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Relational contracts, collaboration and outsourcing in the supply chain

Abstract

Relational contracts are key to supply chain collaboration. The literature has focused on the role of trust stemming from prior interactions with current suppliers – that is, the shadow of the past. However, the role of future interactions – the shadow of the future –, and the role of collaborating internally as an alternative to collaborating with current suppliers, has been relatively neglected. This paper contributes to the literature by examining how the shadow of the future affects the choice to outsource, that is, the choice to collaborate with external suppliers rather than with internal units. Using regression analysis of fine-grained and extensive data on construction projects and carefully controlling for endogeneity, our results show that the shadow of the future promotes outsourcing and that this impact is larger when the shadow of the past is stronger and there is more specificity in the relationship. Our results are consistent with a game theoretic logic in which informally promising future interactions to sustain collaboration is more credible to external suppliers than to internal units because the former can use their assets elsewhere. Also, our results suggest that trust stemming from prior interactions is complementary to the calculativeness logic that stems from the shadow of the future.

Keywords: Outsourcing (Make or Buy), Buyer/Supplier Relationships, Partnering (Alliances), Contracting.

1. Introduction

Supply chains involve many actors, which typically have different objectives. Consequently, it is very important to align all the players' actions for the success of the supply chain. The vast research on supply chain collaboration is a testament to this fact (e.g., Leuschner, Rogers and Charvet, 2013; Flynn, Huo, and Zhao, 2010; Stank, Kelly and Daugherty, 2001; Adams et al, 2014; Fawcett et al., 2012). This body of research has shed light on many topics, such as the broad spectrum of outsourcing arrangements and their risks (Sanders et al., 2007; Feeney, Lacity and Wilcox 2005), the integration of supply chains (Leuschner et al, 2013), and the structure and boundary of the supply chain (Carter, Rogers and Choi, 2015). Fundamental insights from this literature include that formal contracts are insufficient to attain alignment and that supply chain managers need to think in terms of "relational contracts" (Vihnas, Heide and Jap, 2012; Sanders at al., 2007).

Although some progress has been made, we contend that the existing research on relational contracts in supply chain management suffers from two limitations. First, supply chain scholars have focused on how current relationships in the supply chain have been built from previous interactions – a process we call the shadow of the past. Thus, they neglect the importance of expectations about future interactions – which we call the shadow of the future. These two shadows suggest different logics of collaboration, and thus, the literature should identify and study both. In short, whereas past interactions breed goodwill and trust, which lead to cooperative behavior (Gulati and Nickerson, 2008, Flynn, Huo, & Zhao, 2010, Wathne and Heide, 2000, Poppo at al, 2008b), expectations of future interactions involve a tradeoff between collaborating today to increase the likelihood of obtaining future rewards and behaving opportunistically at the expense of future rewards (Baket et al, 2002; Gil and Marion, 2013). While the shadow of the past taps into the psychological and sociological motivations that sustain collaboration, the shadow of the future taps into self-interest maximizing behavior. As relational contracts encompass the analysis of the shadows of the future and the past, which often produce complex patterns, we contend that studying how these two shadows differ and interact is very important to fully understanding supply chain collaboration.

Second, the literature has focused on the study of collaboration of a focal firm with external actors (e.g., suppliers), largely sidestepping the study of its alternative, namely, collaborating with internal actors (e.g., employees, divisions, and departments) (a notable exception is Handfield, Cousins, Lawson, and Petersen, 2015). Schematically, the literature examines how a buyer and supplier relationship has evolved, identifies which factors have enhanced it and considers how this relationship favors performance. However, supply chains involve actors within and between firms; thus, the study of collaboration should include both types of actors. The key insight here is that, depending on the circumstances, eliciting collaboration from internal actors might be harder or easier than eliciting collaboration from external actors. This variation creates a need to link relational contracts to the outsourcing decision, that is, to the choice to collaborate externally versus internally. This connection has been made theoretically by Baker et al (2002) and Klein (1996), but it has been largely neglected by empirical studies both within and outside the supply chain community (two notable exceptions are Gulati and Nickerson, 2008 and Gil and Hartman, 2011). Consequently, we claim that we should examine how relational contracts affect outsourcing as carefully as the literature has studied the impact of relational contracts on current suppliers assuming that the decision to use suppliers is unaffected by relational contracts.

In this article, we attempt to bridge these two gaps by empirically analyzing how the shadow of the future affects the make-or-buy decision in supply transactions. In addition, we explore how this impact is moderated by two factors: the shadow of the past and specificity. We build from game theoretic ideas to predict that a larger expectation of future interactions leads to a larger increase of collaboration incentives for the external supplier in comparison to the increase of collaboration incentives for the internal supplying units. The logic behind this prediction is that when actors are trading off "opportunism today" versus "the promise of future rewards", granting asset ownership to the supplying party (i.e., outsourcing) increases the credibility of the promise of future rewards. Credibility increases because if the buyer denies its promise to the external supplier the latter can use its assets in alternative buyers, an option that is not easily available to the employee. Credibility is important because often these promises are not enforceable by third parties. Simply put, the buyer´s downside risk of not keeping its word is higher if she does not control the asset, and thus promising future benefits to promote collaboration is more credible for a supplier than for an employee.

Further, we propose that our prediction regarding the positive impact of the shadow of the future on the use of outsourcing will hold with more force under two conditions. First, we propose that the shadow of the past will increase the impact of the shadow of the future on the use of outsourcing. On top of creating trust between actors, prior interactions provide a signal of expected future interactions. Both trust and signaling will increase the credibility of promising future volume. This is consistent with recent evidence that has shown that these two shadows are complementary in trust formation (Poppo et al., 2008a) and biding behavior (Gil and Marion, 2013).

The second condition that increases the impact of the shadow of the future on the use of outsourcing is the extent of specificity. When specificity is higher (i.e., the value for both parties in the relationship is higher than the value of their second-best option), the impact of the expectation of future interactions on the incentives to outsource is stronger because higher costs of shifting suppliers increases the credibility of a promise to grant future rewards to the external supplier. If there is no specificity in the relationship, then the buyer can shift to a different supplier without penalty, which in turn, would eliminate the credibility of promising future rewards to the external supplier. In other words, credibility is enhanced when the buyer risks losing value from defection (Williamson, 1983). This interaction may also be rationalized from a different angle: higher incentives for collaboration are most useful when the risk of opportunism is higher, that is, when specificity is present in the transaction.

We test our predictions in the Chilean construction industry using extensive, fine-grained project data that covers over 40% of the square meters executed in Chile from 2004 to 2012. We analyze contractor decisions to internally execute or to outsource to subcontractors in each of the specialty trade activities (e.g., molding, painting) that are needed to complete a construction project. A key feature of our analysis is the use of building permits granted at the regional level as a measure of the shadow of the future. This measure has two desirable properties: i) building permits involve sunk costs and are public, so they provide a fairly credible signal of the expected level of contractor activity in the region, and ii) because each contractor minimally affects the total number of building permits (i.e., the industry is atomized), its effect is exogenous to each contractor, allowing for a causal estimation of the impact of the shadow of the future.

Additionally, the names of each contractor and subcontractor for each specialty tra0de and each project are available in our dataset; thus, we can measure prior interactions in detail. Finally, we use a measure of specificity that is critical for project setting, namely, temporal specificity. This type of specificity arises when timely delivery is essential (Masten et al, 1991). We measure temporal specificity by identifying the specialty trade activities that occur at the beginning of a project and whose timely delivery is more important than later activities because delays cascade throughout the project.

Our results support our predictions. First, we find that the expectation of future interactions favors the outsourcing of the specialty trade activities. Second, we find that this impact is more pronounced when the contractor has more prior interactions with its subcontractors and when temporal specificity is higher. In addition, we show that prior interactions increase the prevalence of outsourcing and that, as with the shadow of the future, the impact is stronger when temporal specificity is higher.

This article is divided into six sections. Following this introduction, the second section develops the hypotheses, and the third section presents a short overview of the construction industry. The fourth section introduces the database and econometric methods, and the fifth section presents the results. Finally, the sixth section presents a discussion of the results and the main conclusions.

2. Hypotheses Development

The make-or-buy decision was first considered by Coase (1937), who argued that managers should weigh the benefits of internal production against the costs of outsourcing to make a decision about these options. Borrowing from Coase's arguments, Williamson (1975) developed the transaction costs economics (TCE) approach. Under TCE assumptions, relationship-specific assets increase the likelihood of opportunistic ex post renegotiation, which is best managed using a hierarchical governance structure (i.e., "make") instead of the market (i.e., "buy"). Thus, as specificity increases, the use of market exchange diminishes, which favors internal performance of the activity (Williamson, 1991). The empirical evidence supports this theory (see Macher and Richman, 2008 for a review).

