How Do Plural-Sourcing Firms Make and Buy? The Impact of Supplier Portfolio Design

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ABSTRACT

This paper uses the notion of contracting strategy to advance research in plural sourcing. We develop and test a theoretical framework to explain how plural-sourcing firms strike the make-and-buy balance depending on their contracting strategy. The focal firm's choice of a contracting strategy is associated with a specific supplier portfolio design, with a bargaining-based strategy resulting in many, narrowly capable suppliers with short tenure, and a relationship-based contracting strategy resulting in fewer, broadly capable suppliers with long tenure. Focal firms with the latter strategy incur lower overall contracting costs than those with the former, and therefore outsource more. Focal firms seek to influence contracting costs associated with their supplier portfolio for "nearly the same inputs" and "nearly the same suppliers". Empirical analysis corresponding to the two levels, namely patent prosecution and legal services at *Fortune 500* firms, provide consistent support for our theory.

Keywords: make-and-buy decisions; plural sourcing; supplier portfolio design; contracting strategy; contracting costs; legal services.

INTRODUCTION

An important issue for firms that rely on knowledge-intensive and complex inputs is the optimal mix of making and buying such inputs. How do firms decide how much to make and how much to buy? Existing literature on plural sourcing provides a useful lens to explore this issue. Scholars have long recognized that focal firms do not make simple dichotomous choices between internal production and external sourcing. Instead, firms often both make and buy the same input. Prior studies identify preconditions for plural sourcing, including demand fluctuation (Adelman 1949), technological volatility (Krzeminska et al. 2013), information asymmetry (Dutta et al. 1995; Heide 2003; Heide et al. 2014), and complementarity in knowledge and incentives (Parmigiani 2007; Puranam et al. 2013).

Building on studies explaining the emergence of plural sourcing ("under what circumstances does it occur?"), recent work also tackles the issue of optimal mixes ("how do firms determine the balance between making and buying?") (Puranam et al. 2013). However, little attention has been paid to the impact of transactional interdependencies in the focal firm's supplier portfolio. For instance, how does the make-and-buy balance shift when plural-sourcing firms choose to buy the same input from a single supplier rather than multiple suppliers?

We develop a theoretical framework to answer such questions by exploring heterogeneity in focal firms' design of their supplier portfolio. When firms exchange complex inputs, writing and

enforcing complete contracts are difficult or impossible. In these circumstances, a focal firm adopts different contracting strategies, equally legitimate and sustainable, to guide choices about its supplier portfolio. We can locate that choice on a continuum. At one extreme, the focal firm may adopt a bargaining-based contracting strategy. It chooses suppliers to increase its bargaining power by reducing commitment, dependence, and switching costs (Inkpen and Beamish 1997; Lippman and Rumelt 2003; Pfeffer and Salancik 1978). At the other extreme, the focal firm may opt for a relationship-based contracting strategy. It encourages suppliers to build commitment, reputation, and trust (Baker et al. 2002; Carson et al. 2006; Macaulay 1963; Sako 1992).

The adoption of a contracting strategy has important consequences for the plural-sourcing firm's supplier ties and its make-and-buy balance. A supplier portfolio located towards the relationship-based extreme results in lower contracting costs and hence more buying than making. A supplier portfolio closer to the bargaining extreme, by contrast, leads to higher contracting costs and more making than buying. These costs include not only "Williamsonian" transaction costs (Williamson 1985), but also "mundane" and "dynamic" costs (Baldwin 2008; Langlois 1992, 2006). We use the term "contracting" rather than "transaction" costs because the relevant costs are associated with a a series of transactions, not a single transaction. Our theoretical framework therefore builds on prior work concerning governance inseparability (Argyres and Liebskind 1999) and knowledge and reputational spillovers across transactions (Mayer 2006). In particular, we identify interdependencies at two levels of analysis, namely for "nearly the same inputs" and "nearly the same suppliers".

To test our framework we study how *Fortune* 500 companies make-and-buy legal services, an apt context involving the exchange of complex, knowledge-intensive, and client-confidential matters. We analyze two panel datasets, patent prosecution and corporate legal services, corresponding to the two levels of analysis. Consistent across the two datasets, we find that *Fortune 500* firms with fewer, more stable, and more broadly capable suppliers tilt their make-and-buy balance in favor of buy, while those with many, less stable, and narrowly capable suppliers tilt the balance in favor of make. However, we find in both datasets that focal firms with a combination of high supplier concentration and stability insource more to mitigate the risk of supplier over-reliance.

Our study contributes to research on plural sourcing and firm boundaries in a number of ways. First, we make a theoretical contribution by highlighting the impact of supplier portfolio design on the make-and-buy balance. To our knowledge, the plural sourcing literature, to date, has not linked its theorizing to focal firms' contracting strategies involving choices about supplier portfolio design. Taking explicit account of such firm choices helps us identify heterogeneity in sourcing strategies and improves the existing theories of the firm (Aral et al. 2012). Second, our theoretical framework highlights the importance of examining three types of contracting costs, namely "Williamsonian" costs arising from supplier opportunism (Williamson 1985), "mundane" costs and "dynamic" costs (Baldwin 2008; Langlois 1992, 2006). We theorize how each dimension of supplier portfolio design, namely supplier concentration, stability, and capability scope, affects the three types of contracting costs differently. These effects would be missed out if we were to analyze one transaction or dyadic (focal firm – supplier) relationship at a time. Third, we contribute theoretically and empirically to plural sourcing research by identifying two levels of analysis, "nearly the same inputs" and "nearly the same suppliers". We demonstrate empirically in a novel context of legal services that the impact of supplier portfolio design on plural sourcing decisions is consistent across the two levels of analysis.

RESEARCH BACKGROUND

Plural sourcing is a strategy to simultaneously employ multiple governance modes for the same input. It therefore differs from more conventional make-or-buy decisions resulting in an exclusive choice of sourcing strategy (e.g., make, buy, or ally) for a given input. Even hybrid governance, for example alliance or "quasi-integration" (Zaheer and Venkatraman 1995), is applied to the entire volume and is a single mode with mixed governance characteristics. Plural sourcing, by contrast, requires the management of more than one governance modes: one governing how a focal firm makes things internally, the other governing how a focal firm buys things externally, and some over-arching meta-governance to guide where to strike this make-and-buy balance.

Substantial prior work explains when and why plural sourcing emerges. One set of explanations focuses on uncertainty. In particular, demand fluctuations motivate firms to maintain both internal and external production capacity (Adelman 1949), while technological volatility enhances firms' incentive to access new ideas via plural sourcing (Jacobides and Billinger 2006; Krzeminska et al. 2013). A

second set of explanations focuses on bargaining and monitoring. Firms may create internal production capacity so that it can bargain hard with suppliers by credibly threatening backwards integration (Harrigan 1986). Internal production also gives focal firms expertise to monitor the quality of external suppliers (Dutta et al. 1995; Heide 2003; Heide et al. 2014).

A third set of explanations focuses on complementarity. Plural sourcing emerges when a focal firm and its suppliers have complementary knowledge or expertise (Parmigiani 2007; Puranam et al. 2013). Plural sourcing also emerges when focal firms identify opportunities for mutual learning with their suppliers (Bradach 1997; Cassiman and Veugelers 2006; Parmigiani 2007). In fact, balancing vertical integration with strategic outsourcing increases overall firm performance, via successful product introductions (Rothaermel et al. 2006) and effective buyer monitoring (Heide et al. 2014).

These theories suggest at least two extensions we undertake below. First, identifying the preconditions for plural sourcing does not shed light on how to choose an optimal make-and-buy balance. If, for example, a focal firm faces greater demand uncertainty, extant theories provide little guidance regarding how to adjust the make-and-buy balance. Second, existing theories assume that the focal firm's make-and-buy balance decisions are independent of its supplier portfolio design. Often, they are not. Different supplier portfolio characteristics are associated with different levels of contracting costs (Langlois 1992, 2006), in part, because they structure incentives to invest in non-contractible assets differently (Baker et al. 2002; Chatain 2010; Dyer 1997).

Puranam *et al.* (2013) suggest a way forward to tackle the issue of an optimal make-and-buy balance. In their model, firms resort to plural sourcing in order to exploit complementarities in incentives. For example plural-sourcing firms might encourage competition or knowledge sharing between internal producers and external suppliers, so that they can motivate both parties to achieve greater productive efficiency. Once plural sourcing emerges, the percentage internally made increases with greater transactional hazards due to supplier opportunism, but declines with stronger complementarities. We build on these insights by relaxing the assumption that contracting costs result only from transactional hazards, and by evaluating the impact of supplier portfolio design.

The second issue, explicitly incorporating the notion of a supplier portfolio into plural sourcing theory, requires going beyond the transaction cost economics (TCE) focus on transactional

characteristics (Williamson 1985). If two suppliers provide the same input to a focal firm, they would have to be treated as two separate transactions, or else completely substitutable as though the two suppliers were one and the same. Thus, in TCE analysis, transactional hazards are invariant to supplier portfolio choice. But having one versus multiple suppliers for the same input might very well influence contracting costs of mundane, Williamsonian or dynamic types.

Our theoretical framework explicitly examines how the focal firm's supplier portfolio design influences different types of contracting costs via interdependencies and governance inseparability across transactions. We therefore build on a "call for tempering the use of transaction as a unit of analysis (without abandoning it entirely)" (Argyres and Liebskind 1999), and a proposal to study plural sourcing of "nearly the same inputs" based on similarity in the underlying technology, knowledge, or expertise (Krzeminska et al. 2013). Our approach permits shifting from investigating a make-or-buy decision for a single transaction to studying make-and-buy decisions of closely related transaction pools (Argyres and Zenger 2012) involving cross-product spillovers (Mayer 2006).

THEORY AND HYPOTHESES

We now develop a set of testable hypotheses that address our research question: what is the impact of supplier portfolio design on the make-and-buy balance? Before developing our hypotheses, we provide an overview of the theoretical approach adopted in this study.

Our theory is grounded in the largely uncontroversial observation that contracting for knowledge and other complex inputs is rife with challenges. Because such inputs are difficult or impossible to fully specify in advance, contracts are incomplete to a varying degree, and in some cases non-verifiable even after actions are taken. Given this, focal firms rely on different contracting strategies, equally legitimate and sustainable, which in turn lead them to design their supplier portfolio differently. A contracting strategy refers to the focal firm's long-term plan to engage with suppliers, by designing the number and characteristics of its suppliers. Contracting strategies are path dependent, shaped in part by past supplier choices and investment in contracting relationships.

