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Estimating Value Creation From Revealed Preferences: Application to Value-Based Strategies

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Running head: Estimating Value Creation From Revealed Preferences

Research abstract

We develop and apply a new set of empirical tools consistent with the tenets of value-based business strategies, leveraging the principle that "no good deal comes undone" and the methods of revealed preferences to empirically estimate drivers of value creation. We demonstrate how to use these tools in an analysis of value creation in buyer–supplier relationships in the UK corporate legal market. We show how the method can uncover evidence of subtle mechanisms that traditional methods cannot easily distinguish from each other. Furthermore, we show how these estimates can be used as parameters of biform games for out-of-sample analyses of strategic decisions. With readily available data on relationships between firms, this approach can be applied to many other contexts of interest to strategy researchers.

Word count: 125 words.

Keywords: value-based strategy, revealed preferences, cooperative game theory, buyer–supplier relationships, client-specific economies of scope

Managerial abstract

Managers need to understand the drivers of value creation for customers in order to make competitive positioning decisions and understand when they can capture value under competition. However, estimates of the relative importance of each driver are typically difficult to obtain. In this paper, we help remedy this problem by demonstrating a novel method that obtains estimates of the contribution of various drivers of value creation from commonly available data of buyer–supplier relationships. These estimates can then be used to inform the strategy-making process.

Word count: 84 words.

INTRODUCTION

The notions of value creation and value capture, as introduced to strategic management by Brandenburger and Stuart (1996), have become a unifying framework for theorizing about firm heterogeneity and competition in competitive strategy research. For instance, use of these notions was instrumental in clarifying central theoretical concepts in the resource-based view (Hoopes, Madsen, and Walker, 2003; Leiblein, 2011; Lippman and Rumelt, 2003; Peteraf and Barney, 2003). By jointly analyzing value creation and value capture, the value-based framework has provided a structure for linking firm performance and demand characteristics (Adner and Zemsky, 2006; Priem, 2007) and has led to novel insights on how value is captured under competition (MacDonald and Ryall, 2004). This framework has been used to study drivers of strategic advantages in various contexts such as factor markets (Adegbesan, 2009), product markets (Chatain and Zemsky, 2011), and networks (Ryall and Sorenson, 2007).

Given the uptick in applied theorizing offered by the value-based framework, the development of empirical methods specifically tailored to it could greatly benefit strategy researchers and practitioners. Yet a chasm remains between the extant theoretical advances and the empirical work adopting a value-based lens. A prominent limitation is the inability of mainstream empirical approaches to identify and estimate parameters of the underlying formal models. Past studies have worked around this problem by relying on proxies for a player's added value[1] (Adegbesan and Higgins, 2011; Chatain, 2011; Jia, Shi, and Wang, 2012; Obloj and Capron, 2011) and bargaining abilities (Bennett, 2013).[2] These empirical studies find patterns consistent with the theory but still fall short of estimating parameters of the theoretical models that generated the empirical predictions.

We argue that to fully exploit the richness of value-based theoretical models, empirical estimation can move beyond corroborating implications of the models to actually estimate the parameters in the model. Further, researchers equipped with parameter estimates would be able to use the formal models to provide quantitative answers to questions such as: What are the

[1] In the value-based framework, both added value and bargaining ability matter to value capture. The added value of a player is the value that would be lost if the player withdraws from the interaction (Brandenburger and Stuart, 1996). Added value is a convenient way of measuring a player's ability to capture value under competition and can thus be understood as a measure of competitive advantage (Adner and Zemsky, 2006). Residual bargaining ability (Brandenburger and Stuart, 2008) is a player's ability to capture value when competition leaves a range of value to be negotiated between firms.

[2] The only exception we are aware of is Grennan (2014), who empirically estimates bargaining abilities out of a formal model of negotiation between buyer and suppliers in the market for medical devices.

returns to investing in further ability to create value? What would happen if a new player entered the competitive interaction? What change in the competitive environment would most benefit or threaten a given firm? While answering these questions is key to formulating strategic advice, traditional econometric techniques are not appropriate for this goal. They are geared toward hypothesis testing but are not consistent with a coherent model of strategic behavior involving multiple actors. As a result, a different toolbox is needed to give researchers the ability to generate out-of-sample predictions, obtained by feeding estimates of value creation determinants into a formal, value-based model of competitive interactions.

By developing such a toolbox, this paper's aim is to put the empirical development of the value-based framework (Brandenburger and Stuart, 1996, 2007; MacDonald and Ryall, 2004) on a par with its theoretical base. We provide a roadmap for estimating value creation in formal models based on biform games and show how empirical estimates can be leveraged in a model of value capture. We develop this approach in the context of buyer–supplier relationships, a canonical setting for strategy research and value-based research. Substantively, the value-based estimates provide the opportunity to disentangle the relative importance of various mechanisms that can explain seemingly similar patterns in the data. The empirical example delves deeper into these issues in the context of vertical relationships between law firms and corporate clients.

The main contribution of this paper is to show how to fit a model of value creation consistent with assumptions of competitive behavior to data typically available to strategy researchers by leveraging the fundamental principles of the value-based framework. We do so by extending recently developed econometric techniques to get consistent estimates of key parameters of a biform game. This method extracts information about value creation from players' observed choices, an approach that is informed by the formal properties of biform games. While the method was originally developed to analyze cooperative game theory models known as matching games (Fox, 2008, 2010), and has been recently applied in the strategic management literature to study alliances (Mindruta, 2013; Mindruta, Moeen, and Agarwal, 2016),[3] we illustrate how it can be further developed to provide answers to other questions of interest to strategic management scholars.

[3] Other relevant applications using Fox's (2008) framework include Yang, Shi, and Goldfarb's (2009) study of the complementarity between sports brands, and Akkus, Cookson, and Hortaçsu's (2015) study of determinant of bank mergers.

By focusing our contribution on the intersection of methodology and theory in strategic management, we echo recent works published in the *Strategic Management Journal* that seek to improve how methods are used in our field (e.g., Hoetker, 2007; Zelner, 2009; and the papers in the January 2016 special issue, *Question-Based Innovations in Strategy Research Methods*). A key difference, however, is that while most of these contributions tend to recommend best practices independent of the theory that is used, ours is specifically tailored to a theoretical stream—the value-based framework—and leverages its theory as an integral component in the development of the empirical method. We thus seek to contribute to the toolbox of empirical researchers who are interested in applying a value-based lens to get deeper insights on questions about firm strategy.

A related contribution of the paper can be found in its application. The paper aims to provide a fuller understanding of the nature of benefits of client-specific scope extensions in a setting where prior studies have suggested their importance. Earlier work (Chatain, 2011) speculated that client-specific economies of scope were largely due to increased value creation occurring from better coordination across lines of work. However, our results suggest that the story is more complicated, and that the benefits of a client-specific scope extension are due to the high cost of creating a relationship in the first place rather than direct synergies between lines of work. Such a fine-grained difference in findings and interpretation could only be brought about because of our use of a more theoretically consistent method.

The paper is organized as follows: In the next section, we argue the advantages of tightly integrating theory and empirical work for value-based empirical studies. We then use an example to explain the principles upon which our proposed method is based. Finally, we apply the method to the study of value creation in buyer–supplier relationships and illustrate how several questions of interest to strategy scholars can be answered.

FUNDAMENTAL COMPETITIVE ASSUMPTIONS OF THE VALUE-BASED FRAMEWORK AND THEIR EMPIRICAL IMPLICATIONS

The value-based framework (Brandenburger and Stuart, 1994, 2008; MacDonald and Ryall, 2004) is a fully developed theory of value creation and value capture. Traditional econometric methods can test implications of the framework but are ill suited to estimate model parameters. To do so requires building into the methods some key theoretical assumptions of the value-based framework.

Shortcomings of traditional empirical analyses for estimation of formal model parameters

The value-based approach frames the problem of firm performance in terms of value creation, occurring when agents working together with other members of the supply chain combine costly input into value output, and value capture, which is the outcome of competition among agents to appropriate the value created. How much value a firm can appropriate and under what conditions are the central questions addressed by the theory (Brandenburger and Stuart, 1996). Within this framework, the analysis of value capture requires information on the value creation possibilities (i.e., the value produced in all possible exchanges involving subsets of players in the supply chain) and assumptions on how competition unfolds among those players.

While the theoretical framework was introduced two decades ago, most of the empirical work in this area is relatively recent. The burgeoning empirical literature has made headway in testing implications of the theory. For example, Chatain's (2011) study of buyer–supplier relationships shows empirical evidence consistent with a central implication, namely that a supplier's value capture varies with its added value. Bennett (2011) examines factors associated with a player's ability to bargain and shows that these factors influence transaction prices, and thus, value capture. A number of other papers have used the framework to establish and test relationships between proxies of value creation and dependent variables (e.g., profit, survival) that are commonly studied in strategy (e.g., Adegbesan and Higgins, 2011; Elfenbein and Zenger, 2014; Obloj and Capron, 2011).

To date, however, the empirical literature has failed to fully connect the observed data with a key assumption underlying the value-based models. Prior contributions have tended to give short shrift to the competitive foundations of the theory because they do not fully account for the competitive interactions between agents. Such reduced-form regression analyses as commonly used in prior empirical work can pick up correlations related to competition but do not constitute in themselves a model of competitive interaction among agents. In general, the idea that observed data is the outcome of a competitive process involving multiple players—a foundation of the value-based approach—is only imperfectly incorporated. At best, empirical studies will incorporate approximations of added value (Capron and Obloj, 2011; Chatain, 2011) or exploit shocks to bargaining abilities (Bennett, 2013) in attempts to exploit indirect implications of the model that can be tested in a traditional fashion.

Thus, while existing techniques have proven useful in testing implications of the theory, they remain of limited use in exploring what would happen if elements of the strategic interaction under consideration changed. For example, researchers may be interested in understanding how changes in agents' ability to create value reshape the distribution of value among participants in a transaction. These changes will affect many components of the value-based framework, such as the value creation possibilities available to players and their relative competitive position. They might also affect players' choices prior to participation in the supply chain, an aspect that asks for a reconsideration of how the first, non-cooperative stage of the biform game is played. While the formal model accommodates the interdependencies between all parameters touched by a change, the challenge of empirical applications is that traditional, reduced-form, empirical methods require these changes to be observed exogenously in the data. This ideal research environment is most often not achievable, either because changes do not occur as expected, or because systematic field experiments are difficult to run, such as when the unit of analysis is the organization.

