Renegotiation

[4] The variable that contributes most to the missing observations is *EARN_RET_VOL*.
[5] Gartner on Outsourcing, 2008–2009 (G00164206).

The dependent variable, *RENEG*, takes the value of one (zero) for the year the contract was renegotiated during the contract life cycle.

Volatility

We operationalize volatility as variability in (a) revenue (*VOL_ SALES*), (b) net income (*VOL_ EARNINGS*), and (c) market value of the client (*VOL_MVE*), for the three-year period preceding contract implementation. These three measures capture variability in important dimensions of performance, including growth, profitability, and firm value, which, in turn, affect project cost flows. We estimate volatility as the three-year rolling standard deviation of the pertinent performance measure (Comin and Philippon 2006). Specifically, for each of the three performance measures, we estimate for each firm *i* in year *t*, the standard deviation in performance,

$$\sigma_{i,t} = \frac{1}{3} \sum_{\tau=-3}^{-1} \left(\gamma_{t+\tau,i} - \bar{\gamma}_{t,i}\right)^{2^{1/2}} \quad (1)$$

where $\bar{\gamma}_{t,i}$ is the mean performance measure of firm *i* between years *t*-3 and *t*-1. For robustness, we also estimate a five-year rolling standard deviation of each of the three performance measures.

Ambiguity

In our theory, ambiguity gives rise to differences of opinion among contracting parties about the potential states of the environment, and the appropriate contractual actions required. We use two measures of ambiguity in our analyses. Our first measure, *CORR_NI_MV*, captures the *ex ante* correlation between market value of the client and its profitability for the three-year period preceding the implementation of the outsourcing contract. Higher correlation implies that there is agreement in the market that accounting performance measures reflect firm value. A high *CORR_NI_MV* thereby implies lower ambiguity because there is greater agreement that accounting measures provide information to investors to assess the probability distribution of future returns. Similar to the volatility estimations, we conduct robustness checks using a five-year window for this measure of ambiguity.

Our second measure of ambiguity, *EARN_RET_VOL*, measures the volatility in abnormal returns around earnings announcements (Dierkens 1991; Krishnaswami and Subramaniam 1999). Specifically, this variable is measured as the standard deviation of the three-day abnormal returns around the announcement of quarterly earnings, across all the quarterly earnings announcements of the client for the five years preceding the announcement of the outsourcing contract. The dates for quarterly earnings announcements are obtained from Compustat. Market-adjusted abnormal returns around the announcement dates are estimated using the CRSP value-weighted index. As in Dierkens (1991) and Krishnaswami and Subramaniam (1999), the standard deviation of the abnormal returns around these earnings announcements reflects the dispersion in the market reaction about the information content of earnings. Higher *EARN_RET_VOL* implies that market participants differ in their perceptions of the meaningfulness of the earnings signal for future cash flows. This arises from a divergence of beliefs among market participants about the extent of uncertainty as well as the impact of uncertainty on firm performance. Thus, *EARN_RET_VOL* reflects lack of consensus about the environmental state and is a proxy for ambiguity.

Trust

Prior research underscores the important role of trust in regulating opportunistic behavior in inter-firm contracts (Zaheer et al. 1998; Poppo and Zenger 2002). Research posts that trust is built incrementally through prior interactions between contracting parties in similar exchanges (Gulati 1995; Poppo et al. 2008). We use existence of a prior contracting relationship between the contracting parties as a proxy for trust. *NEW_DUM* indicates whether the contract is new, as opposed to an extension of a previous contract. A new contract implies that trust is unlikely to have developed within the specific transaction being studied.

Task complexity

Three variables capture task complexity. The first, total contract value (*TCV*), is a measure of contract value scaled by the revenue of the client. Prior research has found that total contract value

is positively associated with task complexity (Masten and Saussier 2002). The second, *NUM_SEG*, is the number of different segments that the outsourcing engagement comprises—for instance, a business process outsourcing deal may include billing services and customer care in which case the number of service segments is two. Similarly, a support engagement may contain hardware as well as software deployment and support, in which case the number of engagements is again recorded as two. The greater the number of service segments, the greater the task complexity. The last measure, *TASK_TYPE*, reflects the complexity of the outsourced task based on its type. Tasks are ordered along a continuum of complexity, with support and training as the lowest level of complexity and business process outsourcing as the highest level.

Control variables

We include prior experience in managing alliances (*EXP_ALLIANCES*) to control for the depth of the client's experiences in managing inter-firm relationships. We also use size (*SIZE*), prior financial performance (*PRIOR_FIN_PERF*), prior market performance (*PRIOR_MKT_PERF*), and book-to-market ratio (*BTM*) of the client in the analyses to control for various firm-level risks that may influence contract choice. A detailed description of the operationalization of these variables and their sources is provided in Table 1.

- Insert Table 1 here-

Methodology

Test of hypotheses

Hypothesis 1 (2) predicts that client environment volatility (ambiguity) is negatively associated with the likelihood of FP contracts. To test these hypotheses, we regress contract compensation type on volatility and ambiguity, as reflected in performance measure properties of the client, and other control variables. Hypothesis 3a (b) predicts that under conditions of volatility (ambiguity), FP contracts are positively associated with renegotiation. To test Hypotheses 3a and 3b, we regress renegotiation occurrence on volatility and ambiguity and their interaction with

compensation type. The vendor's decision to renegotiate a contract with a client could be endogeneous to the type of contract. Therefore, it is important to correct for unobserved heterogeneity that simultaneously impacts self-selection of compensation type and ensuing renegotiation. It is also important to correct for bias that may be induced by endogenous matching of suppliers to the outsourcing projects. We address these endogeneity concerns in two ways. First, we estimate selection of compensation type as a function of client attributes, including performance measure properties, outsourced task characteristics, and relationship attributes as specified in Equation 2 below:

$$P(Y_{ic} = 1) = \Phi(\beta' X_{ic}) \qquad (2)$$

Y_{ic} represents the choice of compensation type (fixed price/ cost plus) by client *i* for contract c, X_{ic} is a vector of performance measure properties, other client attributes, and task and relationship characteristics that determine compensation type for contract c, β is a vector of estimated coefficients for these characteristics, and $\Phi(\cdot)$ is the standard normal CDF. We include industry-adjusted financial and market performance of the client as exclusion criteria in this model. Indeed, we expect that firms with superior performance relative to their peers are better situated to absorb risks associated with outsourcing of more strategic and complex tasks. The latter are also more likely to be governed by CP contracts. We use lagged regressors in our model since our hypotheses pertain to the impact of *ex ante* performance measures on choice of CP or FP contracts. That is, volatility and ambiguity are estimated for the period previous to the contracting date. The hypothesized impact of performance measure volatility and ambiguity on compensation form is provided by the vector $\boldsymbol{\beta}$ of estimated coefficients for these attributes. The selection model in Equation 2 is also used to compute the inverse mills ratio, the correction factor for endogenous selection of compensation form, which we include in a second-stage model of renegotiation.

Second, to correct for simultaneous selection of compensation type and vendor, we include vendor fixed effects in all our models (Ackerberg and Botticini 2002). The underlying assumption

is that unobserved vendor characteristics that are correlated with the drivers of compensation type are invariant across contracts implemented over time. Our analyses also control for industry fixed effects. In the second stage, we estimate the likelihood of renegotiation as a function of compensation choice and its interaction with volatility and ambiguity. Specifically, we estimate:

$$RENEG_{ic} = \beta_0 CONTRACT_{ic} + \beta_1 UNCER_{ic} + \beta_2 (UNCER_{ic} \times COMP_{ic}) + \beta_3 Z_{ic} + \gamma_j \lambda_{ic} + \varepsilon_{ic}, \quad (3)$$

where $RENEG_{ic}$ estimates whether contract c for client i was renegotiated, $CONTRACT_{ic}$ refers to the choice of compensation (Fixed Price/Cost Plus) for outsourcing contract c, $UNCER_{ic}$ estimates the uncertainty (volatility and ambiguity) in the client's environment prior to implementation of contract c, Z_{ic} is a vector of task, relationship and client attributes that characterize contract c, and λ_{ic} is the inverse Mills ratio or correction factor for self-selection of compensation type. The estimation controls for industry and vendor fixed effects.

Multiple outsourcing announcements by firms in our data may give rise to correlated errors. We use a two-way clustered logistic specification to account for these correlations. Petersen (2009) finds that in the presence of both an unobserved firm effect (time-series dependence) and an unobserved time effect (cross-sectional dependence), two-way clustering on firm and time produces standard errors with the least bias. Therefore, in all our analyses, we report pooled regressions with two-way clustered standard errors.

4. Results

Table 2 reports the pooled mean, median, standard deviation, 25th and 75th percentile values for volatility and ambiguity, existing contractual controls, and task complexity across FP and CP contracts. These summary statistics, which point to greater volatility and ambiguity being associated with CP contracts, provide preliminary support for Hypotheses 1 and 2. Consistent with TCE, we also find a significant difference in most measures of task complexity between FP and CP contracts. The value of the average FP contract is nearly 3 percent of operating expenses, while that of the average CP contract is nearly 6 percent. The average number of service lines or

segments underlying the task in FP contracts is 1.71, while the equivalent number in CP contracts is 2.01. The difference in task type, however, is insignificant between the two contract types.

- Insert Table 2 here -

Table 3 reports the pairwise correlations between the variables used in our analysis. The correlations among most of the independent variables are low, suggesting that multicollinearity is not a significant concern. Given the significant correlations between the indicators of volatility, we create a factor score for this construct. Specifically, we conceptualize volatility as a first-order construct comprising sales volatility, earnings volatility, and market value volatility. Composite z-scores were created for the three indicators to facilitate combining and comparing different units of measurement. Factor analysis of the three indicators yielded one factor that was highly explanatory of the data. We use the output matrix of factor score weights to calculate a weighted average score for three-year volatility. We obtain a similar factor score for five-year volatility.[6] The indicators of ambiguity—the *ex ante* correlation between profitability and market value of the firm and volatility in abnormal returns around earnings announcements—on the other hand, did not load on to a single factor; therefore, we included both these measures as such in our analyses.

- Insert Table 3 here-

Table 4 presents cross-tabulations of raw data showing the relation between the likelihood of choice of FP contracts and the key independent variables—*ex ante* volatility (defined as the volatility factor), *ex ante* correlation between profitability and market value, and *ex ante* volatility in abnormal returns around earnings announcements. The second and third columns report the likelihood of choice of an FP contract for firms in the lowest and highest triad of firms respectively, for each of the independent variables. On average, the choice of an FP contract is 16

[6] The volatility factor using a three-year (five-year) window has an eigenvalue of 2.07 (2.01) and explains 65.24 percent (66.15%) of the combined variance.

percent less likely in the highest triad of three-year volatility relative to the lowest triad and 14 percent less likely in the highest triad of five-year volatility. The results support Hypothesis 1 and indicate that volatility is negatively associated with choice of FP contracts. The results also indicate that FP contracts are 8 percent more likely for the highest triad of three-year correlation between profitability and market value, 15 percent more likely for the highest triad of five-year correlation between profitability and market value, and 15 percent more likely for the lowest triad of volatility in abnormal returns around quarterly earnings announcements. These results are consistent with Hypothesis 2 - ambiguity is negatively associated with choice of FP contracts.

- Insert Table 4 here-

The results for the logistic specification of contract choice are presented in Table 5. Model 1 (Model 2) tests the association between compensation type and three-year (five-year) volatility, three-year (five-year) correlation between profitability and market value, and volatility in abnormal returns around earnings announcements. All models control for task complexity, trust, firm controls, vendor and industry fixed effects, and cluster standard errors by firm and year of implementation of the outsourcing contract. To test for linear dependencies across the independent variables, we ran collinearity diagnostics for each equation. The VIF statistics suggest that the results are not impacted by multicollinearity. All three models have significant (p<0.01) chi-square values, log-likelihood ratios, and pseudo R-squares.

