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Relationship-Specificity, Bargaining Power, Growth, and Firm Performance

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RELATIONSHIP-SPECIFICITY, BARGAINING POWER, GROWTH, AND FIRM PERFORMANCE *

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Abstract

We investigate the relevance of relationship-specificity in explaining firm performance and firm value. First, we use an incomplete contracts model to derive hypotheses on how relationship-specificity interacts with bargaining power and growth. And, second, we test these hypotheses on US data for the period 1998 to 2012. We use contract intensity introduced by Nunn (2007) to measure relationship-specificity at the industry level. Relationship-specific investments are considered to be low when a company's inputs are sold on an exchange and high otherwise. Using size as a measure for bargaining power, we find support for our hypothesis that the benefits of bargaining power increase with relationship-specificity. We also find that growth has a stronger impact on firm value when relationship-specificity is high, indicating that the continuation value of the relationship matters. *JEL* Codes: D23, L14 and L25.

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I Introduction

In this paper we study how relationship-specificity may influence firm performance and firm value, given different levels of bargaining power and growth. It is well-established that relationship-specificity may lead to under-investment (Klein, Crawford, and Alchian, 1978; Williamson, 1979, 1985; Grossman and Hart, 1986; Hart and Moore, 1990). Under-investment occurs because the value of the investment inside the relationship is larger than the value outside the relationship. If another party can capture parts of that gain, we have what is called a hold-up problem in the literature.

But, relationship-specificity may also have a positive effect on company performance, for example because productivity is improved using tailored inputs or because the investments lead to less intensive competition in the product markets due to product differentiation or proprietary product technology and high entry or mobility barriers (Porter, 1980, pp. 9, 11, and 133).

With a simple model of hold-up, we illustrate that analytical models cannot determine whether the net profitability effect of higher relationship-specificity is positive or negative. But, we show how more bargaining power tends to benefit a company when investments are relationship-specific, and we show that in a repeated setting the hold-up problem is reduced when the future value of the relationship increases through growth. Bargaining power and growth are usually not studied in incomplete contract models but are important determinants of real world business relations.

To test these hypotheses, we use data for US listed firms during the period 1998 to 2012. To quantify relationship-specificity we use ‘contract intensity’. This variable is introduced by Nunn (2007), and is measured as the proportion of the intermediate inputs that require relationship-specific investments. Nunn relies on data from Rauch (1999) to identify inputs requiring relationship-specific investments. An input sold on an exchange is not considered relationship-specific, since the value of the input inside

the buyer relationship is close to the value outside the relationship.

Nunn (2007) analyzed how countries with better contract enforcement produce and export goods of higher relationship-specificity. Instead of testing the comparative advantage of nations, we use the same variable to test the comparative advantage of companies in dealing with relationship-specificity. To our knowledge, this is the first paper to study the impact of relationship-specificity on firm performance and firm value. This paper is also one of very few papers testing predictions from incomplete contract models on larger data sets. On the other hand, there are a large number of papers testing predictions of governance structure based on Williamson's more informal transaction cost economics (Joskow, 2010), and our predictions are in no way contradictory to the transaction cost thinking spelled out in Williamson's (1979, 1985) work.

In incomplete contracts models, gains from negotiations are usually split 50:50, with a Nash bargaining solution (Nash, 1950).¹ We allow for asymmetric bargaining powers (the generalized Nash-bargaining solution) to study how a change in bargaining power influences profitability when there are high levels of specificity.² We use size (the natural log of sales) as a proxy for bargaining power.³

When partners trade with each other repeatedly, relational contracts can reduce the under-investment due to relationship-specificity (Williamson, 1979; Baker, Gibbons, and Murphy, 2002; Levin, 2003). To study how this effect may impact firm performance, we include growth, where growth is measured as the percentage change in sales.⁴ Higher growth will increase the present value of future punishment from not cooperating and hence increase the scope for relational contracting. The effect of higher growth is equiv-

¹It is understandable that a 50:50 solution is assumed in models studying different governance structures, as it would be too easy to assume that the bargaining process changes under integration (Hart, 1995, footnote 17).

²See for example Noldeke and Schmidt (1998), the appendix of Hart and Moore (1999), Che and Hausch (1999), Antras and Helpman (2004), Schmitz (2006), and Ohlendorf (2009) for other papers that use the generalized Nash bargaining solution (Schmitz, 2013).

³That size is a determinant of bargaining power is assumed by for example Porter (1980); Heide and John (1988), Scherer and Ross (1990, ch. 14), and De Vita, Tekaya, and Wang (2011).

⁴Results are robust for using other measures for growth, see our section on sensitivity analyses.

alent to reducing the discount rate.

Our empirical analyses show that relationship-specificity as such does not have a clear-cut effect on profitability. However, when we add an interaction variable of relationship-specificity and firm size (as a proxy for bargaining power), we find that relationship-specificity is associated with lower (higher) performance for small (large) companies. The results indicate that bargaining power is important for companies with relationship-specific investments. Further analysis reveals that the performance difference is driven by higher profit margins for large firms, which are only partly offset by a reduction in capital efficiency (as measured by asset turnover).

Furthermore, relationship-specificity and company value (Tobin's q) are positively related. In other words, the under-investment problem due to hold-up seems to be canceled out by, or even dominated by, the positive effects of relationship-specificity, such as improved productivity and weaker competition in the product market. We interact our measure of relationships-specificity with growth and find that the value premium of relationship-specificity is driven by growth. This indicates that companies with growth are better at handling the problems associated with relationship-specificity, presumably because growth increases the scope for relational contracts.

Our paper contributes in the following ways. It adds to the scarce empirical works that test hypotheses derived by incomplete contract theory. The paper can also be seen as adding to the large empirical work on transaction costs, though we take a different angle to most of these studies. We do not compare governance structures. Instead we study the performance effect of relationship-specificity within one governance structure, the market organization. Hence we avoid the problem for which the property rights approach has been criticized, that there are also other important factors that change when you move from one governance mode to another, such as how people are monitored and incentivized and how conflicts are resolved (Joskow, 2010). Uniquely, our paper studies how relationship-specificity interacts with bargaining power and growth. Finally,

using a large portion of US listed firms, our paper helps to further understand important drivers of firm performance and firm value.

The paper is organized as follows. In the next section we derive the hypotheses based on a simple illustrative mathematical model of hold-up. In section 3 we relate these hypotheses to a broader, but brief, literature review. We report the research design in section 4. Section 5 describes in detail the sample selection and descriptive statistics. Section 6 reports the results. And, in section 7, we conclude.

II A model

In this section we develop a concise model of hold-up to derive our hypotheses.⁵

There are two productive players in the model, a buyer (player 1) and a seller (player 2). At $t = 0$ they make non-observable investments in physical assets or human capital. The investments may be in product development, production, marketing, sales, distribution or any other capability that will increase value creation. These investments are to some degree specific to this particular relationship. The players are risk neutral and there is no discounting in the single-stage game.

At $t = 1$, after some unmodeled uncertainty is resolved, the players decide whether or not to trade with each other and the content of the trade.⁶ We assume that it is impossible to contract ex-ante on this ex-post decision, because the costs of writing fully specified contracts, or to have them enforced, are prohibitive (Grossman and Hart 1986; Hart and Moore 1990; Hart 1995). If the parties cannot agree on a trade, they may find alternative buyers/suppliers, but total returns to investments are lower, due to the

⁵Our basic model is inspired by Hart (1995). It resembles the model by Whinston (2003), as we use linear benefit functions and quadratic cost functions, and we allow investment specificity to change marginal returns both when the parties trade and when they do not. Whinston (2003) analyzes vertical integration versus nonintegration assuming symmetrical Nash bargaining, while we study the effect of more investment specificity under nonintegration allowing for asymmetrical bargaining powers.

⁶It would be straightforward to explicitly include uncertainty (by adding error terms with expectation zero that disappear when the players maximize their expected values). We nevertheless do not model uncertainty as it would make the model less focused and harder to read.

specificity of the investments.