Yet the power of formal modeling comes precisely because it gives researchers the tools to extrapolate observed behavior to predict the impact of "not-yet-observed-changes" (Nevo and Whinston, 2010). To be able to perform an out-of-sample analysis in empirical work, researchers need to have reliable estimates of the theoretical model itself, rather than of its implications, and replay the estimated model with different data.[4] However, as explained above, traditional reduced-form techniques are not able to provide these estimates because they do not estimate parameters in a way fully consistent with the assumptions of the model. To address this challenge, it is necessary to incorporate these assumptions in the estimation procedures.

Competition in value-based models and revealed preferences

The value-based framework comprises two sets of inputs: assumptions about value creation possibilities and assumptions about competition. While the former are usually easy to parameterize, in a way similar to what is done in traditional regression analyses (see, e.g., how different value creation functions are tested and compared in Mindruta, Moeen, and Agarwal

[4] Such out-of-sample analysis is crucial, for example, to the modern practice of antitrust analysis (Whinston, 2008). In such cases, decision makers have to rely on theory and models to anticipate the effect of large-scale decisions before they happen. Notice that this approach can only be pursued via a "structural" (i.e., model-based) estimation, in contrast to reduced-form estimation techniques, which do not incorporate equilibrium conditions.

[2016]), the latter are still virtually unexploited, hampering progress in the empirical analysis of value-based models.

The assumptions the value-based framework makes about competition are encapsulated in the notion of unrestricted bargaining[5]. Unrestricted bargaining captures the notion of free-form competitive interaction that takes center stage in the theory of value creation and capture presented by Brandenburger and Stuart (1996) and in its biform games extension (Brandenburger and Stuart, 2007). In formal coalitional games, the assumption of unrestricted bargaining is formalized by the solution concept of the core and is used as such by formal modelers in applied theoretical work. What is underappreciated is that unrestricted bargaining also has concrete empirical implications that can be tapped by empirical researchers. The empirical implications of unrestricted bargaining provide an opportunity to estimate model parameters from data in a theoretically consistent way and thus move beyond reduced-form analyses.

Is important to clarify the meaning of unrestricted bargaining in the value-based literature to understand how it maps onto empirical implications. While the word "bargaining" may superficially suggest haggling over a fixed pie, unrestricted bargaining is a more general notion meant to be synonymous with "active deal seeking" by participants in competitive interactions (Brandenburger and Stuart, 1996: 14). Unrestricted bargaining is a strong form of competition that comprises the search for and exploitation of all available value-creating combinations. The essence of unrestricted bargaining can be summarized in the phrase "no good deal goes undone." This notion thus carries the idea that agents acting in a competitive setting will actively search for the best deals available and in the process settle on deals that resist competing offers because they offer superior value to their participants.

This assumption, already found in a key predecessor to the value-based approach (Makowski and Ostroy, 1999), was one driver of the development of the theory (Brandenburger and Stuart, 1996) and has been recently brought again to the fore by recent developed theoretical works that provide new insights on how the unfolding of competition constrains value capture (Gans and Ryall, forthcoming; Montez, Ruiz-Aliseda, and Ryall, 2013).

Empirically, the key is to recognize that combining the knowledge of actual transactions in the data with the assumption that "no good deal goes undone" allows for the systematic

[5] In formal models, the assumption of unrestricted bargaining corresponds to the use of the solution concept of the core.

estimation of the value creation possibilities among buyers and suppliers. The assumption that "no good deal goes undone" constrains how much value counterfactual deals could create relative to those that are observed. These restrictions, which stem from the principle of *unrestricted bargaining*, can be used as a basis for the quantitative estimation of the relative contribution of observable factors to value creation thanks to the logic of *revealed preferences*.

The logic of revealed preferences combines data and restrictions derived from theory as follows[6]: The principle of unrestricted bargaining (our theoretical engine) asserts that if all agents pursued the best deals available to them, the economic exchanges we observe should provide more value to the parties involved than alternative deals that could have been concluded instead of the observed deals (i.e., counterfactual deals). As a result, to each observed set of deals, we can relate various sets of counterfactual deals that should create less value according to the hypothesis of unrestricted bargaining. We follow the logic of revealed preferences by systematically comparing these two sets of deals (observed and counterfactual) to understand what makes a deal valuable. With the appropriate method, we will be able to quantitatively uncover the link between observable data and value creation.

In the rest of the paper, we will provide detailed examples of how to make this mechanic work and apply it to an extended study of buyer–supplier relationships. To get a primer on the construction of counterfactuals, their comparison to an actual outcome and how this can be used to deduce the contribution to value creation of various drivers, the interested reader can jump directly to the next section (titled "Extended Example"). But before diving into this, we explain briefly why we view business-to-business vertical relationships as an appropriate and relevant context for such study.

Business-to-business vertical relationships and value creation

Business-to-business vertical relationships are a great laboratory for extending the reach of methods based on the value-based approach. The theory can be presumed to apply well in these settings, as both buyers and suppliers are arguably strategic in the management of their relationships (Elfenbein and Zenger, 2015). A number of strategic issues have been discussed already in theoretical work in the value-based stream (Chatain and Zemsky, 2007, 2011; Obloj and Zemsky, 2014; Ryall and Sorenson, 2007). Moreover, empirical interest in vertical

[6] Revealed preferences "refer to people's actual choices in real-world situations" (Train, 2007: 174). Revealed preferences differ from stated preferences, which reflect respondents' preferences to hypothetical choice situations. Stated preferences are typically obtained via surveys.

relationships has been a constant in the field of strategy spanning the transaction cost and capability traditions and beyond (e.g., Dyer, 1997; Dyer and Singh, 1998; Hoetker, 2005; Parmigiani and Mitchell, 2009). Developing methods that are appropriate to such settings can contribute beyond the realm of value-based applications.

The empirical analysis in this paper is motivated by the observation that in many industries, a focal firm organizes its supplier base by contracting with a limited set of suppliers. These transactions are relationship-based because they require bilateral learning and adjustment. At the same time, suppliers typically try to establish links with the same buyer for different lines of business. For instance, investment banks typically establish relationships with clients to supply them with multiple services such as debt issuance, provision of derivatives, and initial public offering (IPO) launches. Technology firms such as Cisco and IBM offer a broad set of services and integrate these with products for their customers. In short, it is common in the buyer–supplier context that relationships between these two parties involve multiple product lines.

Such a setting is appropriate for our purpose because it is credible that there is active competition between the various suppliers of a single buyer in a way that is consistent with the notion that "no good deal goes undone." For instance, in the legal advisory business, big corporate clients frequently maintain several long-lasting relationships with different law firms, thus benefiting from a good knowledge of their capabilities, while at the same time proactively and strategically allocating work among these suppliers to make sure that as clients, they get the best service at the best price (Coates, DeStefano, Nanda, and Wilkins, 2011).

Moreover, the pattern of value creation in those relationships that span several services still needs to be explored in depth. Several distinct mechanisms can explain why work is concentrated among a few suppliers who in turn take charge of multiple services for the same client. Early work by Chatain (2011) suggested that synergies between product lines, termed "client-specific economies of scope," were the explanation of the grouping of lines of services, as a supplier combining different product lines would be able to achieve better coordination and knowledge sharing. In value-based terms, this means that more value is created when the client-specific scope is extended. However, this evidence is derived from a reduced-form analysis and cannot adjudicate among different mechanisms.

Indeed, there are competing explanations as to why a few suppliers perform multiple services, even in the absence of synergies arising from the interaction between product lines. For instance, it might be that the cost of creating a relationship is high and that this justifies keeping only a few relationships ongoing, each with multiple product lines, even though there are no direct synergies between the product lines. The only way to disentangle this story from the one involving direct synergies between product lines is to be able to measure the increment of value creation associated with an extension of client-specific scope. This is something that our empirical framework will allow us to do. Our approach will move beyond the correlations between client-specific scope and outcomes found in Chatain (2011) to a more complete and theory-consistent estimation, including an actual measurement of what the agent's behavior, when consistent with the idea that "no good deal goes undone," implies about the benefits—or costs—associated with scope extension.

This particular case illustrates how the use of theory-driven empirical estimations can help researchers test a broader range of theories by moving from testing correlations to estimating parameters of a formal model. More generally, this setting provides an opportunity to demonstrate how our empirical framework can help address existing questions in a novel way.

The next section illustrates via examples how the assumption of unrestricted bargaining can be leveraged to place bounds on the parameters of a model of value creation. The following section will generalize this approach. We will then use the context of the UK legal services market (already studied by Chatain, 2011) to show how topics of interest to value creation in vertical relationships can be addressed with this methodology, thereby demonstrating its broad applicability.

EXTENDED EXAMPLE

In this extended example, we examine an empirical counterpart to Chatain and Zemsky's (2008) biform game model and how it can be used in conjunction with data thanks to the logic of revealed preferences. In their paper, these authors study procurement decisions by buyers who might prefer to purchase from one supplier rather than from several, as well as the product range positioning decisions of suppliers. A game theoretical analysis goes from the fundamental parameters of the model and derives the outcomes to be observed. Here, in the fashion of revealed preferences analysis, we turn this logic on its head and consider instead the reverse problem: what can we deduce about unknown parameters of the game by analyzing the data and assuming these data are the outcome of unrestricted bargaining?

Estimating synergies between practice areas

Assume we can observe the decision of a buyer who has two tasks that need to be taken care of by one or two suppliers. (For simplicity, we neglect unobservable error terms.) The value created task a is executed by supplier i is denoted v_{ai}. We further denote by R the synergy that can be had if the two tasks are given to the same supplier. In keeping with the biform formalism, the efforts to maximize value capture by all parties in the second stage of the biform game through unrestricted bargaining lead to the assignment of tasks to suppliers that maximize value creation (Brandenburger and Stuart, 2008).

If the buyer splits its order between supplier 1 for task A and supplier 2 for task B, the value created will be equal to $V = v_{A1} + v_{B2}$. If all the work is allocated to firm 1, the value is equal to $V = v_{A1} + v_{B1} + R$.

Suppose now that the magnitude of R is unknown but that we know the value parameters. As is typical in econometric approaches, suppose also that we can observe choices of suppliers per task that are made by buyers who themselves know the true value of R. The following table provides all the respective capabilities of three suppliers in two tasks.