In this context, two main areas of research have evolved in the study of supply chains. First, outsourcing has become an important topic in supply chain management (e.g., Feeney, Lacity and Wilcox 2005) as a decision with strategic implications (Sanders et al., 2007). Supply chains involve networks of players wherein a manufacturer must constantly consider the interface between the firm and the supply stage of its value chain (Carter et al., 2015). A second stream of research, which perhaps captures a larger share of the attention, is associated with the study of collaboration in supply chains. Although internal production has been considered the main mechanism to resolve holdup problems in make-or-buy decisions, there are plenty of examples in which collaboration arises in supply chains even in the absence of clearly delineated property rights or adequate formal contractual safeguards (Araujo et al., 2008). These collaborations can arise from relational contracts, which can originate, for instance, from a history of interactions between parties (i.e., from the shadow of the past) or from the gains to be derived from expected future interactions (i.e., from the shadow of the future). Under this view, relational capital originating in relational contracts is important in explaining the success and stability of interorganizational exchanges (Poppo et al., 2008b). Although both shadows are important in relational contracts, the literature has tended to focus on the shadow of the past. Further, the focus on relational contracts with current suppliers while keeping fixed the outsourcing choice, may have led to a relative neglect of collaboration within the firm as a viable alternative to increase collaboration in the supply chain. As Baker et al

(2002) indicates: “the integration [insourcing] decision can be an instrument in the service of the parties’ relationship” (p. 41) (beyond and above the avoidance of hold-up problems).

In the rest of this section, we discuss how the shadow of the future might impact the make-or-buy choice and how this impact is moderated by two conditions: the shadow of the past and the extent of specificity.

2.1. The shadow of the future and the make-or-buy decision

The influence of the shadow of the future on collaboration hinges on the idea of self-enforcing informal agreements (Klein, 1996). To be self-enforcing, both parties to the relationship must have an incentive to satisfy the agreement without the participation of a third party. This incentive exists when the expected value of deviating from the pre-agreed upon action is lower than the expected value of continuing the relationship. Research has indicated that the incentives to satisfy an agreement are greater when continuous business between the parties is expected (i.e., the shadow of the future) (e.g., Poppo et al. 2008a; Welling and Kamman, 2001).

A cornerstone of the literature on relational contracts (e.g., Klein and Murphy, 1988; Klein, 1996; Halac, 2012) is that informal agreements center on the capacity of parties to enforce these agreements through the expectation of gains to be derived from future interactions (Gil and Marion, 2013). The expectation of continuity embedded in a relational contract may provide the incentives to make the specific investments that are necessary to increase the productivity of the buyer-supplier relationship because the possibility of obtaining the required return to justify those investments increases with the expected duration and depth of the relationship. The expectation of continuity also promotes cooperation between parties in many value-sharing activities that are difficult to define and specify contractually, such as those related to tacit knowledge and alliance formation (Dyer and Singh, 1998). In general, this game theoretical logic posits that the longer the expected time horizon of a relationship, the higher the benefits of cooperation (Friedman, 1971) and that an expectation of ongoing interactions is necessary to promote collaboration and trust (Telser, 1980, Axelrod, 1984).

However, the incentives to cooperate within an ongoing relationship increase for both an employee (i.e., make) and for an external subcontractor (i.e., buy). Thus, a relevant question is whether internal or external suppliers will be more incentivized to cooperate by the expectation of increased future business. Baker et al. (2002) show that the increase in expected cooperation stemming from a future relationship is higher for external suppliers because their ownership of assets, which can be devoted to alternative uses, grants them more bargaining power over the principal in comparison to the buying power exerted by the employees of the same principal. This bargaining power, which increases with the opportunity cost of the asset, allows the external agent to bargain for a compensation from the principal to continue the relationship. Thus, the buyer's temptation to renegotiate a contract is smaller under outsourcing than under internal production, increasing the incentives to engage in and the likelihood of pursuing outsourcing.

In our setting, a buyer's larger stream of expected future business increases the likelihood of business continuity. However, the buyer will more credibly promise continuity in the relationship to an external supplier than to an internal employee because the former has more bargaining power stemming from its ability to counteract a broken contractor's promise. This discussion leads to hypothesis 1 (H1):

Hypothesis 1 (H1): *A focal firm with higher expected future business faces reduced incentives to perform the activity internally.*

2.2. The moderating impact of the shadow of the past

Research has shown that relational capital can originate not only from the expectation of future interactions but also from a history of interactions between parties (i.e., from the shadow of the past) (Gulati and Nickerson, 2008). This relational capital arises because repeated exchanges between a buyer and a supplier form embedded social relationships (Granovetter, 1985) from individual-level attachments that facilitate friendship and respect (Kale et al., 2000) or from the promotion of trustworthiness between partners (Vanneste et al., 2014). Prior interactions also facilitate the development of firm capacities to assess its counterpart's capabilities, to avoid the selection of partners who have shown a tendency to engage in opportunistic behavior, to identify ex ante empty threats and non-credible promises that may affect the relative merits of alternative governance choices (Gulati, 1995), to support the development of mutual knowledge that decreases the parties' coordination costs (Gil and Marion, 2013), to promote adaptations to unexpected requests and to generate commitments to mutual problem solving that support the adaptation required to sustain an effective supply chain (Elfenbein and Zenger, 2014; Kwon and Suh, 2004; Poppo et al. 2008a).

If the partner firm fulfills positive expectations through prior interactions, the focal firm will develop greater confidence in the partnership, mitigating future concerns about opportunism (Nooteboom et al., 1997). Recent meta-analysis evidence from Vanneste et al (2014) indicates that there is a positive relationship between the length of prior interactions and trust. If the partner firm does not fulfill positive expectations through its interactions, the focal firm will not develop confidence in the partner, exacerbating concerns about future opportunism and affecting the continuation of the relationship. Thus, more interactions among firms in a supply chain imply closer relationships to ensure efficient performance (e.g., Flynn, Huo, & Zhao, 2010) and the ability to eliminate from consideration suppliers that fail to meet minimum standards (Wathne and Heide, 2000).

Although the relational capital generated by prior interactions may reduce the threat of opportunism even if there is no future volume, the expectation of future interactions promotes cooperation and trust. The discussion of the effects of the shadows of the past and the future, and the debate surrounding them, is long-standing in the literature. For example, Williamson (1993) has termed the former "personal trust" and the latter "calculativeness trust". Zaheer and Harris (2005) have indicated, "*for sociologists trust is only about the past, whereas for economists it is only about the future*" (p. 181), while Vanneste and Frank (2014) have argued that the shadow of the past and the shadow of the future can both lead to cooperation.

An important question arising from the previous discussion is how the shadows of the past and future interact to affect organizational decisions. Relying on questionnaires completed by key respondents in several firms, Poppo et al. (2008a) show that the impact of each of these shadows on one another and on trust formation is increasing, suggesting that the past and the future are intertwined in the origins of interorganizational trust. In a different setting, Gil and Marion (2013) have analyzed California's highway construction sector, finding that contractor bids are lower when prior interactions with subcontractors are accompanied by an expectation of future interactions. Vanneste et al. (2014) have acknowledged that trust based on prior interaction is more valuable and enduring when the trusted party gains more from the relationship in the form of future interactions.

Unlike the existing body of literature, our aim is to analyze how the shadow of the past moderates the effect of the shadow of the future in the firm's make-or-buy decision. We assert that a promise of future volume that sustains collaboration is more credible when there are more prior interactions with the same partner. This relationship history increases the amount of trust in and the productivity of a buyer-supplier match. Productivity is higher because previous interactions with the same supplier promote mutual learning, knowledge, adaptability, and coordination, all of which increase the incentives to invest in relationship-specific assets. Higher productivity incentivizes an increase in the continuation value of a given buyer-supplier relationship.

In sum, the shadow of the past is expected to reinforce both the value of a given buyer-supplier relationship and the incentives to outsource that stem from additional expected interactions. This discussion leads to hypothesis 2 (H2):

Hypothesis 2 (H2): *The negative relationship between a focal firm's expected future business and its incentives to perform an activity internally is stronger when the number of prior interactions with suppliers is higher.*

2.3. The moderating impact of specificity

In this section, we analyze whether specificity moderates the effect of the shadow of the future on the make-or-buy decision. The standard TCE prediction is that the existence of specificity increases the incentives to perform specialty trade activities internally mainly because of the fears and costs of opportunistic behavior (Williamson, 1979 and 1985). However, whether relational governance mitigates losses when opportunities for self-interested behavior exist is highly debated (Poppo et al., 2008b).