The benefits at $t = 1$ are observable to the players but not verifiable to a third party. The benefits depend on the investments at $t = 0$ (e_1 and e_2) and on whether the two parties choose to trade or not at $t = 1$. When they cooperate, assume for simplicity that the value added of each manager is linear in effort,

$$\begin{aligned}\theta_1^C &= \lambda_1 e_1 \\ \theta_2^C &= \lambda_2 e_2,\end{aligned}$$

where $e_j \geq 0$ and $\lambda_j > 0$, for $j \in \{1, 2\}$. If the two parties choose not to cooperate, their benefits are reduced to

$$\begin{aligned}\theta_1^{NC} &= \mu_1 e_1 \\ \theta_2^{NC} &= \mu_2 e_2,\end{aligned}$$

where $0 \leq \mu_j \leq \lambda_j$.⁷ Allowing for *asymmetrical* bargaining power, the players maximize their respective expected payoffs

$$\begin{aligned}\pi_1 &= \theta_1^{NC} + \alpha \left[\theta_1^C + \theta_2^C - \theta_1^{NC} - \theta_2^{NC} \right] - c(e_1) \\ \pi_2 &= \theta_2^{NC} + (1 - \alpha) \left[\theta_1^C + \theta_2^C - \theta_1^{NC} - \theta_2^{NC} \right] - c(e_2),\end{aligned}$$

where $\alpha \in (0, 1)$ denotes the bargaining power of the buyer, in the sense that she gets this share of the extra joint surplus generated by cooperation.⁸ With linear benefits

⁷We could have included constants in these expressions, as in Whinston (2003), but that would not change any of our predictions. We ignore also cross-investments (or cooperative investments) that would affect the outside value of the other party, as such investments are probably less important empirically and we have data only on the buyer side. See Whinston (2003) and Che and Hausch (1999) for models with cross-investments.

⁸This generalized Nash bargaining solution can be derived by assuming that with probability α the buyer makes a take-it-or-leave-it offer to the seller, and with probability $1 - \alpha$, the seller makes a take-it-or-leave-it offer to the buyer.

and quadratic cost functions, $c(e_j) = \frac{1}{2}e_j^2$, the first-order conditions imply the following second-best investment levels

$$e_1^* = \alpha\lambda_1 + (1 - \alpha)\mu_1 \quad (1a)$$

$$e_2^* = (1 - \alpha)\lambda_2 + \alpha\mu_2, \quad (1b)$$

where investments are a weighted average of the productivity under cooperation and non-cooperation, with the bargaining power as weight. Investments are (weakly) smaller than in the first-best scenario, $e_1^* \leq e_1^{FB} = \lambda_1$ and $e_2^* \leq e_2^{FB} = \lambda_2$.⁹

As our data of relationship-specificity are on the buyer's side, we now focus on the buyer. With the second-best investments in (1a) and (1b), the buyer's expected payoff is:

$$\pi_1 = \frac{1}{2} [\alpha\lambda_1 + (1 - \alpha)\mu_1]^2 + \alpha(\lambda_2 - \mu_2) [(1 - \alpha)\lambda_2 + \alpha\mu_2]. \quad (2)$$

First, consider how more specificity may impact the buyer's expected payoff. If more specificity implies a more severe hold-up problem, $(\lambda_j - \mu_j)$ must increase for at least one of the parties.¹⁰ But, and this is an important point, lower outside values (μ_j) may be accompanied by higher inside values (λ_j) . This could be due to higher productivity associated with specific investments or due to less competition in the downstream market. We must therefore allow more relationship-specificity to be associated with both lower outside values (μ_j) and higher inside values (λ_j) . It is straightforward to see that the signs of the partial derivatives $\partial\pi_1/\partial\lambda_1$, $\partial\pi_1/\partial\mu_1$, and $\partial\pi_1/\partial\lambda_2$ are all positive, while the sign of $\partial\pi_1/\partial\mu_2$ is ambiguous, but tends to be negative.¹¹

⁹We use a simple model where relationship-specificity leads to under-investment only. We could instead have used a model where the parties may also overinvest to improve their bargaining position. Whether relationship-specificity leads to under- or overinvestment is, however, less interesting to us, since we are concerned with the negative effect investment distortions have on the profits of the company. Our predictions would have been the same with a model of overinvestment.

¹⁰Note that it is the change of marginal values that affect the investment levels in incomplete models and not necessarily a change of absolute levels.

¹¹The sign of $\partial\pi_1/\partial\mu_2 = \alpha [2\alpha(\lambda_2 - \mu_2) - \lambda_2]$ is ambiguous, as there are two opposing effects. When

In other words, the net effect of more relationship-specificity is ambiguous. The buyer benefits from possible positive effects on the inside value (λ_1 and λ_2 increasing). She may also benefit from worse outside options for her partner (μ_2 decreasing). But she will be hurt by her own outside value dropping (μ_1 decreasing). The strengths of the different partial effects cannot be derived by analytical reasoning, and our first hypothesis is therefore non-directional. We test if company profits are positively or negatively related to relationship-specificity:

Hypothesis 1: Relationship-specificity is related to performance.

Hypothesis 1 is tested against the null hypothesis that relationship-specificity is *not* related to performance. Taking into account dynamic competitive forces (which we do not model), the null hypothesis seems reasonable. Entry and exit in the various industries should lead to approximately the same level of profitability across specificity levels, given reasonably well functioning markets and no other systematic differences correlated with investment specificity.

Next, consider how the buyer's expected payoff depends on her bargaining power, α :¹²

$$d\pi_1/d\alpha = (\lambda_1 - \mu_1) [\alpha\lambda_1 + (1 - \alpha)\mu_1] + (\lambda_2 - \mu_2) [(1 - 2\alpha)\lambda_2 + 2\alpha\mu_2] \quad (3)$$

Note that the derivative can take a negative value, if $\alpha > \frac{1}{2}$, but it seems to be positive for most parametric settings. To study the effect of bargaining power more closely, we introduce the concepts of symmetrical technologies and equal bargaining power.

Definition 1: Technologies are symmetrical when $\lambda_1 = \lambda_2 \equiv \lambda$ and $\mu_1 = \mu_2 \equiv \mu$.¹³

the outside option of the seller (μ_2) decreases, the seller will reduce his investments at $t = 0$ resulting in a smaller joint surplus at $t = 1$. This is bad for the buyer as the joint surplus with cooperation decreases. But, the reduction of the outside option can benefit the buyer in the negotiations at $t = 1$, since the extra joint surplus generated by cooperation may increase. For the buyer, the positive negotiation effect tends to dominate the negative investment effect, as the partial derivative is clearly negative for $\alpha \leq \frac{1}{2}$. In larger data sets, we expect α to be around $\frac{1}{2}$ as there is no reason to believe that, on average, buyers have stronger or weaker bargaining power than the sellers. $\partial\pi_1/\partial\mu_2(\alpha = \frac{1}{2}) = -\frac{1}{2}\mu_2 < 0$.

¹²Since the technology parameters λ_j and μ_j are considered to be independent of the bargaining power, α , the partial derivative and the total derivative of benefits, π_j , with respect to α are identical.

¹³Cost functions are already assumed to be identical.

Definition 2: The parties have equal bargaining powers when $\alpha = \frac{1}{2}$.

It is straightforward to show that the derivative in equation (3) is positive if technologies are symmetrical *or* the parties have equal bargaining powers.¹⁴ It is sufficient, but not necessary, that one of these two conditions is satisfied.

To illustrate how asymmetrical the technologies and the bargaining powers must be for the derivative in equation (3) to become negative, consider an extreme case, where the buyer's investments are *not* relationship-specific at all, $\lambda_1 = \mu_1$. We can then calculate what combinations of bargaining power and relationship-specificity (at the supplier's side) that lead to a positive or negative derivative in equation (3). See figure Ia, with bargaining power (α) on the x-axis and relationship-specificity on the y-axis. Relationship-specificity is measured as $k_2 \equiv 1 - \frac{\mu_2}{\lambda_2}$, which takes value zero if there is no relationship-specificity at the seller's side, $\lambda_2 = \mu_2$, and one if there is no outside option, $\mu_2 = 0$.¹⁵

Insert figure I here

We observe that for the buyer *not* to benefit from stronger bargaining power, the buyer's bargaining power must already be strong and the seller must be exposed to a very serious hold-up problem - while the buyer is not. In large data sets we have no reason to believe that the average buyer faces such extreme environments. On the contrary, we would expect *on average* equal bargaining powers and symmetrical technologies, as we have no reason to believe that buyers *systematically* have stronger or weaker bargaining powers or hold-up problems than suppliers. In other words, we expect more bargaining power to be good for a buyer under conditions of relationship-specificity. If there is no relationship-specificity ($\lambda_1 = \mu_1$ and $\lambda_2 = \mu_2$), we expect bargaining power *not* to play a role (as $d\pi_1/d\alpha = 0$). And, we expect bargaining power to become more important,

¹⁴For symmetrical technologies $d\pi_1/d\alpha = (\lambda - \mu)[(1 - \alpha)\lambda + (1 + \alpha)\mu] > 0$ and for equal bargaining powers $d\pi_1/d\alpha (\alpha = \frac{1}{2}) = \frac{1}{2}(\lambda_1^2 - \mu_1^2) + (\lambda_2 - \mu_2)\mu_2 > 0$.

¹⁵The boundary between the two regions in the figure is given by $k_2 = \frac{1}{2\alpha}$.

the more relationship-specificity the parties face (as defined by $\lambda_i - \mu_i$ for $i \in \{0, 1\}$).