Supplier	v_{Ai}	v_{Bi}
1	10	0
2	3	10
3	8	8

Assume that we observe that the buyer is splitting its tasks between firm 1 for task A and firm 2 for task B. This implies that the value created is equal to $V_{\text{Actual}} = v_{A1} + v_{B2}$.
What information can be extracted from this observation? A lot can be gleaned by contrasting it with counterfactual assignments—assignments that are creating less value by virtue of the fact that the observed assignment maximizes value. One counterfactual is to give all the work to supplier 3. In that case, the counterfactual value created would be $V_{\text{CF}} = v_{A3} + v_{A3} + R$ (the subscript "CF" is for counterfactual).

By the principle of unrestricted bargaining ("no good deal goes undone"), the value created in the observed configuration is by assumption higher than in counterfactuals. We thus have:

$$V_{\text{Actual}} \geq V_{\text{CF}},$$
$$v_{A1} + v_{B2} \geq v_{A3} + v_{A3} + R,$$
$$20 \geq 16 + R.$$

Thus $4 \geq R$, and we have found an upper bound on R.

Now, consider another case that is also observed concurrently. Another buyer, facing a different set of potential suppliers, is seen to have chosen to give all the work to one single supplier, here supplier 6, creating $V_{Actual} = v_{A6} + v_{B6} + R$. Below is the data available regarding the various value creation scenarios:

Supplier	v_{Ai}	v_{Bi}
4	10	0
5	3	10
6	9	8

An alternative not acted upon includes splitting the order between suppliers 4 and 5 and creating $V_{CF_2} = v_{A4} + v_{B5}$. By assumption, the following inequality must be true:

$$V_{\text{Actual}} \geq V_{CF_2}$$
$$v_{A6} + v_{B6} + R \geq v_{A4} + v_{B5}$$
$$17 + R \geq 20$$
$$R \geq 3$$

We have thus obtained a lower bound for the value of the parameter *R.* Taken together, the information from the first and the second example leads us to conclude that the value of *R* is between 3 and 5.

These analyses, which compare actual and potential value creation, gave us the ability to bracket the possible values that a parameter of interest can take. This process can be generalized (as will be shown below, by drawing on Manski [1975] and Fox [2007, 2008, 2010]) to estimate multiple parameters at the same time, account for fixed effects, and provide confidence intervals, within an approach that gives us a theory-based way to analyze data about value creation in buyer–supplier relationships.

Notice that the method we propose here relies on the premise that competition among firms pushes them to find arrangements that are mutually advantageous and robust to counteroffers (Brandenburger and Stuart, 1996). The assumption that "no good deal goes undone" is fundamental to both extant theory and our estimation method. Moreover, comparing actual and potential value creation in this manner has the following main advantages: (1) little information is needed about the beliefs of the players, and (2) all that matters for the comparison to be relevant for the analysis is that the alternatives (the counterfactuals) be feasible for the firms involved (Pakes, 2010).

Estimating entry cost

Following the same approach, it is also possible to say something about the costs of creating a relationship. However, it is important to notice that there are limitations to this exercise when these costs are sunk. This idea is made clear by the following example:

Consider a firm that needs a supplier to fill a new need. It can either use a current supplier or another supplier. Let E be the sunk, one-off, cost of creating a relationship. (This cost should be understood in terms of the opportunity cost of creating the relationship relative to the expected benefits over the life cycle of the client.) Using the current supplier, the firm can expect to create value in the amount of $V_{\text{Incumbent}}$. However, the firm could also use an external supplier with which it has never worked, in which case the firm will expect value to be created in the following way, $V = v_{\text{Entrant}} - E$.

Observing that the entrant is chosen over the incumbent gives us $v_{\text{Entrant}} - E \geq v_{\text{Incumbent}}$ and $v_{\text{Entrant}} - v_{\text{Incumbent}} \geq E$. This gives us a lower bound on E. Notice that as long as we consider that E is sunk, it is impossible to get a point estimate or an upper bound on E because we can only observe E being spent, never being recovered.

This is not a weakness of the procedure but rather a consequence of what can be learned from the data without making a strong assumption about the distributions of the unobserved components of value and heavily relying on this assumption. We will not go this path in this paper, as we concentrate on expounding what estimates can be obtained while (1) sticking as much as possible to the spirit of the theory, and (2) minimizing extraneous assumptions.

Formation of Counterfactuals

Key to our method is a rule for listing relevant counterfactual configurations of buyers–tasks–suppliers in a systematic, theory-derived way. Based on this rule, we will show how the parameters of the game can be estimated by comparing the value created in observed and counterfactual configurations. To this end, we exploit the nature of the equilibrium underlying the buyer–tasks–supplier(s) relationships observed in the data.

To derive this rule, we focus on a necessary condition that should be satisfied by every assignment of a buyer's tasks to suppliers, once all players' first-stage strategic choices to collaborate (i.e., who transacts with whom among buyers and suppliers) have been decided in the market. When "no good deal goes undone," the value generated by an observed assignment of a buyer's tasks to suppliers cannot be improved upon by reallocating a task to another supplier already serving the buyer. Equivalently stated, the value created by the actual assignment of tasks to suppliers should be greater than the value created by any assignment that reallocates one task at a time from one supplier to another, while all other task-supplier pairings remain unchanged for that buyer. By applying this rule to all buyer–supplier relationships, we create a set of inequalities that constitutes the basis for estimation.

We illustrate the creation of counterfactuals with a simple example (Figure 1). The top panel, titled "Observed configuration for a given buyer," describes the observed assignment of tasks (labeled A, B, and C) to suppliers (labeled 1, 2, and 3) for buyer *k.* Task A is fulfilled by supplier 1. Task B is fulfilled by both supplier 1 and supplier 2, which is an indication of dual sourcing, while task C is fulfilled only by supplier 3.

=== Insert Figure 1 about here ===

The middle panel of Figure 1, titled "Creation of counterfactuals most similar to observed configuration," shows six counterfactual assignments, obtained by applying the above-mentioned rule to the observed assignment. To build a counterfactual assignment, we take one pair of observed task–supplier matching and replace it by a counterfactual matching of the same task with one of the suppliers that is not currently supplying that task. This last point is important as it takes care of potential issues with dual sourcing. For concreteness, consider the observed pairing {task A by supplier 1}. In counterfactual CF1 we replaced supplier 1 with supplier 2 (thus, in CF1, {task A by supplier 2}), while the other task–supplier pairings stayed the same (i.e., {task A by supplier 2}, {task B by supplier 1}, {task B by supplier 2}, {task C by supplier 3}). Compared to the observed configuration, supplier 1 has reduced its scope (it now serves only task B), while supplier 2 has increased its client-specific scope (it now serves both task A and task B, instead of just task B). In counterfactual CF2, for task A, we replaced supplier 1 with supplier 3 and kept all other task–supplier pairings constant. This time, supplier 3 increased its client-specific scope, at the expense of supplier 1.

An interesting situation is the construction of counterfactuals involving task B. Because supplier 1 and supplier 2 are both assigned to this task in the observed data, we can only replace them, in turn, by supplier 3. As before, task A and task C continue to be assigned to their current suppliers, supplier 1 and supplier 3, respectively. Thus, the counterfactual configuration CF3 contains the following pairings: {task A by supplier 1} (unchanged), {task B by supplier 3} (modified in the counterfactual), and {task B by supplier 2} and {task C by supplier 3} (both unchanged). Likewise, CF4 is composed of {task A by supplier 1} and {task B by supplier 1} (both unchanged), {task B by supplier 3} (modified in the counterfactual), and {task C by supplier 3} (unchanged).

Following this method, we obtained six counterfactuals in this example. In all these counterfactuals, one supplier takes on one additional task and another supplier loses one task compared to the observed assignment. Once counterfactuals are formed, they are used to generate the necessary conditions about value creation. This is shown in Figure 1's bottom panel, titled "Pairwise comparison of value creation: observed vs. counterfactual." These conditions assert that the value created in the observed configuration is greater than the value created in the counterfactual configurations.

The approach we underlined here has several advantages. Inequalities are necessary conditions that hold for all observed configurations involving a buyer, its suppliers, and the assignment of the buyer's tasks to actual suppliers. These conditions are consistent with a biform game in which the collaboration of buyers and suppliers and the assignment of the buyer's tasks to suppliers emerge as buyers and their suppliers maximize the joint surplus given the competitive environment (Chatain and Zemsky, 2007).[7]

Second, the construction of counterfactuals provides relevant information for the estimation of the effect of variation in client-specific scope. In the potential, unrealized assignment, the actual supplier loses one task, while the newly assigned supplier takes on an additional task and thus increases its client-specific scope relative to that actually realized. This

[7] The reader may ask whether the equilibrium assumption requires that the observed configuration of buyers–tasks–suppliers be a global optimum in the sense that it cannot be improved upon at all. This is not the case. We are relying on a weaker, local equilibrium property that holds within each assignment of a buyer's tasks across its current suppliers: viz. the reallocation of one task at a time within the set of current suppliers does not lead to a strict improvement of the value created. Indeed, the counterfactuals are formed by some of the smallest deviations possible from what is observed—deviations that are compatible with a local optimum that even rather myopic and boundedly rational actors should be able to envision.

procedure allows us to estimate the impact of a change in the supplier's client-specific scope on value creation because it focuses on the variation of client-specific scope in the counterfactuals.

Third, the counterfactual formation rule controls for the heterogeneity among buyers. All exchanges involve reassigning a buyer's tasks to suppliers who are already serving the buyer. Therefore, the interaction terms between buyer attributes (including buyer-task characteristics) and supplier attributes have the same effect on value creation in both the actual and counterfactual configurations.

Fourth, the counterfactual formation rule keeps the demand of the clients constant, as in the actual data. Indeed, reassignments keep the make-or-buy and dual-sourcing decisions of the buyer unchanged. The counterfactual creation method enables creating variation in the client-specific scope but does not require asking what would happen if buyers internalized a task or if they switched from dual sourcing to single sourcing or vice versa.

Lastly, counterfactual assignments are built within the existing relationships between a buyer and its suppliers and do not impose the condition that buyers create new supplier relationships. Reassigning tasks to existing suppliers keeps the focus of the estimation of the effect of variation in client-specific scope. On the contrary, the creation of new collaborations between buyers and other suppliers is required when the focus is on the matching of buyers and suppliers and firms are assumed to have capacity constraints (see, e.g., Fox [2008] for an example).[8]

Notice that the formation of counterfactuals exploits information from the revealed preferences of the players regarding the pairing of suppliers and tasks. Relying on the revealed preferences is one aspect that the method we discuss here shares with discrete choice models. There are, however, major differences between the discrete choice models and the inequalities-based approach. One difference lies in the objective of the estimation. Discrete choice models make inferences about the *likelihood* of a supplier-task pairing to be chosen by a buyer. In contrast, as will become explicit, the inequalities technique estimates the parameters of the underlying joint buyer–supplier value creation function (akin to a "joint payoff") and does not generate probabilistic statements about the observed choices.