- Insert Table 5 here-

The results for the logistic specification of renegotiation are presented in Table 6. Again, Model 1 (Model 2) tests the association between incidence of renegotiation and compensation type conditional on three-year (five-year) volatility, three-year (five-year) correlation between profitability and market value, and volatility in abnormal returns around earnings announcements. Both models control for task complexity and firm controls. However, because of the correlation between renegotiation incidence and trust, the latter variable was omitted from the analyses. The

Inverse Mill's Ratio is insignificant in the regressions, suggesting that the results are not significantly impacted by endogeneity of contract choice. The results are not impacted by multicollinearity either, and both models have significant (p<0.01) chi-square values, log-likelihood ratios, and pseudo R-squares. Standard errors in both models are clustered by firm and year of implementation of the outsourcing contract.

- Insert Table 6 here-

Tests of hypotheses

Hypothesis 1 predicts that volatility is negatively associated with the likelihood of FP contracts. In Table 5, we find that the coefficient of the volatility factor is negative and significant at conventional levels. These results are robust to extending the time period over which the volatility measures are estimated from three to five years (Models 1 and 2). On average, one standard deviation increase in volatility reduces the odds of implementing an FP contract by 73 percent for the three-year specification (Model 1) and 57 percent for the five-year specification (Model 2). Consistent with Hypothesis 1, these results indicate that the greater the performance measure volatility, the lower is the likelihood of choice of FP contracts.

Hypothesis 2 examines the association between ambiguity and likelihood of choice of FP contracts. In both models, correlation between profitability and market value (*CORR_NI_MV*) has a positive coefficient and volatility in abnormal returns around earnings announcements (*EARN_RET_VOL*) has a negative coefficient, indicating that higher performance measure ambiguity is associated with lower likelihood of choice of an FP contract. These results are again robust to a three-year (Model 1) and five-year (Model 2) estimation of *CORR_NI_MV*. On average, a one-standard-deviation increase in *CORR_NI_MV* increases the odds of observing an FP contract by 44 percent (three-year) or 36 percent (five-year). Similarly, a one-standard-deviation increase in *EARN_RET_VOL* decreases the odds of observing an FP contract by 48 percent (three-year) or 46 percent (five-year). Together, these results emphasize that higher

ambiguity in the client's performance measures reduces the ability of contracting parties to reach the *ex ante* agreement required for an FP contract. These results are consistent with Hypothesis 2, which predicts that ambiguity is negatively associated with FP contracts. Table 5 also reveals that task complexity (measured as *TCV* and *TASK_TYPE*) is negatively associated with FP contracts in both models. Complex tasks have a less complete specification and a greater likelihood that adaptations will be required, which increases the likelihood of CP (Bajari and Tadelis 2001).

Hypothesis 3a (b) predicts that under conditions of volatility (ambiguity), FP contracts are positively associated with renegotiation.[7] The results in Table 6 indicate that the coefficient of the interaction between compensation type and the volatility factor (*FP CONTRACT x VOL_FACTOR*) is positive and significant. This result is robust to extending the time period over which the volatility measures are estimated from three to five years (Models 1 and 2), and indicates support for Hypothesis 3a. On average, a one-standard-deviation increase in volatility increases the odds of renegotiating of an FP contract by a factor of six. The results for ambiguity are mixed. We find that the coefficient of the interaction between compensation type and three-year correlation between profitability and market value (*FP CONTRACT x CORR_NI_MV*) is negative and significant. A one-standard-deviation increase in *CORR_NI_MV* decreases the odds of renegotiating of an FP contract by 64 percent. These results are consistent with H3b and indicate that under conditions of ambiguity, FP contracts are more likely to be renegotiated. However, these results are not robust to a five-year estimation. Additionally, the coefficient for interaction between contract compensation type and returns volatility is insignificant. In sum, the results for H3b are mixed. There is some support that under conditions of ambiguity, if parties sub-optimally choose an FP contract, they are subject to a greater likelihood of renegotiation.

[7] The sample size for analysis of renegotiations in Table 6 is smaller due to missing observations.

However, these results are sensitive to the measurement of ambiguity (market value versus returns volatility) and the horizon over which the measurement occurs.

Robustness of results

In addition to endogeneity, we test the robustness of our results to various alternate measures and empirical specifications that we do not report in the interest of parsimony. For example, our results hold for a range of thresholds of contract value ranging from $15 million to $150 million. They also hold for robust standard errors and standard errors clustered by client firm alone. Our results are also robust to the inclusion of year fixed effects.

Our results are also robust to the use of alternate measures. Specifically, we test and find that our results for compensation form and renegotiation are robust to another well-established measure of ambiguity in the literature - *standard deviation of analyst forecasts*. The latter is measured as the standard deviation of all earnings forecasts made by analysts in the last month of the fiscal year preceding the implementation of the outsourcing contract. This variable represents the dispersion or disagreement among analysts about a consensus estimate of the earning forecast.

5. Discussion and conclusion

Inter-firm contracting is plagued with moral hazard costs arising from vendor shirking, the *ex ante* transaction costs of designing contracts, and *ex-post* transaction costs of contract adaptation. Although FP contracts offer the most powerful incentives for vendor effort, they are more expensive to design and can suffer from inefficiency because if renegotiation is required, the vendor can hold up the client and extract rent. *Ex ante* transaction costs of designing contracts, and *ex-post* transaction costs of contract adaptation are a function of environmental uncertainty that manifests in the future after the contract has been signed. Contracting parties have to assess environmental uncertainty and agree on courses of action corresponding to each potential scenario before the contract has been signed. We partition environmental uncertainty into two different aspects—volatility and ambiguity. Volatility influences contract incompleteness by increasing the

likelihood of *ex post* adaptation costs, while ambiguity increases contract design costs by reducing the ability of contracting parties to reach *ex ante* consensus on contract terms.