To further investigate how bargaining power influences the payoffs under different levels of relationship specificity, we consider the net effect of higher inside values (λ_1 and λ_2) and lower outside values (μ_1 and μ_2), while keeping the joint surplus constant. To be able to illustrate the results in a simple way, we assume symmetrical technologies and analyze how $d\pi_1/d\alpha$ depends on $k \equiv 1 - \frac{\mu}{\lambda}$. In figure Ib we show that for most parametric settings bargaining power becomes more important, the more relationship-specificity they are exposed to. In particular, $d\pi_1/d\alpha$ increases in relationship-specificity, k , unless the buyer already has strong bargaining power and the hold-up problem is severe.¹⁶ In figure II we show how $d\pi_1/d\alpha$ depends on relationship specificity, k , for equal bargaining powers, $\alpha = \frac{1}{2}$, with otherwise the same assumptions.¹⁷ Observe that bargaining power is most important for intermediate and high levels of specificity.

Insert figure II here

We can conclude that the negative effects from hold-up tend to be smaller when the buyer has strong bargaining power. The positive effects from more relationship-specificity are more likely to dominate the negative effects under these circumstances, and we can formulate the following hypothesis on bargaining power:

Hypothesis 2: Relationship-specificity will be less damaging for performance (or have a more positive impact) when the company's bargaining power is strong.

So far, we have discussed a one-shot game, which we can call spot governance. Let us now consider a more dynamic setting. With repeated interactions, the parties can

¹⁶The boundary dividing the regions where $\partial^2\pi_1/\partial\alpha\partial k > 0$ (Region A) and $\partial^2\pi_1/\partial\alpha\partial k < 0$ (Region B) is found by solving the two equations $\partial^2\pi_1/\partial\alpha\partial k = 0$ and $d\Pi/dk = 0$, where $\Pi \equiv \pi_1 + \pi_2$. We use $\mu = (1 - k)\lambda$, and allow λ to change when k changes. Combining the two equations we get $k = \frac{1 + \alpha - \sqrt{6\alpha - 3\alpha^2 - 1}}{2\alpha^2 - 2\alpha + 1}$ for the relevant range. Note that the boundary is independent of the level of joint surplus that is assumed.

¹⁷Again we assume symmetrical technologies, and we keep the joint surplus (Π) constant. We then find: $d\pi_1/d\alpha = \frac{1}{2}\Pi \frac{k}{1-k/4} (4 - 3k)$. The graph is drawn assuming $\Pi = 0.9375$, but this assumption affects only the scale of the y-axis.

sometimes reduce the hold-up problem by the use of relational contracts (Williamson, 1979; Baker, Gibbons, and Murphy, 2002). Such contracts are not enforced by courts, but by the shadow of the future. The relational contract can be in the form of a mutual understanding of what a fair division of the joint surplus should be, depending on the inside and outside values of the two parties.¹⁸ If one of the parties chooses to renege on the relational contract (by insisting on the bargaining outcome of the one-shot game instead of sticking to the mutual understanding), the other party can punish for example by refusing to enter into another relational contract in the future (and instead rely on spot contracting - as in the one-shot game).

For a relational contract to improve upon the static setting, the gains in a given period from renegeing on the contract must be offset by the discounted value of future losses. These future losses will depend on the discount rate and on the size of the future gains from cooperation that will be lost when the party reneges, which again depend on the growth rate of the operations. Strong growth leads to large future gains, which is good for the relational contract.

For illustrative purposes, consider a relational contract that can implement first-best. Let $\Pi(e_1^{FB}, e_2^{FB})$ and $\Pi(e_1^*, e_2^*)$ be the expected joint surplus in the next period, net of effort costs, for first-best effort levels and spot-governance effort levels (as given by equations 1a and 1b) respectively. Following Levin (2003) and Bragelien (2007), consider a relational contract where the parties are paid what they would have got under spot governance plus a fixed transfer and a one-step payment (a bonus β).¹⁹ With sufficient symmetry, the bonus is simply paid to the manager who generates the largest benefits (θ_1^C versus θ_2^C), so that the relational contract resembles a tournament with β as the prize (Bragelien, 2007). With discount rate r and growth g , the bonus

¹⁸We assume that these values are uncertain.

¹⁹See Malcomson (2013) for a survey of relational incentive contracts literature, which includes discussions of both Levin (2003) and Bragelien (2007).

payment is restricted by the following inequality to be self-enforcing:²⁰

$$\beta \leq \frac{\Pi(e_1^{FB}, e_2^{FB}) - \Pi(e_1^*, e_2^*)}{r - g} \quad (4)$$

Mathematically, a larger growth rate, g , corresponds to a smaller discount rate (more patient players). With strong growth, the necessary bonus, β , to achieve first-best can be sustained by a relational contract under a larger range of parametric settings. The same will hold for second-best relational contracts, and we can state our third and final hypothesis:

Hypothesis 3: Relationship-specificity will be less damaging for value creation (or have a more positive impact) when company growth is high.

While hypotheses 1 and 2 can be tested using profitability in a given year, we must consider the value of the company when we test hypothesis 3. Remember that the period specified in the model may go over many years. Growth is driven by investments, and investments in a given year may have a negative impact on that year's profits, when the benefits are realized in later years.²¹ In periods of strong growth, when the company invests heavily in general-purpose and relationship-specific assets, the negative $t = 0$ effect in the model may dominate the positive $t = 1$ effect. This problem is neutralized when we look at company value (relative to assets). Hypothesis 3 is supported if company growth is more valuable when relationship-specificity is high.

III Literature Review

Relationship-specificity, or asset-specificity in Williamson's (1985) terminology, has been accepted as the key explanatory variable for the theory of the firm (Coase, 1937), which

²⁰See Gordon's growth model (Gordon, 1962).

²¹Investments may affect profits negatively in three ways. First, not all investments are capitalized. Second, companies may depreciate investments more aggressively than economic reasoning would imply. And, third, investments affect the denominator when profitability is measured relative to assets.

centers on the fundamental question of when to make an intermediate product inside the firm as opposed to buy it in a market (Tadelis, 2010). Transaction cost economics highlights that although there may be many bidders ex-ante, transaction-specific investments in physical or human assets will transform the condition into one of bilateral supply ex post (Williamson, 1985, p. 61).

Transaction cost economics has been a very effective tool to explain real world cases, such as Boeing's acquisition of Vought Aircraft Industries after its unsuccessful outsourcing of the highly specialized fuselage to that company (Tadelis, 2010).²² It has made a big impact on antitrust regulations (Shapiro, 2010). And, there is substantial empirical support for the theories (Joskow, 2010).²³ Researchers have empirically examined decisions to vertically integrate, the design of nonstandard contractual arrangements, and the performance of governance structures over time as conditions change. "The overwhelmingly conclusion of this large number of empirical studies is that specific investments and other attributes that affect transaction costs are both statistically and economically important causal factors influencing the decision to vertically integrate" (Joskow, 2010, p. 584).

Grossman and Hart (1986) used Williamson's notion of incomplete contracts to develop a more formal theory of the boundaries of the firm, where there are both benefits and costs to vertical integration when the parties make relationship-specific investments. These benefits and costs depend crucially on the allocation of residual control rights or property rights (Hart and Moore, 1990). The work by Grossman, Hart and Moore sparked an entirely new strand of literature in economic theory, investigating how incomplete contracts may explain different aspects of economic organization, for example the delegation of authority in organizations (Aghion and Tirole, 1997), the use of debt

²²Williamson mentions the case in a footnote in his Nobel Prize lecture December 8, 2009.

²³See Joskow (1988) and Lafontaine and Slade (2007) for surveys of the empirical evidence. Williamson has indicated that around 1,000 published papers have studied aspects of comparative institutional choice from a transaction cost economics perspective (Joskow, 2010).

for financing (Aghion and Bolton, 1992), intrafirm international trade (Antras, 2003), and public versus private ownership (Hart, Shleifer, and Vishny, 1997).²⁴

While Williamson’s work has stimulated a large empirical literature, the same cannot be said about the theory developed formally on property rights or decision rights (Joskow, 2010; Aghion and Holden, 2011), although there are exceptions, such as Baker and Hubbard (2003, 2004) and Acemoglu, Aghion, Griffith, and Zilibotti (2010). But, property rights theory and transaction cost economics share the main characteristics: incomplete contracts, relationship-specificity and opportunism. The empirical work supporting transaction cost economics can therefore be seen as supporting also some of the fundamental ideas in the property rights literature, especially since much of the empirical literature use measures of asset-specificity as explanatory variable – rather than direct measures of ex-post haggling and adaptation costs – which could have been an alternative path, considering the focus on these costs in the transaction costs literature (Joskow, 2010).

