THE JOURNAL OF FINANCE • VOL. LXI, NO. 3 • JUNE 2006

Corporate Equity Ownership and the Governance of Product Market Relationships

C. EDWARD FEE, CHARLES J. HADLOCK, and SHAWN THOMAS*

ABSTRACT

We assemble a sample of over 10,000 customer–supplier relationships and determine whether the customer owns equity in the supplier. We find that factors related to both contractual incompleteness and financial market frictions are important in the decision of a customer firm to take an equity stake in their supplier. Evidence on the variation in the size of observed equity positions suggests that there are limits to the size of optimal ownership stakes in many relationships. Finally, we find that relationships accompanied by equity ownership last significantly longer than other relationships, suggesting that ownership aids in bonding trading parties together.

CORPORATIONS OFTEN HOLD EQUITY BLOCKS in other corporations. Despite the frequency of this occurrence, the motivation for these holdings is not well understood. In the context of product market relationships, partial equity ownership represents an organizational form that is potentially quite different both from no ownership and from complete vertical integration. Recent work by Allen and Phillips (2000) suggests that there may be some unique benefits to this alternative organizational form; however, the picture is far from complete.

In this paper, we study the decision to take an equity stake in a trading partner in a sample of over 10,000 customer–supplier pairs from 1988 to 2001. We examine whether variables that proxy for the theorized benefits of equity ownership are systematically related to the presence or size of observed equity stakes. In addition, we investigate whether the presence of an ownership position is related to the subsequent evolution of the trading relationship.

Our analysis reveals several interesting findings. First, we find that intense trading relationships in which a firm sells a significant fraction of its output to a single customer are quite common. Second, we find that it is relatively rare for a customer to take a partial equity stake in their supplier.[1] Specifically, equity stakes are present in only 3.31% of all sample relationships, although

*C. Edward Fee and Charles J. Hadlock are from Michigan State University and Shawn Thomas is from the University of Pittsburgh. We thank Mihir Desai, Zsuzsanna Fluck, Paul Irvine, Jim Linck, Wei-Lin Liu, John Martin, Josh Lerner, Gordon Phillips, David Robinson, Mukunthan Santhanakrishnan, David Scharfstein, an anonymous referee, and seminar participants at George Washington University, the University of Georgia, Harvard Business School, Temple University, the University of Virginia, Washington University in St. Louis, and the 2005 AFA meetings for helpful comments. Hoon-Taek Seo provided superb research assistance. All errors remain our own.

[1] Sample suppliers are much smaller than customers and thus almost never hold equity in their customers.

this frequency is higher in some subsamples. The low overall incidence of equity ownership suggests that many trading relationships can be governed effectively by explicit or implicit contracts, with no need for an equity tie. However, in a substantial number of relationships, equity does appear to be useful. Studying these relationships provides us an opportunity to understand the types of frictions that arise in customer–supplier relationships and the role of equity in easing these frictions.

Our results suggest that factors related both to contractual frictions and financial constraints contribute to the partial ownership decision. Equity stakes are much more common when the supplier is a research and development (R&D)–intensive firm. Since we expect R&D activities to be particularly prone to contractual frictions arising from poorly delineated property rights, this finding is consistent with an incomplete contracts motivation for the use of equity. The presence of an equity stake is also significantly related to the fraction of a supplier's sales that are made to the customer. This suggests that equity ownership may encourage efficient actions in settings in which firms are concerned with expropriation and holdup problems arising from relationship-specific investments. Equity stakes are also significantly more common in relationships with formal alliance agreements, indicating that explicit contracts and equity ownership are often used together to govern potential incentive conflicts. Since relationships with explicit alliances are more likely to include substantial relationship-specific investments and/or scope for incentive conflicts, this finding suggests that equity ownership helps ease inefficiencies arising from incomplete contracting in these settings.

Turning to financial constraints, we find that suppliers who have negative free cash flow are relatively more likely to have customers as blockholders. This suggests that part of the equity stake phenomenon reflects behavior in which customers serve as informed sources of capital to ease financial constraints at the supplier level. Relationships that exist at the time of a supplier's initial public offering (IPO) are also more likely to be characterized by a customer equity stake, suggesting that suppliers without access to public equity markets find partner financing to be relatively attractive. Customer financial constraints also can be important, as customers with deeper pockets appear to be more likely to invest in their suppliers.

When we study the size of observed equity blocks, we find that variables that are positively related to the likelihood of observing a block are often negatively related to block size. This suggests that there are limits to equity ownership, perhaps because suppliers are concerned about customers having too much control over their operations at high ownership levels. Thus, in settings in which incentives must be delicately managed, it appears that an equity stake is relatively more likely to be established, but the size of the stake will be moderate.

Turning to the possible effects of partial equity stakes, we find that relationships accompanied by equity ownership last significantly longer than other relationships. Customers in relationships with equity are also much more likely to be represented on the supplier's board. However, outright mergers between

customers and suppliers are rare, even when customers own equity in their suppliers. These findings suggest that ownership may affect relationship governance and thereby help bond trading parties. Presumably, the decision to establish a stake is made in anticipation of these types of potential future benefits.

The rest of the paper is organized as follows. In Section I, we review the existing literature and outline our empirical strategy. In Section II, we discuss our data, sample selection, and summary statistics. Section III presents our main multivariate results on the factors associated with equity stakes in product market relationships. Section IV reports our findings on equity ownership and the dynamics of relationships. We conclude in Section V.

I. Related Literature and Empirical Strategy

A. Theoretical Considerations

One way to organize a trading relationship is for two firms to vertically integrate. Understanding the determinants of full integration is a classic issue in the theory of the firm and has motivated a large literature on incomplete contracts.[2] If we view equity stakes as a form of partial integration, we might expect that the factors that the theory suggests will affect the vertical integration decision will also affect the likelihood of observing partial equity stakes. Thus, we might expect relationships characterized by a high degree of asset specificity and/or the presence of important noncontractible decisions to be more likely to exhibit partial equity blocks.[3]

This view of partial equity investments, while informative, may overlook some of the subtleties that arise in this hybrid ownership structure. An alternative view of partial ownership is that it provides the blockholder an incentive to partially internalize the effect of its actions on a trading partner (e.g., Riordan (1991), Mathews (2003)). Thus, in cases in which one party may underinvest in actions that help the other party, a partial equity stake may improve total surplus. The size of such stakes will be limited if high ownership by a blockholder begins to dilute the target's incentives. This view of partial equity ownership as a solution, albeit imperfect, to a double moral hazard problem would suggest that equity stakes are more likely to be observed in relationships in which actions by one party have a significant positive spillover effect on their partner.