Our conceptualization of the two uncertainty types is from Williamson (1985), who posits that volatility increases the difficulty of anticipating possible future contingencies at the time of the contract design and therefore increases the likelihood of *ex post* adaptation cost. Ambiguity arises from disagreement about the extent and importance of environmental variables for future performance, and equivocality about cause-effect relationships between variables, courses of action, and their potential effects (Daft and Macintosh 1981; Krishnan et al. 2016). Firms can have different responses to the same event arising from their perceptions about the event. In the presence of volatility and ambiguity, contracting parties would prefer flexible contracts (such as CP contracts) that can be adapted as conditions change and as additional information is obtained. We also posit that use of FP contracts in conditions of volatility and ambiguity leads to a lack of fit between the contract and the environment, resulting in higher renegotiation. We use publicly available data on large contracts and find support for our hypotheses.

Our results have implications for the design of accounting systems. Previous research has explored the role of environmental uncertainty on performance measure quality and implications for managerial compensation contracting (Banker and Datar 1989; Feltham and Xie 1994). At the same time, the design of the accounting system can itself influence volatility and ambiguity. Examples include, inappropriate allocation of overhead costs (e.g., using volume-based cost drivers instead of refined drivers that have a cause-effect relationship with the cost pool), improper pooling of heterogeneous costs, failure to recognize cost asymmetry, and misallocation of excess capacity costs. When firms focus primarily on the absorption of costs with the goal of accurately reporting aggregate costs, they fail to separate the impact of important exogenous macroeconomic factors that affect their costs from the endogenous factors that arise from managerial decisions. This leads to hidden costs (Joshi et al. 2001) and other errors in identifying important cost drivers

such as capacity and volume (Balakrishnan and Sivaramakrishnan 2002; Brüggen et al. 2011). If accounting measures accurately reflect the true economic performance of the firm, then the only cause of volatility in performance measures would be uncontrollability driven by environmental uncertainty. However, poorly designed accounting systems can contribute to volatility in performance measures. When volatility is caused by the accounting system and is observed by a contracting party (such as vendors), it could be incorrectly interpreted as environmental uncertainty. This causes contracting frictions and vendors' reluctance to agree to FP contracts, even in situations where the FP contract is economically optimal.

Ambiguity in accounting measures can be driven by bias, i.e., intentional misrepresentation of accounting performance measures through budgetary slack, earnings management, and fraud. Considerable research finds evidence that firms manage their earnings through income increasing accruals (e.g., Healy 1985) or income decreasing accruals (e.g., Holthausen et al. 1995) to maximize managerial incentive compensation (Sloan 1993). Studies have also found evidence of budget biasing and gaming (see Covaleski et al. 2003 and Luft and Shields 2009 for reviews). Biased performance measures, which arise when managers make decisions that improve the performance measure but not firm value (Abernethy et al. 2013), contribute to ambiguity with attendant implications for inter-firm contracting. Our results indicate that poor quality accounting systems impact inter-firm contracting and could lead to sub-optimal contracting outcomes.

Volatility and ambiguity could influence another important contractual control mechanism, which is contract duration. A large body of literature has emphasized the importance of contract duration in the presence of contractual hazards. One of the early studies in this area was Joskow (1987), who finds that asset specificity is positively associated with contract duration in the case of coal suppliers and electric utilities. Similar association between asset specificity and contract duration were found in other industries (e.g. Masten and Crocker 1985; Goldberg and Erickson 1987; Crocker and Masten 1988). Recently, Costello (2013) finds similar empirical evidence that

information asymmetry is associated with short-term contracts, while presence of relationship specific investments is associated with long-term contracts. Furthermore, Costello identifies another contract design variable that is simultaneously used with contract duration – financial covenants - and finds that when information asymmetry is high, contracting parties use financial covenants as a substitute for short-term contracts. We do not include contract duration in our analysis because recent theory posits that contract form (such as the use of covenants) and contract duration, along with other time-related factors such as advance termination notice, timing and extent of unilateral actions, and renegotiation are *simultaneously* determined design mechanisms that firms use to address *ex ante* and *ex post* contracting problems. Guriev and Kvasov (2005, 1370) note that contract duration is "not only a dimension along which the relationship unfolds, but also a continuous verifiable variable that can be included in contracts." Future work could incorporate the fact that parties contract on time before the contract begins, as well as invest in continuous time during the contract. Future research can also study contract design mechanisms such as duration using structural models (e.g., Bajari et al. 2014). Another topic to explore in future research is whether the fit between contract type and uncertainty is manifested in post-contractual performance. It could also be fruitful to examine the impact of changes in the performance measurement system on the association between uncertainty and contract type. For example, if a company installs a more refined cost accounting system that increases the precision of performance measures, what would be the impact on the likelihood of FP versus CP contracts? These relationships warrant future research attention.

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TABLE 1
Variable definitions

Variable	Description	Measure	Source
Contract Type			
CONTRACT	Contractual pricing mechanism	Dummy variable that indicates one of the following choices: *Fixed price*: Fixed payment per billing cycle or per transaction per billing cycle *Cost Plus*: Payment based on variable factors such as time and materials used during the billing cycle or improvements against key performance indicators or any combination of these factors. 1 denotes choice of a fixed price contract.	IDC
Renegotiation			
RENEG	Renegotiation incidence	Dummy variable coded as 1 for the year the contract was renegotiated and 0 otherwise	IDC
Volatility (VOL_FACTOR - Factor analysis of following three variables)			
VOL_SALES	Volatility in sales	Standard deviation of revenue of the client for the three-year period preceding the implementation of the outsourcing contract.	Compustat
VOL_EARNINGS	Volatility in income	Standard deviation of net income of the client for the three-year period preceding the implementation of the outsourcing contract.	Compustat
VOL_MVE	Volatility in firm value	Standard deviation of market value of common stock of the client for the three-year period preceding the implementation of the outsourcing contract.	Compustat
Ambiguity			
CORR_NI_MV	*Ex ante* correlation between market and financial performance	*Ex ante* correlation between market value of the client and its profitability for the three-year period preceding the implementation of the outsourcing contract. The lower the correlation, the greater the asymmetry between the firm and the market and the greater the performance ambiguity.	Compustat
EARN_RET_VOL	Volatility in abnormal returns around earnings announcements	Standard deviation of the three-day abnormal returns around the announcement of quarterly earnings, across all the quarterly earnings announcements of the client for the five years preceding the implementation of the outsourcing contract. The greater the volatility, the greater the asymmetry between the firm and the market and the greater the performance ambiguity.	CRSP
Relational Characteristics			
NEW_DUM	Indicator of existing contract	Dummy variable indicates whether the contract is new or an expansion/ extension of terms of an existing contract. 1 indicates a new contract.	IDC
Task Complexity			
TCV	Total contract value	Contract value scaled by operating expenses of the client. Operating expenses is defined as the sum of cost of goods sold (COMPUSTAT DATA ITEM *COGS*) and sales, general, and administrative expenses (COMPUSTAT DATA ITEM *XSGA*). The greater the total contract value, the greater the complexity of the outsourced task.	IDC, Compustat