We do not compare governance structures, the usual object of study for transaction cost economics. Instead, we study the performance effect of relationship-specificity (and interaction effects of other factors) for one governance mode, the market organization. There is another small strand of literature that does look at the performance implications of transaction costs in Buyer-Supplier relationships. These studies rely on self-reported indicators of delivery performance and satisfaction with the supplier.²⁵ Heide and Stump (1995), Artz (1999) and De Vita, Tekaya, and Wang (2011) find a negative relationship between the buyer’s specific investments and the performance indicators they use. These results support the premise of our model that relationship-specificity impacts the relationship in a negative way, but they do not say anything about how the

²⁴See Aghion and Holden (2011) for a more thorough discussion of these applications, and a stock of what we have learnt over the last 25 years, using incomplete contracts to study the theory of the firm. See also Tirole (1999).

²⁵Delivery performance may for example include statements about quality and timeliness.

specificity may impact overall productivity and profitability.

Furthermore, Heide and Stump (1995) find that the continuation value of the relationship matters for performance. With high levels of specificity, performance improves when the parties expect the relationship to last for a long time.²⁶ Similarly, Gil and Marion (2013) show that the future value of ongoing relationships are important for contractors and subcontractors when it comes to bidding for California highway contracts. More specifically, they show that past interactions are of value only when the future contract volume in the relevant region is sufficiently large. Both these studies support our prediction that growth is beneficial in the presence of relationship-specificity, as growth increases the expected continuation value.

In our empirical work we use size as a proxy for bargaining power. This is not new in the literature. Heide and John (1988) argue that small firms (agents) are faced with dependence when they invest in specific assets related to a large counterpart (principal). De Vita, Tekaya, and Wang (2011) suggest that future analysis of transaction costs should take into account that firm size is an indicator of the power relationship between two parties. That a buyer's bargaining power is influenced by the relative size of the parties is also a core assumption of Porter (1980, p. 24). When a given buyer purchases a large portion of the sales, the buyer becomes very important to the results of the seller. According to Porter, size becomes particularly important when high fixed costs characterize the industry.

Doyle and Inderst (2007) have a thorough discussion of why a buyer's size may matter for negotiations. They argue that sufficient size makes it more credible to respond to an increase in the purchasing price by switching elsewhere. A large buyer may even take steps to encourage entry by alternative suppliers. And, losing a large customer will hurt more for a supplier.

²⁶Another interesting result (which is not relevant for our study since we have data only on the buyer side) is how human and asset-specific investments by the supplier seem to offset some of the negative effects from the specific investments by the buyer (Artz, 1999; De Vita, Tekaya, and Wang, 2011).

Somewhat surprisingly, there are not many empirical studies of bargaining, and in particular not studies that distinguish between bargaining position and bargaining power (Draganska, Klapper, and Villas-Boas, 2010). Bargaining position is influenced by outside options, while bargaining power can be affected by many factors such as negotiation skills, patience, branding and size. Draganska, Klapper, and Villas-Boas (2010) show that both retailer size and manufacturer size affect bargaining power in the German market for coffee. The larger you are, the more bargaining power you have. See also Misra and Mohanty (2006) who show that bargaining power and profit shares are positively related in a supermarket-retailer setting. Casterella, Francis, Lewis, and Walker (2004) find that audit fees are lower, the larger the clients are in absolute size and relative to their auditor's industry clientele, and they attribute the effect to bargaining power.

Note that the conjecture that size is good for profits is not straightforward, as shown by Chipty and Snyder (1999) and Raskovich (2003). Chipty and Snyder (1999) show that mergers among buyers lead to lower prices in a bargaining setting only if the surplus generated from bargaining is concave in quantity, and Raskovich (2003) shows that being a pivotal buyer weakens a buyer's bargaining position. But, both these papers assume that incremental surplus generated by trade is split 50:50. As shown by Adilov and Alexander (2006), becoming big through merger can be good if it improves bargaining power, and this bargaining power effect can dominate for example the pivotal buyer effect.

IV Research design

IV.A Contract intensity as a measure of relationship-specificity

We operationalize relationship-specificity with the ‘contract intensity’ (CI) measure introduced by Nunn (2007). CI is measured on a continuous scale from 0 (low) to 1 (high) at the 6-digit NAICS industry level using the U.S. Bureau of Economic Analysis (BEA) input-output tables. Firms that are active in industries where the inputs are sold on an organized exchange do not require relationship-specific investments, since there are many alternative buyers and sellers. We use the CI data that Nunn has made available on his website, based on 1997 data. The measure is constant over time and only varies between 6-digit NAICS industries.

Examples of industries that require few relationship-specific investments include (CI score in parentheses) ‘Poultry processing’ (0.024), ‘Flour milling’ (0.024), and ‘Petroleum refineries’ (0.036). Examples of industries with high contract intensity include ‘Automobile & light truck manufacturing’ (0.980), ‘Heavy duty truck manufacturing’ (0.977) and ‘Electronic computer manufacturing’ (0.956).

IV.B Profitability: Test of hypotheses 1 and 2

To test our first hypothesis (the relation between relationship-specificity and firm performance), we regress the following model:

$$ROCE_{ij} = \beta_0 + \beta_1 CI_j + \beta_2 \ln Sales_{ij} + \beta_3 SalesGrowth_{ij} + \beta_4 FirmAge_{ij} + \theta_j + \epsilon_{ij} \quad (5)$$

We measure firm performance as the return on capital employed ($ROCE_{ij}$), which is computed as after tax EBIT scaled by beginning of year assets. We use firm size (the

natural log of sales) as a proxy for bargaining power.²⁷ We include the annual change in sales growth (*SalesGrowth*) and firm age (*FirmAge*) - the number of years the firm has been listed - as control variables. Our test variable for hypothesis 1 is β_1 . We do not formulate an expectation for the sign of the test variable as the hypothesis is unsigned. A positive (negative) coefficient for CI would imply that high CI firms are more (less) profitable than low CI firms. We expect the coefficient for bargaining power (*lnSales*) to be positive. We do not have expectations for the signs of the control variables sales growth and firm age.²⁸

To test our second hypothesis (the interaction of relationship-specificity and bargaining power), we add an interaction of *CI* and *lnSales* ($CI \times lnSales$) to the model:

$$ROCE_{ij} = \beta_0 + \beta_1 CI_j + \beta_2 CI_j \times lnSales_{ij} + \beta_3 lnSales_{ij} + \beta_4 SalesGrowth_{ij} + \beta_5 FirmAge_{ij} + \theta_j + \epsilon_{ij} \quad (6)$$

Thus, our test variable for hypothesis 2 is β_2 . If higher (lower) bargaining power results in higher (lower) profits for firms in high CI industries, then β_2 would be positive, while the reverse would hold for a negative β_2 . We expect the coefficient β_2 to be positive.

In order to examine the relation between relationship-specificity and performance, we use the random-effects model. This model allows us to have an industry specific intercept, while at the same time use contract intensity, which is industry specific, as an independent variable. As such, contract intensity (CI_j) and the industry specific incremental intercept θ_j , subscripted with ‘*j*’, are industry specific, while variables with subscripts ‘*ij*’ are measured at the firm level. Industries are identified using the 6-digit NAICS industry classification. We allow error terms to correlate over time by firm (AR-1, a first-order autoregressive relation).²⁹

²⁷See the literature review in the previous section for a discussion of why size can be used as a proxy for bargaining power.

²⁸We include year-indicator variables in all regressions, but these are not reported.

²⁹The results are similar when we pool the observations, or when we estimate the regressions by year.

IV.C Firm value: Test of hypothesis 3

To test if relationship-specificity is associated with growth, we regress the following model:

$$q_{ij} = \gamma_0 + \gamma_1 CI_j \times SalesGrowth_{ij} + \gamma_2 CI_j + \gamma_3 \ln Sales_{ij} + \gamma_4 SalesGrowth_{ij} + \gamma_5 FirmAge_{ij} + \gamma_6 ROCE_{ij} + \eta_j + \mu_{ij} \quad (7)$$

We use Tobin's q (q_{ij}), computed as the market value of assets divided by the book value of assets, as the measure of firm value.³⁰ Growth ($SalesGrowth$) is the percentage change in annual sales. The test statistic for hypothesis 3 is the coefficient for the interaction of CI and $SalesGrowth$ (γ_1). A positive (negative) coefficient would indicate that growth in high CI industries is associated with higher (lower) value than investments in low CI industries. Thus, we expect the coefficient γ_1 to be positive.

We expect firm age to be negatively associated with firm value as mature firms have fewer growth opportunities. We expect profitability and growth to be positively associated with firm value. We have no prediction for firm size. Again, we use the random effects model with an AR-1 error term structure, and we include year-indicator variables in all regressions.

V Sample

Our sample consists of all U.S. listed firms included in COMPUSTAT with fiscal years from 1998 through 2012. We require firms to be incorporated in the U.S., and we exclude firm-years with sales below \$20 million (in 2012 purchasing power). We cover industries for which Nunn's measure of relationship-specificity is available. This results in a sample

See VI.D Sensitivity analyses.