While partial equity ownership may at times alleviate incentive problems, Aghion and Tirole (1994) show that it is possible for partial equity ownership

[2] Classic work in this area includes the transactions cost economics approach (e.g., Williamson (1975, 1985), Klein, Crawford, and Alchian (1978)) and the property rights approach (e.g., Grossman and Hart (1986), Hart and Moore (1990)).

[3] Holmström and Roberts (1998) and Whinston (2003) discuss the difficulties associated with testing different contracting-based theories of vertical integration. We use the term partial integration loosely to indicate a midway point between full vertical integration and complete nonintegration. Some theories would suggest that an ownership stake without control is functionally equivalent to nonintegration.

to be irrelevant in relationships in which parties bargain ex post over any trading surplus. In their analysis, the price that product market partners agree on adjusts with equity stakes in a way that leaves both partners with the same surplus that they would realize without the ownership position. However, recent papers by Dasgupta and Tao (2000), Harbaugh (2001), and Van den Steen (2002) show that when one generalizes the Aghion and Tirole (1994) framework, there can be a role for partial equity stakes to increase relationship efficiency by changing the threat points in the bargaining game over joint surplus. For example, Dasgupta and Tao (2000) show that equity stakes will tilt a supplier toward relationship-specific investments because part of the return from the general investment accrues to the customer via its equity position.

These models of partial equity ownership are quite specialized. Thus, it is hard to interpret them as literal descriptions of typical multidimensional, long-lived product market relationships. Nevertheless, this work suggests that equity may play a role in enhancing efficiency in environments in which contracting is incomplete. In addition, it seems possible that equity stakes may serve a role in encouraging information sharing or cooperation between trading parties over time in ways not captured by existing models. In our empirical analysis, we hope to both confirm some general possibilities suggested by existing theory and to inform further work in this area.

B. Related Empirical Evidence

Several prior studies identify factors that are related to the presence of equity stakes in product market relationships.[4] A number of results reported in this literature are consistent with an incomplete contracts motivation for the presence of equity stakes, including the common result that R&D-intensive relationships are more likely to include an equity tie between partners. While these prior studies are informative, they do not provide a comprehensive picture of equity holdings in a broad cross section of publicly traded U.S. firms. In particular, these studies are typically restricted to specific industries (e.g., biotechnology), types of product market relationships (e.g., technology transfer agreements), and types of firms (e.g., private firms, foreign firms). Our study is distinguished not only by our large and broad sample of relationships, but also by the availability of several unique explanatory variables and information on the size of equity stakes and relationship dynamics.

Our investigation is also related to the study by Allen and Phillips (2000). In a sample of public firms, these authors find that equity blocks established in connection with product market alliances exhibit comparatively large positive announcement returns and subsequent improvements in operating performance. Similarly, in samples of private firms, Gompers and Lerner (2000) and Santhanakrishnan (2003) find that equity ties are more successful when a strategic overlap or alliance exists between a venture capital investor and a

[4] A partial list includes Pisano (1989), Gulati (1995), Oxley (1997), Robinson and Stuart (2001), and Pablo and Subramaniam (2002).

firm. These results suggest that there is something special about equity ownership coupled with a product market relationship. However, because these studies select their samples based on the existence of an equity block, they are unable to contrast relationships accompanied by equity stakes with relationships not accompanied by such stakes. As we show, close trading relationships without equity ownership are quite common.

C. Empirical Strategy

Our approach is to identify several variables that theory suggests may be related to equity stakes and then to examine whether these variables systematically predict the presence of a stake. It should be kept in mind that we conduct this analysis within a set of relationships in which firms have decided not to vertically integrate, and thus our inferences are conditional on contracting or other problems not being so severe that integration is the dominant organizational form. In a subsection below, we discuss the implications of this sample selection rule in interpreting our results. Our preceding discussion establishes that there may be several scenarios under which equity plays a role in easing incentive conflicts and contracting frictions between trading parties in a world with incomplete contracts. We refer to this general role for partial equity stakes as the *contracting hypothesis*.

One variable that we expect to be related to contracting problems is the R&D focus of the relationship. As is well recognized (e.g., Aghion and Tirole (1994)), property rights are often quite blurry when it comes to R&D activities. In addition, when firms are sharing knowledge, there may be significant potential for the activities of one party to indirectly benefit the other party in ways that are outside the scope of any contractual agreement. If equity stakes alleviate these frictions, then they should be more prevalent in R&D-oriented relationships. As mentioned above, other authors find a relation between R&D and equity stakes in certain specialized samples.

The second contracting factor we study is the fraction of a firm's sales that are made to their product market partner. The idea here is that the more a supplier sells to a given customer, the more likely it is that the supplier is making a substantial relationship-specific investment, and consequently, the greater will be their concerns about expropriation. If equity stakes serve to ease concerns about expropriation or holdup, we would expect to observe greater equity stakes when this sales dependence variable is elevated.

The final factor we identify to test the contracting hypothesis is a variable indicating whether the two firms in a relationship have an explicit alliance agreement. Many prior studies of corporate equity ownership either restrict attention to alliances (e.g., Pablo and Subramaniam (2002)), or use the existence of an alliance to identify a product market relationship (e.g., Allen and Phillips (2000)). As we show below, it is quite common for firms to have close product market relationships without an alliance agreement. The existence of a formal alliance agreement suggests that trading partners are concerned about conflicts that may evolve over time and that they attempt to ameliorate these

conflicts using a contractual mechanism. If these contractual agreements can only imperfectly alleviate potential problems that may arise, we would expect to observe the presence of an equity stake as an additional governance device. Additionally, the formal alliance itself can be viewed as a form of relationship-specific investment. As such, the contracting hypothesis might predict a greater need for equity in alliances as compared to relationships with less mutual investment.