Focal firms choose their contracting strategies in order to manage contracting costs of various types. We adopt the term "contracting" rather than "transaction" costs because costs are associated with a specific supplier portfolio involving a series of related transactions, not with one transaction at

a time. These costs are not restricted to costs related to opportunism, but also include the "mundane" costs of selecting among bidders and creating transactional interfaces (Baldwin 2008; Langlois 2006), and the "dynamic" costs of not having the capabilities when you need them (Langlois 1992), due in part to suppliers' reluctance to make non-contractible investments (Hart and Moore 1990).

We identify two extremes along the contracting strategy continuum. At one extreme, "bargaining-based" contracting strategy is deployed when plural-sourcing firms rely on strong bargaining power to counteract difficult-to-anticipate changes in market structure (Argyres and Liebskind 1999) and to avoid dependence on suppliers for critical resources (Inkpen and Beamish 1997; Pfeffer and Salancik 1978). When a firm becomes aware of supplier opportunism it can guard against threats of hold-up because of low switching costs between different suppliers or in-house capacity. In short, plural-sourcing firms pursuing this contracting strategy minimize commitment, and the conduct of either party today has little reputational implications when negotiating in the future.

At the other extreme, a relationship-based contracting strategy emerges when plural sourcing firms rely on commitment, reputation, and trust to implement agreements. This contracting strategy is embedded in the behavioral and normative assumptions of relational contracting (Gibbons and Henderson 2012), which has long research provenance in business law (Macneil 1974) and sociology (Macaulay 1963). Relational contracts are incomplete and rely on social relations for enforcement. Plural sourcing firms with this contracting strategy enforce agreements with sanctions linked to supplier reputation, continuity, and trust (Carson et al. 2006). The prospect of future business - the shadow of the future - incentivizes suppliers to cooperate in a repeated game (Axelrod 1984).

Plural-sourcing firms do not face a binary choice in selecting a contracting strategy, but rather position themselves along the contracting strategy continuum. While this choice is not directly observable, it is revealed in the supplier portfolio design. We develop hypotheses about the effect of such choice on the make-and-buy balance by demonstrating how each dimension of supplier portfolio design primarily, though not exclusively, influences a specific type of contracting cost faced by focal firms. We are not first to demonstrate how heterogeneity in supplier characteristics affects supplier portfolio design (Hoetker 2005). But we are first to highlight these points in a plural sourcing context for the purpose of understanding how they affect the make-and-buy balance.

Supplier concentration

Our first hypothesis concerns the number of suppliers chosen by the plural sourcing firms and the distribution of work among them. This is distinct from market concentration, i.e. the number of potential suppliers available in the marketplace. Instead, supplier concentration refers to the focal firm's choice about how many suppliers to contract with in a market structure that is reasonably fragmented and how to distribute work among those chosen.

According to TCE, market concentration increases the risk of holdup and opportunistic behavior as firms are relatively constrained in their choice of suppliers. But given such transactional hazards, focal firms can further influence the costs of contracting they face with their choice of suppliers. High supplier concentration is a manifestation of a relationship-based contracting strategy and creates incentives for suppliers to make relation-specific investment (Aral et al. 2012; Moeen et al. 2013). A concentrated portfolio of suppliers lowers contracting costs in the market relative to those in hierarchy, primarily the so-called "mundane" costs of creating transactional interfaces (Baldwin 2008), and the costs of searching for and negotiating with suppliers (Langlois 2006). In addition, supplier concentration signals inter-organizational trust and commitment (Dyer 1997; Sako and Helper 1998), further reducing contracting costs in the market relative to hierarchy (Gulati and Nickerson 2008). Focal firms rely on relational capital to learn from suppliers and reputational effects to deter supplier opportunism (Kale et al. 2000). Consequently, high supplier concentration lowers the overall contracting costs that focal firms face and increases their reliance on buying in plural sourcing.

By contrast, low supplier concentration is evidence of a bargaining-based contracting strategy. Under this strategy, plural-sourcing firms attempt to spread work across many suppliers. Consequently, they incur more mundane contracting costs because they commit less to building supplier relationships. Indeed, an important aim of a bargaining-based contracting strategy is to decrease the costs of switching between suppliers and to retain more internal capacity to discipline potentially opportunistic suppliers (Harrigan 1986). But this results in higher contracting costs and, therefore increased reliance on insourcing. Thus, we suggest the following hypothesis:

H1: Plural-sourcing focal firms that choose a more (less) concentrated portfolio of suppliers rely less (more) on insourcing in the make-and-buy balance.

Supplier stability

Another aspect of a supplier portfolio relates to its longitudinal design, in particular the extent of repeated transactions with suppliers over time. With a relationship-based contracting strategy, repeated interactions build trust between transacting parties and provide incentives to make non-contractible investments (Baker et al. 2002; Dyer 1997). The key mechanism here is a reduction in the likelihood of supplier opportunism, as long-term interaction decreases the risk of supplier hold-up and related "Williamsonian" contracting costs. This effect has been shown to be important in different settings including IT sourcing decisions and strategic alliances (Aral et al. 2012; Gulati 1995). Stable ties also facilitate coordination and learning over the design of contractual arrangements (Mayer and Argyres 2004), reducing the need to constantly renegotiate contracts. Vanneste *et al*. (2010) find evidence of a learning effect, over and above an effect generated by trust, that improves coordination with suppliers. These trends further reduce mundane contracting costs (Langlois 2006). Consequently, high supplier stability results in low contracting costs, and plural-sourcing firms rely more on buying.

By contrast, low supplier stability is evidence of a bargaining-based contracting strategy. Focal firms treat each round of bargaining as independent in an attempt to increase flexibility and minimize commitment. Focal firms avoid dependence on specific suppliers for critical resources (Argyres and Liebskind 1999; Inkpen and Beamish 1997; Pfeffer and Salancik 1978) allowing them to bargain from a position of strength due to low switching costs. However, supplier instability enhances suppliers' incentives to behave opportunistically and does not promote the standardization of transaction interfaces (Langlois 2006; Williamson 1985). Hence, supplier instability increases the overall costs of contracting and the benefits of producing internally. Thus, we suggest the following hypothesis:

H2: Plural-sourcing focal firms that choose a more (less) stable portfolio of suppliers rely less (more) on insourcing in the make-and-buy balance.

Breadth of supplier capabilities

A third aspect of supplier portfolio design is the breadth of supplier capabilities. In competitive markets with many suppliers, firms can choose between suppliers with a broad or narrow scope of capabilities (Chatain and Zemsky 2007). But for plural-sourcing firms, this choice is influenced by considerations over and above the desire to access superior external capabilities (Jacobides and Hitt

2005). Focal firms choose suppliers with varying breadths of capabilities to retain strategic flexibility in the face of near-term operational uncertainty. Focal firms need not use all available supplier capabilities, and the choice of broadly capable suppliers can be part of a forward-looking strategy of securing real options to use specific capabilities that a supplier possesses in case the need arises.

Of course, plural-sourcing firms may source the required capabilities from many narrowly specialized suppliers or from a few suppliers having a broad range of capabilities. But employing a relationship-based contracting strategy increases reliance on broadly capable suppliers. Underpinned by commitment and trust, focal firms can address changing environmental conditions by accessing a different mix of capabilities available from the existing pool of suppliers. A portfolio of broadly capable suppliers then reduces contracting costs, especially of the "dynamic" sort.. Langlois (1992:113) describes such dynamic contracting costs as those related to "persuading, negotiating with, coordinating among, and teaching outside suppliers in the face of economic change" or, alternatively, "as the costs of not having the capabilities you need when you need them." In essence, suppliers become "one-stop shops" for focal firms, enhancing their client-specific knowledge and reducing the overall costs of contracting (Chatain 2010; Chatain and Zemsky 2007). Knowing this, focal firms invest less in internal capacity and rely more on external buying.

By contrast, focal firms pursuing a bargaining-based contracting strategy do not have a preference for broadly capable suppliers so as to avoid relying on any one or a few suppliers. When conditions change and new capabilities are required, focal firms transfer work to different "specialist" suppliers or to in-house producers. This results in a portfolio comprised of more narrowly capable suppliers. In turn, focal firms increase their reliance on insourcing because they face higher "dynamic" and other costs of contracting. Thus, the choice over capability breadth affects contracting costs and the make-and-buy balance. This leads us to the following hypothesis:

H3: Plural-sourcing focal firms that choose suppliers with a broader (narrower) scope of capabilities in their portfolio rely less (more) on insourcing in the make-and-buy balance.

Supplier concentration and stability

Up until now, we treated the three dimensions of supplier concentration, stability, and capability scope, as independent of each other to be evaluated separately by plural-sourcing firms. Such a view, however, ignores combinatorial effects that might also figure in the design of a supplier portfolio.

In particular, contracting with a few suppliers or entering into highly stable relationships signals a relationship-based contracting strategy designed to prompt suppliers to make non-contractible investments. But doing both may lead to too much dependence on them (Pfeffer and Salancik 1978), giving rise to risks of supplier over-reliance. These risks are idiosyncratic, arising not necessarily from opportunistic suppliers, but from unforeseen disruptions such as technical mishaps, key employee departures, natural disaster, or bankruptcies. Such risk is higher for focal firms that rely on a smaller number of suppliers over time, as they have fewer alternatives to deal with supply shocks. Supply shocks have important performance implications especially when inputs are complex and not standardized. So focal firms develop buffering strategies in the form of building additional internal production capacity in order to mitigate these risks (Bode et al. 2011; Craighead et al. 2007).

Besides, plural-sourcing firms that rely on a few suppliers over time do not have the capacity to monitor suppliers well as they are shielded from contact with new external suppliers, some with superior capabilities (Heide 2003; Uzzi 1997). Information asymmetry between the focal firm and suppliers can increase as the focal firm gradually loses the ability to understand the procured inputs. Internalizing some production helps ameliorate this problem without risking relational capital with existing suppliers. Overall, by increasing internal production, focal firms reduce their exposure to unforeseen supply disruptions and information asymmetry between them and their suppliers. Thus:

H4: Plural-sourcing focal firms that choose a more (less) concentrated and more (less) stable supplier portfolio rely more (less) on insourcing in the make-and-buy balance.