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[8] Fox (2007) compares the sum of the value created by two actual buyer–supplier pairs (e.g., A-X and B-Y) to that of pairs where the partners are exchanged (A-Y and B-X). This approach underlies Mindruta's (2012) study of alliance formation.

This divergence in purpose is related to the difference in the assumptions behind the two methods. Discrete choice models are usually derived under the assumption of "utility maximizing behavior" of the decision maker (Train, 2007). In our context, this would mean that the observed task–supplier pairing occurs because the buyer has unilaterally a higher "utility" from assigning the task to supplier i relative to choosing supplier j ($j \neq i$) for that task. On the contrary, the inequalities technique relies on an equilibrium assumption that stipulates that the *joint* value created by a buyer and its actual suppliers cannot be improved upon by making incremental changes, one at a time, in the range of services provided by each supplier for the given buyer. Importantly, these estimation methods also differ on how they handle the distribution of the error terms. To calculate the probability of buyer–supplier–task tie formation, all discrete choice models are bound to make assumptions about the distribution of the error terms. In many settings, these assumptions, such as the independence of irrelevant alternatives, can lead to inappropriate representations of reality, with implications for the reliability of the estimates in the analysis of interdependent buyer–supplier decisions (see discussion in Mindruta et al. 2016, pp. 215-218). On the contrary, the inequalities-based approach does not impose a distribution on the error terms, nor do they assume the independence of irrelevant alternatives, and thus require fewer and less restrictive assumptions for estimation.

Formal definitions

Recall that counterfactual formation involves taking one task at a time and reallocating it to a different supplier, while all other supplier-task pairings remain unchanged for a given buyer. Let *a* denote one of the tasks of buyer *k*. Holding the rest of the allocation of suppliers to tasks constant, one can focus on comparing the value created by the discrete allocation of actual supplier *i* to task *a* with the value of the counterfactual allocation of a supplier *j* to task *a*. Denote n_{ik} the client-specific scope of supplier *i*, i.e., the count of the number of tasks that supplier *i* takes care of for buyer *k*.

The incremental value $\Delta \mathrm{V}_{\mathrm{ik}}^{Actual}(a)$ created by the actual supplier *i* with observed scope of n_i while taking on the n_i-th task *a* of buyer *k* can be written formally as:

$$\Delta V_{ik}^{Actual}(a) = WTP_{ai} - C_{ai} + s_{n_{ik}} + \lambda_{ak} + \varepsilon_{aik} \qquad (1)$$

Equation (1) means that the incremental value created is a function of the buyer's willingness to pay for having supplier *i* on task *a* (WTP_{ia}); the supplier *i*'s opportunity cost for this line of business (C_{ai}); and $s_{n_{ik}}$, the incremental change in value from increasing the client-specific scope of supplier i from $n_{ik} - 1$ (the scope of supplier i if it were not to supply area *a*) to n_{ik} (its actual scope). We also include a buyer-task fixed effect λ_{ak} and an error term ε_{aik}. Note that the error term should be interpreted as representing evaluation errors or any additional information not observed by the researcher that agents take into account prior to deciding on the allocation of tasks.

As it is central to our analysis, the formulation of incremental change s_{n_i} deserves elaboration. Formally, s_{n_i} is the product of the vector $S = (s_2, s_3, \dots, s_N)$ of incremental change of value of client-specific scope for scope breadth of 2 (s_2) up to the maximum possible in the data (s_N), with the supplier-specific vector of indicator variables $D_i = (d_2, d_3, \dots, d_N)$ such that d_n is equal to 1 if the observed scope of supplier i is equal to *n,* and zero otherwise.

In the counterfactual assignment, task *a* is given to supplier *j*. As a result, supplier *j* increases its client-specific scope from an observed n_{jk} to the counterfactual level of $n_{jk} + 1$, which means that we need to include $s_{n_{jk}+1}$, rather than the observed $s_{n_{jk}}$, in the incremental value formula for the counterfactual. Thus, the incremental value that results from giving task *a* to supplier *j* is written:

$$\Delta V_{jk}^{CF}(a) = WTP_{aj} - C_{aj} + s_{n_{jk}+1} + \lambda_{ak} + \varepsilon_{ajk} \qquad (2)$$

The marginal value equations (1) and (2) disentangle the effects of the value creation abilities of each task and the impact of a discrete change in the level of client-specific economy of scope. The terms *willingness to pay* (WTP_{ai}, respectively WTP_{aj}) and *cost* (C_{ai}, respectively C_{aj}) capture the heterogeneity in value creation across suppliers and tasks. In the empirical application, this feature of the model allows for suppliers to be strong in some tasks and weak in others. The terms $s_{n_{ik}}$ and $s_{n_{jk}+1}$ capture the idea that adding an extra task to a supplier's assignment may modify the joint value created.[9] Thanks to these terms, the model allows for the value created to depend on the number of tasks that are carried out by a supplier, in addition to a supplier's ability to create value in any particular task. Moreover, the model is agnostic regarding the sign of the s_n terms, which may be different depending on n. As we discussed, there are two alternative scenarios. If there is an optimal number of tasks to be

[9] The term s_n can be understood as the net marginal impact on value creation due to a one-unit increase in the number of tasks undertaken by a supplier for a given buyer, $s_n = s_n^{WTP} - s_n^{Cost}$. For instance, a positive term $s_n > 0$ means that if a supplier serves n tasks rather than $n - 1$ there is a positive impact on the joint value creation, controlling for other factors.

grouped for a given supplier, we would expect s_n to be positive for lower values of n and decreasing up to the optimal n. Alternatively, suppose that undertaking any additional work involves fixed costs that are not related to the number of tasks a supplier fulfills for any given buyer. In this case we would expect s_n to be negative for any level of n.

The assumption of unrestricted bargaining married with revealed preference implies that, holding other allocations constant, the incremental value created by assigning a supplier to a task is higher in the actual than in the counterfactual allocation:

$$\Delta \mathrm{V}_{\mathrm{ik}}^{Actual}(a) > \Delta V_{jk}^{CF}(a) \tag{3}$$

Equivalently:

$$WTP_{ai} - C_{ai} + s_{n_{ik}} + \varepsilon_{aik} > WTP_{aj} - C_{aj} + s_{n_{jk}+1} + \varepsilon_{ajk} \tag{4}$$

Importantly, the buyer-task effect λ_{ak}, which was on both sides of the inequality, cancelled out. Indeed, these comparisons are made within alternative assignments of tasks to the existing suppliers of each individual buyer, which has the advantage of controlling for unobserved heterogeneity at the buyer-task level and, implicitly, at the buyer level.[10]

Panel 3 of Figure 1 illustrates the pairwise comparison of value creation for the example discussed in panels 1 and 3 of the same figure.

Context and Data: The UK Corporate Legal Market

Context

The empirical context for this study is the UK corporate legal market in the years 2002 to 2006. The corporate clients (i.e., the buyers) are among the 250 largest market capitalizations of the London Stock Exchange and the suppliers are large British law firms (among the top 100 by size) and the London offices of large U.S. law firms.[11]

The data on buyer–supplier relationships come from a survey conducted by *Client Report*, an industry trade magazine targeted at general counsels.[12] The survey was addressed to the general counsels of the corporations belonging to the top 250 largest market capitalizations in the London stock market and produced a very high response rate. General counsels gave the list of their main legal advisers and the legal areas in which they used them (i.e., the tasks). Table 1

[10] For the reader familiar with discrete choice methods, the relevant analogy here is to consider buyer-tasks as "nests."

[11] We use the term "client" for "buyer," "law firm" for "supplier," and "legal area" for "task" when referring to the details of the empirical context.

[12] *Client Report* stopped publication in 2009.

shows one of these lists, detailing the legal supplier base of British Airways in 2005. The first four years of those data were used in Chatain (2011). The classification of legal areas was stable over time and generally accepted and shared across market participants.

In the data, law firm-client relationships typically lasted several years: the average yearly rate of law firm-client relationship termination was only 12.7%. Moreover, clients also typically maintained multiple relationships simultaneously, with each client using an average of 3.76 law firms in a given year over the period. Over the time span of the study, the trend was toward using more law firms, with the average number of law firms per client at 3.17 in 2002 but rising steadily each year, to 4.25 in 2006 (t-test of difference in mean is significant at $p < 0.0001$).

Clients needed advice in 4.48 legal areas on average. The legal areas are those commonly used in the industry and are the same as those used by market research firms. With multiple law firms and multiple areas of work, the structure of the client–law firm interface is quite complex.

On the one hand, law firms are used across multiple areas. A proportion of 35.8% of client–law firm relationships spanned more than one legal area in a given year. These 35.8% of client–law firm relationships that involved a client-specific scope superior to 1 accounted for 59.2% of all area-level observations. In other words, at the finest level of observation (the task, referred to as a legal area in this market), most sourcing decisions are taken against a backdrop of frequent cross-selling. On the other hand, clients sometimes use different suppliers for the same area of legal work. In the *Client Report* survey**,** dual sourcing, whereby a given area of work is divided among several suppliers, concerned 21.7% of the year-firm-area cases.

Moreover, the allocation of areas of legal work to suppliers appears more fluid than the existence of relationships between buyers and suppliers, showing a process of dynamic reallocation over time. At the area level, excluding cases where the need for the area went away altogether, the yearly rate of termination was 26.8%, more than twice the rate of termination of overall relationships (12.7%). Similarly, there was a yearly 40.0% rate of addition of suppliers at the area level.

The emerging picture is consistent with previous research in the same setting (Chatain, 2011) showing that when buyers face a need in a new legal area, they are much more likely to pick one of their existing suppliers rather than an outsider, after controlling for task ability. This is also consistent with work in the U.S corporate legal context (Coates, DeStefano, Nanda, and

Wilkins, 2011) showing that clients purposefully maintain multiple deep relationships with law firms, while at the same time picking for specific areas those they think are the best fit.