Equity investments by product market partners may also arise because of financial market imperfections.[5] In particular, firms may have a difficult time securing external financing at reasonable terms in arm's length transactions because of information problems (e.g., Myers and Majluf (1984)). If a product market partner, by virtue of their relationship with the firm, has the ability to more accurately assess a firm's value, they may be in a superior position to provide financing.[6] We refer to this possibility as the *financial frictions hypothesis*.

To test this hypothesis, we consider two types of factors that may proxy for problems in raising capital. First, we consider a firm's need for external funding, since financing problems can be avoided if a firm has sufficient internal funding. We measure external capital needs as the difference between a firm's capital spending and its internal cash flow. Second, we consider variables that may proxy for the severity of information problems when firms decide to access the external capital markets. We expect that the relative preference for partner financing should be elevated when these variables are elevated. We identify these variables from the existing literature (described below).

While both the contracting hypothesis and the financial frictions hypothesis suggest that partial equity ownership may be an optimal arrangement under some circumstances, contracting theories also suggest that there can be limits to the optimal size of ownership stakes (e.g., Burkart, Gromb, and Panunzi (1997)). In particular, majority stakes can allow one firm to control the other, and large minority stakes might lead to the possibility of seizing control in the future. Concerns about control may impair incentives, suggesting that there are limits to the optimal size of equity blocks. Thus, in situations in which equity ownership has the potential to ease contracting frictions by delicately managing incentives, we may observe moderately sized equity stakes rather than large blocks. We directly examine this possibility in the data.

To add to our understanding of the role of ownership in relationships, it would be helpful to evaluate whether the presence of a partial equity stake actually has an effect on how a relationship evolves over time. This is a challenge, since many possible effects concern variables that we do not observe (pricing, investment, etc.). To address this issue indirectly, we examine relationship durability.

[5] With the exception of Allen and Phillips (2000) and Pablo and Subramaniam (2002), prior studies of partial equity stakes largely ignore the role of financial frictions. Of related interest, Johnson and Houston (2000) present evidence that the formation of joint ventures is associated with both contractual frictions and financial constraints.

[6] Similar arguments have been made for the choice of private financing over public financing (e.g., Hertzel and Smith (1993) and Hadlock and James (2002)). See Lerner, Shane, and Tsai (2003) for evidence on equity market conditions and partner financing.

If relationships with equity stakes tend to last longer, this would suggest that equity aids in fostering cooperation and increasing trading surplus.

II. Data and Sample Selection

A. Identifying Customer–Supplier Relationships

Initially, we select all firms listed on the merged Center for Research in Security Prices (CRSP) and Compustat databases with nonmissing values reported for book value of assets and fiscal year-end stock price. Our ownership data are only available starting in 1988, and thus we restrict our attention to the 1988 to 2001 period. Disclosure rules require that firms report the names of all customers responsible for over 10% of their annual sales, and some firms voluntarily report the names of other major customers when sales are below this threshold. We treat all disclosed customers as major customers of the firm, although much of our later analysis conditions on the magnitude of trade between the customer and the supplier. The identity of the firm's customers and sales to these customers are extracted from the Compustat industry segment files.[7]

For each customer, we determine whether the customer is another CRSP/Compustat listed firm. This is a difficult task, as customer names are often abbreviated. Following Fee and Thomas (2004), we use an algorithm to select the four names listed in the CRSP historical name field that are most likely to match the customer's reported name. We then use visual inspection and industry information to determine if the customer is in fact one of these CRSP firms. For customer names for which we find no match on CRSP, we search the *Directory of Corporate Affiliations* to determine if the customer is a subsidiary of a publicly traded firm. If it is, we assign to the customer the CRSP identifier of the parent corporation. We are deliberately conservative in our matching of customer names to firm identifiers, and thus we are confident that customers are matched to the appropriate financial information.

We retain in our sample all relationship-years from 1988 to 2001 in which a supplier is listed on both the CRSP and Compustat databases, and the supplier is matched in the observation year with a customer that we can confirm appears in the CRSP and Compustat databases at some point during the sample period. The resulting sample includes 10,493 distinct relationships that represent 27,037 relationship-years.

B. Firms in Customer–Supplier Relationships

In Panel A of Table I we report summary statistics, where each relationship is treated as a single observation. Firm characteristics are measured as of the first

[7] The main results we report below hold if we restrict attention to relationships with sales dependence above the 10%, 15%, and 20% thresholds. The 10% reporting threshold does lead to a nonrandom sample. However, under reasonable assumptions, this should not bias the coefficient estimates because the selection condition is based on the level of an explanatory variable, rather than the dependent variable. For a discussion, see Wooldridge (2002).

Table I

Characteristics of Firms in Customer–Supplier Relationships

Customer and supplier firms are identified from the Compustat industry segment file. The sample period is 1988 to 2001 and all statistics are inflation adjusted to 2001 dollars. Each customer–supplier relationship is treated as a single observation in Panel A. Summary statistics for supplier and customer firms are based on firm characteristics in the first year that we observe the relationship during the sample period. The figures for all Compustat firms in Panel A are from 1993, which is the year near the middle of our sample period with the greatest number of new relationships. Assets are total book assets in millions of dollars. Firm age is the number of years since the firm first has book assets reported on Compustat. R&D intensity is a firm's annual R&D expenditures divided by total assets. Missing values for R&D are treated as 0. The market-to-book ratio (MB) is calculated as (total assets − book value of equity + market value of equity)/total assets. Both R&D intensity and MB are winsorized at the 1% and 99% levels throughout the paper. Frequencies for all Compustat firms reported in Panel B are calculated over the set of all CRSP/Compustat firm-years with nonmissing data between 1988 and 2001. The percentage of supplier (customer) years in which a supplier (customer) is involved in multiple relationships is calculated over the entire set of supplier (customer) firm-years.