DATA AND METHODS

Levels of analysis and empirical context

Our study investigates the make-and-buy decisions at two levels of analysis, for "nearly the same inputs" and for "nearly the same suppliers". This section explains why these two levels are selected, and justifies the choice of legal services as the appropriate empirical context to test our hypotheses.

We begin by addressing a threshold issue in any plural sourcing study, namely whether focal firms really make-and-buy the same product or service simultaneouly. Williamson (1985) is a skeptic, and suggests that plural sourcing is an artifact of ill-identified transactional heterogeneity. Consistent with this argument, He and Nickerson (2006) find that although trucking firms appear to engage in plural sourcing by using both internal and external drivers, closer analysis reveals that outsourced and insourced hauling jobs are qualitatively different. Similarly, Azoulay (2004) demonstrates that project characteristics often not apparent on initial review ultimately guide pharmaceutical companies when deciding whether projects should be outsourced or assigned to company employees.

So what is the appropriate level of analysis for plural sourcing? We answer this question in two steps. First, following Krzeminska *et al.* (2013), we pragmatically identify "nearly the same inputs" based on underlying technology, knowledge, and expertise. We think an ideal candidate for such similarity is patent prosecution, consisting of a highly standardized process of drafting and filing patents at the patent office. Large corporations can use either in-house attorneys or external law firms to file a patent (Mayer et al. 2012; Moeen et al. 2013). Second, going beyond Krzeminska *et al.* (2013), we identify a group of transactions carried out by "nearly the same suppliers." A law firm may provide a range of legal services to client firms with substantial knowledge complementarities. For example, the focal firm's choice of the law firm for patent litigation may be influenced by the prior choice of which law firm actually filed the patent in question. In order to take account of such transactional interdependencies, we design a study of corporate legal services of which patent prosecution is a part. In doing so, we admit the possibility of more input heterogeneity than with the study of patent prosecution, but also highlight the possibility of capturing spillover effects only observable when we study "nearly the same suppliers", such as law firms in our study.

To ascertain that corporate legal services are an appropriate empirical context, we carried out semi-structured interviews in 2010 with 52 in-house lawyers at large firms in the US and UK (Sako 2011). We asked the corporation's chief lawyer or General Counsel (GC) how he or she makes decisions about legal resources in the in-house legal department and at law firms. The GC was found to be relatively autonomous in making decisions about hiring and was also in charge of an annual "panel review" of law firm performance. That review led to GC decision either to retain or drop law

firms for work in specific practice areas. Within the constraints set by these GC decisions, our interviews revealed a decentralized system of allocating legal work, for instance with individual in-house lawyers deciding whether or not to use an external attorney to prosecute a specific patent.

Our interviews also revealed three points salient to our theory. First, our interviews identified preconditions for the emergence of plural sourcing, including demand uncertainty due to unanticipated large "bet-the-house" litigation cases, and teamwork resulting from knowledge complementarity between in-house lawyers and outside counsel. Some interviewees said they brought more work in-house in order to increase their bargaining power in response to high "billable hour" fees charged by law firms. Second, interviews revealed substantial variation in the make-buy balance. When asked what proportion of the firm's legal budget was spent on external law firms, interviewee answers varied from 12% to 93%. As explained by one in-house lawyer at an investment bank:

> *What has to be done in-house? Nothing! …We can hire another 200 lawyers and bring more of the work in-house, or we can fire all in-house lawyers and you can manage all the outside counsel. Those are the two ends of the spectrum. The question to me is where do you want to be in the middle?*

Moreover, while some legal departments were moving towards greater insourcing, others were found to be outsourcing more. These findings contradict observations by others that either all firms favor more in-house lawyer capacity (Schwarcz 2007) or greater outsourcing (Regan and Heegan 2010).

Third, our interviews revealed that, while lawyers may draft detailed written contracts on behalf of client firms, their own retainer contracts were open-ended, often by design. Interviewees hinted at different ways in which client firms could govern relationships with law firms. Some GCs clearly employed a relationship-based contracting strategy, as the following quotation reveals:

> *Only three firms were chosen for the panel. I don't let our panel law firms compete against each other. … If I have a piece of work, I don't say to all three of them, "Give me a price." We tend to spread the work around, and we work with each of them individually.*

Other GCs, however, showed a preference for a bargaining-based contracting strategy:

> *We have developed additional capacity, particularly in the anti-trust area, with other firms… because it's important that the firms understand that they are in competition.*

Some others were keenly aware of tradeoffs between bargaining- and relationship-based strategies:

> *[I]f you spread your job too thinly, people don't have much knowledge of your business, and you might save a bob on one deal but I bet you it will come back and haunt you.*

Overall, our interviews confirm that legal services constitute an ideal setting for studying plural sourcing. We now proceed to testing our hypotheses with two datasets, described below.

Data, sampling and variables – Patent prosecution sourcing

For the analysis of patent prosecution sourcing, we start from the 2006 list of *Fortune* 500 firms and track their patenting activity from 1990 to 2006. We collect information on their subsidiaries using S&P's Capital IQ database of corporate affiliations. The dataset we create contains information on their patent filling activities for granted patents applied during this time period. This information is collected from a variety of sources to ensure maximum reliability, including the NBER's and Harvard patent databases and the patent application data (or PAIR data) available from the USPTO (Hall et al. 2001; Ronald et al. 2013). We then match this data with financial data from Compustat and drop the first three years of observations as some of our measures use lagged values. Our final sample consists of 298,332 patent applications structured as an unbalanced panel of 1535 firm-year observations with 131 focal firms that apply for patents in at least 5 years during the study period, 1993 to 2006.

Dependent variable

Information on variables used in this patent prosecution study is listed in Table 1. Our dependent variable is the percentage of patent applications insourced in a given year, that is, filed using an in-house lawyer as opposed to a lawyer at an outside law firm. This information has been previously used by Moeen *et al.* (2013) and Mayer *et al.* (2012). The dependent variable information is available at the "Attorney or Agent" field of the granted patent document where the lawyer responsible for the filing of the patent is listed. That said, it is still sometimes difficult to identify the organizational affiliation of the listed patent lawyer. Using a semi-manual approach we are able to distinguish between cases where the attorney listed is the name of a law firm and designate these patents as outsourced. However, when the name of an individual patent lawyer is listed it is usually, but not always, the name of an in-house lawyer (Mayer et al. 2012; Moeen et al. 2013).

We thus use the PAIR data available from the USPTO as the primary source for constructing our dependent variable. Three reasons motivate this choice. First, the PAIR data list the address of the patent lawyer used for filing the patent. This makes it easier to identify whether the listed name is an in-house lawyer or works for an external law firm. Second, PAIR data is more accurate as the information is recorded at the time of the actual application and the historic corporate affiliation of patent lawyers can be more easily retrieved. Third, the number of missing values is much lower in the

PAIR data. In our sample of patents, roughly 9% of the application files fail to list the relevant lawyer for our analyses while the equivalent figure is 16% for the granted patent documents. Only a small fraction of patents (1.6%) do not have a patent lawyer listed in both application files and granted patent files. These patents are dropped from the sample.

Independent variables

Following standard practice for patent data, the variable *Supplier concentration* is calculated as the non-biased Herfindahl index of the distribution of the outsourced patents across different law firms (Garcia-Vega 2006; Moeen et al. 2013). The non-biased measure corrects for the bias introduced when focal firms outsource few patents (Hall 2002) and is calculated as follows:

$$\frac{P_{it}\sum_j\left(P_{itj}/P_{it}\right)^2-1}{P_{it}-1}$$

where P_{it} is the number of patent applications outsourced by focal firm i in year t and P_{itj} is the number of patent applications outsourced by focal firm i to outside lawyer at law firm j in year t.

For *Supplier stability* we look at the law firms used by a focal firm in a given year and calculate the number of years each law firm was used during the previous three years. We then average this number and take the natural logarithm. This measures captures the degree of stability in the focal firm's contracting history with its suppliers. It indicates a focal firm's "shadow of the past" which is a determinant of near-term trust and continuity casting "the shadow of the future" (Poppo et al. 2008).

To calculate the breadth of *Supplier capabilities* we create a list of patents that focal firms outsourced to law firms during each year. We then calculate, for each law firm, a non-biased Herfindahl index of patent concentration across technology classes at the 1-digit level of the international patent classification (IPC). The IPC is a hierarchical classification that groups the different patented technologies in eight broadly defined technology areas. A high degree of concentration is indicative of a law firm's narrow capability breadth since it is filling patents in only a few technology areas. On the other hand, a low degree of concentration indicates broad law firm capability scope as it is filling patents for focal firms across many technology areas. Having calculated this measure for each law firm, we average the values for the law firms used by a focal firm in a given year and then subtract it from one to generate a measure of breadth as follows:

$$1 - \frac{\sum_j \sum_c \left(P_{jtc}/P_{jt}\right)^2}{J_{it}}$$

where P_{jt} is the number of patents outsourced to law firm j in year t by focal firms in our sample, P_{jtc} is the number of patents in technology class c outsourced to law firm j in year t by focal firms in our sample and J_{it} is the number of law firms used by focal firm i in year t. We also calculate the same measure using the Harvard patent database that includes information on patent lawyers for all granted patents. However, there are a many missing values and it is more difficult to identify the organizational affiliation. We present results based on both measures and observe consistent trends.

Control variables

We include several control variables to account for alternative explanations. We include the natural log of the annual count of successful patent applications to control for scale effects. We also include the standardized difference of last versus current-year count of patent applications to control for the degree of variability in demand for patenting work (Adelman 1949). We include the average number of citations received by focal firm patents annually adjusted for truncation to account for the quality of the patented technologies (Hall et al. 2001) as well as a measure of non-biased technological concentration of patents applied across patent classes to control for the diversity of patenting output. We include the average number of claims listed, the average measures of generality and originality (see Trajtenberg *et al*. (1997), and the average number of citations made to other patents by patents applied to control for differences in the amount of effort required to draft the patent document.