³⁰See appendix for a more detailed description of the construction of the variables used.

of 29,118 firm-year observations for 4,067 unique firms.

Descriptive statistics for the full sample are included in table I. To provide insight in differences between industries, we group firms into 12 industries using Fama and French industry classification.³¹ Contract intensity is not available for firms in ‘Telecom’, ‘Wholesale/Retail’ and ‘Finance’. Median values for the main variables of interest for firms in the remaining nine industries are reported in table II.

CI varies in a predictable way across the industries. CI is lowest for ‘Energy’ (0.171), followed by ‘Chemicals’ (0.278), where the inputs are more likely to be traded on exchanges, compared with industries like ‘Consumer durables’ (0.686) and ‘Business equipment’ (0.888), where firms are more likely to make relation-specific investments. Firms in low CI industries tend to be larger than firms in high CI industries. This indicates that relationship-specific investments reduce economies of scale, and/or that firms with more relationship-specific investments are more difficult to manage.

There is no clear relation between CI and profitability at the industry level. Consider for example the high CI industries. We find that the median firm’s ROCE in ‘Business equipment’ is only 3.1%, which makes it the least profitable industry. Firms in ‘Consumer durables’, also a high CI industry, on the other hand have a median profitability of 6.3%, which is above the overall sample median of 5.2%. Likewise, it does not seem to be the case that low CI industries necessarily have higher growth. While the highest sales growth is in ‘Energy’ (20.3%), the median sales growth in ‘Utilities’ only amount to 5.3%.

As for firm value, there seems to be no relation between Tobin’s q ratio and CI. The median q for firms in ‘Healthcare’ is 2.164, which is the highest across the industries. Its CI of 0.503, however, is below the full sample’s median of 0.686. Industries with high

³¹In our regression analyses we use the 6-digit NAICS industry classification. We present the industry breakdown using the Fama and French classification as this provides a more detailed breakdown than the 2-digit NAICS, which aggregates the observations as follows: 77.0% in ‘31, 32, 33 Manufacturing’, 9.6% in ‘51 Information’, 7.2% in ‘21 Mining’, 5.6% in ‘32 Utilities’ and the remaining 0.7% of the firmyears are in ‘11 Agriculture’.

CI do not have consistent low or high q values.

Insert table I here

Insert table II here

We continue by partitioning the firms in the sample into terciles based on their contract intensity. In table III we compare the first tercile with the lowest CI values (A) with the third tercile, where firms have high CI values (B), while not reporting the middle tercile. Observe that high CI firms are less profitable, but have higher valuations, compared with low CI firms. In other words, relationship-specificity seems to affect profitability negatively, while the effect on firm value indicates the opposite, providing conflicting evidence for hypothesis 1.

Comparing high CI firms with low CI firms, we further find that firms in high CI industries are smaller and younger, and have higher asset turnover. With respect to growth (*SalesGrowth*), there is no clear difference between firms in low and high CI industries.

Insert table III here

We explore the relation between performance and firm value with the interactions of CI with firm size and CI and sales growth in figures III and IV respectively, where we plot observations in the lowest and highest CI tercile.

In figure III, the firms are grouped by firm size ($\ln\text{Sales}$). The 10% of firms with the lowest (highest) sales are grouped into decile 1 (10).³² Figure IIIa shows the mean profitability for each of the size deciles, for both low and high CI industries. The general trend is that larger firms are more profitable than smaller firms, which is consistent with larger firms enjoying, for example, more bargaining power upstream, economies of scale

³²The partitioning into deciles for firm size and sales growth is done by year.

in operations, and more market power downstream. When comparing low versus high CI firms, a characteristic of upstream relations, we find that firms in low CI industries are more profitable than firms in high CI industries, but only for size deciles 1-6. For larger firms (deciles 7-10), the reverse holds, although the difference in performance is smaller. Thus, figure IIIa displays an interaction effect between firm size and CI with respect to profitability. When firms are small, the costs associated with relationship-specificity outweigh the benefits, while the opposite is true for large firms. This provides support for hypothesis 2. In the next section we will investigate if this effect is significant and if it holds controlling for other factors.

When examining firm value (Tobin's q) in figure IIIb, we find that firms in high CI industries have a higher q , and that this value premium increases in firm size.

Insert figure III here

In figure IV, we examine the relation between sales growth and firm value, for both firms in low and high CI industries.³³ The 10% of firms with the lowest (highest) sales growth are grouped into decile 1 (10). As expected, firms with more growth have a higher q . Comparing low versus high CI industries, we find a higher value for firms in high CI industries. The premium increases for higher levels of growth (deciles 6 to 10), thus providing support for hypothesis 3.

Insert figure IV here

³³We do not examine the relation between growth and profitability, as investments in growth may affect profits negatively in the short run, see footnote 21.

VI Results

VI.A Profitability: Test of hypotheses 1 and 2

Regression results for the tests of hypotheses 1 and 2 are included in table IV columns 1 and 2, respectively. In column 1 we regress ROCE on CI and the control variables, which tests whether or not relationship-specificity is related with firm performance. Univariate results reported in table III indicated that firms in low CI industries are more profitable than firms in high CI industries. This no longer holds when controlling for size, firm age, industry and year. Thus, hypothesis 1, which states that firm performance and relationship-specificity are related, is *not* supported by this analysis. As expected, we find a positive coefficient for the control variable size ($\ln Sales$), indicating that more bargaining power results in higher profits.

In column 2 we include the interaction of firm size and contract intensity ($CI \times \ln Sales$), which tests hypothesis 2. We find a positive interaction for the coefficient of $CI \times \ln Sales$ (0.0715, z-value 10.44) which indicates that the gap in profitability between small and large firms widens as contract intensity increases. Thus, we find support for hypothesis 2, that the benefits of bargaining power increase with relationship-specificity. The effect is economically very substantial; increasing firm size by one standard deviation from the mean multiplying by the interquartile range of CI corresponds to a ROCE that is about 2.8% higher.³⁴

Insert table IV here

³⁴The interquartile range of CI is about 0.4 (See table I: 75th percentile - 25th percentile = 0.821 - 0.419 \approx 0.4) multiplied by the coefficient of $CI \times \ln Sales$ (0.0715) is about 2.8%. The mean ROCE for the sample is 3.7%.

VI.B Firm value: Test of hypothesis 3

In table V we report our results that test hypothesis 3 which states that there is an association between firm value and the interaction of CI and growth ($CI \times SalesGrowth$). In column 1 we first report the regression without the test variable. As expected, we find that profitability ($ROCE$) and growth ($SalesGrowth$) are positively associated with firm value (q), while firm age ($firmAge$) and firm size ($lnSales$) are negatively related with firm value. Consistent with figure IV and table III, we find that relationship-specificity (CI) is positively related with firm value.

In model 2 we test hypothesis 3 by adding an interaction variable of CI and growth ($CI \times SalesGrowth$).³⁵ Much in line with figure 4, we find support for hypothesis 3, as the coefficient for $CI \times SalesGrowth$ is positive and significant (0.416, z-value 16.95). This coefficient is also economically substantial. Multiplying the interquartile range of CI with the average coefficient of $CI \times SalesGrowth$ corresponds to an incremental market value of 16.6%. We find that the coefficient for $SalesGrowth$ turned negative. Thus, the association between growth and firm value is driven by growth in high relationship-specificity industries. In other words, relationship-specificity seems to be less damaging for value creation (or have a more positive impact) when company growth is high.

Insert table V here

VI.C ROCE drivers

In this section we further analyze how the gap in profitability between large and small firms increases in CI, as reported in column 2 of table IV. Since ROCE profitability can be decomposed into two components (EBIT margin and asset turnover), we examine the relation between CI and these components. EBIT margin ($EbitSales$) captures

³⁵The results remain robust whether or not $CI \times lnSales$ is included.

operating income statement effects, while asset turnover (*AssetTurn*) focuses on the capital efficiency of the operations.

Columns 1-2 show the results for *EbitSales*, while the results for *AssetTurn* are reported in columns 3-4. For both variables, we first report the base effect of including CI only (columns 1 and 3), as well as the main regression where both CI and its interaction with firm size are included (columns 2 and 4). We find that the interaction $CI \times \ln Sales$ has partially offsetting effects for both components, resulting in a net positive effect (0.0715 as reported in table IV). We find a higher EBIT margin ($CI \times \ln Sales$ has a coefficient of 0.119), which is partly offset by reduced capital efficiency ($CI \times \ln Sales$ has a coefficient of -0.176). Thus, large firms in high CI industries have reduced capital efficiency, but offset these with higher margins, compared with smaller firms in high CI industries. These results are consistent with our ex-ante predictions, since stronger bargaining power should have a positive impact on the EBIT margin.