To get a sense of the concentration of the procurement and of the role of cross-selling, it is useful to compare the frequency of cross-selling in the data to that of a simulated benchmark where client tasks are randomly and independently allocated to law firms according to the law firms' actual market share for the type of task. This preserves the law firms level of activity, but forces cross-selling to only occur by chance, in effect muting the role of client-specific scope while preserving that of law firms capabilities. Figure 2 compares the actual distribution of client-specific scope (the number of areas a given law firm sells to a given client), where values superior to 1 indicate cross-selling, with the simulated distribution. Strikingly, most of the areas (79.1%) in the simulated data are part of relationships of scope equal to 1 (no cross-selling), while the majority of observed ties (59.2%) are in relationships of scope equal to 2 or more. This comparison demonstrates the existence of forces that make clients and law firms group their activities in way that entails a significant amount of cross-selling. Our empirical analysis will explore why.

=== Insert Figure 2 about here ===

Sample

The constraints imposed by the scope of the estimation and limitations on the availability of cost data restricted the analysis to 5,502 buyer–task–supplier ties (75.5%) out of the 7,291 originally given in the survey, dropping a total of 1,789 ties. Because the method exploits the variation within a buyer's supplier base, we dropped buyers that either used only one firm for all their needs or mentioned only one type of legal need. Moreover, the information on quality and cost was missing for some suppliers mentioned in the survey. The missing data on quality is captured by a dummy variable. We dropped the observations for which cost was not available.

The remaining 119 law firms included in the analysis are the largest and most prominent in the market. To have a sense of the relevance of this population, one can note that in 2005 the 100 largest UK-based law firms had a combined turnover of £9.6 billion.[13] Moreover, in 2004, 21.7% of UK solicitors worked in firms with 81 or more partners (Cole, 2004). A firm with this number of partners would be ranked somewhere between 25th and 50th by revenue. By the same token, in 2004, 37% of UK lawyers practiced in firms with 26 or more partners, while firms in

[13] Fiscal year ending 30 March 2005.

the 90th–100th bracket of the 2005 ranking had 28 to 38 partners. The top 100 law firm rankings therefore capture a large share of the legal business conducted in the UK and, presumably, the lion's share of the corporate legal business. Once the observations not showing the necessary variation for the estimation and those lacking cost data are removed, the average number of law firms considered per client is slightly higher (3.98 vs. 3.77), as is the proportion of ties that are part of law firm-client relationships with client-specific scope superior to one line of service (62.1% vs. 59.2%). The breakdown of legal areas by type remains very similar**.**

Over the five-year span of 2002 to 2006, there were a total of 1,229 answers (out of a possible maximum of 1,250), each constituted by the set of law firms working for a client and the legal areas in which they were involved for this client, for a total of 7,291 year-client-firm-area observations. The set of clients answering the survey changed over time due to changes in market capitalization. In total, 357 different clients were mentioned in the survey, along with 294 different law firms. The number of combinations of legal areas and locations (London, rest of England and Wales, Scotland[14]) is very large. The most commonly found legal area and place was corporate finance in London (17.4% of observations). One law firm garnered 16.1% of the ties, while the average market share was 8.6%. The largest market share in the top 19 legal areas (comprising 80.8% of the ties) was 26.3% (banking in London), suggesting that alternative suppliers were usually available to clients.

Variables

This setting offers fine-grained data on the span of buyer–supplier relationships. Turning to buyers and suppliers themselves, note that our empirical strategy will implicitly include buyer-year fixed effects, removing the need to control for time-varying buyer characteristics.

Quality ratings. As a proxy for willingness-to-pay for expertise, we used the yearly recommendations for law firms in multiple legal areas produced by Chambers and Partners, the parent firm of *Client Report*. We relied on publicly available financial data on the top law firms to construct a proxy for the cost of production. These sources of data are reviewed in turn.

We derived the ratings of quality from the yearly reports published by *Chambers and Partners' Guides to the UK Legal Profession*. Each guide presents the rankings of recommended firms in over 60 areas of law. This guide has been consistently published every year since 1990 and is acknowledged as one of the two leading providers of information about the UK legal

[14] Scotland's legal system is distinct from that of England and Wales.

market. The guide is a result of six months of research (January to June) by a team of 30 lawyers and legal journalists. Firms are ranked within tiered lists. According to Chambers and Partners, the rankings are meant to reflect “technical legal ability, professional conduct, client service, commercial awareness/astuteness, diligence, commitment, and other qualities that the client considers relevant” (Ghosh, 2005). Table 1 gives an example of one of these rankings. We used these rankings to construct the supplier quality rating, which takes values between 0 and 1, with 0 corresponding to the lowest ranking and 1 to the highest. We created a separate dummy variable for suppliers not being listed (no ranking). When the quality ratings are matched to the buyer–supplier relationship data, there is a higher proportion of ties going to suppliers with higher ratings, reflecting a correlation between rating and law firm market share in the FTSE 250. Moreover, although ratings were usually relatively stable over the five-year span of this study, unreported analyses suggest that drops in ratings were associated with a higher likelihood of subsequent buyer–task–supplier tie termination.

=== Insert Table 1 about here ===

Opportunity cost of lawyers. We used financial information available for the top 100 UK law firms and top 25 foreign law firms in London to create a proxy for the cost of providing legal services. We compiled this information from the yearly league tables provided by the trade publications *Legal Business* and *The Lawyer*. We constructed a measure of cost per lawyer, calculated by dividing the total cost of a firm by its number of practicing lawyers, including partners and non-partners. This metric is widely reported in league tables and used in trade journals. The main component of the costs of a law firm consists of salaries for administrative staff members and lawyers who are not partners.

The opportunity cost of these employees can be measured by their salaries, which can be thought of as reflecting their marginal product in the job market and thus the value of their next best use in the economy. They need to be compensated at a competitive level in order to stay in the firm.

In contrast, the opportunity cost of partners is not as easily measured. For our purpose, we will assume it is equal to zero in the short run. The reason is that partners are committed to the law firm and cannot switch jobs as easily as a salaried lawyer, at least in the short run. Moreover, while constructing counterfactuals, we made the assumption that firms were not capacity constrained, which enabled them to take another piece of business if it were available.

The implication is that partners are not working at full capacity and thus that they would not be creating additional value if they did not work for a given buyer. As no value creation is forgone in the short run, the opportunity cost is zero.

As a result, the ratio of total cost to total number of lawyers (salaried lawyers and partners) can be understood as a proxy for the short-run opportunity cost of the firm's main suppliers. While examining buyer–supplier relationships in a given year, we use the previous year's information on rankings. Note that this information is equally available to all agents. Moreover, supplier quality and cost positions are medium- to long-run decision variables, contrary to prices, which can be easily changed and are subject to negotiation.

Relationship-specific experience. In order to account for accumulated relationship-specific experience at the level of the product line, we create a variable that indicates that a spell of relationship is left-censored. We also count the number of years a relationship is observed at the product line level.

Table 2 shows the descriptive statistics and cross-correlations at the business line level for client-specific scope, cost per lawyer, quality rating, no ranking, left-censored relationship, and relationship length.

=== Insert Table 2 about here ===

Estimation

To form the estimator, we first rewrite the marginal value expressions (1) and (2) into their empirical counterparts, replacing each theoretical term by its corresponding variable in the dataset and the parameters to be estimated $(\alpha, \beta, \delta_2, \ldots, \delta_N)$. In a basic specification, the willingness-to-pay component of the formulas becomes $\alpha \cdot Rating_{ai}$ (or $\alpha \cdot Rating_{aj}$), where α is the parameter to estimate. Likewise, the opportunity cost component is replaced by the cost-per-lawyer variable and the parameter β to estimate, $\beta \cdot Cpl_i$ (or $\beta \cdot Cpl_{ji}$). The influence of scope on value creation is measured by the vector of parameters $(\delta_2, \ldots, \delta_N)$ which is the empirical counterpart to the vector $(s_2, \ldots, s_N)$. In keeping with equations (1) and (2), s_{n_i} is replaced by $\delta_{n_{ik}}$ and s_{n_j+1} is replaced by $\delta_{n_{ik}+1}$ in equations (5) and (6).

We thus obtain the following expressions for the empirical counterparts of the marginal value equations:

$$\Delta V_{ik}^{Actual}(a, \Theta) = \alpha \cdot Rating_{ai} - \beta \cdot Cpl_i + \delta_{n_{ik}} + \lambda_{ak} + \varepsilon_{aik}\ , \tag{5}$$

$$\Delta V_{jk}^{CF}(a,\Theta) = \alpha \cdot Rating_{aj} - \beta \cdot Cpl_j + \delta_{n_{jk}+1} + \lambda_{ak} + \varepsilon_{ajk}. \quad (6)$$

Taken together, the expressions (1)- (6) lead to the following inequality:

$$\alpha \cdot Rating_{ai} - \beta \cdot Cpl_i + \delta_{n_{ik}} + \varepsilon_{aik} > \alpha \cdot Rating_{aj} - \beta \cdot Cpl_j + \delta_{n_{jk}+1} + \varepsilon_{ajk} \quad (7)$$

In the estimation procedure we seek to find the set of parameters $\Theta = (\alpha, \beta, \delta_2, \ldots, \delta_N)$ that satisfies the highest number of inequalities (7) in the data. Technically, the estimates are those that maximize the following objective function:

$$Q(\Theta) = \sum_{k\in K} \sum_{a\in A_k} \sum_{i\in M_{ak}} \sum_{j\in M_k/\{i\}} \mathbf{1}\left\{\Delta V_{ik}^{Actual}(a,\Theta) \geq \Delta V_{jk}^{CF}(a,\Theta)\right\} \quad (7)$$

In this equation, K is the set of buyers, M_{ak} is the set of suppliers serving buyer k, A_{ik} is the set of tasks that supplier i is fulfilling for buyer k and $\mathbf{1}\{\cdot\}$ is an indicator function, equal to 1 when the expression in brackets is true, and 0 otherwise. The indicator function $\mathbf{1}\{\cdot\}$ takes a value of 1 if for parameters $\{\alpha, \beta, \delta_2, \ldots, \delta_N\}$, the inequality $\Delta V_{ik}^{Actual}(a,\Theta) \geq \Delta V_{jk}^{CF}(a,\Theta)$ is true. The function $Q(\Theta)$ then sums these indicator functions over all tasks and all buyers.