We argue that when specificity is higher (i.e., when the value obtained by both parties is higher within the relationship than outside it), the impact of expected future business on the incentives to outsource is higher. This stronger impact can be rationalized from two different, albeit related, angles. First, in a buyer-supplier relationship characterized by specificity, the buyer's costs of shifting suppliers are higher. Thus, the credibility of a promise to grant future rewards to that supplier increases. If there are no specific assets in the buyer-supplier relationship, the buyer may shift to a different supplier without penalty, which in turn, reduces the credibility of promised future rewards to the supplier stemming from the shadow of the future. Thus, the credibility of future volume as a promise that sustains collaboration with an external supplier is enhanced when the buyer bears higher costs from defecting from her promise (Williamson, 1983).

Second, the moderating effect of specificity on the relationship between the shadow of the future and outsourcing may also be rationalized from the perspective that the external supplier's incentives for collaboration are higher when the risk of opportunism is higher. If a buyer that faces specificity in its exchanges with suppliers can credibly promise to reward them with future work if they do not behave opportunistically, then suppliers will have more to lose from holding up the buyer, which reduces expected shirking. This complementary rationale is consistent with ideas from TCE (Williamson, 1991). Additionally, the expectation of continuity provides parties with incentives to make the specific investments necessary to improve the productivity of the buyer-supplier relationship.

The type of specificity that we analyze is temporal specificity (Masten et al., 1991). In many cases, particularly in project-based industries (Winch, 2001; Chang and Ive 2007a; 2007b), the performance of the supply chain as a whole is highly dependent on the timely completion of its constituent activities. Thus, coordination among activities is important, particularly with respect to sequential handoffs and/or overlapping activities (Tommelein et al., 1999). Knowing the importance of timely delivery, external suppliers may behave opportunistically in order to extract quasi-rents from the buyer (Masten et al., 1991). For example, the supplier might indicate that more time and work has to done, but requiring a higher price than previously agreed. We speculate that temporal specificity is an important, but seldom studied condition in many supply chains. We believe that incorporating it to the study of supply chain collaboration is novel and fruitful.

In sum, the effects of expected future interactions on the make-or-buy decision are modified by the transactional setting. A transactional setting in which opportunism looms large will benefit more from creating future expected interactions. More generally, a key insight of our framework is that the impact of relational contracts on the make-or-buy choice is increasing in the level of specificity, i.e., relational contracts are more valuable when the risk of opportunistic behavior is greater. The incentives for cooperation under a stronger shadow of the future, for both the buyer and the external supplier, are higher when there are relationship-specific collaborations. Based on this discussion, we obtain hypothesis 3 (H3):

Hypothesis 3 (H3): *The negative relationship between the focal firm's expected future volume of business and its incentives to perform the activity internally is stronger when the temporal specificity of the activity is greater.*

3. Empirical Setting

We analyze the study hypotheses in the context of the construction industry. This industry is important (accounting for 8-10% of GDP in many countries; see Gordon, 1992) and represents an ideal setting for research on governance because construction projects are long-lasting, non-standardized, and require both cooperation and contractual relationships among specialized project constituents. These characteristics produce complex relations between contractors and subcontractors (Puddicombe, 2009; Winch, 2001). Recent research has started to address this industry in areas such as vertical integration and outsourcing (Brahm and Tarziján, 2014; Gonzalez-Diaz et al., 2000), repeated interaction (Gil and Marion, 2013), hybrid contracting (Ebers and Oelermans, 2013), alliances (Lui and Ngo, 2004) and contract choice (Corts, 2012; Bajari et al., 2008).

The value chain in the construction industry functions as follows. A contractor, who may be in charge of many different projects simultaneously, builds a project for an owner-developer according to the specifications provided by the designer, who is typically (though not always) appointed by the owner. During the construction period, the contractor must decode and interpret the designer's documents to produce a quality product for the owner-developer. Various specialty trade activities (e.g., metallic structure, formwork, electrical work, plumbing) must be executed, and the building contractor must decide whether to make or buy each activity. This choice is the unit of analysis of this paper. In this setting, "making" implies executing the activity internally, whereas "buying" implies outsourcing the activity to subcontractors (also known as specialty trade contractors). These subcontractors are typically specialized, that is, there is little diversification of activities (Ng and Tang, 2010). The contractor's primary function with respect to the specialty trades is to coordinate the subcontractors and internal teams to ensure timely and successful project delivery (Tommelein and Ballard, 1997).

Several characteristics of construction projects are very interesting for the study of supply chains. To highlight these characteristics, we use the ontology of supply chains proposed by Carter et al (2015). First, as indicated in the previous paragraph, a construction project is a point of convergence in a vast network of contractors, subcontractors, professional services firms, and suppliers, all collaborating to deliver the final building. A network view of construction projects is important to understanding the project supply chain (Dubois and Gadde, 2000). Consequently, the tension between control and self-organization to adapt to frequent changes in projects is an important challenge. Second, because the inputs and materials that are used in construction projects are highly specialized, specific supply chains, which are largely independent, are formed for each input. This creates high variance in supply chains coalescing at a single point. Third, all of these supply chains are relative to the focal agent, which in the case of construction projects, is the main contractor. The same contractor coordinates and manages these separate supply chains. Thus, we have a desirable situation of high variance in the supply chains of a single focal actor.

Another interesting feature of construction projects supply chains is activities need to be performed in sequence. In this setting, if an activity is not properly conducted, all subsequent activities, and the project as a whole, will suffer. This is especially true for activities that have to be performed earlier, in which case the costs of poor performance can be quite high. In these activities, contractors might behave opportunistically in order to extract quasi rents from the buyer. This type of specificity, and ensuing transactional hazards, is very important in construction (Winch, 2001). In the variables measurement section, we develop temporal specificity in detail.

The construction industry tends to be specific to the regional context. First, the high transportation costs and geographical specificity of projects incentivize the generation of "construction districts," clusters of firms operating within a particular region (Buzzelli and Harris, 2006). Second, the industry relies heavily on local regulations, institutions, government offices and quality inspectors (e.g., for building permit issuance), which vary between and within countries (Cacciatori and Jacobides, 2005; Winch 2001). Contractors and subcontractors also tend to specialize in the types of projects they execute (e.g., residential buildings, office buildings, industrial buildings, educational facilities, commercial buildings) (Ball, 2003). Some of these projects are more standardized (e.g., large housing complexes), whereas others exhibit high degrees of heterogeneity and differentiation (e.g., health facilities, industrial buildings).

4. Methods

4.1. Data

We used a unique database provided by ONDAC S.A., a firm that collects detailed data on construction projects and sells it to construction suppliers and building material manufacturers. The database covers the period from January 2004 to October 2012 and includes 46,420,398 square meters built over 12,272 projects. The database includes approximately 40% of the total square meters constructed in Chile during that period.

For each project, detailed information about the building contractor is available (e.g., executives, website, address, and company name). Most importantly, we have information about the nine main specialty trade activities executed: 1) building and installing the metallic structure; 2) building the formwork; 3) installing electrical service; 4) installing plumbing and water service; 5) installing the heating and cooling system; 6) building and installing the windows; 7) painting; 8) building and installing the furnishings and appliances; and 9) installing gas service. These activities account for a large proportion of the total number of activities in a typical construction project (Riley et al., 2005). The data indicate whether the contractor performed each activity internally or relied on an external subcontractor. In the case of the latter, detailed information about the subcontractor is also available (e.g., executives, website, address, and company name). We also have detailed information about each project, such as square meters (m2), geographic location (city, state), project dates, and comments about each project's overall characteristics. Finally, each project is classified as one of the following types: housing complex, office building, residential building, health facility, educational facility, hotel, industry, commercial project (e.g., banks and supermarkets), religious building, or single-family house.

4.2. Variable measurement

Vertical integration. The dependent variable is a dummy variable that assumes a value of 1 if the specialty trade activity was performed internally by the building contractor and zero otherwise. For each project, we include nine dummy variables, one for each specialty activity.

Future volume in the region (Shadow of the future). To compute the shadow of the future, we used the natural logarithm of the total number of approved building permits in year t+1 in the region in which the focal project is being executed. We obtained building permit statistics from the Institute of Statistics, which releases a yearly statistical review of building permits by geographical region. We consider building permits at the regional level because subcontractors and contractors tend to have local operations.