We also include the annual percentage of patents applied that cite a previously litigated patent using the LitAlert database. This variable controls for patent litigation risk as patents that cite other litigated patents are themselves more likely to be litigated (Moeen et al. 2013). In order to control for patterns of past behavior in focal firm sourcing decisions, we include another control, past outsourcing, as the annual number of outsourced patents averaged across patent classes of outsourced patents. Yet another control is the technological distance between patents applied for and the focal firm's existing patent stock using Jaffe's (1986) proximity measure. "Self cites" is the annual percentage of citations to other patents owned by the focal firm averaged for all patents applied. This controls for the degree of focal firm-specific knowledge in drafting and filling a patent (Moeen et al.

2013). Finally, we include controls for focal firm annual R&D intensity, sales, profitability, debt, advertising intensity and employee count.

- Insert Table 1 about here -

Data, sampling and variables – corporate legal services sourcing

For the analysis of corporate legal services, we collect information on the size and composition of focal firm legal departments and their relationships with law firms. This information is not publicly available, so we use proprietary survey data collected by ALM Legal Intelligence (ALM), a research unit within the American Lawyer Media Group. We use ALM's annual GC survey which reports the number of in-house lawyers at focal firms and the law firms providing significant legal services to the focal firms in specific practice areas. We also used ALM reports on major focal firm legal activity, including major litigations, M&A transactions, and bankruptcies. These firm-level data are available from 2004-2005 for *Fortune* 250 companies and then from 2006-2011 for *Fortune* 500 companies.

To be included in our sample, we require companies to have ALM annual survey data. They must have information on operations in Compustat corporate and industry segment files, and must also not have undergone bankruptcy proceedings during the observation period. Our final dataset is an unbalanced panel consisting of 1226 firm-year observations from 284 focal firms observed for up to eight years from 2004 to 2011. Our reported number of observations drops to 942 because several statistical analyses require the inclusion of one-year lagged variables.

Dependent variable

In contrast to the patent prosecution study, we lack detailed data on the total amount of legal work undertaken by law firms on behalf of focal firms in our sample. Such data are not publicly available so we adopt an alternative measurement approach. We use the annual count of focal firm in-house lawyers reported by ALM as our dependent variable, *In-house lawyers*, and include information on external law firms as key right hand-side variables. Modeled in this way, changes in the dependent variable can be attributed to two possibilities: a) increased (decreased) reliance on legal services provided by focal firm in-house lawyers rather than by outside law firms; or b) an increase (decrease) in the overall amount of legal work that needs to be undertaken on behalf of the focal firm. We aim to isolate changes in the make-and-buy balance while controlling for changes in the overall amount of

legal work. Thus, we control for several focal firm characteristics related to overall demand for legal services. We describe these controls after operationalizing key independent variables.

Independent variables

Supplier concentration is the natural log of the annual number of law firms doing significant legal work for a focal firm in a given practice areas (such as mergers and acquisitions) averaged across all practice areas. A high value suggests that a focal firm has many suppliers in the same practice area, which is indicative of low supplier concentration. We therefore take the reverse of this measure for hypothesis testing purposes. Data for this variable come from ALM's annual survey, which asks GCs to identify law firms doing significant legal work on their behalf in given practice areas.

For *Supplier stability* we first look at the annual number of law firms used by focal firms across different practice areas and consider each law firm-practice area dyad as a distinct relationship. These relationships are characterized as stable when the law firm was used in the same practice area or when no other law firm was used in the same practice area during the previous year. We then take the natural log of the annual count of such stable relationships. In this way we do not characterize relationships between law firms and focal firms as unstable if that is due merely to fluctuations in the demand for legal services. Going back two or three years might yield a better measure of stability but we have only a limited number of years to work with in the ALM data. Given this constraint, we think our supplier stability measure to be valid and reasonable.

The breadth of *Supplier capabilities* is proxied by the number of practice areas provided by law firms to their clients. In ALM's annual survey, law firms report the different practice areas for each focal firm they serve. For example, a law firm could provide services only in one practice area to its client focal firm, say, IP litigation. Alternatively, the law firm could provide services in many different practice areas, say, IP litigation, regulatory compliance, and employment. For each law firm, we first calculate the annual average number of practice areas per client firm. A small number of practice areas per client is indicative of a law firm with narrow capability scope, i.e. the law firm is a specialist. A large number of practice areas per client firm suggests that the law firm is used as a "full service" provider with a broad range of capabilities. After having calculated the number of practice areas per client for each law firm in our sample, we then average this number across all law firms

providing services to our focal firms and take the natural logarithm. Although we do not observe the full range of relationships between law firms and their customers, this measure is a good proxy. The fact that a top US corporation chooses to work with a law firm is indicative of capability in this area.

Control variables

As with our patent prosecution study, we benefit from the panel structure of these data to account for unobserved heterogeneity among focal firms in our sample. We then add a number of time-varying controls including annual sales, R&D intensity, advertising intensity, the annual number of patents applied and degree of internationalization, that is, the natural log of the number of countries where each corporation operates via a subsidiary. In addition, we include information on focal firm debt, profitability and employee count. We also control for the effect of focal firm product diversification using the entropy measure based on 4-digit SIC codes. This accounts for scope economies present in diversified corporations that might also influence the sourcing of legal services (Parmigiani 2007). A count of the number of practice areas in which external law firms provide services to the focal firm is also included. We also control for the GC's power and influence in the top management team. We construct a 0-1 dummy variable taking the value of one when the GC has the title Senior or Executive Vice President in addition to GC. Data on GC titles are obtained from the S&P Capital IQ database.

The use of fixed effects and the inclusion of these variables help us control for "average" annual focal firm demand for legal services. Yet, there may be occasional fluctuations in the demand for legal work meriting special control. For example, an R&D-intensive focal firm may have higher average demand for legal services compared to other focal firms, but then have a temporary spike in demand when an important patent lawsuit goes to trial. To control for such possibilities, we include as controls the annual count of acquisitions undertaken and new major litigation cases started where the focal firm is involved either as defendant or plaintiff. It is important to note that ALM only collects data for "important" acquisitions and lawsuits as reported in trade publications. Although this may result in some omissions, we think it unlikely to bias results as reporting criteria are similar for all sampled firms. We also use annual selling, general and administrative (SG&A) expenses as a proxy for focal firm indirect expenses, including legal expenses. SG&A expenses are reported in Compustat.

We also take advantage of information included in focal firm annual reports, and adopt a methodology for assessing legal services demand developed by finance researchers. The methodology uses textual analytics to extract information on focal firm activities as reflected in regulatory fillings (Li 2008; Loughran and McDonald 2011). In particular, we use a list of words compiled by Loughran *et al*. (2011) and thought to be synonymous with "uncertain" and "litigious" terms. The "uncertain" synonyms include words such as "unpredicted" and the "litigious" synonyms include words such as "tort". More utterances of either synonym type imply higher focal firm demand for legal services. We take the natural log of the annual count of such synonyms in focal firm annual reports.

Finally, we include a 0-1 dummy variable which is equal to one for the years after the 2007-2008 financial crisis to account for a more turbulent external environment during these years. Overall, this set of control variables permits substantial control of annual fluctuations in the demand for legal services, and thus allows us to observe with better precision variation in focal firm in-house lawyer counts linked to supplier portfolio design choices.

Econometric specifications

To test our hypotheses, we use different statistical models across the two levels of analysis. For our patent prosecution study, we use a random-effects Tobit estimator given that the primary dependent variable is a ratio bound by 0 and 1. The use of a fixed-effects model is problematic as estimates are inconsistent (Greene 2004). We do, however, also employ OLS fixed-effects specifications using the natural log of the number of insourced patents as a dependent variable. For the corporate legal services study, our primary dependent variable is a count characterized by over-dispersion, so we employ a conditional fixed-effects negative binomial estimator. But standard errors are not robust in this model. So we also provide OLS fixed-effects estimates with robust standard errors using the natural log of in-house lawyers and the number of in-house lawyers divided by focal firm sales (in US$100 billion) as alternative dependent variables.

There are two additional issues our analysis needs to address. The first is that our dependent variables are realizations of dynamic processes, with past values influencing future ones. Firms are relatively constrained in setting their in-house legal capacity as there are significant costs related to hiring and firing in-house attorneys. This gives rise to state dependence and the possibility of serially

correlated error terms. The second is that plural-sourcing firms make decisions about supplier portfolio design and the make-and-buy balance simultaneously according to our framework. This point is also discussed by Moeen *et al*. (2013) who investigate the effect of focal firm outsourcing on supplier concentration. Endogeneity is therefore an issue that needs to be addressed.

To this end, we employ dynamic panel data models with general methods of moments (GMM)-type instruments (Arellano and Bond 1991; Arellano and Bover 1995). These models generate plausibly exogenous instruments from lagged values of the time series and are robust to heteroskedasticity in the cross-section and unknown patterns of serial correlation (Vogelsang 2012). This has a number of advantages. In particular, we are able to model the inter-temporal dependence of the time series by including the lagged dependent variable as a regressor. This allows us to correct for the presence of autocorrelation that could have resulted in unbiased but inefficient parameter estimates. In addition, these models allow us to quantify the degree of dependence given that the parameter for the lagged dependent variable is estimated without suffering from significant downward bias (Nickell 1981). Finally, the results of these models rest on much less restrictive assumptions regarding the exogeneity of regressors compared to standard fixed or random effects models. So, while not providing definitive evidence, results from these models move closer towards establishing the causal effect of supplier portfolio characteristics on the make-and-buy balance.

RESULTS

Patent prosecution sourcing

We start by presenting results from the analysis of the plural sourcing make-and-buy balance for patent prosecution work. Descriptive statistics and pair-wise correlations are reported in Table 2. On average, plural-sourcing firms in our sample insource 36% of their patent applications. There is significant variation across focal firms, with 11 firms in our sample outsourcing all of their patent applications while the median firm in our sample insources 27% of patent applications. No focal firm insources all of the patents filed during the study period, but a few do so during specific years. From the descriptive statistics, it is clear that the scale of patenting output is an important determinant of the decision to insource. Smaller focal firms tend to outsource more patent prosecution work as it does not make sense to invest in in-house capacity when the volume of patents filed each year is small.