TABLE 1 (Continued)
Variable definitions

NUM_SEG	Number of service segments in the outsourcing engagement	Number of different segments that the outsourcing engagement comprises—for instance, a business process outsourcing deal may comprise billing services and customer care in which case the number of service segments is two. Similarly, a support engagement may comprise hardware as well as software deployment and support in which case the number of engagements is again recorded as two. The greater the number of service segments, the greater the complexity of the outsourced task.	IDC
TASK_TYPE	Type of outsourcing contract	Tasks are ordered along a continuum of complexity as follows: 1: Support and Training; 2: Application, Network, and Desktop Management; 3: IT Outsourcing; 4: Custom Enterprise; Application Development; 5: Business Process Outsourcing	IDC
Firm-Level Controls			
EXP_ALLIANCES	Prior experience in managing alliances	The cumulative number of strategic alliances implemented by the client as of the year prior to implementation of the outsourcing contract measures the depth of its experience in managing inter-firm relationships.	SDC Platinum, IDC
SIZE	Total assets of the client	Total assets of the client	Compustat
PRIOR_FIN_PERF	*Ex ante* industry-adjusted return on assets	Net income as a percent of total assets of the client as of the year prior to implementation of the outsourcing contract	Compustat
PRIOR_MKT_PERF	*Ex ante* industry- and risk-adjusted abnormal returns	Calendar-time abnormal returns for the three-year period preceding the implementation of the outsourcing contract. Specifically, we estimate the Fama and French (1993) three-factor model: $R_{pt} - R_{ft} = \alpha + \beta_m (R_{mt} - R_{ft}) + \beta_s SMB_t + \beta_h HML_t + \varepsilon_t$ where R_t is the excess return to a stock in calendar month t, R_{ft} is the risk-free interest rate, R_{mt} is the CRSP value-weighted market index return, SMB_t is the difference in returns between a portfolio of "small" and "big" stocks, and HML_t is the difference in returns between a portfolio of "high" and "low" book-to-market stocks. A sample stock is included in calendar month t if it is within the 36-month period preceding the date of implementation of the outsourcing contract. The expected value of the intercept (α) in the above equation measures the monthly abnormal return in excess of that achieved by passive investments in the factors. The implied three-year abnormal return is $(1 + \alpha)^{36} - 1$, the estimated average buy-and-hold return resulting from earning the intercept return every month for 36 months. All standard errors in the model are corrected for heteroskedasticity.	CRSP
BTM	Book-to-market ratio of the client	Ratio of book value of common equity to market value of equity of the client. Market value of equity is defined as the product of the number of shares outstanding and market price.	Compustat

Notes: This table provides a summary of the construction of variables used in this study and the data sources.

TABLE 2
Descriptive statistics

	FP contracts						CP contracts					
Variable	**N**	**Mean**	**Median**	**Std. Dev.**	**Q25**	**Q75**	**N**	**Mean**	**Median**	**Std. Dev.**	**Q25**	**Q75**
RENEG	292	0.05	0.00	0.21	0.00	0.00	302	0.04	0.00	0.19	0.00	0.00
VOL_SALES (3-yr)	292	2,155.94	1,095.62	2,871.36	466.59	2,567.81	302	2,509.50	1,118.43	4,929.46	396.52	2,785.82
VOL_MVE (3-yr)	288	6,123.66	2,081.77	11,060.58	633.04	7,024.55	296	9,181.39	2,435.94	17,804.08	858.15	9,208.31
VOL_EARNINGS (3-yr)	292	774.77	237.39	1,699.92	82.49	706.92	302	881.71	247.53	3,798.48	90.05	825.57
VOL_SALES (5-yr)	292	3,012.85	1,727.78	3,795.51	623.79	3,510.17	302	3,346.87	1,610.27	5,022.64	630.22	3,667.20
VOL_MVE (5-yr)	288	7,268.61	3,144.79	11,432.26	1,100.91	7,972.93	296	10,949.15	3,214.39	20,664.81	1,163.26	11,061.00
VOL_EARNINGS (5-yr)	292	814.39	337.53	1,432.42	116.21	850.91	302	904.02	386.71	3,023.84	128.24	949.42
CORR_NI_MV (3-yr)	288	0.42	0.72	0.65	0.03	0.95	296	0.25	0.47	0.72	-0.41	0.94
CORR_NI_MV (5-yr)	288	0.52	0.69	0.49	0.34	0.88	296	0.38	0.52	0.51	0.10	0.81
EARN_RET_VOL	236	0.05	0.05	0.02	0.03	0.07	245	0.06	0.05	0.02	0.04	0.07
NEW_DUM	292	0.72	1.00	0.45	0.00	1.00	302	0.68	1.00	0.47	0.00	1.00
EXP_ALLIANCES	292	18.12	4.50	45.90	1.00	14.00	302	22.11	5.00	51.46	1.00	25.00
TCV	292	0.03	0.01	0.05	0.00	0.03	302	0.06	0.02	0.15	0.00	0.05
NUM_SEG	292	1.71	1.00	1.12	1.00	2.00	302	2.01	1.00	1.41	1.00	3.00
TASK_TYPE	292	2.75	3.00	1.23	1.00	4.00	302	2.56	3.00	1.23	1.00	3.00
SIZE	292	82,526.82	16,303.20	209,512.30	5,965.42	44,137.90	302	82,470.85	17,544.00	226,567.70	5,257.80	45,885.00
PRIOR_FIN_PERF	292	1.42	0.42	4.95	0.08	1.24	302	2.11	0.56	5.85	0.15	1.43
PRIOR_MKT_PERF	292	0.13	0.02	0.73	-0.28	0.44	302	0.33	0.02	1.27	-0.30	0.41
BTM	283	0.59	0.45	0.74	0.29	0.68	287	0.57	0.45	0.52	0.27	0.76

Notes: (1) Data are from 599 outsourcing initiatives of over $15 million, implemented between 1995 and 2008 for publicly traded corporations.
(2) See Table 1 for variable definitions.