The function $Q(\Theta)$is a step function. To find its maximum (and thus, the coefficient estimates for which the maximum is attained), we follow Santiago and Fox (2008) and apply the differential evolution algorithm (Storn and Price, 1997). We compute the confidence intervals around the point estimates using the subsampling procedure (Politis, Romano and Wolf, 1999), which gives consistent estimates for the maximum score estimator.[15] We implement the estimation in Mathematica 10.0 by adapting the toolkit developed and made available by Santiago and Fox (2008).

As we already noted, the estimator relies on minimal conditions on the error term: the assumption that needs to be true regarding the ε_{ikl} terms is that of rank order property for probability of choice. Rank property states that when comparing two alternatives, the one with the highest value, net of the error term, has a higher probability of being selected.[16] Thus, the rank property is compatible with the theoretical assumptions of a value-creation value-capture

[15]Subsampling is a procedure that involves drawing samples without replacement, while the bootstrap draws samples with replacement. The bootstrap is inconsistent when used with a maximum score estimator (Abrevaya and Huang, 2005). Subsampling is a more conservative approach, requiring weaker assumptions on the distribution of the unobservables, but as a result converges at a lower rate (cube root of sample size) than the bootstrap (square root).

[16]Formally, the distribution of the ε_{aik} and ε_{ajk} should be such that if $WTP_{ai} - C_i + s_{N_{ik}} > WTP_{jl} - C_j + s_{N_{jk}+1}$ then $\Pr(i \text{ is chosen}) > \Pr(j \text{ is chosen})$, but no more requirement is imposed.

model. Importantly, the method does not impose a specific distribution on the error terms, and arbitrary patterns of heteroskedasticity are permitted (Horowitz, 1998: 71).

The estimator is consistent, even when it is only used over a subset of the choices available (Fox, 2008). Further, the estimator performs well in small samples and situations where the logit model is misspecified (Fox, 2008).[17]

The estimator requires a scale normalization on the vector $\Theta = (\alpha, \beta, \delta_2, \ldots, \delta_n)$ (Fox, 2010).[18] We follow the standard procedure and impose that one coefficient (here, the coefficient α of the rating variable) has the value of ± 1, which will scale the other coefficient estimates. The sign of this coefficient is identified by choosing it to be the sign that yields a better fit of the model. To this purpose, we run each model specification twice, once for α =1 and once for α =-1, and we choose the sign returning a higher number of predicted inequalities. As expected, the positive sign of the rating always leads to a better model fit in our sample, consistent with the expectation that supplier rating has a positive impact on value creation.

Results

Results are shown on Table 3. In column 1, we start with a baseline model including quality rating as the scaling factor, the cost per lawyer, and a dummy for the case when the law firm is not ranked at all. The 95% confidence interval for the cost per lawyer variable is entirely below zero.

In column 2, we introduce further variables to account for the length of a relationship between a law firm and its client, so we can take advantage of the panel nature of the data. The effect associated with the left-censored variable, which picks up the possibility that there is already an ongoing relationship of unknown length between the law firm and the client, is positive, of limited magnitude. The limited magnitude is not surprising as the variable is pooling both existing long-lasting relationships and relationships that have just started. The relationship length variable counts the number of years a relationship has been observed in the data between the law firm and the client. It seems indistinguishable from zero at conventional levels of significance. Cost per lawyer remains negative (95% confidence interval [-3.38, -0.39]).

[17] The maximum score estimator was originally developed for a discrete choice model by Manski (1975). Fox (2007, 2008, 2010) develops this line of research and shows that the maximum score estimator can be used for estimations based on necessary conditions formulated as inequalities.

[18] The scale and variance are not identifiable in discrete choice models either and also need a normalization.

=== Insert Table 3 about here ===

Column 3 refines the analysis of relationship by introducing the possibility of a non-linear effect with a squared relationship length as a variable. The magnitude of the effect is very small, even if it sits in the 90% confidence interval away from zero. Moreover, the explanatory power of the model (percentage of inequalities correctly predicted) is virtually unchanged at about 77%. While we cannot rule out these effects, they do not seem explain enough of the phenomenon, and we will not pursue this path further.

In column 4, we introduce the main set of variables of interest: dummy variables capturing the incremental benefit from changes in client-specific scope when moving away from the observed level of scope (breadth) of the relationships. These are the variables δ_2 to δ_5, with δ_n estimating the value created or lost if client-specific scope attains *n,* starting from *n*-1. Notice that because there are few instances when the client-specific scope of a law firm is higher than 5 in the data, we created one dummy (δ_5) to capture all changes in scope higher than 5.

The introduction of dummy variables markedly improves the fit of the model. Now, 87% of the inequalities are correctly predicted. All coefficients are strongly negative, with magnitude above 1, which means that scope extension has more impact on value creation than an improvement in reputation rating that would take a firm from not ranked to the top of the rankings. Moreover, the 95% confidence intervals are all clearly bounded away from zero. Meanwhile, the estimated coefficient for costs and not being ranked become hard to distinguish from zero, while the left censored variable keeps its magnitude.

In unreported analyses, we restricted the sample to counterfactuals involving either the more reputed law firms or those with a history of repeated transactions with the focal client. By focusing on law firms that clients have arguably the most information on, our goal was to test whether the results were sensitive to the definition of the set of alternatives that the clients might consider. The results were similar to those involving the full sample, indicating that our main results are not driven by the inclusion of potentially irrelevant counterfactuals.

These estimates, which by construction take into account the value creation alternatives available in a configuration of client–law area–supplier, suggest that a lot of value is lost in the relationships by increasing marginally the scope of the supplier. This is consistent with the idea that incremental benefits from scope become gradually exhausted until they become smaller than the inevitable, though small, fixed costs associated with scope extension.

Note that this result is not mechanically resulting from the way the estimates were calculated. Under the null hypothesis, the observed scope could be explained only by the merits of each firm in terms of quality, cost, and relationship length, such that the existing scope levels would not matter for value creation. Accordingly, the estimates of scope increase variables would be equal to zero as the current preferences for the allocation of suppliers to tasks would be purely explained by variables other than client-specific economies of scope. As we discussed, there are two other plausible scenarios in the buyer–supplier setting. In a first scenario, if scope extensions (net of intrinsic quality and costs) are triggered by better ability to create synergies at higher levels of client-specific scope, we could plausibly observe small positive values for the coefficients capturing the increase in scope. Under such a scenario, broader scope would still be beneficial at the observed margin, but no more extension would happen, because of the lack of intrinsic ability of suppliers in the areas they do not serve (as measured by the rankings). Nonetheless, positive coefficients with a large magnitude would be difficult to rationalize, as they would imply that large economic gains are left on the table and/or that the supplier base should have been even more concentrated.

In a second scenario, it is possible to envision that scope extensions might already destroy value at lower levels of operation, but that these value losses are still less costly than the alternative of creating a new relationship from scratch. Here, we would expect a negative impact on value creation of the marginal scope increase. We will probe this explanation later when we estimate a lower bound on the cost of creating a relationship.

While the results of column 4 strongly suggest that there are no more gains (but actually negative gains) to scope expansion beyond the observed levels in the sample, these leave open the question of the nature and magnitude of the marginal gains to a wider client-specific scope on value creation. Indeed, while scope extensions *beyond the observed scope* are value destructive, it does not mean that this is also necessarily the case for scope extensions at *lower levels* of breadth (i.e., when suppliers are executing one or a small number of tasks for a buyer). By design, the thought experiment underlying our estimates does not formally estimate how changes in client-specific scope affect value creation when these changes are far away from the observed levels of client-specific scope. This is because the changes we estimate are by construction only of one line of business more or less than what is observed.

However, we can attempt to estimate whether there is a total effect of breadth on value creation by estimating a model where the breadth of scope is introduced as a variable. We cannot include it simultaneously with the dummies for scope extension due to collinearity issues. This will help us test if there is an intrinsic preference for breadth, keeping in mind that the marginal return of scope increase is negative. The results, presented in column 5, show a negative, but not different from zero, total effect of scope (number of lines served) on value. The overall zero coefficient could be interpreted as the sum of positive effects up to the point where they become negative, as found in the previous regressions. This would imply that there are moderate positive effects across product lines when clients and suppliers gradually increase the breadth of their relationship, but that these effects are exhausted at the observed level of scope.

APPLICATION: USING THE ESTIMATES TO ASSESS STRATEGIC DECISIONS

A natural way to use the empirical estimates of the factors driving value creation to better understand competition in the UK corporate legal market is therefore to use them in conjunction with simple cooperative games. We now analyze a few fictional situations involving buyers and suppliers in the UK legal market. The goal is to show how the estimates from the previous section can be used to provide concrete advice to firms involved in competitive interactions.

Seizing a new opportunity and the cost of creating a new relationship

When a buyer has a new legal need, a new opportunity is offered to its existing suppliers. However, this opportunity represents a new competitive ground as suppliers vie to capture it. Factoring in both capability and scope can help us understand better for whom, and to what extent, the new opportunity can be profitable. Consider the example depicted in Table 4

=== Insert Table 4 about here ===

. The buyer has had needs for three areas of business (i.e., tasks; columns 1 to 3) and now needs services in another area 4 (column 4). It is currently using two suppliers. Each cell of the table gives the rating and cost of a supplier's work in a given area. An X designates when a supplier is actually working on the task for the buyer. We see that supplier 1 works on task 1, while supplier 2 works on tasks 2 and 3.

For simplicity we assume that all the error terms in equation (1) and (2) are equal to zero. In this example, supplier 1 is serving the buyer in area 1, while supplier 2 is serving the buyer in areas 2 and 3. Notice that this arrangement is value maximizing assuming that the cost of creating a buyer–supplier relationship is sunk. Cost variables are set at identical values across suppliers so that they do not affect decisions. The ratings for suppliers 1 and 2 are, for the moment, left at unspecified values $Rating_1$ and $Rating_2$, respectively.

Given current scope and capabilities, which supplier can expect to be better placed to profitably serve the buyer in area 4? Compare the increments of value that each supplier would be able to create if it were to serve area 4 in addition to those it already serves, using rounded values of the estimates from model 5 of Table 3.

Supplier 1's incremental value created is superior to that of supplier 2 if and only if:

$$Rating_1 - \beta \cdot Cost + \delta_2 > Rating_2 - \beta \cdot Cost_2 + \delta_3$$

$$Rating_1 - \beta \cdot Cost - Rating_2 + \beta \cdot Cost_2 > \delta_3 - \delta_2$$

The combined quality and cost advantage of supplier 1 over supplier 2 should be more than the difference between dis-synergies associated with a scope increasing to 3 for supplier 1 and to 2 for supplier 2 (i.e., $\delta_3 - \delta_2$).