- Insert Table 2 about here -

Figure 1 panel (a) presents the time trend for our dependent variable, *Insourcing ratio*. It exhibits a slow downward move from 1993 to 2000, after which it stabilizes. This trend could be explained by the rapid increase in patenting output by focal firms in our sample during these years, consistent with a general increase in patent applications at the USPTO during the 1990s. As focal firms sought to manage fast-growing numbers of patent applications, constraints on in-house prosecution capacity led to more outsourcing. Panel (b) presents descriptive insights on the role of supplier portfolio design in shifting the make-and-buy balance. As expected, focal firms making supplier portfolio design choices consistent with a bargaining-based strategy have higher average *Insourcing ratio* than focal firms adopting a relationship-based strategy.

- Insert Figure 1 and Table 3 about here -

Table 3 presents the results from regression analysis. In model (1) we can see that the coefficient of *Supplier concentration* is negative and significant, indicating that the proportion of patent applications insourced decreases with the concentration of work across law firms. This is consistent with findings from Moeen *et al.* (2013), and suggests that a large number of suppliers results in more work being internalized. Although this result might sound counter-intuitive, it is consistent with a bargaining-based contracting strategy. Similarly, in Model (2) we find the coefficient for *Supplier stability* to be negative and significant as described in Hypothesis 2. More stable relationships with suppliers generate trust and prospects of continuity leading to less insourcing when making-and-buying. The third hypothesis also receives strong support as the breadth of *Supplier capabilities* has a negative effect on the extent of insourcing. Sourcing from suppliers with a broad capability scope reduces the costs of contracting and, consequently, reliance on internal patent lawyers. Model (4) presents the full model with the interaction term between *Supplier concentration* and *Supplier stability*. As described in Hypothesis 4, the interaction term enters positively in the equation suggesting that too much reliance on a small group of stable suppliers over time prompts focal firms to increase insourcing in order to mitigate the risk of supplier over-reliance.

Model (5) provides results with alternative measures for the three independent variables. *Supplier concentration* is measured as the average number of capabilities offered to the focal firm by

its suppliers in a given year, i.e. the number of different technology areas (defined at the 1-digit IPC level) in which a law firm files patents for the focal firm. The use of the same suppliers across a wide range of capabilities reduces the costs of contracting, particularly of the mundane type emphasized in Hypothesis 1. *Supplier stability* is measured looking back one year only as opposed to three while the breadth of *Supplier capabilities* is measured using all of the patents outsourced to law firms (not just patents outsourced by corporations in our sample) but relies on less accurate data with a higher number of missing values. Results provide support to all our hypotheses. Next, we use the natural logarithm of the number of insourced patents as the dependent variable and a fixed-effects OLS model with robust standard errors in Model (6). All results hold.

In Model (7) we use the dynamic panel data difference GMM estimator (Arellano and Bond 1991) to account for autocorrelation and the potential endogeneity of our independent variables. With this approach, endogeneity is addressed by generating plausibly exogenous instruments from lagged differences in orthogonal deviations (Roodman 2006). These differences are assumed to be uncorrelated with the error term, an assumption supported by diagnostic tests. The Arellano-Bond *z* test for second- and higher-order auto-correlation is not statistically significant (0.11 and 0.93 respectively). This is not weakened by the number of instruments as instrument count is lower than the number of cross-sectional units (Roodman 2006). Hansen's *J* test, a robust variant of the Sargan test of overidentifying restrictions, fails to reject the null hypothesis that the instruments generated are exogenous. The *p*-value of the test is 0.31, an indication that the instruments are both exogenous as a group as well as relevant to our analysis. These results add value by providing additional evidence on the causal effect of supplier portfolio design on the make-and-buy balance.

Finally, we undertook additional analysis related to Hypothesis 3, which suggests that using broadly capable suppliers lowers dynamic contracting costs. In particular, do focal firms actually turn to their existing, broadly capable suppliers when the need for additional capabilities arises? We identify such instances in cases where the focal firm applied for a patent in a technology area (defined at the 1-digit IPC level) in which it had not applied for a patent in the previous year. We find that focal firms are much more likely to outsource these patents and tend to use their existing law firms for these. We also find that the law firms chosen are broadly capable and have the required capabilities as

indicated by having a higher absolute and relative number of patents filed in the requisite technology area compared to other law firms. This evidence provides further support for Hypothesis 3.

From the control variables we find that the number of patent applications has a strong effect on insourcing, a pattern that can be explained by requisite investment in in-house capacity. In addition, changes in the number of patent applications have a negative effect on insourcing, indicating that firms use external suppliers when faced with demand spikes. The average number of citations received and claims listed in the patent applications, as proxies of patent quality, are negatively correlated with the dependent variable. These results are consistent with previous findings (Mayer et al. 2012) and suggest that focal firms with a high quality technological output tend to outsource patent fillings. R&D intensity is positively correlated with our dependent variable in some models, pointing to the benefits of coordination between in-house patent lawyers and scientists (Reitzig and Puranam 2009; Somaya et al. 2007). Lastly, past outsourcing has a negative effect, highlighting the existence of path dependence in focal firm sourcing decisions.

Corporate legal services sourcing

As explained in the methods section, we supplement the analysis of patent prosecution make-and-buy strategies with insights from a focal firm-level study of corporate legal services. Recall here that the dependent variable relates to focal firm in-house lawyer counts. Descriptive statistics and pair-wise correlations for this study are reported in Table 4. The sample mean of our dependent variable is 72.03 while the median is 34. There is significant variation among focal firms in our sample with the count of in-house lawyers ranging from fewer than 10 at some focal firms to more than 1200 in the case of one focal firm, General Electric. The average focal firm employs roughly 9 law firms, uses 2.6 law firms across practice areas and retains 3.6 law firms from those used last year. In addition, law firms in our sample provide services, on average, across 0.54 practice areas per corporate client.

- Insert Table 4 about here -

The time trend of in-house lawyer counts, Figure 2 panel (a), exhibits relative stability with the exception of 2008 when there was a discernible upsurge. This fluctuation could have followed from the onset of the financial crisis inducing focal firms to insource more legal work as a way to increase bargaining power and save costs. Panel (b) of Figure 2 presents descriptive insights on the role of

supplier portfolio design in shifting the make-and-buy balance of corporate legal services. Focal firms choosing suppliers consistent with a bargaining-based contracting strategy also have higher in-house lawyer counts, consistent with our theoretical framework.

- Insert Figure 2 and Table 5 about here -

Table 5 presents the regression analysis. In Model (1) we use a conditional fixed-effects negative binomial estimator and results provide support to our hypotheses. All three independent variables, *Supplier concentration, Supplier stability* and *Supplier capabilities*, are correlated with a smaller in-house legal department while the interaction term between *Supplier concentration* and *Supplier stability* results in increases in the count of in-house lawyers. These results are consistent with our four hypotheses and with what we observe for patent application sourcing decisions. This suggests that our framework also applies to understanding make-and-buy decisions for related transactions provided by "nearly the same suppliers", as in the case of law firms.

As robustness checks we use the natural log of the number of in-house lawyers as the dependent variable with an OLS fixed-effects estimator and robust standard errors in Model (2). All results hold. We get identical results when using the number of in-house lawyers divided by sales as the dependent variable. Finally, like in the case of patent prosecution analysis, we use a dynamic panel data estimator. Here, we use the system GMM estimator (Arellano and Bover 1995; Blundell and Bond 1998). While the difference GMM estimator is generally preferable, it is problematic in this setting as the estimator is found to have large finite sample bias and poor precision when time series are short and persistent like in our case (Alonso-Borrego and Arellano 1999). The Arellano-Bond z test and Hansen's J test suggest that the instruments used are exogenous and we find all three supplier portfolio characteristics to have a negative effect on the size of the internal legal department. Yet, the interaction term between *Supplier concentration* and *Supplier stability* is positive but not significant (p=0.16) as expected in hypothesis 4. Not surprisingly, we find that the lagged value explains a large percentage of variation in the dependent variable, a finding consistent with the view that firms are constrained in rapidly altering their in-house legal capacity.

From the control variables, R&D intensity has a positive effect, pointing to the benefits of resource co-specialization between in-house lawyers and scientists. In addition, uncertain words have

a positive effect suggesting that environmental turbulence prompts firms to build their legal capacity. Yet, litigious words have a negative but not significant effect. While we expect litigious words to be strongly correlated with the overall amount of legal work undertaken, the lack of significant effect is not surprising given that a lot of this type of work is outsourced. We also find product diversification to have a positive effect in two models, possibly because multi-product firms can apply their legal resources across a wider range of business lines. Lastly, the coefficient for *GC on TMT* is positive and significant in the first model. This could be due to the GC's power to command large legal departments, and/or to "legal astuteness" referring to corporate top management's proactive stance to use internal legal resources, not least the GC, to make strategic decisions (Bagley 2008).

DISCUSSION AND CONCLUSION

Recent research has increased our understanding about when plural sourcing may emerge, but that begs the question of where focal firms strike the make-and-buy balance once they resort to plural sourcing strategy. Our study addresses this question with a theoretical framework highlighting the impact of supplier portfolio design. Our framework emphasizes that supplier portfolio design is a strategic choice made by firms. It is not a mere reflection of market structure or transactional characteristics, but is grounded in different contracting strategies that focal firms pursue. Thus, we expect different contracting strategies to exist in the same industry with the same market structure.

Our theory builds on an important stream of work that identifies interdependencies between transactions for a focal firm, resulting in knowledge and reputation spillovers between transactions (Mayer 2006), governance inseparability (Argyres and Liebskind 1999), and interdependencies among suppliers for a set of transactions. We respond to a call to free the firm boundary literature from constraints imposed by focusing on the transaction level alone as the unit of analysis (Argyres and Liebskind 1999; Moeen et al. 2013). We link this insight to plural sourcing research by highlighting the need to examine make-and-buy at two levels of aggregation for the focal firm: first at a level that identifies very similar inputs (Krzeminska et al. 2013); and second, at a level that identifies inputs provided by very similar suppliers, in our case, law firms.

Our empirical analyses, informed by interviews and based on rich data at two levels of analysis provide robust support for our theory. We found statistically significant decreases in the proportion of

patents insourced and the number of in-house lawyers when the portfolio of law firms doing work for focal firms is characterized by high concentration, high stability, and broad capability scope. We also found that choosing a highly concentrated and highly stable portfolio of suppliers increased insourcing, a combinatorial effect that raises the risk of over-reliance on the same set of suppliers over time. These results proved robust to different model specifications and estimations, including approaches designed specifically to address autocorrelation and endogeneity concerns.