TABLE 3
Pairwise correlations

VARIABLES	CONTRACT	RENEG	VOL_SALES (3-yr)	VOL_MVE (3-yr)	VOL_EARNINGS (3-yr)	VOL_SALES (5-yr)	VOL_MVE (5-yr)	VOL_EARNINGS (5-yr)	CORR_NI_MV (3-yr)	CORR_NI_MV (5-yr)	EARN_RET_VOL	NEW_DUM	EXP_ALLIANCES	TCV	NUM_SEG	TASK_TYPE	SIZE	PRIOR_FIN_PERF	PRIOR_MKT_PERF	BTM
CONTRACT	1																			
RENEG	0.03	1																		
VOL_SALES (3-yr)	-0.04	-0.01	1																	
VOL_MVE (3-yr)	-0.10	0.01	0.51	1																
VOL_EARNINGS (3-yr)	-0.02	0.07	0.69	0.38	1															
VOL_SALES (5-yr)	-0.04	-0.01	0.85	0.53	0.55	1														
VOL_MVE (5-yr)	-0.11	0.01	0.43	0.90	0.29	0.51	1													
VOL_EARNINGS (5-yr)	-0.02	0.06	0.71	0.39	0.96	0.61	0.32	1												
CORR_NI_MV (3-yr)	0.13	0.05	0.06	0.00	0.06	0.03	-0.05	0.04	1											
CORR_NI_MV (5-yr)	0.13	0.00	0.05	-0.06	0.05	0.07	-0.05	0.05	0.64	1										
EARN_RET_VOL	-0.09	-0.01	-0.14	-0.07	-0.02	-0.18	-0.08	-0.04	0.00	-0.03	1									
NEW_DUM	0.05	0.14	-0.04	0.00	0.05	-0.06	-0.03	0.03	0.04	-0.04	0.03	1								
EXP_ALLIANCES	-0.04	0.01	0.13	0.41	0.11	0.16	0.51	0.14	-0.10	-0.09	0.09	0.01	1							
TCV	-0.15	0.29	-0.13	-0.11	-0.05	-0.17	-0.12	-0.06	0.03	-0.04	0.08	0.10	-0.09	1						
NUM_SEG	-0.12	0.19	-0.08	-0.10	-0.05	-0.12	-0.12	-0.06	0.02	-0.05	0.03	-0.03	-0.11	0.28	1					
TASK_TYPE	0.08	0.00	0.06	0.03	0.05	0.04	0.04	0.05	0.00	0.04	-0.06	-0.10	0.04	0.05	0.05	1				
SIZE	0.00	0.05	0.59	0.45	0.40	0.64	0.42	0.42	0.05	0.06	-0.23	-0.05	0.04	-0.09	-0.05	0.03	1			
PRIOR_FIN_PERF	-0.06	-0.01	-0.02	0.08	0.02	0.04	0.09	0.03	-0.06	0.01	0.02	-0.02	0.06	0.00	0.02	-0.10	-0.04	1		
PRIOR_MKT_PERF	-0.09	-0.02	-0.09	-0.02	-0.10	-0.09	-0.01	-0.10	0.12	0.14	0.15	0.05	-0.04	0.05	0.00	-0.01	-0.08	0.06	1	
BTM	0.01	0.06	0.11	-0.02	0.25	0.08	-0.07	0.22	-0.05	-0.09	0.09	0.08	-0.06	0.00	0.02	0.01	0.07	-0.04	-0.20	1

Notes: (1) Data are from 599 outsourcing initiatives of over $15 million, implemented between 1995 and 2008 for publicly traded corporations. (2) See Table 1 for variable definitions. (3) Correlations above 0.08 are significant at $p<0.10$.

TABLE 4
Cross-tabulations of performance measure properties and existing controls

Likelihood of FP contract (%)	**Lowest triad**	**Highest triad**	**Test of difference (p-value)**
VOL_FACTOR (3-yr)	0.61	0.44	0.16***
VOL_FACTOR (5-yr)	0.60	0.47	0.14***
CORR_NI_MV (3-yr)	0.47	0.55	-0.08*
CORR_NI_MV (5-yr)	0.45	0.60	-0.15***
EARN_RET_VOL	0.56	0.41	0.15***

Notes: (1) This table shows cross tabulations of raw data from 599 contracts of the association between the likelihood of choice of FP contracts and volatility (defined as the volatility factor) and ambiguity measured as *CORR_NI_MV* or *EARN_RET_VOL*. The second and third columns report the likelihood of choice of an FP contract for firms in the lowest and highest triad of firms, respectively, for each of the variables. (2) *p<0.10; **p<0.05; ***p<0.01.