Panel A: Characteristics of Customer and Supplier Firms

	Median	Mean	Observations
Supplier assets	65.84	649.59	10,493
Customer assets	12,216.49	35,909.13	9,398
Supplier assets/customer assets	0.0078	0.8038	9,398
Assets of all Compustat firms	134.02	2,539.97	7,126
Supplier age	6.00	9.72	10,493
Customer age	30.00	27.89	9,398
Supplier age/customer age	0.29	0.76	9,398
Age of all Compustat firms	8.00	12.55	7,126
Supplier R&D intensity	0.0108	0.0723	10,493
Customer R&D intensity	0.0089	0.0364	9,398
Supplier R&D intensity/customer R&D intensity	0.75	3.35	5,397
R&D intensity of all Compustat firms	0.0000	0.0353	7,125
Supplier MB	1.65	2.60	10,457
Customer MB	1.46	2.08	8,968
Supplier MB/Customer MB	1.05	1.56	8,936

Panel B: Incidence of Types of Relationships

	Percentage	Observations
% Compustat observations identified as suppliers	16.78	101,523
% Compustat observations identified as suppliers, assets <$100 million	20.33	46,058
% Compustat observations identified as suppliers, assets >$10 billion	6.16	4,869
% Compustat observations identified as customers	7.17	101,523
% Compustat observations identified as customers, assets <$100 million	1.08	46,058
% Compustat observations identified as customers, assets >$10 billion	40.11	4,869
% Suppliers in multiple relationships	38.94	16,565
% Customers in multiple relationships	37.11	9,197

sample-period year that the relationship is observed. For comparison purposes, we also report statistics for the entire Compustat universe. As we report in the table, suppliers are typically much smaller than their major customers, with a median ratio of supplier assets to customer assets of less than 0.01. The median supplier in our sample has (inflation-adjusted) assets of $65.84 million, which compares to a median for all Compustat firms of $134.02 million (see Panel A of Table I). Thus, sample suppliers are small firms, but not extraordinarily so. Suppliers are typically much younger than their major customers (median age of 6.00 vs. 30.00), and slightly younger than the median Compustat firm. The median level of R&D intensity for suppliers is slightly larger than it is for customers, and both groups of firms appear to have fairly similar market-to-book ratios (MBs).[8]

To gauge the overall frequency of trading relationships between independent firms, we report in Table I, Panel B the fraction of firm-year observations in the entire CRSP/Compustat universe for which a firm is involved in an identified relationship. We find that in 16.78% (7.17%) of all firm-years, a firm is identified as a supplier (customer) in a trading relationship. Smaller firms are relatively more likely to be identified as suppliers, while larger firms are more likely to be major customers. Prior studies of vertical integration suggest that close trading relationships often occur within firms. Our figures here complement this evidence by indicating that a sizable fraction of public firms are involved in intense trading relationships that span across firms. The figures in the table also indicate that many firms are in multiple relationships. In particular, more than one-third of the sample supplier-years (customer-years) are cases in which the firm is a supplier (customer) in another relationship in that same year.

C. Ownership and Alliances

We gather ownership information from the Compact Disclosure database. This data source reports information on 5% blockholders collected from federal filings for virtually all publicly traded U.S. firms from 1988 onward.[9] For each relationship, we use the Compact Disclosure disks to determine whether the customer is ever listed as a 5% blockholder in the supplier. We supplement this with information collected directly from the supplier's proxy statements. Details on how we record this ownership information are reported in the Appendix. Our final data set includes information on whether the customer owned equity in the supplier and, if so, the size of the equity stake around the end of each

[8] R&D intensity is a firm's annual R&D expenditures divided by total assets. Missing values for R&D are treated as 0. The MB is calculated as (total assets − book value of equity + market value of equity)/total assets. Both R&D intensity and MB are winsorized at the 1% and 99% levels. Age is the number of years since the firm first has a book assets figure reported by Compustat.

[9] For more on this database, see Anderson and Lee (1997). The 5% ownership reporting threshold should not be important in testing contracting theories that typically assert that ownership positions should be nontrivial. This threshold may weaken our ability to detect evidence supporting the financial frictions hypothesis.

fiscal year. By adding the requirement that a supplier be listed on Compact Disclosure, our final sample size falls slightly to 10,211 relationships.

To gather information on alliances, we select the first year in which a relationship appears during our sample period and search for whether the firms were listed together in the Securities Data Corporation (SDC) strategic alliance database at any point in time from 1980 up to 365 days after the end of this fiscal year. The SDC database begins listing alliances in 1980, and the comprehensiveness of their coverage appears to increase starting in 1985. Thus, we believe that we should detect most instances in which relationships are accompanied by alliance agreements.

D. Characteristics of Customer–Supplier Relationships

We present basic information on sample relationships in Panel A of Table II. The mean (median) value for the fraction of the supplier's sales made to their customer is 19.23% (13.73%). This confirms that we have selected relationships in which the supplier sells a substantial fraction of their output to a single customer. A fairly small fraction (5.09%) of sample relationships entail alliance agreements, indicating that intense trading relationships often exist without these formal arrangements. Relationships between firms in different industries are common, which is not surprising given that inputs provided by suppliers are often quite different from the outputs sold by customers. Finally, we report in the table that there is substantial heterogeneity in the estimated duration of trading relationships, with a 25th percentile of only 1 year and a 75th percentile of 6 years.

Turning to ownership, we define a relationship to have had an equity stake if the customer owned a block in the supplier at some point in the relationship during the sample period. In almost all cases in which there is an equity stake, the ownership position appears early in the relationship.[10] As we report in Panel B of Table II, equity ownership by customers in their suppliers is the exception rather than the rule. In fact, customers hold a 5% block of the supplier's equity in only 3.31% of our sample trading relationships. Thus, while we have a sample of suppliers who are either moderately or highly dependent on certain large customers, it appears that many of these relationships function without the need for the customer to purchase equity in the supplier.