Insert table VI here

VI.D Sensitivity analyses

We perform several sensitivity analyses. First, we use various alternative measures for growth, profitability, size and Tobin's q. As alternatives to sales growth, we use capital expenditures and capital expenditures plus R&D expenditures, where both are measured as a percentage of beginning of year total assets.³⁶ As alternatives for ROCE as the measure of profitability, we use return on equity and return on assets. Alternative measures for size includes total assets and the number of employees. The alternative measure we used for Tobin's q is the market-to-book ratio. For each of the alternative measures, the results remain essentially unchanged.

³⁶It is conceivable that firms may use R&D and capital expenditures as substitutes for growth. For example, a firm may either perform R&D itself, or chose to purchase successful R&D companies. In either case, the company will have acquired the R&D.

We further test if the results may be driven by firms that are in a specific stage in the firm life cycle. We partition the firms into the following stages: ‘Introduction’, ‘Growth’, ‘Mature’, ‘Shake-out’, and ‘Decline’, following Dickinson (2011). We find that the results are very stable across these stages. Additionally, we have performed tests where we included additional control variables such as leverage, the number of business segments and the Herfindahl index. All the main results of our paper remain unchanged in these analyses.

We have assumed a first-order autoregressive relation for the error term.³⁷ We repeat the analyses where we run each regression by year. The results remain robust.³⁸ Also, we perform tests to see if our regressions may be affected by possible multicollinearity. This is unlikely to be the case.³⁹

Finally, we perform an alternative test where the random effects model is not used. First, we find firm-specific estimates of the relations between profitability and firm size, as well as firm value and growth. These relations are estimated using groups consisting of firms in the same industry-year. Next, we compute the average of each coefficient by industry. Then, we test if these coefficients (at the industry level) are associated with the industry’s CI.

In particular, we estimate the following regressions by 6-digit NAICS industry-year:⁴⁰

$$ROCE_i = \beta_0 + \beta_1 \ln Sales_i + \beta_2 SalesGrowth_i + \beta_3 FirmAge_i + \epsilon_i \quad (8)$$

$$q_i = \gamma_0 + \gamma_1 \ln Sales_i + \gamma_2 SalesGrowth_i + \gamma_3 FirmAge_i + \gamma_4 ROCE_i + \mu_i \quad (9)$$

These regressions are essentially the same regressions as reported in the main analyses,

³⁷The results are similar when pooling the data.

³⁸The coefficient on $CI \times \ln Sales$ (model 4, table IV) that tests hypothesis 2, is positive in all regressions and is significant at 1% in 14 out of the 15 regressions. The coefficient on $CI \times SalesGrowth$ (model 4, table V) that tests hypothesis 3, is positive in all regressions and is significant at 5% in one regression, and significant at 1% in 11 out of the 15 regressions

³⁹The variance inflation factors (VIF) for each of the variables in the regressions are well below 10.

⁴⁰There are 5,364 of these industry-years for 458 industries.

with the main difference being that contract intensity (CI) and its interactions are dropped as these are constant within the industry. We require that each industry-year regression has at least 10 degrees of freedom. For the regression on $ROCE$ (q) 41 (38) industries have at least one industry-year that meets this requirement.⁴¹ For each industry, we compute the average of the yearly estimated coefficients, $\hat{\beta}_{1k}$ and $\hat{\gamma}_{2k}$. We then test if these industry coefficients are associated with contract intensity (CI) by running the following regressions:

$$\hat{\beta}_{1k} = \rho_0 + \rho_1 CI_k + \kappa_k \quad (10)$$

$$\hat{\gamma}_{2k} = \phi_0 + \phi_1 CI_k + \xi_k \quad (11)$$

where $\hat{\beta}_{1k}$ ($\hat{\gamma}_{2k}$) is the regression coefficient of $\ln Sales$ on $ROCE$ ($SalesGrowth$ on q) for industry k and CI_k is contract intensity for industry k . Thus, ρ_1 and ϕ_1 test hypotheses 2 and 3, respectively. We find coefficients that are consistent with the main analyses. The coefficient of $CI \times \ln Sales$ on $ROCE$ using the random-effects model (table IV, column 2) is 0.0715 (z-value 10.44; significant at 1%). The coefficient CI_k on $\hat{\beta}_{1k}$ is 0.0422 (t-value 2.09), which is significant at 5%. The coefficient of $CI \times SalesGrowth$ on q using the random-effects model (table V, column 2) is 0.416 (z-value 16.95; significant at 1%), while the coefficient CI_k on $\hat{\gamma}_{2k}$ is 0.501 (t-value 2.03; significant at 5%). Thus, this alternative method where about 90% of the industries are not used (as these do not have enough degrees of freedom to estimate industry-year coefficients), has qualitatively similar results that are statistically significant at 5%.

⁴¹Requiring fewer degrees of freedom would result in a larger sample of industries which would contain less precise estimates, while a larger degrees of freedom would result in fewer industries. Requiring both fewer and more degrees of freedom results in essentially the same results although at a lower level of statistical significance.

VII Conclusion

In this paper we investigate the relevance of relationship-specificity in explaining firm performance and firm value. We use an incomplete contracts model to derive hypotheses on how relationship-specificity interacts with bargaining power and growth. This leads to hypotheses which we test using US data for the period 1998-2012. We use contract intensity introduced by Nunn (2007) to measure relationship-specificity at the industry level. Relationship-specific investments are considered to be low when a company's inputs are sold on an exchange and high otherwise.

We show that relationship-specificity, as measured by upstream contract intensity, is important for a company's profitability and value. The stand-alone effect of relationship-specificity is ambiguous, but there are significant positive interaction effects with bargaining power (size) and growth. Bargaining power and growth are important factors when a company is exposed to relationship-specificity because they affect how benefits from relationship-specific investments are shared among the supplier and the buyer. Bargaining power affects renegotiations in a one-shot game, while growth is helpful to sustain a relational contract.

These results indicate that transaction cost economics and incomplete contracts models, where relationship-specificity plays a central role, can be important for our understanding of how firms relate to suppliers. We add thus to the extensive evidence in support of transaction cost economics. Moreover, we show that the mechanisms studied in transaction cost economics are important not only for the choice of governance structure, but also for firm performance within one structure, the market organization.

This is one of few empirical papers to use an incomplete contracts model to derive testable hypotheses, and the only one, to our knowledge, to use such a large data set to test them (listed US companies 1998-2012). The large data set and the robustness of our results across various specifications underscore the usefulness of incomplete contracting

to better understand performance drivers of buyer-supplier relationships, even though our data do not permit us to distinguish between the level of relationship-specificity and its marginal effects on benefits.

The measure we use for relationship-specificity, contract intensity, is a coarse measure, but it is sufficient for our purposes. It measures a key characteristic of upstream relations, which is independent of operational and downstream drivers of firm performance. Interaction variables with contract intensity should therefore capture mainly upstream effects. Furthermore, size seems to be an appropriate measure for bargaining power in the interaction variable, since it is difficult to see what other effects size should have on an upstream relationship.⁴²

The roles of bargaining power and growth have not, so far, been studied extensively in the literature in conjunction with relationship-specificity. With this paper, we draw attention to how important these variables are as drivers of firm performance when contract intensity is high. The results can justify further research into how these two variables interact with relationship-specificity. In particular, we would welcome empirical papers with richer data on these two variables, as our data set permits only high-level analyses of the relations.

With our model and empirical work we capture important aspects of relationship specificity, but there are also other types of transaction costs (Williamson, 1985, p. 20). Ex-ante costs include the costs of drafting, negotiating and safeguarding an agreement. Ex-post costs include maladaptation costs, haggling costs, the costs of dispute settlements, and bonding costs. In our model, joint surplus is driven by the level of ex-ante investments (which is affected by ex-post hold-up). Our empirical work does not, however, distinguish between the various effects of relationship-specificity, as we study the net effect on firm profits and value.

⁴²Upstream effects not related to contract intensity (such as ex-ante bargaining), operational effects (such as economies of scale) and downstream effect (such as market power) should be captured by the stand-alone size variable.

The explanation we have put forward in this paper for the positive interaction effect of contract intensity and size on profitability is based on how it affects ex-post bargaining power. We cannot rule out that there are alternative explanations that could play a role as well. Size can for example also affect economies of scale in dealing with relationship-specificity (e.g. with respect to writing contracts, safeguarding them, and settling disputes).

Our explanation for the positive interaction effect of contract intensity and growth on firm value is the positive effect of growth on relational contracting. An alternative explanation could be that investments in high-growth industries create more value when there is relationship-specificity, because such specificity protects against rivalry in the downstream market.