Implications for organization and strategy research

Our study has important implications for organization and strategy research. First, we advance plural sourcing research from questions about emergence to questions regarding the make-and-buy balance and why that balance differs across plural-sourcing firms. We develop hypotheses about plural sourcing based on alternative contracting strategies. A bargaining-based contracting strategy renders insourcing more attractive. It lets focal firms negotiate with suppliers while demonstrating the capacity to terminate contracts and do more internally. By contrast, a relationship-based contracting strategy renders outsourcing more attractive. It lets focal firms "go lean" on internal capacity, while picking broadly capable suppliers able to make commitments to supply existing and new capabilities for the long term. If organization studies is fundamentally concerned with how firms differ (Nelson 1991), then our study advances make-and-buy research with a sharp organizational focus.

Second, our theory yields comprehensive insights on how supplier portfolio design affects plural sourcing. We do so by evaluating a broad range of contracting costs over and above the Williamsonian costs that arise from transaction characteristics like asset specificity (Williamson 1985). These contracting costs include the "mundane" costs of selecting among bidders and creating transactional interfaces (Baldwin 2008; Langlois 2006) and the "dynamic" costs of not having the capabilities when you need them (Langlois 1992).

Third, we conceptualize and operationalize supplier portfolio design with multiple dimensions rather than a single dimension. This raises the question of how different aspects of supplier portfolio design are related to each other. We theorize how each dimension is primarily associated with a different type of contracting costs, in particular supplier concentration with "mundane" contracting costs, supplier stability with Williamsonian contracting costs, and supplier capability breadth with

"dynamic" contracting costs. Our data also lend support to the view that each aspect is independent of the other and that a particular contracting strategy may be signaled by any one of the aspects. Supplier portfolio design and the make-and-buy decision are mutually reinforcing and theories of the firm will benefit from explicitly accounting for this dynamic in studying firm boundary setting.

Finally, our theory of plural sourcing is generalizable to other empirical contexts given its reliance on observable generic characteristics of supplier portfolio design, namely concentration, stability, and capability scope. We chose legal services but our theory is applicable to other contexts where contracts are incomplete and conditions for the emergence of plural sourcing exist. They likely include other knowledge-intensive and complex goods and services.

Implications for practice

Because our theory is about design choices made by firms, the findings of this study have concrete and actionable implications for business managers and legal professionals. Specifically, our theory suggests that even in the face of a common pressure to do 'more for less', GCs are likely to continue to source legal services differently by relying on a variety of supplier portfolio designs. This is because supplier portfolio design does not merely reflect the nature of legal work, but depends on the underlying contracting strategy. It is the GC's choice to invest in different contracting strategies, each with its upsides and downside risk, and implement them through the "panel review" of law firms.

Our plural sourcing theory also has currency in legal circles that have witnessed a vigorous debate on the role of GCs (Veasey and Guglielmo 2012). Ben Heineman of GE, among others, has been a strong advocate of a powerful GC (Smith 2001). In-house lawyers are expected to increasingly play a dual role of a lawyer and business partner (Green 2012), as legal work in compliance and risk management increases (Kurer 2015). Corporate executives turn to the GC to pre-empt going to jail and to fend against endless threats of lawsuits. Our study lends support to this strategic perspective, by highlighting the importance of managing the law firm portfolio to achieve these ends.

Limitations and further research

A number of limitations of this study are worth noting. The first is self-imposed to simplify the analysis. Plural sourcing in its full manifestation involves not only internally made and externally bought inputs but also hybrid forms combining aspects of each - call them "ally" production modes

(Jacobides and Billinger 2006). Moreover, we limited our analysis to external sourcing from law firms only, excluding other types of providers such as "contract" lawyers and accounting firms with legal expertise. Future research might take account of the full range of sourcing options to replace or complement internal capabilities (Susskind 2008).

A second limitation relates to data availability. Our study of plural sourcing of patent prosecution work had a clean measure of the make-and-buy balance, but the corresponding analysis for firm-level legal services had to use a second-best proxy for measuring the make-and-buy balance, namely the number of focal firm in-house lawyers. We deal with this limitation by including several control variables that proxy to a satisfactory level the overall demand for legal work. Future research may seek more precise data on internal and external hours of legal work.

A third limitation relates to generalizability. We think our theoretical framework and evidence can be generalized to other large, established firms that have the internal resources enabling them to make a genuine choice in the design of plural sourcing. But this leaves other contexts to which we are reluctant to apply our findings without modification. The discount consumer services purchasing giant, Groupon, was founded in 2008, but did not have a full-time in-house counsel until 2011 when it already operated in 48 countries generating $1.6 billion in revenue (Evers 2011). Groupon's history suggests that explanation of plural sourcing strategies for legal services in entrepreneurial firms may require quite different assumptions and methods to account for confounding effects related to organizational newness and timing of professionalization (Hellmann and Puri 2002).

Conclusion

We began this study by asking why firms differ in their plural sourcing strategies. We end it with a call for organization researchers to continue developing plural sourcing theories and evidence relevant to different organizational forms in a variety of industry contexts. We chose legal services as one such context. This exercise might be extended to further our understanding of make-and-buy strategies for other professionals including accountants, information technology specialists, financial analysts, strategy consultants, engineers, and marketing executives. Studying these professionals in markets and hierarchies (Sako 2013) is important now more than ever before as line executives look to them as business partners in pursuit of organizational excellence.

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Table 1. Variable names, descriptions and sources

Patent prosecution		Corporate legal services	
Variable name	Variable description	Variable name	Variable description
Insourcing ratio	Ratio of patent applications insourced to the total patents applied by the focal firm	*In-house lawyers*	Number of lawyers working in the focal firm's legal department
Supplier concentration	Non-biased Herfindahl index of the distribution of outsourced patents across the law firms used by the focal firm	*Supplier concentration*	Reverse of the natural log of the average number of law firms providing legal services in each different practice area for the focal firm
Supplier stability	Natural log of the average number of years that each law firm (used in year t) was also used between t-1 and t-3	*Supplier stability*	Natural log of the number of stable relationships between the focal firm and law firms across the different practice areas (a relationship is stable if the same law firm, or no other law firm, was used in the same practice area in t-1)
Supplier capabilities (breadth)	We calculate the non-biased measure of concentration across patent classes (1-digit IPC) for all patents outsourced to law firms in our sample in a given year. We then average this number for the law firms providing services to the focal firm and subtract it from 1 to generate a measure of breadth	*Supplier capabilities (breadth)*	We calculate the average number of practice areas per client focal firm for each law firm. We then average this number for all law firms providing services for the focal firm and take the natural log.
		Control variables	
Patents applied	Natural log of the number of successful (i.e. granted) patent applications	*Practice areas*	Natural log of the number of practice areas in which law firms provide services
Dif in patents applied	Standardized difference in the number of patent applications in year t from year t-1	*Internationalization*	Natural log of the number of countries where the focal firm has subsidiaries
Citations received	Average number of (forward) citations received for patents applied	*R&D intensity*	R&D expense divided by sales
Tech concentration	Non-biased measure of concentration across patent classes for patents applied	*Advertising intensity*	Advertising expenses divided by sales
Claims	Average number of claims for patents applied	*Patents*	Natural log of the number of successful (i.e. granted) patent applications
Generality	Average measure of generality for patents applied	*GC on TMT*	0-1 dummy taking the value of one when the focal firm's general counsel is senior or executive vice
Originality	Average measure of originality for patents applied	*Debt*	Total debt divided by total assets
Citations made	Average number of backwards citations for patents applied	*Profitability*	Operating income (EBITDA) divided by sales
Litigation	Percentage of applied patents citing a previously litigated patent	*Employees*	Natural log of the number of employees
Past outsourcing	Average number of outsourced patents in the past 3 years for the patent classes of patents applied	*Product diversification*	Entropy measure of diversification across different product markets
Jaffe tech proximity	Jaffe's measure of technological proximity between patents applied in year t and the firm's existing patent stock	*SG&A expenses*	Natural log of selling, general & administrative expenses
Self cites	Average percentage of self citations out of total citations for patents applied	*Sales*	Natural log of sales
R&D intensity	R&D expense divided by sales	*Litigation*	Number of significant litigation cases where the focal firm was either a defendant or plaintiff
Sales	Natural log of sales	*Acquisitions*	Number of significant acquisitions undertaken by the focal firm
Profitability	Operating income (EBITDA) divided by sales	*Uncertain words*	Natural log of uncertain words in the focal firm's anual report
Debt	Total debt divided by total assets	*Litigious words*	Natural log of litigious words in the focal firm's anual report
Advertising intensity	Advertising expenses divided by sales	*Financial crisis*	0-1 dummy taking the value of 1 for the years following the 2008 crisis
Employees	Natural log of the number of employees		
Source: USPTO, Compustat, Capital IQ, LitAlert		Source: ALM, Compustat, Capital IQ	

Table 2. Descriptive statistics and pairwise correlations for analyses of patent applications insourcing, 1993-2006