To obtain a building permit, the contractor must comply with many requirements, such as detailed drawings, structural calculations, project costs, and technical specifications. These requirements entail joint work among project participants (e.g., designers and suppliers) well in advance of the permit request, which creates visibility for the suppliers. Additionally, before requesting a building permit, the contractor must file for approval of the draft of the project. This information becomes publicly available once this requirement is met. Thus, industry players have access to reliable information about the planned volume of contractor operations in each region.

Our measure of future volume is consistent with Gil and Marion (2013), who used the volume of regional permits issued in the year following an auction to proxy for the "shadow of the future" for highway construction projects. Similarly to Gil and Marion's measure, our proxy for the shadow of the future has the advantage of being exogenous to the individual contractor, which favors the identification of causality. Because the contractor might decide to increase its future volume as a consequence of the boundary choices made earlier (e.g., the contractor may outsource to redirect scarce managerial attention to growth opportunities), it is important to use a measure of the shadow of the future that is independent of the contractor and not subject to reverse causality problems. The number of building permits at the regional level meets this exogeneity requirement because the construction industry is not highly concentrated, and thus, the total number of building permits issued at the regional level cannot be accounted for by any individual contractor[1]. In our data, the mean market share at the regional level is 4.4%, but the distribution of contractors is highly skewed toward zero: the median is 2.1%, the 75th percentile is 6.4%, the 90th percentile is 13%, and the 99th percentile is only 27.6%.

As a robustness check, we disaggregated building permits by industry sector at the regional level, e.g., we used future building permits in the housing sector to analyze a project in that sector. Our results remained unchanged. Although contractors tend to specialize in industry sectors, subcontractors do not; thus, we prefer the aggregate measure.

Stock of prior interactions (Shadow of the past). Gulati (1995) and Corts and Singh (2004) have used the number of interactions between each pair of firms before the transaction under analysis. We constructed a similar variable. First, we created the adjacency matrices in which the rows show the contractors and the columns show the subcontractors. These matrices, which display the frequency of transactions between each possible contractor-subcontractor pair, were computed for each specialty trade activity and region. To obtain the stock of prior interactions, we computed these matrices, restricting our observations to the four years before the start of a project[2]. For

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[1] Alternatively, we can use a contractor-level measure of future volume, such as the volume built in year t+1. However, this requires us to pursue one of two alternatives that may alter the spirit of the paper: 1) adjust the theory to allow for endogeneity by including bi-directional and alternative mechanisms (e.g., the likelihood of performing the activity internally and building in-house capacity increases when you can use that capacity repeatedly over time; or 2) adjust the empirics to eliminate these alternative mechanisms. In non-reported results (available upon request), we checked that the second alternative was feasible and obtained findings analogous to our main predictions. However, this alternative complicates the analysis by requiring us to address the additional mechanisms. In the end, our story is about expected interactions and causality, which are better captured by exogenous regional volume.

[2] As we compute this variable using the previous four years, i.e., from t-4 to t-1, and our dependent variable is

example, if a project started in 2011, we computed the adjacency matrices for the period from 2007 to 2010[3]. Because we compute this variable using the previous four years and our dependent variable is specified at year t, we lose the first four years of data. Next, we computed the average number of projects that a contractor has executed with each subcontractor in each specialty trade activity in each region. For example, if the contractor completed 10 projects over the previous 4 years in a particular region and he subcontracted a particular specialty trade in 6 of them, 4 to subcontractor A and 2 to contractor B, then our measure of prior interactions for that specialty trade and region is 3. If the contractor had no prior projects or if it always integrated a particular specialty trade activity, we set this variable to zero because these situations entail no interaction with subcontractors.

Our measure of prior interactions captures each contractor's overall propensity to repeat subcontractors in its projects. Because contractors and subcontractors are highly specialized geographically, this measure also largely captures repeated interactions occurring at the local level[4]. Similarly to our measure of the shadow of the future, prior interactions might be affected by endogeneity, in this case mainly by omitted variable bias. To address this issue we include, in addition to a large set of fixed effects (FE), two control variables tailored to prior interactions:

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specified at year t, we lose the first four years of data. In addition, given that firms do not enter the database at the same time, some variance in prior interactions may be related to entry timing rather than different strategies regarding prior interactions. However, the inclusion of contractor fixed effects controls for this confounding effect. Additionally, we perform robustness checks in which we restrict contractors to have different number of projects in the previous 4 years. The results did not change.

[3] The length of the period used to measure prior interactions depends on the length of the time of the actual transaction. For example, Corts and Singh (2004) have analyzed the drilling of exploratory wells, which takes between 30 and 60 days, and prior interactions are considered over the previous 6 months; Elfenbein and Zenger (2014) have studied the supply auctions of a large manufacturing company and use the previous 4 quarters to measure the stock of prior relationships. Given that the projects analyzed in this article last 1.5 years, on average, and that an activity takes between 20% and 30% of the total project time, on average, we believe that 4 years is an appropriate time window for our setting.

[4] As a robustness check, we measure prior repeated interactions between two specific parties taking into account the relationship that a contractor has in its prior interactions with each of its subcontractors. That is, when the focal activity in a project in year *t* was executed by subcontractor "s", we used the number of prior interactions with that particular subcontractor "s". To obtain this measure, we displayed adjacency matrices and counted the number of times that the contractor interacted with each subcontractor over the past four years in that activity. Our results are robust to this alternative measure.

"Average contractor vertical integration over the previous 4 years" and "Number of contractor projects over the previous 4 years". These variables are described in the appendix[5].

Activity executed at the start of the project. A particularly important requirement in construction projects is the "timely coordination" of the "trade parade" of specialty trade activities (Tommelein et al., 1999; Eccles, 1981). Accordingly, scholars have suggested the term temporal specificity for this and other project-based industries (Masten et al., 1991). Temporal specificity refers to the existence of critical paths (i.e., activities that are prerequisites for other tasks), which may lead to heavy losses if the project sequence breaks down (Tommelein et al., 1999; Bashford et al., 2003). These expenses may include not only financial opportunity costs but also operational costs (Ng and Tang, 2010) due to disruptions to hard-to-balance capacity plans across projects (O'Brien and Fisher, 2010). Knowing the criticality of schedule, subcontractors might behave opportunistically, typically by claiming that more work and time is needed and requesting a higher price than originally agreed upon (Chang and Ive, 2007a and 2007b). Requiring extra work at higher prices is more frequent when change orders are more likely, particular if the change orders have ambiguous apportionment responsibilities[6], and when the costs of disrupting the project are higher.

[5] The "stock of prior interactions" variable may suffer from endogeneity because a higher level of vertical integration decreases the likelihood of interacting with subcontractors. We address this problem in two ways. First, and to detach the measure of prior interactions from the make-or-buy choice in year *t*, we computed prior interactions over the four years before the project, i.e., from *t-4* to *t-1*. Second, we include the contractor's degree of vertical integration during the same period as our measurement of prior interactions as a control variable, that is, from *t-4* to *t-1*. This avoids bias from not accounting for the fact that prior vertical integration affects both current integration and previous prior interactions. In addition, we added the number of projects over the previous four years as a second control variable. The rationale for the latter control variable is that a contractor with fewer projects, conditional on its degree of prior integration, will face a lower likelihood of interacting repeatedly with subcontractors.

[6] Change orders are requests made by a party in the project to do some rework, to change a particular aspect of the project, or to add new work. It is more often that these change orders come from the owner, the contractor or the designer. These change orders typically undermine the contractual terms devised by the contractor, such as liquidated damages clauses or payment retentions and guarantees, that attempt to discourage supplier opportunism (Chang and Ive, 2007b; Uher, 1991; Greenwood et al., 2005).

The subcontractors involved at the beginning of a project typically face greater uncertainty and thus more change orders (Winch, 2001). These subcontractors also have more bargaining power because a delay during an early stage cascades to subsequent activities, creating higher disruption costs (Bashford et al., 2003). Thus, to capture the higher propensity of these subcontractors to exploit temporal specificity, we used a dummy variable that takes the value of 1 if the specialty trade activity is "building and installing the metallic structure" or "building the formwork" (the two activities executed in the first stages of the project) and 0 for activities that are performed in later stages of the project.

Control variables. We included a large set of control variables as well as year, contractor, activity, region and type of project FE in our models. In the appendix, we detail these variables and their measurement.

Table I summarizes the descriptive statistics and displays the correlation matrix for the variables considered in this study.