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Appendix I Variable Definitions

<i>Variable</i>	<i>Definition</i>
AssetTurn	Asset turnover, sales divided by beginning of year assets
CI	Contract intensity, a proxy for relationship-specificity, which is measured as the proportion of the intermediate inputs that require relationship-specific investments. The measure is made available by Nunn (2007)
CI×lnSales	Interaction of CI and lnSales
CI×SalesGrowth	Interaction of CI and SalesGrowth
Ebit/Sales	Earnings before interest and tax divided by sales
FirmAge	Number of years firm is included in CRSP
lnSales	Natural log of sales (in millions)
MTB	Market to book ratio, computed as end of fiscal year market value divided by end of year book value of equity
q	Tobin's q, computed as end of year market value of assets divided by end of year book value of assets
ROCE	Return on capital employed, computed as $\text{ebit} \times (1 - \text{tax rate})$, where the tax rate is the sum of current and deferred taxes divided by pretax income
ROS	Net income divided by sales
SalesGrowth	Percentage growth in annual sales

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Table I
Summary Statistics Full Sample

This table reports descriptive statistics for our sample of firms over 1998-2012 from COMPUSTAT that have been incorporated in the United States and have sales of at least \$20 million (in 2012 purchasing power). The sample is composed of 29,118 firm-year observations from 4,067 unique firms. All continuous variables are winsorized by fiscal year at 1% and 99%. See appendix I for variable definitions.

	Full sample					
	P25	Median	P75	Mean	Stdev.	N
<i>Contract intensity</i>						
CI	0.419	0.686	0.821	0.603	0.255	29,118
<i>General and growth-related variables</i>						
lnSales	4.265	5.566	7.050	5.762	1.830	29,118
FirmAge	6.000	14.000	29.000	17.922	13.788	29,118
SalesGrowth	-0.030	0.082	0.239	0.172	0.469	29,118
<i>Operating performance</i>						
ROCE	0.003	0.052	0.101	0.037	0.137	29,118
ROS	-0.029	0.038	0.088	-0.036	0.343	29,118
Ebit/Sales	0.005	0.074	0.139	0.026	0.278	29,118
AssetTurn	0.631	0.988	1.412	1.108	0.676	29,118
<i>Firm valuation</i>						
q	1.093	1.432	2.135	1.908	1.552	29,118
MTB	1.219	1.952	3.301	2.897	3.191	29,118

Table II
Key Variables by Industry

This table reports the number of observations, as well as the medians for key variables by industry. Firms are classified into industries based on their main SIC code using Fama and French's 12 industry classification. Contract intensity (*CI*) is not available for firms in Telecom, Wholesale/Retail and Finance. The industries are sorted by contract intensity.

Industry	n	CI	lnSales	SalesGrowth	ROCE	q
Energy	2,137	0.171	6.181	0.203	0.063	1.362
Chemicals	1,221	0.278	6.846	0.072	0.071	1.392
Utilities	1,566	0.285	7.521	0.053	0.045	1.180
Other	621	0.458	6.008	0.058	0.048	1.341
Healthcare	3,921	0.503	4.531	0.135	0.049	2.164
Consumer nondurables	3,142	0.527	5.961	0.048	0.068	1.289
Manufacturing	6,174	0.583	6.089	0.065	0.062	1.280
Consumer durables	1,411	0.686	5.840	0.062	0.063	1.260
Business equipment	8,925	0.888	4.954	0.090	0.031	1.654
<i>Total</i>	29,118					

Table III
Summary Statistics by Contract Intensity

This table reports summary statistics partitioned on contract intensity. Firms in the lowest (highest) CI tercile are grouped in A (B). Both groups contain 9,706 firm-year observations. Differences in medians (means) are tested with Wilcoxon-Mann-Whitney ranked test (t-test). All continuous variables are winsorized by fiscal year at 1% and 99%.

	Low contract intensity (A)			High contract intensity (B)			Difference (B-A)	
	Median	Mean	Stdev.	Median	Mean	Stdev.	Median	Mean
<i>Contract intensity</i>								
CI	0.285	0.300	0.137	0.888	0.871	0.065	0.603**	0.571**
<i>General and growth-related variables</i>								
lnSales	6.447	6.369	1.899	4.994	5.274	1.683	-1.453**	-1.095**
FirmAge	18.000	21.570	15.298	12.000	14.895	12.004	-6.000**	-6.675**
SalesGrowth	0.078	0.183	0.481	0.085	0.166	0.479	0.007	-0.017*
<i>Operating performance</i>								
ROCE	0.056	0.056	0.114	0.041	0.016	0.155	-0.015**	-0.040**
ROS	0.045	0.006	0.266	0.028	-0.067	0.383	-0.017**	-0.073**
Ebit/Sales	0.092	0.070	0.250	0.052	-0.010	0.280	-0.040**	-0.080**
AssetTurn	0.894	1.048	0.722	1.035	1.163	0.658	0.141**	0.115**
<i>Firm valuation</i>								
q	1.279	1.601	1.063	1.602	2.153	1.892	0.323**	0.552**
MTB	1.782	2.576	2.771	2.085	3.175	3.556	0.303**	0.599**

Table IV
OLS Regression ROCE

The dependent variable in models 1-2 is ROCE. H1 (H2) is tested in model 1 (2). The test variables (CI and CI×lnSales) are included under ‘test variables’. Contract intensity (CI) is measured at the 6-digit NAICS industry level. The random effects model was used with random effects for industries (6-digit NAICS), allowing the error term to correlate over time by firm (first-order autoregressive relation). Year-indicator variables are included but not tabulated. The R-squared variable is not valid for the random effects model and is not included. All continuous variables are winsorized by fiscal year at 1% and 99%. lnSales, SalesGrowth, and FirmAge are standardized (mean 0, standard deviation 1). The dependent variable and CI are not standardized. Z-value in parentheses. See appendix I for additional information on variable definitions.

	ROCE	
	Model 1	Model 2
<i>Test variables</i>		
CI	0.00382 (0.28)	-0.00152 (-0.12)
CI×lnSales		0.0715** (10.44)
<i>Control variables</i>		
lnSales	0.0820** (40.60)	0.0399** (8.91)
SalesGrowth	0.0142** (25.20)	0.0143** (25.28)
FirmAge	-0.00720** (-3.10)	-0.00646** (-2.79)
Constant	0.0259** (2.98)	0.0307** (3.63)
Observations	29,118	29,118

* and ** indicate significance at 5% and 1%, respectively.

Table V
OLS Regression q

The dependent variable in models 1-2 is q. CI×SalesGrowth tests hypothesis 3 in model 2, and is included under ‘test variable’. Contract intensity (CI) is measured at the 6-digit NAICS industry level. The random effects model was used with random effects for industries (6-digit NAICS), allowing the error term to correlate over time by firm (first-order autoregressive relation). Year-indicator variables are included but not tabulated. The R-squared variable is not valid for the random effects model and is not included. All continuous variables are winsorized by fiscal year at 1% and 99%. lnSales, SalesGrowth, FirmAge and ROCE are standardized (mean 0, standard deviation 1). The dependent variable and CI are not standardized. Z-value in parentheses. See appendix I for additional information on variable definitions.

	q	
	Model 1	Model 2
<i>Test variable</i>		
CI×SalesGrowth		0.416** (16.95)
<i>Control variables</i>		
CI	0.501** (4.00)	0.481** (3.84)
lnSales	-0.0855** (-4.58)	-0.0972** (-5.22)
SalesGrowth	0.172** (23.99)	-0.0759** (-4.64)
FirmAge	-0.0579** (-2.97)	-0.0576** (-2.96)
ROCE	0.206** (21.57)	0.219** (22.94)
Constant	1.168** (14.27)	1.172** (14.34)
Observations	29,118	29,118

* and ** indicate significance at 5% and 1%, respectively.

Table VI
OLS Regression ROCE Drivers

This table further examines two drivers of ROCE; EbitSales (models 1-2) and AssetTurn (models 3-4). Variables that test the hypotheses (CI and interaction variable CI×lnSales) are included under ‘test variables’. Contract intensity (CI) is measured at the 6-digit NAICS industry level. The random effects model was used with random effects for industries (6-digit NAICS), allowing the error term to correlate over time by firm (first-order autoregressive relation). Year-indicator variables are included but not tabulated. The R-squared variable is not valid for the random effects model and hence is not included. All continuous variables are winsorized by fiscal year at 1% and 99%. lnSales, SalesGrowth, and FirmAge are standardized (mean 0, standard deviation 1). The dependent variables and CI are not standardized. Z-value in parentheses. See appendix I for additional information on variable definitions.