Replacing the symbols by the estimated values, the condition can be rewritten as:

$$Rating_1 - Rating_2 > -1.80 + 1.85 = 0.05$$

This gap in ratings can be compared to the standard deviation of 0.30 found for the quality variable in the sample. The comparatively lower increase in dis-synergies that supplier 2 would have to deal with only gives it a minimal advantage. Unless the gap in quality between the two suppliers is relatively high, the buyer will be able to extract a lot of value by pitting the two suppliers against each other.

Now modify the example so that supplier 2's scope is equal to 3 (instead of 2). In that case, the capability advantage required so that supplier 1 is creating more value is equal to:

$$Rating_1 - Rating_2 > \delta_4 - \delta_2 = -1.48 + 1.85 = 0.37$$

This is a much higher hurdle to overcome. At that level of client-specific scope, supplier 2's incremental penalty from scope expansion (-1.48) is lower than supplier 1's (-1.85), which represents a substantial gap of 0.37—more than one standard deviation in the rating measure. Because it has a wider client-specific scope and there are some relative increasing returns associated with broader scope, supplier 2 has an advantage.

Estimating the cost of creating a new buyer–supplier relationship

Armed with these estimates, we can calculate lower bounds for the cost of adding another buyer–supplier relationship and expending the set of alternative suppliers. To do so, we start from the following observation: If client-specific scope extensions are value reducing, as we found in the previous analyses, and yet buyers are not taking steps to restrict supplier's client-specific scope, the implication is that the cost of expanding scope is less that that of creating an additional buyer–supplier relationship.

This would be true for the simplest case that consists of reducing the scope of an existing supplier from *n* to *n*-1 and adding a new supplier with client-specific scope equal to 1. Formally, consider the value creation of actual supplier *i* with overall client-specific scope n_i in line a, and compare it to the alternative of creating a relationship with supplier *j* at cost *R*. Omitting fixed effects (which cancel out) and assuming other unobservables are equal to zero, we have:

$$WTP_{ai} - C_i + s_{n_i} > WTP_{aj} - C_j - R$$

$$R > -s_{n_i} + \left(WTP_{aj} - WTP_{ai}\right) + \left(C_i - C_j\right) \qquad (3)$$

This inequality is valid for all instances of one supplier having a client-specific scope equal or superior to two lines of business and defines a lower bound R^{LB} on *R*.

We can make several assumptions on the extent of the difference in value creation between *j* and *i*, net of scope effects. A neutral assumption is to consider that the buyer could find a similar supplier so that $WTP_{ai} – Cost_j = WTP_{aj} – Cost_i$. Another, more optimistic assumption is that the buyer could establish a relationship with the best alternative supplier possible, the one for which WTP_{aj} - $Cost_j$ is maximum among all suppliers.

Taking these assumptions to the data with the estimates from model 4 of Table 3, we can compute a lower bound for the cost of creating a relationship in the status quo scenario of no improvement in supplier value creation ($R^{LB}_{Status\ Quo}$), and another, tighter (i.e., of superior value), lower bound in the best alternative supplier scenario ($R^{LB}_{Best\ Alternative}$). Table 5 shows the results of these calculations, and Figure 3 shows the empirical cumulative distribution of the values for the lower bounds. The mean value for $R^{LB}_{Status\ Quo}$ is 1.74, and that for $R^{LB}_{Best\ Alternative}$ is 2.09. These are substantially high values, given that they are expressed in units of quality rating, with the value of 1 corresponding to the gap between the lowest-ranked firm and the top firm.

=== Insert Figure 3 and Table 5 about here ===

DISCUSSION AND CONCLUSION

Implications for value creation in vertical relationships and supplier horizontal scope

Understanding the link between value creation and a firm's horizontal scope choices is of fundamental importance to business strategy, as it contributes to heterogeneity in firm performance. In this paper, we focused on one specific aspect of this broad question by looking at how the breadth of services delivered to a client by a supplier (i.e., a supplier's client-specific scope) influences value creation. Perhaps surprisingly, we showed that conditional on the existence of a buyer–supplier relationship, an increase in supplier client-specific scope reduces value creation at the margin. This result holds across the full range of client-specific breadth of services observed in the data, and the estimates are net of willingness to pay for supplier services and opportunity costs. This implies that taking over a new task is not a trivial business and requires significant effort and learning, all consuming time and resources, even if the client is already well known.

While it is commonly argued that suppliers vie to expand the number of areas they serve for a client in order to benefit from synergies enabled by better coordination across multiple lines of business, our results indicate that the effect of scope expansion on value creation is subtler. As our analyses also imply a large cost of creating a relationship in the first place, before any scope extension, we can offer a solution to the puzzle of finding that client-scope extensions are reducing value, while also observing systematically broader client-specific scope than chance would allow. We suggest that observed levels of client-specific scope are the result of two opposing forces: the dis-synergies in scope extension push toward spreading out services among more suppliers, but the cost of creating a buyer–supplier relationship puts a limit on how many relationships can be created and entertained at the same time.

Where are these dis-synergies of scope extension coming from? Their presence is consistent with the existence of non-trivial adjustment costs associated with extending the scope for a client. These costs could be due, for example, to the need of getting familiarized with the different parts of the client's business. They can also occur due to limited time or attention resources from key individuals on the supplier side, such that extending a relationship is almost like creating a new one. That these adjustment costs are so high is quite surprising, especially in light of the fact that suppliers already have a relationship with the client (which accounts for the costs associated with the acquisition of general knowledge about the client), and may mean that general knowledge is sticky and not easy to transfer, even within the boundaries of a supplier.

Why do scope extensions occur in spite of the patterns of dis-synergies found in the value creation function? Our analysis suggests that suppliers may achieve scope economies at the level of the relationship by economizing on the cost of creating a relationship in the first place, rather than by reducing costs within the existing relationship. Indeed, starting a new relationship is subject to set-up costs and our analysis estimates the lower bounds of these costs as substantially high. Some of these costs can be due, for example, to the need to invest in relationship-specific assets, routines, and knowledge (Crawford, 1990; Dyer and Singh, 1998). Furthermore, forming new relationships may also be subject to higher governance-related costs than continuing an existing relationship, as new ties occur under the shadow of potential holdup (Klein, 1996). Such relationships can be seen as governed by a relational contract (Baker, Gibbons and Murphy, 2002; Board, 2011). In Board's (2011) formal model, the cost of creating a new relationship can be interpreted as a manifestation of a buyer's deliberate bias toward current suppliers in order to reduce the probability of holdup by guaranteeing them enough value capture if the relationship is sustained. By implication, the high cost of creating a relationship that we find in our analysis could be a combination of (1) real costs (time and resources) for creating relationship-specific assets, and (2) governance-related bias toward insiders that manifests itself as an additional cost in the estimation.

While such interpretation in terms of relational contracts emphasizes the rationality of such bias, another interpretation is that this bias represents a form of cognitive lock-in (Uzzi, 1997). However, qualitative evidence in a similar context pictures astute clients who are consciously maintaining a balance of close relationships (and thus bias toward insiders) and competition between insiders when it comes to allocating specific pieces of work (Coates et al, 2011), which gives less credence to a cognitive lock-in interpretation. In sum, even though we are not able to fully untangle the mechanisms driving the effects of dis-synergies and new relationship creation on value creation, we are nevertheless showing that several opposing forces are simultaneously at play.

Future research can help further unpack these mechanisms and enrich those that are taken into account in the analysis. Two venues are worth investigating. The first is to produce a finer-grained understanding of the value of co-specialization between buyers and suppliers. For this, measures of the potential for co-specialization at the level of the product could be introduced, as in Elfenbein and Zenger (2014). The second is the exploration of the sources of complementarities between tasks. This could also be easily introduced, in the same revealed preference framework, by adding indicator variables for additional value created (or destroyed) when the same supplier does two specific types of tasks.

Implications for empirical work in value-based strategy

These results speak to the inter-firm relationship literature, but the paper's broader motivation is to demonstrate how combining the fundamental assumptions of value-based strategy with the logic of revealed preference can enable further empirical progress. Taking a revealed preference approach that explicitly incorporates basic theoretical insights from biform games is a useful and practical perspective for applied strategy research. By exploiting the information in the completed transactions and systematically analyzing how they differ from well-defined counterfactuals, this approach makes it possible to estimate the relative importance of various drivers of value creation.

In addition to buyer–supplier relationships, the methods developed in this paper can be applied to most datasets listing observed relationships in supply chains, network of firms and ecosystems. The essential data requirements are observations of existing trading relationships and identification of a set of credible potential counterfactuals. In this respect, our empirical method follows a similar heuristic to that underlying recent theoretical work by Gans and Ryall (forthcoming) and Montez, Ruiz-Aliseda, and Ryall (2013) that relies on the comparison of an observed set of relationships with simple counterfactuals to assess the effect of competition on value capture.

Implications for practitioners

This work also has implications for practitioners. We showed that the estimates can be used to analyze strategic interactions "out of the sample." With the parameters estimated from data taken from real situations, simple cooperative games can be analyzed to understand the challenges faced by the different players. For instance, it is possible to quantify the trade-offs between value creation from capability and from client-specific scope, which makes possible an understanding of the relative strength of firms in different competitive scenarios. Matching these analyses of the competitive environment with an internal analysis of what a given firm can do and at what costs would provide a complete picture of the trade-offs a firm faces and would be a valuable input for decision making with respect to resource allocation and organizational commitments.

Conclusion

In this paper we developed and applied a new set of empirical tools for scholars in the value-based stream of research. We relied on the idea that "no good deal comes undone," a foundational principle of the value-based approach, to develop empirical analyses relying on revealed preferences to estimate drivers of value creation. Thanks to this novel approach, we analyzed data on buyer–supplier relationships in the UK corporate legal market and uncovered evidence for mechanisms that traditional methods could not easily distinguish from each other. Future work could rely and expand on this methodology in many settings of interest to strategic management and provide estimates of drivers of value creation that are theoretically consistent with the competitive assumptions of the value-based framework.