[Insert Table I around here]

4.3. Econometric model

To empirically analyze the contractors' integration decisions, we pooled the specialty trade choices and performed a cross-sectional analysis including FE for year, region, type of project, specialty trade activity and contractor. Accordingly, we used the following econometric model to study the vertical integration decision of building contractor *i* for activity *j* and project *n*:

$$\text{Vertical integration}_{i,\ j,\ n} = \beta_0 + \beta_1 * \text{Future volume}_{i,\ n} + \text{Controls} + \text{FE} + \mu_{i,\ j,\ n} \quad (1)$$

Equation (1) was used to evaluate hypotheses 1, which predicts that $\beta_1 < 0$. To study hypotheses 2 and 3, we consider the following econometric model:

$$\text{Vertical integration}_{i,j,n} = \beta_0 + \beta_1 * \text{Future volume}_{i,n} + \beta_2 * \text{Stock of prior interactions}_{i,j,n} + \beta_3 * \text{Future volume}_{i,n} * \text{Stock of prior interactions}_{i,j,n} + \beta_4 * \text{Activity at the start}_{i,j,n} + \beta_5 * \text{Future volume}_{i,n} * \text{Activity at the start}_{i,j,n} + \beta_5 * \text{Stock of prior interactions}_{i,j,n} * \text{Activity at the start}_{i,j,n} + \text{Controls} + \text{FE} + \mu_{i,j,n} \quad (2)$$

According to hypotheses 2 and 3, we would expect that β_3 and $\beta_5 < 0$. We included an interaction term between "Activity at the start" and "Stock of prior interactions" to avoid the confounding effect of the interaction between past interactions and specificity.

We used OLS to estimate (1) and (2). Because the dependent variables of the models are dichotomous, the OLS model becomes a *linear probability model* (LPM). Although logit or probit models would also be appropriate, the interpretation of logit and probit results is troublesome, particularly for interaction terms. A LPM simplifies the interpretation of our coefficients of interest. Our results are robust to the use of both LPM and logit/probit models[7]. To further reduce omitted variable bias, we included several control variables (see the appendix) and a wide array of FE (e.g., contractor, type of project, activity, year, and region).

5. Results

The results are presented in table II. The overall fit of models to data is good, with r-squares of approximately 40%. Overall, the signs and significance of the coefficients do not change when we

[7] In logit models, the marginal effects of each variable are different for each observation (Hoetker, 2007; Wieserma and Bowen, 2009) and allow for a fitted curve of predicted probabilities that is nonlinear and bounded between 0 and 1, two features that are violated by LPMs. Further, interaction terms, in addition to varying across observations, can change their signs, requiring complex graphical techniques to analyze the coefficients (Wieserma and Bowen, 2009). Given that we are interested in the overall effect of the variables rather than predictions for specific construction firms, a LPM is sufficiently accurate and easy to interpret (see Wooldridge, 2009: 587). This is particularly true for large sample analyses because the central limit theorem relaxes the need to model non-normal errors (Wooldridge, 2009). We conducted robustness checks of all of our models; the results did not change (available upon request). Thus, for simplicity, we maintain the OLS specification.

estimate logit models. Model 5 (logit) is comparable to model 2 (OLS), indicating that the LPM provides reliable estimates.

We will focus on model 2 to evaluate our first hypothesis. Model 1, as explained below, is used to elucidate a multicollinearity issue that arises in the evaluation of H1. From a naïve analysis of model 2, it may be concluded that future volume is not related to outsourcing. However, the null statistical significance of the future volume variable is paired with a large effect: a one standard deviation change in future volume is related to a decrease of 4.8 percentage points in vertical integration (see figure 1). This disconnect is produced by the presence of multicollinearity, which inflates the standard errors of the coefficient of future volume in model 2. This multicollinearity is explained by the high correlation between the "future volume in the region" and the set of region dummies[8]. Multicollinearity occurs because the volume of each region, although it varies over the sample period, differs considerably by region. Multicollinearity can be confirmed by examining model 1, which excludes the regional dummies. In this model, the future volume in the region is statistically significant at the 99% confidence level. Given that multicollinearity only reduces the statistical significance of the "future volume" coefficient, inferences and conclusions can be drawn from model 2. Our results support H1: future interactions diminish the incentives to produce an activity internally (i.e., they increase the use of outsourcing). Our results also show that the impact of future interactions on the "make-or-buy" decision is larger than the individual impact of prior interactions.

As the baseline expectation suggested, model 2 shows that prior interactions are significantly (at the 99% confidence level) and negatively related to vertical integration. A one standard deviation change in prior interactions diminishes vertical integration by 2.1 percentage points (i.e., from 50% to 47.9%).

[8] The VIF of future volume is 71. The VIF of the dummy of the metropolitan region (the largest region) is around 131. (Both of these factors are well above the maximum recommended value of 10). This translates into a decrease in the t-test of 88% (=1-1:71^0.5) and 91% (=1-131^0.5), respectively.

[Insert Table II, Figure 1 around here]

5.1. Interaction with the shadow of past

In model 3, we include an interaction term between future volume and prior interactions. The coefficient of this interaction is negative, though the coefficient is *individually* not significant. However, the *joint* test of significance for the individual terms plus their interaction is highly significant (at the 99% confidence level). This result is not uncommon for interaction terms because they are prone to multicollinearity, producing low individual significance but high joint significance[9]. Moreover, the economic significance of the interaction term for the impact of future volume is relatively strong: when prior interactions are low (i.e., the mean minus one standard deviation), the impact of one standard deviation increase in future volume promotes a decrease of 3.8 percentage points in vertical integration. Conversely, if prior interactions are high (i.e., the mean plus one standard deviation), a one standard deviation increase in future volume produces a decrease of 5.6 percentage points in vertical integration. This result is graphically depicted in figure 2. This multicollinearity can also be interpreted as evidence of a deep interrelationship between the shadow of the future and the shadow of the past in explaining vertical integration. The results of model 3 support H2 and its underlying rationale: the credibility of future volume as a promise that sustains collaboration is higher when suppliers are trusted, leading to higher levels of outsourcing.

[Insert Figure 2 around here]

5.2. Interaction with temporal specificity

In model 4, we estimate equation (2). First, the results show that the interaction term between future volume and the dummy for activities that occur at the beginning of a project is significant (at the 95% confidence level) and negatively related to the internal performance of the activity. An increase of one standard deviation in future volume diminishes the internal performance of the

[9] The VIF of the interaction term is 230, which translates into a 93% decrease in the value of the t-test.

activity by 6.3 percentage points. However, this latter value decreases to only 4.1 percentage points when the activity occurs at later stages. This result is graphically displayed in figure 3; it supports both H3 and its rationale. The credibility of future volume as a promise that sustains collaboration is higher when the buyer bears higher costs if the promise is not kept. A complementary interpretation of this result is that relational contracts are more valuable when the risk of opportunistic behavior is larger.

The results also show a negative and significant (at the 90% significance level) interaction term between prior interactions and the dummy of activities that occur at the beginning of a project (the joint test for the variable of prior interactions and its interaction term is significant at the 99% level). This interaction term is an important control variable: it allows us to interpret the interaction between temporal specificity and future volume as a result of increasing credibility of the promise without confounding it with the trust and goodwill that is mainly captured by the shadow of the past. Interestingly, the significant result for the interaction between specificity and the shadow of the past can also be interpreted as the impact that trust and goodwill have on containing opportunism without being affected by the signaling content of continuing interactions into the future (which is captured by the future volume). Figure 4 provides an interesting summary of these two dynamics. Trust and goodwill stemming from prior interactions decrease opportunistic behavior (or increase collaboration), thus reducing the impact of specificity on the make-or-buy decision. In addition, specificity increases the credibility of future rewards informally promised to suppliers, which increases outsourcing.

[Insert Figure 4 around here]

6. Discussion and Conclusion

In this article, we explored how relational contracts affect collaboration incentives and the make-or-buy decision. We studied these topics using a large database of construction projects, where the main contractor faces make-or-buy decisions in nine specialty trades. Our results can be summarized as follows. First, we show that increases in expected future interactions with the focal contractor increase collaboration incentives for external suppliers, increasing the likelihood of outsourcing. In short, collaboration through the market rather than through the firm is enhanced as the shadow of the future lengthens. The rationale for this result is that under conditions of some specificity in the relationship between a buyer and a supplier, granting asset ownership at the supply stage (i.e., outsourcing) increases the credibility of a promise of future volume, mainly because the external supplier has the freedom to channel its assets toward alternative customers if the buyer reneges on its promises of future volume. Second, we found the impact of the shadow of the future on outsourcing is stronger when the shadow of the past is larger and when specificity is higher. The main rationale for this second set of findings is that promises are more credible when the supplier is known and trusted and when the buyer has more to lose from broken promises.