	EbitSales		AssetTurn	
	Model 1	Model 2	Model 3	Model 4
<i>Test variables</i>				
CI	0.0420 (1.46)	0.0353 (1.24)	0.267** (2.71)	0.279** (2.81)
CI×lnSales		0.119** (8.57)		-0.176** (-6.13)
<i>Control variables</i>				
lnSales	0.178** (43.33)	0.109** (12.04)	0.133** (15.68)	0.236** (12.49)
SalesGrowth	0.0332** (31.81)	0.0332** (31.89)	0.185** (89.36)	0.185** (89.27)
FirmAge	0.000181 (0.04)	0.00125 (0.25)	-0.0611** (-6.01)	-0.0623** (-6.13)
Constant	-0.00627 (-0.34)	0.000911 (0.05)	1.078** (18.41)	1.068** (18.11)
Observations	29,118	29,118	29,118	29,118

* and ** indicate significance at 5% and 1%, respectively.

Figure I
Expected payoff and bargaining power

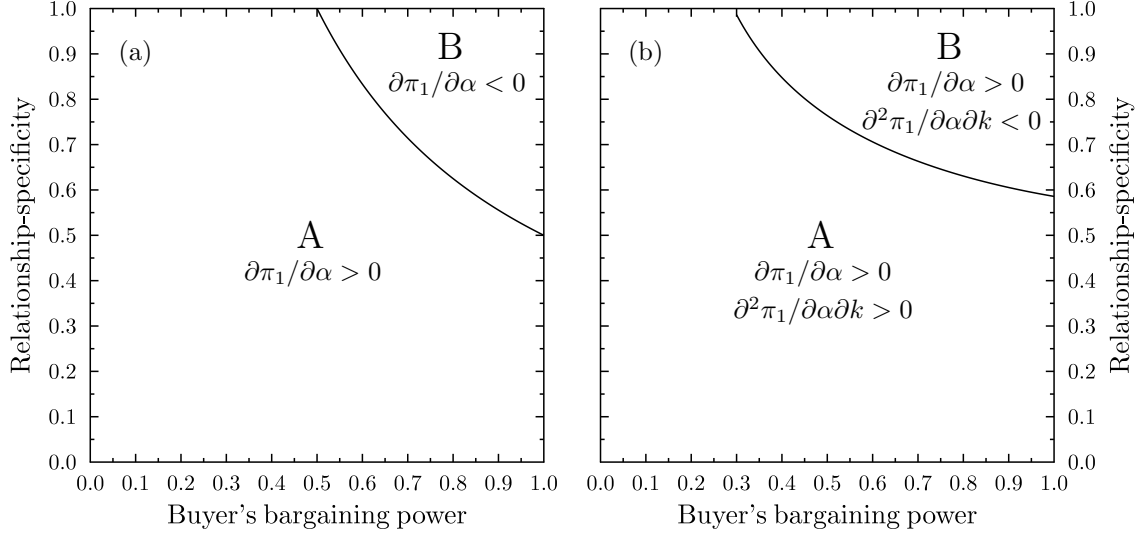
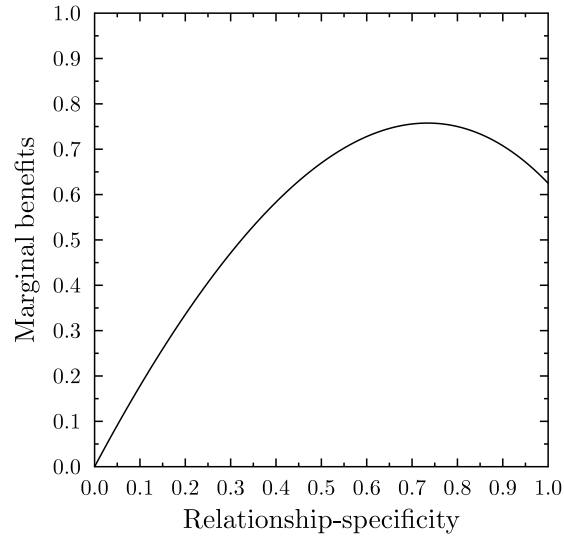


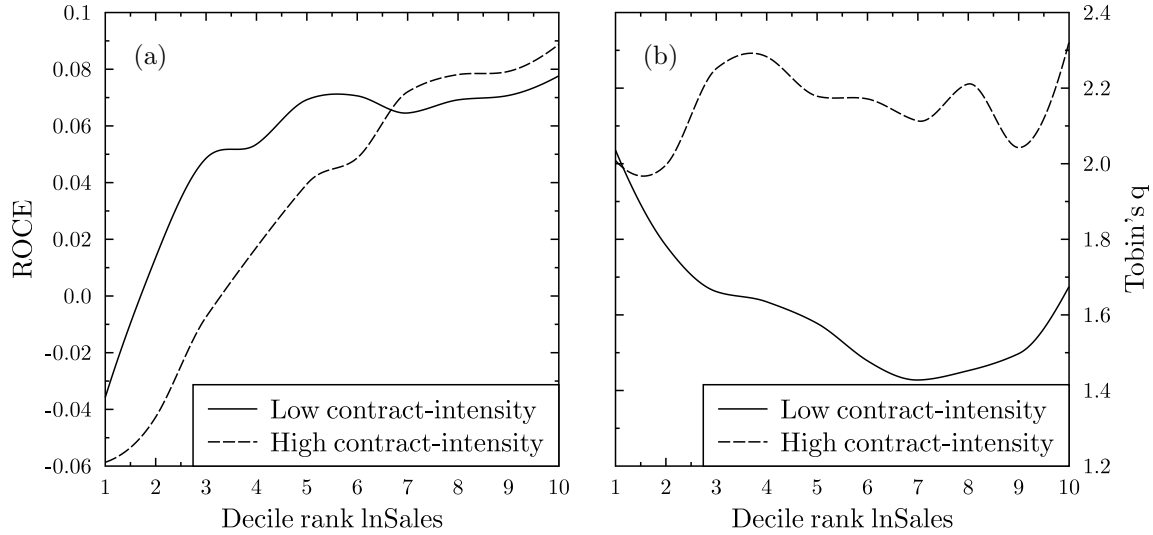
Figure Ia illustrates how the buyer’s expected payoff depends on her bargaining power when the buyer does not have a hold-up problem, $\lambda_1 = \mu_1$. The seller’s relationship-specificity is on the y-axis ($k_2 = 1 - \mu_2/\lambda_2$). We find that $\partial\pi_1/\partial\alpha > 0$ in region A and $\partial\pi_1/\partial\alpha < 0$ in region B. Figure Ib illustrates how the buyer’s expected payoff depends on her bargaining power under symmetrical technologies ($\partial\pi_1/\partial\alpha > 0$ for all parameters). Relationship-specificity is on the y-axis ($k = 1 - \mu/\lambda$). Keeping the joint surplus constant, by allowing both λ and μ to change when the relationship specificity (k) changes, we find that $\partial^2\pi_1/\partial\alpha\partial k > 0$ in region A, while $\partial^2\pi_1/\partial\alpha\partial k < 0$ in region B.

Figure II
Expected payoff and bargaining power for different levels of specificity



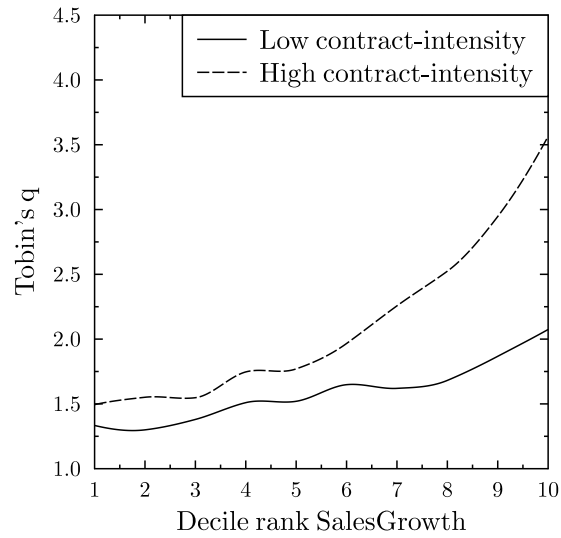
This figure illustrates the buyer's marginal benefits of increasing bargaining power ($\partial\pi_1/\partial\alpha$) for different levels of specificity (k), assuming symmetrical technologies and equal bargaining power. The joint surplus is kept constant (at 0.9375), by allowing both λ and μ to change when relationship specificity (k) changes.

Figure III
ROCE and Tobin's q for contract intensity by firm size



Firms are grouped into terciles based on their industry contract intensity (CI): low, middle and high contract intensity. Figure IIIa (IIIb) shows the average ROCE (Tobin's q) by firm size (lnSales) decile for firms in the low and the high CI tercile. The smallest 10% of firms are in decile 1, the largest 10% in decile 10.

Figure IV
Tobin's q for contract intensity by sales growth



Firms are grouped into terciles based on their industry contract intensity (CI): low, middle and high contract intensity. This figure shows the average Tobin's q for by sales growth decile for firms in the low and the high CI tercile. Sales growth is computed as the percentage growth annual sales. Firms with the lowest 10% sales growth are in decile 1, the largest 10% in decile 10.