	Variable	Mean	St.Dev.	Pair-wise correlations																			
				(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
(1)	Insourcing ratio	0.36	0.34	1.00																					
(2)	Supplier concentration	0.38	0.30	-0.35*	1.00																				
(3)	Supplier stability	0.71	0.28	-0.28*	0.02	1.00																			
(4)	Supplier capabilities	0.79	0.17	-0.15*	0.06*	0.26*	1.00																		
(5)	Patents applied	3.98	1.61	0.48*	-0.56*	0.21*	0.17*	1.00																	
(6)	Dif in patents applied	-0.05	0.61	0.04	-0.09*	-0.22*	0.01	0.15*	1.00																
(7)	Citations received	42.09	39.08	-0.10*	-0.06*	0.05	0.02	0.04	-0.01	1.00															
(8)	Tech concentration	0.20	0.20	-0.34*	0.51*	-0.16*	-0.12*	-0.61*	-0.16*	0.04	1.00														
(9)	Claims	19.20	5.72	-0.27*	0.07*	0.14*	0.14*	-0.08*	-0.03	0.37*	0.13*	1.00													
(10)	Generality	0.35	0.17	0.05	-0.02	-0.27*	-0.01	-0.06*	0.11*	0.24*	0	0.02	1.00												
(11)	Originality	0.52	0.10	-0.12*	0.10*	0.08*	0.02	-0.15*	-0.07*	0.15*	-0.01	0.25*	-0.12*	1.00											
(12)	Citations made	21.62	18.92	-0.15*	0.05*	0.21*	0.04	-0.09*	-0.07*	0.18*	0.06*	0.31*	-0.27*	0.45*	1.00										
(13)	Litigation	0.02	0.04	0.02	-0.01	-0.14*	-0.05	-0.03	-0.06*	0.21*	0.11*	0.11*	0.22*	-0.02	-0.02	1.00									
(14)	Past outsourcing	21.55	50.55	-0.11*	-0.20*	0.31*	0.18*	0.46*	-0.02	0.10*	-0.09*	0.09*	-0.16*	-0.06*	0.02	-0.01	1.00								
(15)	Jaffe tech proximity	0.74	0.25	0.39*	-0.41*	0.28*	0.12*	0.71*	0.05	0.09*	-0.38*	0.00	-0.10*	-0.18*	0.05*	0.01	0.33*	1.00							
(16)	Self cites	0.10	0.08	0.39*	-0.21*	0.08*	0.08*	0.52*	-0.01	-0.04	-0.22*	-0.14*	0.09*	-0.24*	-0.18*	0.04	0.17*	0.44*	1.00						
(17)	R&D intensity	0.04	0.05	0.26*	-0.33*	0.06*	0.03	0.48*	0.04	0.18*	-0.14*	-0.02	-0.02	-0.17*	-0.04	0.08*	0.47*	0.38*	0.17*	1.00					
(18)	Sales	9.07	1.06	0.15*	-0.19*	0.17*	0.12*	0.35*	-0.06*	-0.02	-0.17*	0.01	-0.23*	0.04	0.09*	-0.07*	0.13*	0.23*	0.09*	0.06*	1.00				
(19)	Profitability	0.18	0.10	0.06*	-0.08*	-0.01	0.00	0.15*	-0.01	0.13*	0.00	0.05	0.05	-0.06*	0.05*	0.14*	0.14*	0.16*	0.12*	0.29*	0.08*	1.00			
(20)	Debt	0.06	0.07	0.11*	-0.02	0.02	0.06*	0.12*	-0.03	-0.07*	-0.08*	-0.09*	0.07*	-0.14*	-0.09*	-0.02	-0.03	0.10*	0.18*	-0.06*	0.24*	0.06*	1.00		
(21)	Advertising intensity	0.02	0.03	-0.04	0.06*	0.06*	0.06*	-0.03	0.04	-0.05*	0.06*	0.02	-0.04	-0.05	0.05*	-0.01	0.04	0.06*	-0.07*	0.01	0.09*	0.16*	0.06*	1.00	
(22)	Employees	3.59	0.98	0.14*	-0.25*	0.12*	0.15*	0.35*	-0.04	-0.05	-0.22*	-0.08*	-0.12*	-0.04	0.01	-0.06*	0.07*	0.23*	0.12*	0.01	0.83*	-0.01	0.24*	0.06*	1.00

N=1535, * statistically significant at the 5% level

Table 4. Descriptive statistics and pairwise correlations for analyses of in-house lawyer counts, 2005-2011

Variable	Mean	St.Dev.	Pair-wise correlations																				
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
1) In-house lawyers	72.03	123.95	1.00																				
2) Supplier concentration	0.92	0.30	-0.22*	1.00																			
3) Supplier stability	1.92	0.97	0.18*	-0.61*	1.00																		
4) Supplier capabilities	0.43	0.14	-0.03	-0.28*	0.14*	1.00																	
5) Practice areas	1.53	0.50	0.09*	-0.39*	0.71*	0.16*	1.00																
6) Internationalization	2.24	1.48	0.30*	-0.18*	0.18*	-0.07*	0.12*	1.00															
7) R&D intensity	0.02	0.05	0.18*	-0.08*	0.08*	-0.08*	0.09*	0.41*	1.00														
8) Advertising intensity	0.01	0.03	0.15*	-0.01	0.02	-0.01	0.02	0.14*	0.07*	1.00													
9) Patents	1.96	2.22	0.28*	-0.16*	0.18*	-0.03	0.11*	0.64*	0.56*	0.08*	1.00												
10) GC on TMT	0.79	0.41	0.03	-0.12*	0.09*	-0.05	0.01	0.02	0.05	0.06	0.08*	1.00											
11) Debt	0.04	0.07	0.22*	-0.03	0.08*	0.01	0.06*	0.04	0.00	0.02	0.06	-0.09*	1.00										
12) Profitability	0.16	0.13	0.31*	-0.14*	0.12*	-0.08*	0.09*	0.24*	0.20*	0.10*	0.13*	0.11*	0.10*	1.00									
13) Employees	3.67	1.11	0.34*	-0.26*	0.26*	0.02	0.21*	0.24*	0.06	0.10*	0.22*	0.09*	0.00	-0.03	1.00								
14) Diversification	0.90	0.36	0.10*	-0.02	0.05	0.05	-0.01	0.17*	-0.11*	0.09*	0.17*	0.00	0.00	0.00	0.15*	1.00							
15) SG&A expenses	6.66	2.92	0.06	-0.08*	0.11*	0.05	0.10*	0.24*	0.28*	0.28*	0.32*	0.06*	-0.07*	-0.14*	0.37*	0.08*	1.00						
16) Sales	9.66	0.90	0.48*	-0.27*	0.30*	0.04	0.24*	0.18*	0.07*	0.03	0.23*	0.07*	0.10*	0.09*	0.61*	0.08*	0.32*	1.00					
17) Litigation	0.13	0.44	0.40*	-0.16*	0.16*	-0.06	0.12*	0.18*	0.30*	0.12*	0.15*	0.03	0.02	0.24*	0.12*	-0.04	0.07*	0.22*	1.00				
18) Acquisitions	0.08	0.33	0.27*	-0.05	0.03	-0.10*	0.04	0.08*	0.08*	-0.01	0.04	0.00	0.18*	0.23*	0.11*	0.01	-0.02	0.23*	0.12*	1.00			
19) Uncertain words	6.67	0.52	0.20*	-0.08*	0.11*	-0.13*	0.11*	0.04	0.07*	0.00	0.02	0.14*	0.07*	0.21*	-0.21*	-0.06*	-0.27*	0.03	0.14*	0.10*	1.00		
20) Litigious words	6.95	0.90	0.15*	-0.11*	0.11*	-0.07*	0.10*	-0.01	0.05	-0.03	0.01	0.14*	0.04	0.16*	-0.11*	-0.07*	-0.21*	0.08*	0.09*	0.09*	0.84*	1.00	
21) Financial crisis	0.61	0.49	-0.08*	-0.09*	0.16*	-0.09*	0.04	-0.02	-0.01	-0.04	-0.05	0.00	-0.08*	-0.06	-0.16*	-0.03	0.02	-0.19*	0.02	-0.08*	0.11*	0.00	1.00

N=942, * statistically significant at the 5% level

Table 3. Panel data regression models of patent applications insourcing, 1993-2006

Models (1) to (5) employ a random effects Tobit estimator and use the ratio of insourced patent applications over the overall number of patent applications as the dependent variable. Model (6) employes a fixed effects OLS estimator with robust standard errors with the natural log of the number of insourced patents as the dependent variable. Model (7) also uses the natural log of the number of insourced patents as a dependent varible but employs a dynamic panel data estimator with GMM-type instruments and robust standard errors. *p*-values are reported in parentheses.

	(1) RE Tobit	(2) RE Tobit	(3) RE Tobit	(4) RE Tobit	(5) RE Tobit	(6) FE OLS	(7) GMM
Lagged DV							0.469**
							(0.00)
Supplier concentration	-0.043*			-0.159**	-0.284**	-0.105**	-0.631*
	(0.05)			(0.00)	(0.00)	(0.00)	(0.04)
Supplier stability		-0.179**		-0.301**	-0.193**	-0.304**	-0.877**
		(0.00)		(0.00)	(0.00)	(0.00)	(0.00)
Supplier capabilities			-0.150**	-0.141**	-0.103**	-0.369**	-0.800**
			(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Supplier concentration x				0.260**	0.104*	0.076**	1.480**
Supplier stability				(0.00)	(0.01)	(0.00)	(0.00)
Control variables							
Patents applied	0.090**	0.092**	0.096**	0.099**	0.119**	1.141**	0.700**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dif in patents applied	-0.029**	-0.045**	-0.030**	-0.045**	-0.030**	-0.134**	0.085
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.16)
Citations received	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**	-0.002**	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.98)
Tech concentration	0.007	-0.042	-0.022	-0.040	-0.117**	0.628**	0.419
	(0.85)	(0.23)	(0.55)	(0.27)	(0.00)	(0.00)	(0.15)
Claims	-0.005**	-0.005**	-0.005**	-0.005**	-0.005**	-0.012**	-0.011†
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.09)
Generality	0.118**	0.083*	0.123**	0.078*	0.037	0.345**	-0.030
	(0.00)	(0.02)	(0.00)	(0.02)	(0.23)	(0.01)	(0.87)
Originality	0.060	0.102†	0.064	0.104†	0.152**	0.268	0.294
	(0.28)	(0.06)	(0.25)	(0.05)	(0.00)	(0.18)	(0.32)
Citations made	-0.001*	-0.000	-0.001*	-0.000	-0.001*	-0.002	-0.003
	(0.03)	(0.12)	(0.04)	(0.21)	(0.03)	(0.16)	(0.24)
Litigation	0.022	-0.044	0.004	-0.072	-0.101	0.056	-0.128
	(0.83)	(0.66)	(0.97)	(0.47)	(0.29)	(0.88)	(0.78)
Past outsourcing	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**	-0.001*	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.49)
Jaffe tech proximity	-0.004	0.056†	-0.010	0.033	0.023	-0.379**	-0.231
	(0.88)	(0.07)	(0.74)	(0.28)	(0.42)	(0.00)	(0.14)
Self cites	-0.011	0.051	0.005	0.078	0.078	0.213	0.343
	(0.90)	(0.57)	(0.96)	(0.38)	(0.34)	(0.52)	(0.46)
R&D intensity	0.373	0.476*	0.405†	0.494*	0.300	-0.157	-1.255
	(0.10)	(0.03)	(0.08)	(0.02)	(0.13)	(0.87)	(0.17)
Sales	-0.015	-0.002	-0.016	-0.003	0.006	0.007	-0.079
	(0.35)	(0.88)	(0.30)	(0.84)	(0.65)	(0.92)	(0.54)
Profitability	-0.039	-0.057	-0.050	-0.036	-0.111	0.137	-0.010
	(0.62)	(0.47)	(0.53)	(0.64)	(0.12)	(0.66)	(0.98)
Debt	-0.036	-0.005	-0.023	-0.017	0.040	-0.294	-0.354
	(0.73)	(0.96)	(0.82)	(0.86)	(0.67)	(0.45)	(0.38)
Advertising intensity	0.096	0.120	0.085	0.095	0.028	-2.753*	-1.417
	(0.76)	(0.69)	(0.79)	(0.75)	(0.92)	(0.04)	(0.37)
Employees	-0.014	-0.024	-0.008	-0.019	-0.027†	-0.115	0.004
	(0.44)	(0.16)	(0.67)	(0.27)	(0.09)	(0.12)	(0.98)
Constant	0.259*	0.221†	0.322**	0.354**	0.469**	-0.345	
	(0.03)	(0.05)	(0.01)	(0.00)	(0.00)	(0.56)	
Technology area dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N (number of firms)	1535 (131)	1535 (131)	1535 (131)	1535 (131)	1535 (131)	1535 (131)	1282(129)
Wald x^2 (R^2)	328.430	413.301	359.903	471.508	720.08	(0.485)	520.856