We contribute to the literature on supply chain collaboration on several fronts. First, we show that it is important to consider the role of the shadow of the future – i.e., the expectation of future interactions – as a basis for relational contracts. This important driver of collaboration has been relatively neglected in favor of the shadow of the past – i.e., the history of prior interactions. We show that the more calculative logic of the shadow of the future explains the choice to collaborate with external suppliers (rather than with internal units) as much as the trust and goodwill logic of the shadow of the past. Although only two prior papers have studied related questions, they yield results that are consistent with ours. Gulati and Nickerson (2008) have shown that the trust stemming from prior interactions diminishes vertical integration; however, they use questionnaires for only two firms, and more importantly, they do not explore future interactions. Using a large sample administrative data, Gil and Hartman (2011) show that stronger social networks lead to lower vertical integration, studying neither prior nor future interactions.

Second, we show that the shadows of the future and the past are complementary in creating collaboration incentives. This result suggests that the trust produced by previous interactions is complementary to the self-interested calculus triggered by continuing the relationship into the future. Although this result is consistent with prior research (Gil and Marion, 2012; Poppo et al 2008), these two logics may be substitutes, namely, goodwill and trust may be crowded out by self-interest (Vanneste and Frank; 2014). We believe that further research on how these two logics interact to form and sustain relational contracts would be fruitful. We can readily pinpoint two avenues of inquiry: i) additional testing of the substitution versus complementarity of the "sociological" and "calculative" logics, and ii) additional study of the conditions under which each shadow is more important for collaboration, independent of their interaction. Extant research by Schilke and Cook (2015) provides a way forward on the latter issue by presenting conditions that determine when and where a 'calculative logic' in relationships exerts a higher impact than a 'goodwill logic' on predicting trustworthiness between exchanging parties.

Third, we go beyond studying solely how relational contracts affect collaboration with suppliers to study how relational contracts affect the make-or-buy choice, namely, the choice between collaborating within the firm and using the market. The literature so far has emphasized how relational contracts affect collaboration with suppliers without realizing that the choice to use suppliers in the first place is also affected by relational contracts. As Baker et al (2002) mention, "integration [insourcing] can be an instrument in the service of the parties' relationship" (p. 41). We show that informal promises of future volume are both more credible and conducive to collaborative effort from an external party than from an internal one, particularly if the external party is trusted and the stakes are high.

Fourth, we show that capital goods projects, such as construction, can be a great source of analysis for supply chain scholars. As discussed in the empirical setting section, in a construction project, typically many supply chains coalesce at the same unit, the project. We explored the make-or-buy decision for nine different specialty trades. Because the different products and services that are used to complete a capital goods project are very different and require highly specialized inputs and suppliers, the supply chains for these different products are almost entirely independent from one another. This characteristic provides considerable variance of choices and realities to study. In addition to this rich variance, these different supply chains share a focal actor, which in our case, is the contractor. This high variance relative to one actor is valuable for empirical studies. As Carter et al (2015) remind us, supply chains are always relative to a specific actor.

Finally, we also highlight the importance of temporal specificity in capital goods projects, a condition that might be encountered in many others supply chains. When activities are sequential and timing is important, collaboration is much more important in the first activities of the supply chain. We found that the negative effects of specificity on outsourcing decrease as both prior and future expected interactions increase. We think that this finding is also relevant because it suggests that managers can worry less about outsourcing activities with higher levels of specificity when they have built relationships with external parties in their supply chain or when they are able to credibly signal expectations of future business and future interactions to suppliers. To sum up, we contend that capital goods projects provide an excellent setting in which to study supply chain phenomena.

We can elaborate some important managerial implications from our work. First, when the collaborative behavior of suppliers is incentivized by promises of future interactions, managers should take great care to ensure the credibility of those promises. This can be conducted in several ways. Our results point to the fruitfulness of making promises to trusted contractors that are costly if broken. Second, the results indicate that signaling future work is especially valuable when the likelihood of opportunistic behavior stemming from transactional hazards is greater. Third, managers should not forget that outsourcing is a tool that can be used to increase collaboration incentives. This is especially relevant when informal promises are important to collaboration.

Our study has some limitations. First, we analyze a specific economic sector, the construction industry. Although the empirics might generalize to other project-based sectors, a more comprehensive study across economic sectors should be undertaken to confirm our findings. For instance, construction projects show important variance in size and duration, which might not be the case in all project-based industries. Second, local regulations are important in the construction industry, and thus, our conclusions should be taken with care when applied to different settings. Third, additional research should focus on intermediate organizational forms. Whereas our focus is on pure forms (i.e., the make-or-buy decision), many organizational arrangements are not pure (Stinchcombe, 1985). Therefore, we should view governance forms as distributed on a continuum beyond the make-or-buy dichotomy. Fourth, there are location-specific factors, other than regulations, that can influence the behaviors of contractors and subcontractors.

In conclusion, we believe that our main contribution is the development of a more nuanced theory of collaboration in the supply chain (see Carter et al., 2015). The distinction between trust stemming from past interactions and self-interested calculations stemming from expected future interactions as well as the comparative analysis of collaboration within and between firms are two subtle factors that can enhance our understanding of supply chain collaborations.

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TABLES AND FIGURES

Table I. Correlation matrix and descriptive statistics.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Integration of specialty trade activity	1.000															
2	Stock of prior interactions with subcontractors in the previous 4 years	-0.283	1.000														
3	Future volume in region	-0.046	0.054	1.000													
4	Activity executed at the start of the project	0.211	-0.020	0.027	1.000												
5	Thinness of the subcontractor market	0.216	-0.078	-0.026	0.530	1.000											
6	Project distance	-0.022	0.066	-0.382	-0.008	0.035	1.000										
7	Contractor capability on the specialty trade activity	0.112	-0.002	-0.022	-0.123	-0.086	-0.145	1.000									
8	Project size	-0.165	0.139	-0.121	-0.011	0.018	0.109	0.127	1.000								
9	Contractor size	-0.213	0.265	-0.100	-0.016	0.010	0.201	0.211	0.593	1.000							
10	Simultaneous number of projects of the contractor	-0.106	0.163	-0.077	-0.027	-0.002	0.196	0.172	0.132	0.613	1.000						
11	Contractor market share	-0.028	0.077	-0.403	-0.038	0.094	0.200	0.227	0.295	0.500	0.340	1.000					
12	Contractor diversification	-0.214	0.136	0.025	0.009	-0.017	0.121	0.013	0.210	0.470	0.366	0.148	1.000				
13	Contractor geographical dispersion	-0.127	0.120	-0.220	-0.023	-0.005	0.427	-0.016	0.212	0.544	0.560	0.363	0.370	1.000			
14	Contractor average vertical integration in the previous 4 years	0.516	-0.583	-0.141	0.199	0.183	-0.072	0.172	-0.223	-0.392	-0.200	-0.028	-0.353	-0.219	1.000		
15	Contractor number of projects in the previous 4 years	-0.171	0.314	0.010	-0.016	0.039	0.232	0.206	0.256	0.617	0.692	0.312	0.436	0.492	-0.348	1.000	
16	Demand uncertainty in the prior decade	-0.042	-0.056	0.016	0.001	-0.130	-0.052	-0.049	-0.015	0.055	0.060	-0.144	-0.024	-0.009	0.009	-0.130	1.000
	N	9198	9198	9198	9198	9198	9198	9198	9198	9198	9198	9198	9198	9198	9198	9198	9198
	Mean	0.485	1.718	14.785	0.286	0.217	0.532	0.402	8.226	9.855	5.754	0.044	0.246	0.225	0.511	16.266	46.536
	Std. Dev.	0.500	1.732	0.958	0.452	0.265	1.203	0.342	1.757	1.806	5.506	0.057	0.253	0.263	0.336	13.960	29.638
	Min	0.000	0.000	12.365	0.000	0.015	0.000	0.000	0.088	0.237	1.000	0.000	0.000	0.000	0.000	1.000	5.830
	Max	1.000	21.000	15.747	1.000	1.000	8.000	1.000	11.971	12.921	29.000	0.462	0.791	0.751	1.000	70.000	86.060

Table II. Regression models (†)(‡)