The overall sample rate of equity participation of 3.31% in product market relationships is significantly lower than what others report. For example, Gulati (1995) finds equity ties in over 50% of his sample of product market partners. This indicates, not surprisingly, that previous studies' samples are composed of relationships that are quite different from the typical buyer–supplier relationship between publicly traded firms. The rate of equity participation that we report is also much lower than recent figures on block ownership rates reported

[10] In 93% (74%) of all relationships with equity, we observe the stake in the first or second year (last year) of the relationship. Our results are qualitatively unchanged when we restrict attention to equity stakes that exist early in the relationship.

by Barclay, Holderness, and Sheehan (2003) and Field and Sheehan (2004). To investigate, we select a random sample of 100 suppliers in our sample in 1995 and examine all available electronic proxy statements. Similar to Barclay et al. (2003), we find that just over 30% of the selected suppliers have blocks held by other corporations, with approximately half of these blocks held by nonfinancial

Table II

Characteristics of Customer–Supplier Relationships

Customer and supplier firms are identified from the Compustat industry segment file. Customer and supplier firms must also be listed in Compact Disclosure. The sample period is 1988 to 2001 and includes 10,211 unique customer–supplier relationships. All figures are inflation adjusted to 2001 dollars. Each customer–supplier relationship is treated as a single observation in this table. Summary statistics are based on firm or relationship characteristics in the first year that we observe the relationship during the sample period. The number of observations used to calculate each statistic is indicated in the right-hand column. Supplier sales dependence is the percentage of supplier sales that are made to the customer. The percentage of relationships accompanied by an alliance is determined by examining whether firms in a relationship had a formal alliance agreement in place as of the first year during the sample period that we detect their trading relationship. Alliance data are from Securities Data Corporation's joint ventures/strategic alliance database. Relationships in the same 4-digit (3-digit, 2-digit, 1-digit) Standard Industrial Classification (SIC) code are those relationships in which the customer and supplier have the same 4-digit (3-digit, 2-digit, 1-digit) SIC code in the first year the relationship is observed. In calculating relationship duration, we assume a relationship starts in the first year the customer–supplier relationship is observed in the Compustat industry segment file (1978 to 2001). Relationship durations for relationships first observed in 1978 are excluded from this calculation, since the actual starting year for the relationship cannot be observed. Relationship duration is calculated by estimating the distribution of survival times using the Kaplan–Meier product limit estimator. This estimation accounts for censoring and late entry. Summary statistics for the indicated subsamples in Panel B are based on firm or relationship characteristics in the first year that we observe the relationship during the sample period. Medians are calculated over the sample of all relationships based on these first-year characteristics. A relationship is deemed to have an equity stake if the customer owned a block of equity in the supplier at some point in the sample period overlapping their sales relationship. R&D intensity is a firm's annual R&D expenditures divided by total assets. Missing values for R&D are treated as 0. Supplier age is the number of years since the firm first has book assets reported on Compustat. Supplier assets are total book assets. Supplier free cash flow is a firm's income before extraordinary items plus depreciation and amortization less capital expenditures. *** denotes significance at the 0.01 level of the differences between subsamples (e.g., no alliance vs. alliance) as assessed using a *t*-test.

Panel A: Relationship Characteristics

	Statistic	Observations
Supplier sales dependence—mean	19.23%	8,337
Supplier sales dependence—25th percentile	10.10%	8,337
Supplier sales dependence—50th percentile	13.73%	8,337
Supplier sales dependence—75th percentile	22.00%	8,337
Relationships accompanied by an alliance	5.09%	10,211
Relationships in same 4-digit SIC code	8.04%	10,038
Relationships in same 3-digit SIC code	16.40%	10,038
Relationships in same 2-digit SIC code	23.29%	10,038
Relationships in same 1-digit SIC code	42.77%	10,038
Relationship duration—25th percentile	1 year	10,062
Relationship duration—50th percentile	3 years	10,062
Relationship duration—75th percentile	6 years	10,062

(*continued*)

Table II—*Continued*

Panel B: Frequency of Equity Stakes		
	Percentage	Observations
Relationships in which customer has an equity stake in supplier	3.31	10,211
Relationships with equity stake, supplier R&D intensity ≤ median	1.65	5,106
Relationships with equity stake, supplier R&D intensity > median	4.98***	5,105
Relationships with equity stake, supplier sales dependence ≤ median	2.49	4,169
Relationships with equity stake, supplier sales dependence > median	5.09***	4,168
Relationships with equity stake, no alliance	2.46	9,691
Relationships with equity stake, alliance	19.23***	520
Relationships with equity stake, supplier age ≤ median	4.56	5,591
Relationships with equity stake, supplier age > median	1.80***	4,620
Relationships with equity stake, supplier assets ≤ median	3.29	5,108
Relationships with equity stake, supplier assets > median	3.33	5,103
Relationships with equity stake, supplier free cash flow ≤ 0	4.43	5,255
Relationships with equity stake, supplier free cash flow > 0	2.04***	4,749

firms. Thus, it appears that many firms have corporate blockholders, but a relatively small fraction of these blockholders are large customers.

In Table II, Panel B we report statistics on ownership rates for subsamples grouped by firm and relationship characteristics. Consistent with the contracting hypothesis, we find that suppliers with high R&D intensity (i.e., R&D intensity above the sample median) are significantly more likely to have equity stakes held by customers compared to low R&D intensity suppliers. In addition, relationships in which the customer is responsible for a large (greater than median) fraction of the supplier's sales are also characterized by a higher frequency of equity stakes.[11] Finally, there is a significant difference between relationships with an alliance agreement and relationships without such an agreement. The magnitudes here are particularly large. We find that 19.23% of all relationships accompanied by an alliance have an equity stake, compared to 2.46% for all other relationships.

Turning to other figures in Table II, we find that younger suppliers are more likely to have an equity stake held by the customer, while firm size does not appear to be related to the likelihood of a stake. If younger firms have greater

[11] In cases in which the supplier sells more than 25% (50%) of their output to a customer, the fraction of relationships with an equity stake is 9.03% (14.15%). This suggests that equity ties are increasing in sales dependence, but also that partial equity stakes are more the exception rather than the rule.

information problems, the difference across age groups could be interpreted as broadly consistent with the financing frictions hypothesis. More convincing evidence is provided when we divide the sample into suppliers who have negative and positive free cash flow, where free cash flow is defined as operating earnings plus depreciation minus capital expenditures. Here we find that customers with negative free cash flow are more likely to have customers with equity stakes.