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TABLES

Table 1. British Airways' suppliers of legal services (2005)

Law firm (supplier)	Area of legal service (task)
Addleshaw Goddard	Commercial
Addleshaw Goddard	Employment
Addleshaw Goddard	TMT
Baker & McKensie	Employment
Bristows	IP
Gates & Partners	Aviation
Gates & Partners	Insurance
Slaughter and May	Corporate finance
Slaughter and May	Projects
Slaughter and May	Tax
Slaughter and May	Commercial
Wragge & Co LLP	IP
Wragge & Co LLP	Litigation
Wragge & Co LLP	Property

Table 2. Descriptive statistics and correlation table

	Variable	Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)
(1)	Client-specific scope	2.22	1.31	1	9	1				
(2)	Cost per lawyer	0.16	0.04	0.05	0.47	0.05	1			
(3)	Quality ranking	0.69	0.30	0	1	-0.03	-0.05	1		
(4)	Not ranked	0.09	0.29	0	1	0.04	0.05	-0.73	1	
(5)	Left-censored rel.	0.79	0.41	0	1	0.17	-0.01	0.08	-0.11	1
(6)	Relationship length	2.36	1.33	1	5	0.22	0.08	0.13	-0.09	0.22

Table 3. Estimation results

Model	(1)	(2)	(3)	(4)	(5)
Quality rating	+1	+1	+1	+1	+1
	N/A	N/A	N/A	N/A	N/A
Cost per lawyer	-1.34	-1.20	-1.22	-0.21	-0.27
	[-3.47, -0.62]	[-3.38, -0.39]	[-3.27, -0.42]	[-2.91, 0.62]	[-4.72, 0.95]
Not ranked	-0.15	-5.23	-4.23	-0.33	-3.80
	[-0.33, 108.81]	[-8.50, -1.40]	[-6.78, -0.23]	[-0.52, 0.11]	[-5.36, 4.48]
Left censored		0.24	0.21	0.39	0.46
		[0.07, 0.62]	[-0.01, 0.57]	[0.05, 0.86]	[-0.55, 1.03]
Relationship length		-0.04	-0.28	-0.06	-0.07
		[-0.30, 0.06]	[-0.81, 0.04]	[-0.31, 0.11]	[-0.41, 0.15]
Relationship length squared			0.05		
			[-0.01, 0.14]		
δ_2				-1.85	
				[-2.23, -1.32]	
δ_3				-1.80	
				[-2.22, -1.23]	
δ_4				-1.48	
				[-1.89, -0.97]	
δ_5 and more				-1.49	
				[-1.90, -0.97]	
No. of other areas served					-0.45
					[-0.57, 0.47]
No. inequalities	17763	17763	17763	17763	17763
No. inequalities satisfied	13615	13658	13662	15409	14345
Percentage inequ. satisfied	76.6%	76.9%	76.9%	86.7%	80.8%
Estimation time	2.29	7.86	11.82	13.54	11.32
Number subsamples	1000	1000	1000	1000	1000
Subsampling time	1077.35	3012.44	4693.72	6708.20	4819.24

Note: Subsampled asymmetric 95% confidence intervals in brackets.

Table 4. Current allocation of tasks to suppliers and supplier characteristics

		Buyer's needs per task							
		Current needs						New need	
Supplier		Task 1	Observed	Task 2	Observed	Task 3	Observed	Task 4	Observed
Supplier 1	Rating	1.0	X	0.2		0.0		Rating_1	?
	Cost	0.16		0.16		0.16		0.16	
Supplier 2	Rating	0.0		0.4	X	1.0	X	Rating_2	?
	Cost	0.16		0.16		0.16		0.16	

Table 5. Implied lower bounds on cost of search and relationship creation

Lower bound	Mean	Median	Min.	Max.
$R^{LB}_{Status\ Quo}$	1.74	1.80	1.48	1.85
$R^{LB}_{Best\ Alternative}$	2.09	2.03	1.48	3.73

Notes: The estimations are scaled by the quality variable. The lower bound on the cost of entry is obtained by computing the value that would be saved by reducing the scope of a current supplier if its scope is 2 or more, and substituting it by an outside supplier. The logic is that the cost of search and relationship creation has to be at least as high as this figure to rationalize why buyers are not creating an extra relationship with a supplier. In the calculations for $R^{LB}_{Status\ Quo}$, the outside supplier is assumed to create as much value as the supplier currently serving the buyer. In the calculations for $R^{LB}_{Best\ Alternative}$, the outside supplier is assumed to be the best in the market in terms of quality–cost wedge. The estimates from model 4 of Table 3 were used to quantify the contributions of quality and cost to value creation. A total of 3,415 cases were used.

1. Observed configuration for a given buyer

Buyer *k,* suppliers 1, 2, 3 and tasks A, B, and C

Assignment		Tasks A	Tasks B	Tasks C
Observed:	Supplier(s)	1	1, 2	3

2. Creation of counterfactuals most similar to observed configuration

One single task assigned differently from the observed configuration

Counterfactual assignments		Tasks A	Tasks B	Tasks C
CF 1:	Supplier	$\boxed{2}$	1, 2	3
CF 2:	Supplier	$\boxed{3}$	1, 2	3
CF 3:	Supplier	1	$\boxed{3}$, 2	3
CF 4:	Supplier	1	1, $\boxed{3}$	3
CF 5:	Supplier	1	1, 2	$\boxed{1}$
CF 6:	Supplier	1	1, 2	$\boxed{2}$

One supplier takes one more task, another loses one

$\boxed{}$ Task that is allocated differently from the observed configuration in the counterfactual

3. Pairwise comparison of value creation: observed vs. counterfactual

Each counterfactual provides a comparison to the observed allocation that is used to create necessary conditions

ΔV^{Actual} (Observed: A by Firm 1) > ΔV^{CF} (CF 1: A by Firm 2)

ΔV^{Actual} (Observed: A by Firm 1) > ΔV^{CF} (CF 2: A by Firm 3)

ΔV^{Actual} (Observed: B by Firm 1) > ΔV^{CF} (CF 3: B by Firm 3)

ΔV^{Actual} (Observed: B by Firm 2) > ΔV^{CF} (CF 4: B by Firm 3)

ΔV^{Actual} (Observed: C by Firm 3) > ΔV^{CF} (CF 5: C by Firm 1)

ΔV^{Actual} (Observed: C by Firm 3) > ΔV^{CF} (CF 6: C by Firm 2)

Necessary conditions for observed allocation to create more value than counterfactuals

Figure 1. Creation of counterfactuals from observed data.

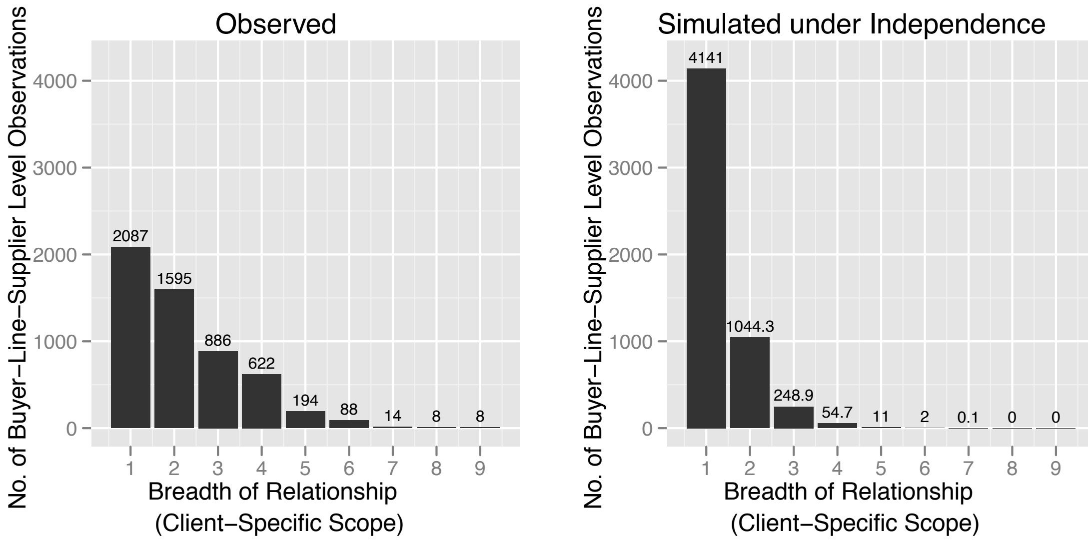

Figure 2. Observed and simulated client-specific scope.

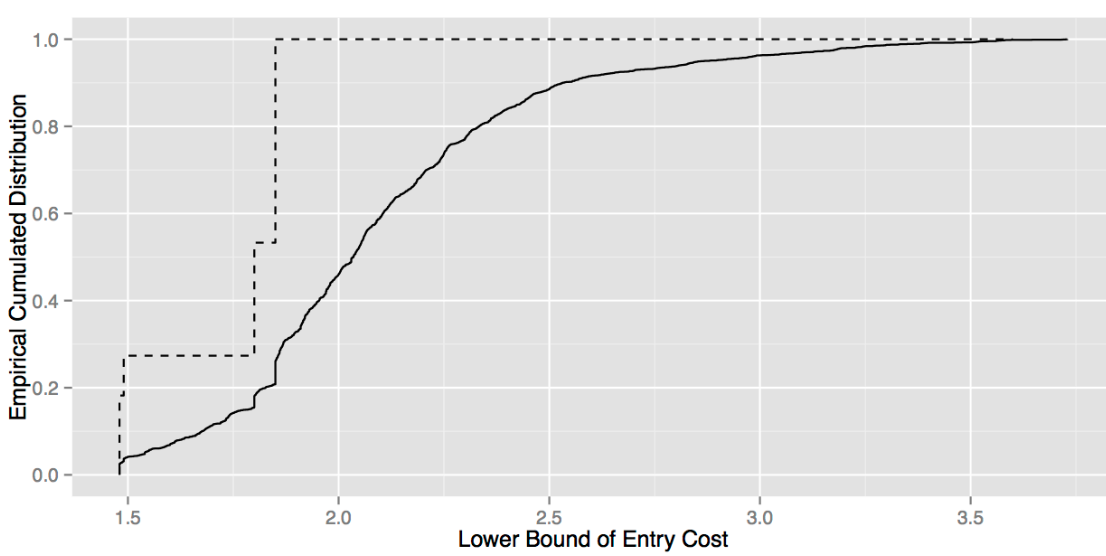

Figure 3: Empirical cumulative distribution function for lower bound of entry cost with best possible alternative supplier (solid line) and status quo supplier (broken line). The graph reads as follows: To explain 75% of the observed cases where there is no new relationship created, the cost of creating a new relationship needs to be at least equal to 1.85 if a new supplier is just as good as the existing one (broken line), or at least equal to 2.26 if the best outside supplier can be reached, and all errors terms are equal to zero.