	Dependent Variable: Integration of the Specialty Trade Activity				
	Model 1	Model 2	Model 3	Model 4	Model 5
Main variables: *Method:*	OLS	OLS	OLS	OLS	LOGIT
Future volume in region	-0.033***	-0.050 π	-0.045 π §	-0.036 π §	-0.391
	(0.008)	(0.038)	(0.039)	(0.039)	(0.267)
Stock of prior interactions with subcontractors	-0.012***	-0.012***	0.029 §	0.033 §	-0.085***
	(0.004)	(0.004)	(0.039)	(0.039)	(0.031)
Activity executed at the start of the project	0.341***	0.343***	0.345***	0.683***	2.766***
	(0.028)	(0.028)	(0.027)	(0.016)	(0.191)
Future volume in region X Stock of prior interactions			-0.003 §	-0.003 π §	
			(0.002)	(0.003)	
Future volume in region X Activity executed at the start of the project				-0.023**	
				(0.011)	
Stock of prior interactions X Activity executed at the start of the project				-0.010* §	
				(0.005)	
Control variables:					
Project Distance	0.012**	0.016***	0.016***	0.016***	0.010***
	(0.005)	(0.006)	(0.006)	(0.006)	(0.036)
Thinness of the subcontractor market	0.067***	0.058**	0.057**	0.090***	0.457**
	(0.027)	(0.027)	(0.027)	(0.031)	(0.191)
Contractor capability on the specialty trade activity	0.088***	0.083***	0.083***	0.083***	0.539***
	(0.016)	(0.017)	(0.017)	(0.017)	(0.110)
Project size	-0.020***	-0.020***	-0.020***	-0.020***	-0.129***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.024)
Contractor size	0.006	0.006	0.006	0.007	0.037
	(0.007)	(0.008)	(0.008)	(0.008)	(0.051)
Simultaneous number of projects of the contractor	-0.004**	-0.003*	-0.003*	-0.003*	-0.017
	(0.002)	(0.002)	(0.002)	(0.002)	(0.013)
Contractor market share	-0.377*	-0.438**	-0.439***	-0.441***	-2.909***
	(0.150)	(0.152)	(0.152)	(0.152)	(1.039)
Contractor diversification	-0.031	-0.034	-0.034	-0.035	-0.224
	(0.034)	(0.034)	(0.034)	(0.034)	(0.216)
Contractor geographical dispersion	0.011	0.010	0.010	0.009	0.020
	(0.035)	(0.036)	(0.036)	(0.036)	(0.244)
Contractor average vertical integration in the previous 4 years	0.455***	0.457***	0.454***	0.457***	2.374***
	(0.026)	(0.027)	(0.027)	(0.027)	(0.173)
Contractor number of projects in the previous 4 years	-0.003*	-0.002*	-0.002	-0.002	-0.016*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.009)
Demand uncertainty in the prior decade	0.0001	0.0003	0.0003	0.0003	0.002
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.003)
Constant	0.975***	1.243**	1.170**	1.033**	5.690
	(0.135)	(0.532)	(0.539)	(0.544)	(3.805)
Type of Project, Year, and Specialty Trade Activity Fixed Effect?	YES	YES	YES	YES	YES
Region Fixed Effects?	NO	YES	YES	YES	YES
Contractor Fixed Effect?	YES	YES	YES	YES	YES
Number of Observations	9198	9198	9198	9198	9198
R-Square [pseudo]	39.82%	40.07%	40.07%	40.13%	[33.79%]

(‡) Huber-White robust standard errors in parentheses (†) $p < 0.1$ *; $p < 0.05$ **; $p < 0.01$ *** (§) p value < 0.01 in a joint t-test (π) The variable of region future volume is highly collinear with the region fixed effects generating a large variance inflation factor.

Figure 1. The impact of the "Future volume in the region" on the likelihood of vertical integration.

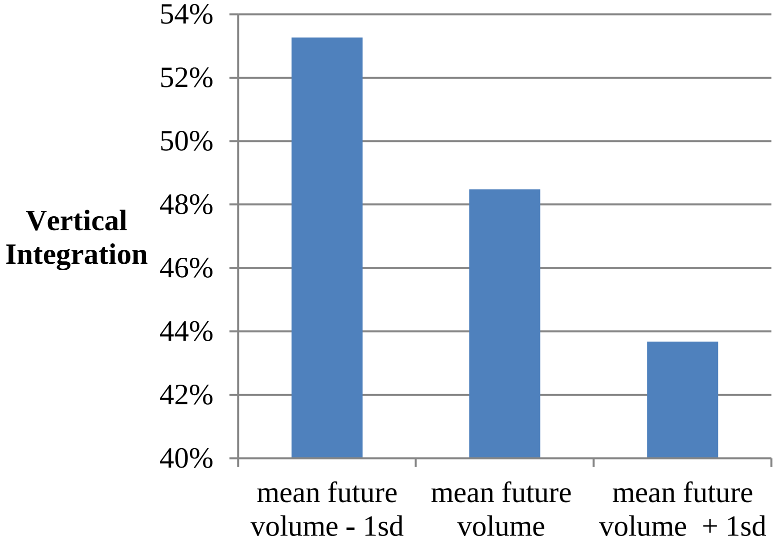


Figure 2. The moderating role of the "stock of prior interactions" on the impact of future volume in the region on vertical integration. [Construction of this graph: Using the estimates from model 4, we compute the derivative of vertical integration on "future volume", and setting "activity at start of the project" at its mean, we allow for "Prior interaction" to move one standard deviation around its mean. Then, we multiply the result by one standard deviation in future volume]

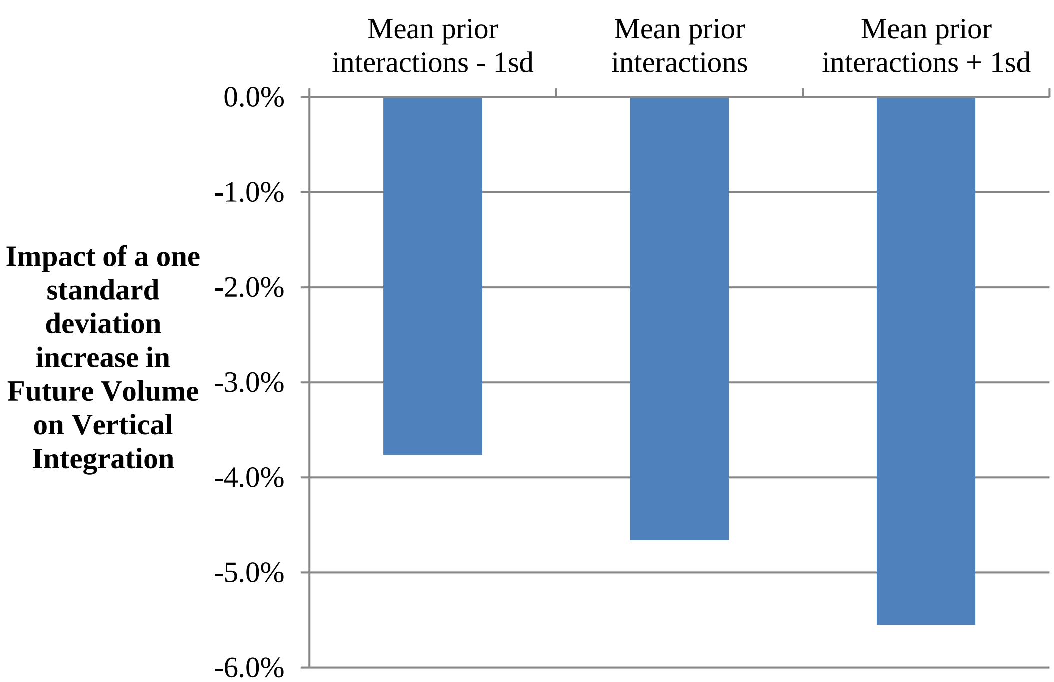


Figure 3. The moderating effect of the schedule of the activity on the impact of "Future volume on the region" on the likelihood of vertical integration. [Construction of this graph: Using the estimates of model

4, we compute the derivative of vertical integration on "future volume", and setting "prior interaction" at its mean, we allow for "activity at start of the project" to be 0 or 1. Then, we multiply the result by one standard deviation in future volume]