Overall, the figures in Tables I and II indicate that close trading relationships between firms are common, yet equity ties are not common. The rate of equity participation does appear to be higher in subsamples in which we would expect equity to help alleviate contracting problems or financial constraints. When these problems are too severe, firms in a trading relationship may choose to vertically integrate. If they choose not to integrate, our univariate evidence suggests that in some cases equity participation helps ease underlying contracting and financial frictions. Explicit long-term contracts in the form of alliance agreements also appear to be used occasionally to govern relationships, and alliances and equity ties appear to be related. However, these devices are more typically used alone, as the majority of alliances have no equity ties and the majority of equity ties are made without an alliance agreement.

E. The Establishment of Equity Stakes

Before turning to modeling the equity stake decision, it is informative to investigate how ownership positions are typically established. To determine this, we perform news searches in the Factiva.com news sources (newspapers, newswires, magazines, etc.). Approximately two-thirds (66.86%) of the observed equity stakes appear to be established as part of a formal or informal business arrangement; for example, anticipated cooperation on an activity of mutual interest, establishment of a supply contract, signing of a licensing agreement, etc.[12] Less common ways in which these stakes arise are as a result of a carve-out, spin-off, or joint venture (17.46%), as consideration in asset sales between parties (5.62%), and for other miscellaneous reasons (10.06%). The anecdotal evidence here suggests that equity stakes are not typically merely coincidental to trading relationships, but rather they serve a role in maintaining such relationships. In addition, it appears that many stakes represent newly issued shares, suggesting that alleviation of financial constraints may be part of the motivation for the formation of these positions.

III. Models of Equity Stakes

A. Determinants of Equity Stakes in Customer–Supplier Relationships

We now turn to a multivariate analysis of the determinants of equity stakes. Our approach is to estimate logit models in which the dependent variable takes a value of 1 if a relationship is characterized by an equity stake, and 0 otherwise.

[12] In the majority of these cases (76%), news articles indicate that the stake was established in direct connection with the signing of some type of explicit agreement. In the remaining cases, we find more limited evidence that the ownership position is directly related to a business relationship or explicit contract.

All of the explanatory variables are measured as of the first year during the sample period that we observe the relationship. To account for possible changes in ownership patterns over time, all models include a year trend.[13]

In column 1 of Table III, we report results for a simple specification that includes the supplier's R&D intensity and the fraction of the supplier's sales to the customer (sales dependence) as explanatory variables. We do not have explicit data on the nature of each trading relationship, so we assume that suppliers with high levels of R&D are more likely to be involved in R&D-focused trade with the customer. The estimates on the R&D variable and the sales dependence variable in column 1 are both positive and highly significant. Since we expect contracting frictions to be elevated in R&D-focused relationships and in arrangements in which the supplier is dependent on the customer, these findings provide strong initial support for the contracting motivation for the use of partial equity stakes.

In column 2 of Table III, we add the strategic alliance dummy variable. As we report in the table, the coefficient on this variable is positive and highly significant. Since alliance agreements are more likely to be observed in situations in which firms make important relationship-specific investments and/or there is significant scope for incentive conflicts to arise over time, the fact that partial equity stakes are correlated with alliances appears highly consistent with their serving a role in easing contractual frictions.[14] Inclusion of the alliance variable lowers the estimated coefficients on the R&D and sales dependence variables, but they remain positive and significant at the 1% level. Thus, while prior studies frequently restrict attention to alliances, our evidence suggests that contracting frictions play a role in determining ownership structure even in relationships not governed by such an agreement.

One may be concerned that our contracting frictions variables are correlated with other characteristics, such as the supplier's size or age, that are not as clearly related to the theory. In column 3 of Table III, we add these variables to the specification. The coefficient on age is negative and significant, indicating that younger firms are more likely to have equity stakes held by their trading partners. Surprisingly, the coefficient on firm size is positive and significant. In contrast to our univariate analysis, this finding suggests that larger firms are more likely to have equity blocks held by their product market partners. The coefficients on the variables related to contractual frictions maintain their signs and significance levels with these added controls.

[13] We choose the conservative approach of estimating models at the relationship level, rather than the relationship-year level, since there is often little time variation in relationship characteristics. The regression results we report in Tables III and VI are generally even more significant when we use relationship-years as the unit of observation. The results are also qualitatively unchanged if we use year dummies rather than a year trend in the regression models.

[14] The correlation between alliances and ownership may indicate that they are complementary in a technological sense, or alternatively, that they are both affected by a common factor, such as the scope for conflicts in the relationship. Both interpretations are consistent with ownership serving a role in easing contractual frictions. For a discussion of interpreting correlation patterns in organizational choices, see Athey and Stern (2003).

Table III

Logit Models of Equity Stakes in Customer–Supplier Relationships

Customer and supplier firms are identified from the Compustat industry segment file. Customer and supplier firms must also be listed in Compact Disclosure. The sample period is 1988 to 2001 and all variables are inflation adjusted to 2001 dollars. Each customer–supplier relationship is treated as a single observation in these regressions. The dependent variable assumes a value of 1 if the customer takes an equity stake in the supplier at some point during the relationship and 0 otherwise. All coefficient estimates are derived from a logistic regression model. Asymptotic standard errors are reported in parentheses. Independent variables are coded based on firm or relationship characteristics in the first year that we observe the relationship during the sample period. Supplier R&D intensity is a firm's annual R&D expenditures divided by total assets. Missing values for R&D are treated as 0. Supplier sales dependence is the percentage of supplier sales that are made to the customer. Alliance is a dummy variable that takes a value of 1 if the firms in a relationship had a formal alliance agreement in place as of the first year during the sample period that we detect their trading relationship and 0 otherwise. Supplier age is the number of years since the firm first has book assets reported on Compustat. Log supplier assets is the natural logarithm of supplier total assets. Supplier free cash flow ≤ 0 is a dummy variable that takes a value of 1 if a supplier's free cash flow is less than or equal to 0. Supplier free cash flow is a firm's income before extraordinary items plus depreciation and amortization less capital expenditures. Supplier return volatility is the standard deviation of daily returns for suppliers in the first fiscal year we identify the relationship. R&D intensity and return volatility are winsorized at the 1% and 99% levels. Supplier leverage is total debt (short-term plus long-term) divided by total debt plus market equity. Supplier cash dividend is a dummy variable that takes a value of 1 if the firm paid a cash dividend in the first year of the relationship and 0 otherwise. The year variable is set equal to the first sample year in which we observe a relationship minus 1988. *** denotes significance at the 0.01 level.