p- values in parentheses, † p ≤ 10%, * p ≤ 5%, ** p ≤1%

Table 5. Panel data regression models of in-house lawyer counts, 2005-2011

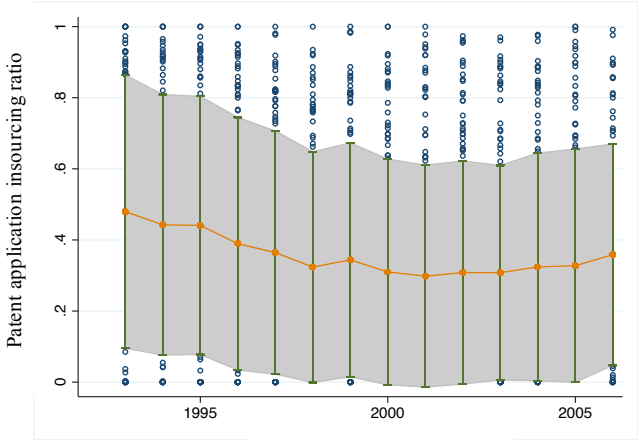
Model (1) uses the number of lawyers as a dependent variable and employs a conditional fixed effects negative binomial estimator. Model (2) is a fixed effects OLS model with robust standard errors and uses the natural log of the number of in-house laywers as a dependent variable. Model (4) uses the natural log of the ratio of the number of lawyers divided by sales as the dependent variable but employs a dynamic panel data estimator with GMM-type instruments and robust standard errors. *p*-values are reported in parentheses.

	(1) FE NBreg	(2) FE OLS	(3) GMM
Lagged DV			0.852**
			(0.00)
Supplier concentration	-0.136*	-0.150*	-0.520**
	(0.03)	(0.04)	(0.00)
Supplier stability	-0.051†	-0.065†	-0.129†
	(0.08)	(0.06)	(0.10)
Supplier capabilities	-0.221*	-0.282*	-0.282†
	(0.02)	(0.02)	(0.09)
Supplier concentration x	0.078*	0.075†	0.098
Supplier stability	(0.02)	(0.06)	(0.16)
Control variables			
Practice areas	-0.021	0.011	0.003
	(0.45)	(0.70)	(0.97)
Internationalization	0.067	0.188	0.037*
	(0.34)	(0.25)	(0.01)
R&D intensity	1.323*	1.294†	0.738†
	(0.03)	(0.10)	(0.07)
Advertising intensity	1.949	0.168	2.053*
	(0.11)	(0.88)	(0.03)
Patents	0.065**	0.059†	0.003
	(0.00)	(0.06)	(0.70)
GC on TMT	0.093†	0.050	0.011
	(0.06)	(0.26)	(0.86)
Debt	0.041	0.028	-0.155
	(0.89)	(0.93)	(0.35)
Profitability	0.054	0.045	-0.212
	(0.70)	(0.79)	(0.25)
Employees	0.258**	0.168	0.018
	(0.00)	(0.12)	(0.33)
Product diversification	0.141**	0.052	0.053†
	(0.00)	(0.58)	(0.08)
SG&A expenses	-0.037	0.094	-0.017
	(0.31)	(0.41)	(0.33)
Sales	-0.155*	-0.094	-0.107**
	(0.01)	(0.29)	(0.00)
Litigation	-0.009	0.007	-0.005
	(0.62)	(0.81)	(0.81)
Acquisitions	-0.056*	-0.068	-0.046
	(0.02)	(0.11)	(0.10)
Uncertain words	0.094†	0.111†	0.076
	(0.07)	(0.08)	(0.16)
Litigious words	-0.038	-0.036	-0.004
	(0.12)	(0.18)	(0.86)
Financial crisis	0.087**	0.104**	0.007
	(0.00)	(0.00)	(0.80)
Constant	3.845**	2.205**	1.956**
	(0.00)	(0.01)	(0.00)
N (number of firms)	942(284)	942(284)	942(284)
Wald x^2 (R^2)	127.025	(0.141)	5623.396

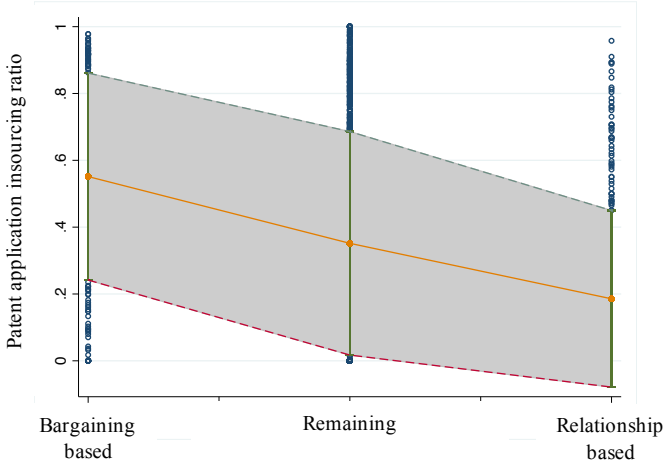
p- values in parentheses, † p ≤ 10%, * p ≤ 5%, ** p ≤1%

Figure 1. Patent application insourcing and supplier portfolio design

Panel (a) illustrates trends in patent application insourcing from 1993-2006. Panel (b) groups firms according to their supplier portfolio design. The right-hand "Relationship-based" scenario measures the patent application insourcing ratio in focal firms with above sample median levels of *Supplier concentration*, *Supplier capabilities* and *Supplier stability*. The left-hand "Bargaining based" scenario measures the same in focal firms with below sample median levels of these same three supplier portfolio characteristics. The middle "remaining" scenario measures the same for remaining focal firms. In both panels, solid dots connected by a trend line within the shaded area represent the mean trend. The shaded area above and below the mean trend represents observations one standard deviation above or below the mean trend. Hollow dots represent observations one standard deviation above (or below) the mean.



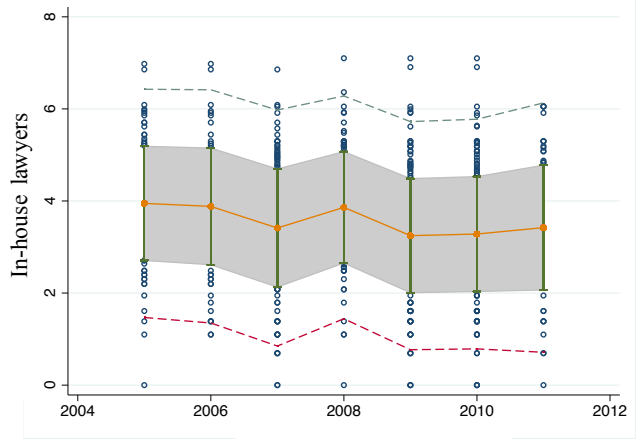
(a) Average values and variation of patent application insourcing ratio over time



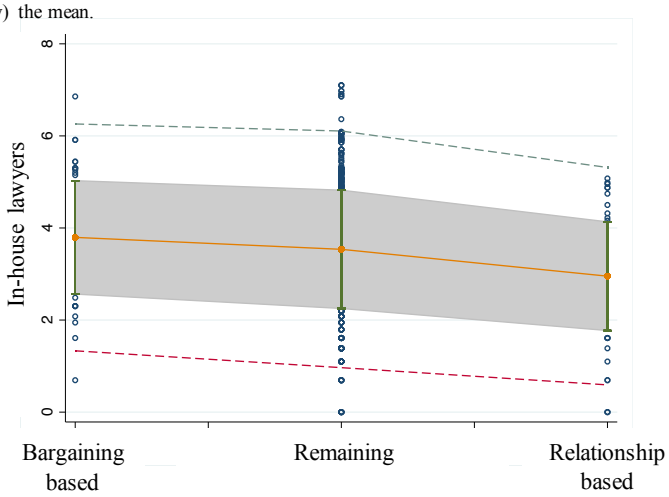
(b) Supplier portfolio design

Figure 2. In-house lawyers and supplier portfolio design

Panel (a) illustrates trends in the number of in-house lawyers (natural log) from 2005-2011. Panel (b) groups firms according to their supplier portfolio design. The left-hand "Bargaining based" scenario measures in-house lawyers in focal firms with below sample median levels of *Supplier concentration*, *Supplier capabilities* and *Supplier stability*. The right-hand "Relationship based" scenario measures the same in focal firms with above sample median levels of these same three supplier portfolio characteristics. The middle "remaining" scenario measures the same for remaining focal firms. In both panels, solid dots connected by a trend line within the shaded area represent the mean trend. The shaded area above and below the mean trend represents observations one standard deviation above or below the mean trend. Dotted lines above and below the shaded area define the range for observations two standard deviations above or below the mean trend. Hollow dots represent observations one standard deviation above (or below) the mean.



(a) Average values and variation of in-house lawyers over time



(b) Supplier portfolio design