TABLE 5
Contract type as a function of performance measure properties (Logistic model)

DV = CONTRACT (Likelihood of FP)	Model 1 (3-year measures)	Model 2 (5-year measures)
Volatility		
VOL_FACTOR	-0.73** (0.30)	-0.57* (0.33)
Ambiguity		
CORR_NI_MV	0.44** (0.18)	0.36*** (0.11)
EARN_RET_VOL	-0.48** (0.21)	-0.46** (0.21)
Relational Characteristics		
NEW_DUM	0.28 (0.37)	0.30 (0.36)
Task Complexity		
TCV	-0.39*** (0.13)	-0.35*** (0.13)
NUM_SEG	-0.11 (0.09)	-0.11 (0.10)
TASK_TYPE	-0.32** (0.15)	-0.32** (0.13)
Firm-Level Controls		
EXP_ALLIANCES	0.10 (0.19)	0.11 (0.24)
SIZE	0.12 (0.23)	0.07 (0.26)
PRIOR_FIN_PERF	-0.29** (0.13)	-0.30** (0.14)
PRIOR_MKT_PERF	-1.00** (0.43)	-0.91** (0.42)
BTM	-0.90 (0.77)	-0.92 (0.75)
Vendor fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
N	481	481
Pseudo R^2	0.19	0.19

Notes: (1) Data are from 599 outsourcing initiatives of over $15 million, implemented between 1995 and 2008 for publicly traded corporations. (2) The Logistic analysis includes 481 observations due to missing values on some of the variables. (3) Data sources include International Data Corporation (IDC), Lexis-Nexis, Dow Jones News Retrieval Service, CRSP, and Compustat. (4) The model is $(Y_{ic} = 1) = \Phi(\beta' X_{ic})$ while Y_{it} represents the choice of compensation type (fixed price/cost plus) by client *i* for contract *c*, $\boldsymbol{X}_{ic}$ is a vector of performance measure properties, other client attributes, and task and relationship characteristics that determine compensation type for contract *c*, $\boldsymbol{\beta}$ is a vector of estimated coefficients for these characteristics, and $\Phi(\cdot)$ is the standard normal CDF. We include industry-adjusted financial and market performance of the client as exclusion criteria in this model. (5) See Table 1 for variable definitions. (6) *p<0.10; **p<0.05; ***p<0.01.

TABLE 6
Likelihood of renegotiation (Logistic model)

DV = RENEG (Likelihood of renegotiation)	Model 1	Model 2
CONTRACT	-1.05 (1.53)	-1.52 (1.58)
VOL_FACTOR (3-yr)	-0.07 (0.22)	
CORR_NI_MV (3-yr)	0.52 (0.40)	
VOL_FACTOR (5-yr)		-0.14 (0.30)
CORR_NI_MV (5-yr)		0.33 (0.41)
EARN_RET_VOL	0.11 (0.69)	-0.02 (0.71)
FP CONTRACT x VOL_FACTOR	2.01*** (0.54)	1.64*** (0.23)
FP CONTRACT x EARN_RET_VOL	-0.42 (1.00)	-0.25 (0.95)
FP CONTRACT x CORR_NI_MV	-1.03*** (0.30)	- 0.17 (0.53)
Task Complexity		
TCV	0.39*** (0.05)	0.39*** (0.05)
NUM_SEGMENTS	0.65** (0.28)	0.66*** (0.22)
TASK_TYPE	-0.11 (0.44)	- 0.23 (0.38)
Firm-Level Controls		
EXP_ALLIANCES	-0.19 (0.15)	-0.16 (0.13)
SIZE	-0.14 (0.22)	-0.05 (0.18)
BTM	1.33** (0.67)	1.51** (0.72)
Inverse Mills ratio	1.57 (1.17)	1.92* (1.01)
N	324	324
Pseudo R^2	0.39	0.37

Notes: (1) Data are from 599 outsourcing initiatives of over $15 million, implemented between 1995 and 2008. (2) The Logistic analysis includes 324 observations due to missing values on some of the variables. (3) Data sources include International Data Corporation (IDC), Lexis-Nexis, Dow Jones News Retrieval Service, CRSP, and Compustat. (4) The model is logistic two-way clustered (by firm and time) regressions of the form: $RENEG_{ic} = \beta_0 CONTRACTic + \beta_1 UNCER_{ic} + \beta_2 (UNCER_{ic} \text{ x } CONTRACT_{ic}) + \beta_3 Z_{ic} + \gamma j \lambda_{ic} + \varepsilon_{ic}$, where $RENEG_{ic}$ estimates whether contract *c* was renegotiated, $CONTRACT_{ic}$ refers to the choice of compensation (fixed price/cost plus) for outsourcing contract *c* for vendor *i*, *UNCERic* estimates the uncertainty (including volatility and ambiguity) in the client's environment prior to implementation of contract *c*, $\mathbf{Z}_{ic}$ is a vector of task, relationship, and client attributes that characterize contract *c*, and λ_{ic} is the inverse Mills ratio or correction factor for self-selection of compensation type. The estimation controls for industry and vendor fixed effects. (5) *p<0.10; **p<0.05; ***p<0.01.

APPENDIX

SEC filing of the General Motors (Client) and EDS (vendor) outsourcing deal

The SEC filing by General Motors (GM) describes the contract between GM (client) and EDS (vendor). EDS would be providing GM with (i) infrastructure (mainframe, super-computing, midrange, and distributed computing hardware and software, voice, data and video communications services and networks, end-user hardware, and replacement), (ii) IT services (participating in planning infrastructure, development, implementation and maintenance, infrastructure integration, monitoring), (iii) applications software for business planning, financial, human resource management, sales, service marketing, engineering, purchasing, product control and logistics, production/manufacturing, materials management and legal, (iv) helpdesk support, (v) timesharing services, (v) data management, and (vi) disaster recovery and business continuity.

The contract is cost-plus, and is stated as “Cost-Plus Pricing Methodology” and includes a “Markup Percentage.”

Some relevant parts of the SEC filing are reproduced below:

Services sought from EDS

1. Infrastructure.

(a) Scope. Except with respect to Plant Floor Services, which are covered in Section I.A.5 below, the scope of the computing and communications infrastructure ("Infrastructure") is as follows:

(1) Mainframe, super-computing, midrange and Distributed computing hardware and system software.

(2) Voice, data and video communications services and networks. However, the parties mutually agree that the videoconferencing products and services included in the above shall be limited to (i) those for which terms and pricing are specified in the Videoconferencing Terms and Pricing document, dated March 29, 1996, mutually developed by GM and EDS, and (ii) those being provided to GM by EDS as of the Effective Date to the extent that, prior to the Effective Date, they were mutually treated by the parties as within the scope of Section 1.3 of the Master Agreement.