	(1)	(2)	(3)	(4)	(5)
Supplier R&D intensity	2.59***	1.63***	2.67***	2.43***	1.96***
	(0.33)	(0.38)	(0.42)	(0.43)	(0.46)
Supplier sales dependence	2.40***	1.98***	2.00***	1.86***	1.81***
	(0.22)	(0.24)	(0.25)	(0.25)	(0.26)
Alliance		1.77***	1.54***	1.51***	1.39***
		(0.15)	(0.16)	(0.16)	(0.17)
Supplier age			−0.08***	−0.08***	−0.08***
			(0.01)	(0.01)	(0.01)
Log supplier assets			0.30***	0.31***	0.34***
			(0.04)	(0.04)	(0.05)
Supplier free cash flow ≤ 0				0.48***	0.62***
				(0.14)	(0.15)
Supplier return volatility					−0.63
					(3.57)
Supplier leverage					−1.58***
					(0.42)
Supplier cash dividend					0.11
					(0.19)
Year	−0.05***	−0.06***	−0.09***	−0.09***	−0.11***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Constant	−3.78***	−3.76***	−4.47***	−4.72***	−4.54***
	(0.12)	(0.12)	(0.22)	(0.24)	(0.31)
Number of observations	8,337	8,337	8,337	8,182	7,484
Log likelihood	−1,240.48	−1,181.65	−1,125.96	−1,100.05	−1,000.07
Pseudo R^2	7.71%	12.09%	16.23%	16.58%	16.97%

Turning to financial market frictions possibilities, we include in column 4 a dummy variable that assumes a value of 1 when a firm has cash flows that are insufficient to cover its capital expenditures (negative free cash flow). These are firms that are likely to need external funding and may turn to their partners for financing if other sources of capital are relatively expensive. The estimated coefficient on this variable in column 4 is positive and significant, lending support to the financial frictions motivation for the presence of partial equity stakes.

To investigate the role of other variables that may represent capital market frictions, we include variables related to the supplier's stock return volatility (a proxy for asymmetric information), the supplier's leverage ratio (a proxy for financial constraints), and a dummy variable indicating whether the supplier pays dividends (indicating a lack of financial constraints). The estimates on the volatility measure and the dividend measure are small and insignificant, while the estimate on the leverage ratio is significant and negative, opposite of the expected sign. We hesitate to infer much from the leverage coefficient, because leverage is endogenous and borrowing may serve as a substitute for customer equity financing. Clearly, these additional variables add no additional support for the financial frictions hypothesis.

To summarize the evidence, it appears that the existence of a financial deficit is related to partner financing. However, further distinctions based on the severity of financial constraints or information problems cannot be easily detected. We interpret this evidence as broadly consistent with the financial frictions hypothesis, with the caveat that the types of frictions and the mechanism by which they lead to partner financing are quite murky.

To gauge the economic magnitude of the estimates, we select the model in column 4 of Table III and calculate the estimated effect of changing the explanatory variables on the implied probability of observing an equity stake. We vary the explanatory variables, one at a time, from the 10th percentile level to the 90th percentile level for scalar variables, and from 0 to 1 for dummy variables. All other variables are held constant at their sample mean. For the R&D variable, the estimated likelihood of observing an equity stake increases from 1.8% to 2.9%. The corresponding figures for the sales dependence variable are 1.6% and 3.0%. Relationships without alliances have a 1.9% estimated likelihood of observing an equity stake, increasing to 8.2% when an alliance is present. These figures indicate that the likelihood of observing an equity stake seems to rise sharply as our measures of contracting frictions increase.

The other estimates in specification 4 of Table III also seem to have reasonably large economic magnitudes. As firm age moves from the 10th percentile to the 90th percentile, the estimated probability of observing an equity stake declines sharply from 3.9% to 0.6%. When we turn to firm size, the figures are 1.1% and 4.6%, respectively. Finally, when suppliers move from positive free cash flow to negative free cash flow status, the estimated likelihood of observing an equity stake jumps from 1.6% up to 2.6%. This increase suggests that financial constraints play an economically significant role in the decision to obtain partner financing.

B. Robustness and Extensions

The results above support both the contracting and financial frictions motivations for the use of partial equity ownership stakes in product market relationships. In this subsection, we experiment with some alternative empirical specifications in order to assess the robustness of these findings and to further add to our understanding of the partial equity stake phenomenon. In our subsequent analysis, we refer to specification 4 of Table III as our baseline model.

One concern with the findings above is that they may be driven by a particular industry. For example, much of the related empirical literature focuses on the pharmaceutical sector, and it is possible that our findings are driven by that industry. To investigate, we experiment with (1) dropping all pharmaceutical firms, and (2) including industry dummy variables (using Fama and French (1997) industry definitions). These alterations to our baseline model have no effect on the signs or significance levels of any of the explanatory variables included in Table III.