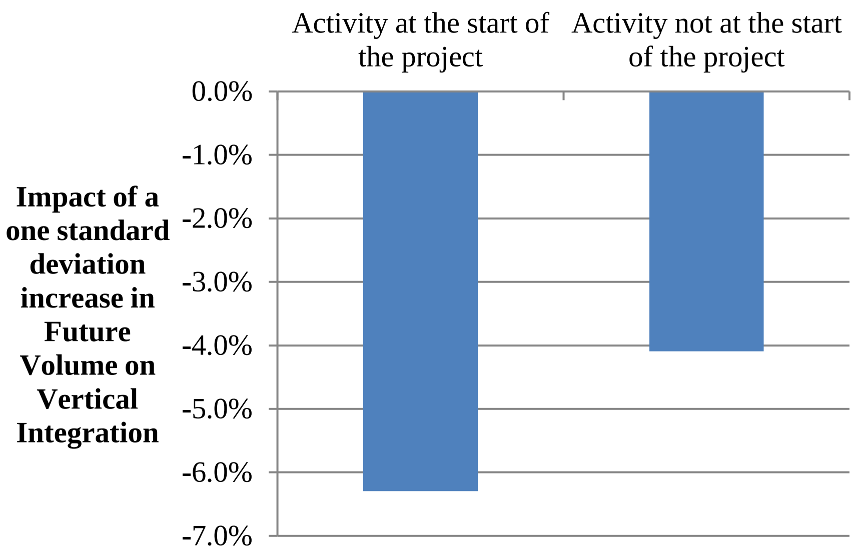
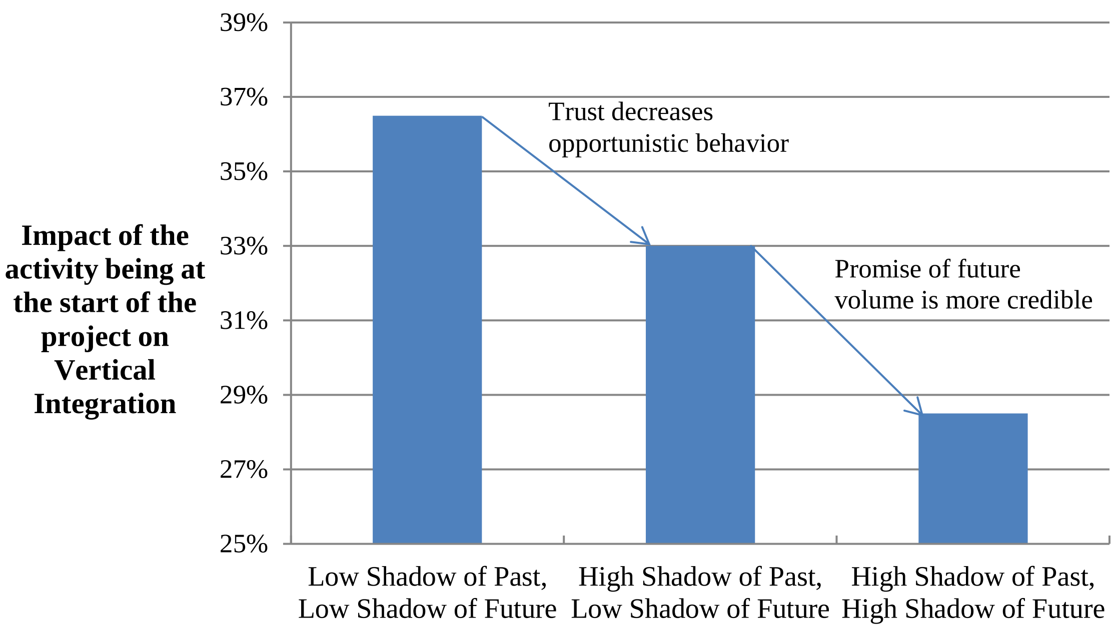


Figure 4. The impact of the location of the activities at the start of the project on the likelihood of vertical integration diminishes with increases in prior and expected interactions. [Construction of this graph: Using estimates of model 4, we compute the derivative of vertical integration on "activity at start of the project" and then varied the extent of prior interaction and future volume. Low is the mean minus one standard deviation; High is the mean plus one standard deviation]



APPENDIX: Control Variables Measurement

Thinness of the subcontractor market. Because subcontractors specialize geographically (Ball, 2003; Somerville, 1999), we measured the thinness of the subcontractor market using a measure of market concentration of the subcontractors in each specialty trade activity and geographical region, the Herfindahl-Hirschmann Index (HHI). A high HHI indicates that a few subcontractors dominate the subcontractor market, increasing their bargaining power relative to contractors. The HHI was computed for a two-year window to avoid spurious changes; for example, the HHI associated with the year 2012 was computed using data for the 2011-2012 period.

Project distance. Project distance should affect vertical integration: A distant project is harder for a contractor to monitor, and local subcontractors may see an unknown foreign contractor as less trustworthy. Project distance was measured by computing the distance between the project's region and the region that contains the highest percentage of total square meters built by the contractor in the year of the project. We tested other measures, such as the distance between the project's location and the region containing the contractor headquarters, and our results remained unchanged.

Contractor capabilities. To capture the influence of capabilities on firm boundaries (Argyres, 1996; Argyres et al, 2012), we measured the *differential in capabilities* between the contractor and the subcontractors with respect to the different specialty trade activities (Jacobides and Hitt, 2005). We computed the number of accumulated square meters built by the contractors and subcontractors in each subcontracting activity for the previous four years of the project (from t-4 to t-1). Using this information, we computed the percentile in which the contractor would be placed in the ranking of the subcontractors for each of the nine specialty trade activities considered in this study. A higher ranking is associated with greater capabilities. To capture the geographic specializations of the contractors and subcontractors, we computed this ranking for each of the 11 regions in our dataset.

Project size. Large projects tend to be more complex and to affect the vertical integration choice (Bajari et al, 2008). Accordingly, we include the natural logarithm of the project size, in square meters, as a control variable.

Contractor size. A widely used control variable in the strategic management literature is company size (Boyd, Gove and Hitt, 2005). We controlled for size by using natural logarithm of the square meters built by each contractor for each year of the sample.

Contractor number of simultaneous projects. Addressing a large number of projects simultaneously is complex, which might affect the governance choices of contractors by increasing the costs of internal production. Given that projects last for at least a year, on average, we computed the total number of projects that a particular contractor executed in each year of the sample.

Contractor market share. A contractor with market power stemming from a high market share might possess the ability to influence (or discipline) the behavior of subcontractors to counteract the impact of transactional hazards, reducing the likelihood of vertical integration (Shervani, Frazier and Challagalla, 2007). For the construction industry, several authors have noted that market power may exist at the geographical level (Ball, 2003; Gil and Marion, 2013). Accordingly, contractor market share was measured at the region level by the contractor's share of the total square meters built in each region for each year of the sample.

Contractor diversification. Diversification might affect the degree of vertical integration (Rawley and Simcoe, 2010). We measured the degree of diversification by calculating the HHI (Nayyar, 1992), which we computed as the sum of the squares of the share of each project type in the total square meters built by the contractor for each year of the sample.

Geographical dispersion. The geographical dispersion of the contractor affects its monitoring ability and thus, its vertical scope. Geographical dispersion is computed as the HHI index, using the square meters built by each contractor in each year in the different regions of the country.

Contractor average vertical integration in previous four years. The number of repeated interactions tends to be smaller in the case of a contractor that integrates more of its projects because it has fewer opportunities to repeat subcontractors. Thus, we included the integration of the contractor over the same period as the repeated interaction variable, that is, over 4 years. As governance choices tend to persist (Argyres and Zenger, 2013) and prior choices affect subsequent ones, this variable is very likely to bias the results if it is omitted from the model. In essence, by including this variable, we are acknowledging that repeated interaction measures two choices: The first is whether to vertically integrate or use the market. The second, contingent on choosing outsourcing, is the frequency of the use of subcontractors.

Contractor number of projects in previous four years. Similarly to prior vertical integration, the number of projects that the contractor executed in the previous four years will be related to prior interactions: more projects will give the contractor more opportunities to interact repeatedly with its subcontractors. If this variable is also related to vertical integration, then the results might be biased. Thus, we included the total number of projects of the contractor in the previous four years as a control variable.

Uncertainty. Uncertainty may affect vertical integration (Williamson, 1985). Based on Leiblein and Miller (2003), we measure uncertainty as the squared sum of the errors for a linear regression of the monthly building permits for each project type and each region for ten years before the year we are analyzing (e.g., for 2008, we used data from 1999 to 2008). We collected the building permit information from reports released by the Chilean Institute of Statistics. Because seasonality may systematically affect the squared sum of the errors, the data series were seasonally adjusted using the Arima X-12 procedure.