(3) End-user hardware (e.g., telephones, desktop PC's, Unix workstations, 3270/5080 terminals) connected to or using the computing or communications environment described in sub-Sections I.A.1(a)(1) and I.A.1(a)(2) hereof.

(4) Replacements of any of the foregoing which serve the same or comparable functions as the foregoing.

(b) Services. EDS shall be responsible for meeting GM's requirements, in accordance with GM's stated IT strategies, directions, architecture and standards, for the following services applicable to the Infrastructure functions described in sub-Section I.A.1 (a) above:

(1) Participation in the investigation of and planning for architecture and related Infrastructure technologies supporting GM's IT strategies and directions.

(2) Development, implementation, and maintenance of infrastructure architecture and standards for all computing and communications environments used by EDS to provide services to both GM and EDS' other customers ("Shared Infrastructure").

(3) Participation in the development and maintenance of Infrastructure architecture and standards relating to all computing and communications environments desired by GM which are not shared by EDS' other customers ("Dedicated Infrastructure").

(4) Infrastructure capability, capacity and Configuration management for Shared Infrastructure.

(5) Participation in Infrastructure capability and configuration and performance of Infrastructure capacity management for Dedicated Infrastructure.

(6) Infrastructure integration, installation, and operations.

(7) Infrastructure performance monitoring and improvements (without limiting GM's right to monitor performance as mutually agreed by the parties).

2. Application Software.

(a) Scope. Except with respect to Plant Floor Services which are covered in Section I.A.5 below, EDS is Responsible pursuant to sub-Section I.A.2 (b) below for meeting GM's requirements for the development of application software and Implementation of commercial off-the-shelf application software (with the "make or buy" decision being made by GM with input from EDS) to support the following GM business functions and processes (or their successors) and their related sub-functions and processes:

(1) Business Planning.

(2) Financial.

(3) Human Resource Management.

(4) Sales, Service, Marketing and Aftersales.

(5) Engineering.

(6) Purchasing.

(7) Production Control and Logistics.

(8) Production/Manufacturing.

(9) Materials Management (e.g., ISP, GPS), excluding material handling conveyances.

(10) Corporate Affairs and Legal.

(b) Services. EDS shall be responsible for meeting GM's Requirements, in accordance with GM's stated IT strategies, directions, architecture and standards, for the following services in connection with application software used to support the business functions and processes set forth in sub-Section I.A.2(a) above:

(1) Participation in the investigation of new application software and application software technologies supporting GM's IT strategies and directions.

(2) Participation in the development and maintenance of application architecture and standards.

(3) Maintenance, change control, and enhancement of current and future application software.

(4) Development and implementation of software interfaces.

(5) Integration and operational support of current and future application software.

(6) Troubleshooting and problem resolution.

(7) Output distribution (e.g., on-line, print, plot, microfiche).

(8) Performance tuning and run-time improvements.

(9) Development (with the "make or buy" decision being made by GM with input from EDS) and implementation of new and replacement application software.

(10) Help-desk support.

(11) Timesharing services.

3. Data Management.

(a) Scope. Except with respect to Plant Floor Services which are covered in Section I.A.5 below, EDS will be responsible for meeting GM's requirements for the management of data used by or for applications software used to support the various GM business functions described in sub-Section I.A.2(a) above.

(b) Services. EDS shall be responsible for meeting GM's requirements, in accordance with GM's stated IT strategies, directions, architecture and standards, for the following data management services to support the business functions and processes set forth in sub-Section I.A.2(a) above:

(1) Participation in the development and maintenance of GM data standards.

(2) Participation in the development and maintenance of data architecture and technical standards.

(3) Implementation and maintenance of databases shared within GM and data warehouses.

(4) Participation in the investigation of and planning for new data/information technologies.

4. IT-Related Services. Except with respect to Plant Floor Services which are covered in Section I.A.5 below, EDS shall be responsible for meeting GM's requirements, in accordance with GM's stated IT strategies, directions, architecture and standards, for the following cross-functional services applicable to the business functions and processes set forth in sub-Sections I.A.1(a), I.A.2(a), and I.A.3(a) above:

(a) Reports on: performance status, invoice detail, scope of work detail and other descriptions related to MSA Services.

(b) Investigation, acquisition, required development, maintenance and use of IT-related methodologies and tools as requested by GM.

(c) Implementation of IT security controls.

(d) Compliance management with respect to EDS' delivery of MSA Services in accordance with GM's stated IT strategies, direction, architecture and standards.

(e) Participation in planning for business continuity services.

(f) Planning for IT disaster recovery services jointly with GM.

(g) Delivery of IT disaster recovery and IT-related business continuity services.

(h) Participation as requested by GM in IT planning, technology assessment and other data management activities.

(i) NAO COe training for the term of the current NAO COagreement, dated November 30, 1993.

(j) Training in the use of EDS software and/or Technologies custom-developed by EDS for GM.

(k) Backup and quality control (without limiting GM's right to assess the quality of delivered MSA Services).

5. Plant Floor Services. EDS shall be responsible for plant floor services to the extent set forth in sub-Section 1.3(e) of the MSA ("Plant Floor Services").

Pricing details

(d) The term "Modified Cost-Plus Pricing Methodology" shall mean the Cost-Plus pricing methodology set forth in Section D3.3 of this Exhibit D.

(e) The term "Modified EDS Cost" for any MSA Services shall mean the costs incurred by EDS in providing those MSA Services determined in accordance with sub-Sections D3.3(c) and D3.3(d) of this Exhibit D.

(f) The term "Modified Markup Percentage" shall mean, for any MSA Services provided by EDS to any GM User Organization pursuant to the Modified CP Pricing Methodology, the percentage computed in accordance with the calculation methodology set forth in a mutually agreed policy letter for that purpose, signed prior to the Effective Date by the GM and EDS Corporate Contract Managers.