While our analysis above assumes that the explanatory variables have a causal effect on the likelihood of an equity stake, it is possible that reverse causality is present. In particular, an equity tie may lead to a higher degree of sales dependence, rather than the other way around. In some sense this is not a concern, since an equity tie leading to more sales would also suggest that equity plays a role in easing contractual frictions. To investigate the direction of causality, in unreported results, we estimate the baseline specification on the subsample of cases for which the ownership position did not exist at the start of the observed trading relationship. This model uses relationship characteristics measured prior to the establishment of any ownership position to predict the subsequent establishment of an equity stake. When we estimate this model, the coefficients on the contracting variables remain significant. This provides evidence that elevated contractual frictions lead to the formation of equity stakes rather than the other way around.

In some cases, we first observe a relationship when the supplier initially appears on Compustat. In these relationships, the parties are likely to have had a significant level of trade before the supplier's IPO, and one may suspect that equity ties are more common in these cases. To investigate, we create an IPO dummy variable indicating whether a relationship exists in the first year a supplier has a stock price listed on Compustat. When we add this variable to our baseline model, the estimate is positive and significant, while the other estimates are qualitatively unchanged. This suggests that partner financing is particularly likely when a supplier does not have access to public equity markets. Since financial constraints are likely to be elevated for these firms, this can be interpreted as providing additional support for the financial frictions hypothesis.

As an extension to our preceding analysis, we consider the role of customer characteristics on equity ties. Our approach is to replace the age, size, R&D, and free cash flow variables in our baseline specification with the corresponding variables based on customer characteristics. Buyers are too large relative to

suppliers to include in these models a measure of the buyer's dependence on the seller. The estimated coefficients (not reported) from this model for the customer's age and size variables are small and insignificant. The coefficient on the customer's R&D intensity is positive and significant at the 5% level, lending additional support to the hypothesis that R&D-focused relationships are more frequently accompanied by equity ownership. Finally, the coefficient on a dummy variable indicating whether the customer has negative free cash flow is negative and significant at the 10% level (p-value = 0.073). This provides some suggestive evidence that deep pockets are necessary for informed sources of capital to be the optimal financiers of financially constrained partners.

While we assume that the variables related to R&D intensity, sales dependence, and alliances are indicators of contractual frictions, it is possible that these variables are also related to financing frictions. For example, information flows may be greater when the buyer and supplier have a close relationship, in which case asymmetric information considerations may dictate that the buyer will be the optimal financier for the supplier. To check our contracting interpretation, we run our baseline logit model predicting equity stakes on subsamples in which (1) the supplier has positive free cash flow, and (2) the supplier has free cash flow greater than 5% of book assets. The negative cash flow dummy variable is necessarily excluded in these models. In these subsamples, we expect financial frictions to be relatively unimportant, as the supplier has a diminished need for external capital. The coefficients on the contracting friction variables in these models have the same signs and significance levels as those we report in Table III (estimates not reported). This increases our confidence that contracting frictions are an important factor in the creation of partial equity stakes.

C. Sample Selection and Vertical Integration

Our preceding analysis examines the decision to establish a partial equity stake conditional on the decision not to fully vertically integrate. This conditioning generates sample selection issues that should be considered in interpreting the results.[15] One interpretation of our findings is that they provide evidence on the role of equity in easing contractual and financing frictions in situations in which vertical integration is not an optimal organizational form, say because of the preference of the supplier to remain independent. In these settings, our evidence suggests that contracting and financing frictions remain present, and equity serves a role in easing these frictions. One can view the conditional analysis as informative and interesting in its own right, as it tells us about easing frictions when vertical integration is not an appropriate choice.

[15] This conditioning may lead us to understate our prior results. If partial equity ownership and vertical integration are chosen for similar reasons, regression equations describing the desirability of each of these choices relative to no ownership should have correlated error terms and variable coefficients of the same signs. In models predicting equity stakes within a sample of nonintegrators, a Heckman-type argument would then suggest a negative correlation between the error term and variables that lead to partial stakes, biasing the estimated coefficients toward 0.

Ideally, we would like to have information on whether trading relationships are organized with no ownership, partial ownership, or full vertical integration.[16] We could then estimate multinomial models of the choice of organizational form to present a richer picture of partial equity ownership relative to other alternatives. While a full-scale analysis of this type is not feasible, it is possible for a smaller sample. In particular, we can exploit the fact that, starting in 1999, segments of firms listed on Compustat report their level of sales to other segments in the firm.

Using this segment data, we are able to identify 374 segments that sell at least 10% of their output to other segments of the same firm. We treat these relationships as cases of full vertical integration, and append them to the rest of our sample. Restricting attention to the 1999 to 2001 period, we estimate a multinomial logit model predicting how a relationship is organized when there are three possibilities, namely, no ownership, partial equity, or full integration. For the full integration observations, we measure the age and R&D variables at the firm level, while the size, sales dependence, and free cash flow variables are constructed using data from the segment supplying the rest of the firm. We eliminate the alliance variable, as no such variable is available for the integrated relationships.

We report results for this multinomial logit estimation in columns 1 and 2 of Table IV. The estimated coefficients for the equation explaining the choice of partial equity versus no ownership, reported in column 1, are very similar in character to our earlier findings.[17] In particular, we find that partial equity is significantly more likely than no ownership in relationships characterized by high R&D intensity, a high level of sales dependence, and negative supplier free cash flow. This provides fairly convincing evidence that our earlier findings are robust to including vertical integration as an additional organizational form choice.

The estimated coefficients for the equation predicting vertical integration versus no ownership, reported in column 2, are also informative. The coefficient on sales dependence is positive, large in magnitude, and highly significant. Consistent with many theories of vertical integration, this finding suggests that when one firm is very dependent on another, the likelihood of full integration versus complete independence increases sharply. This evidence, combined with our earlier findings, suggests that as trading partners become more dependent, some type of equity tie, either partial ownership or full integration, is often desired.

Interestingly, the coefficient on the R&D variable in the model explaining vertical integration versus no ownership (column 2 of Table IV) is actually negative and significant. Thus, while R&D-oriented relationships appear relatively

[16] For an analysis of partial versus full ownership in an international context, see Desai, Foley, and Hines (2004).

[17] The multinomial logit model is restrictive in that it assumes that choices obey the independence of irrelevant alternatives (IIA) assumption. Using a test proposed by Hausman and McFadden (1984) and outlined by Greene (1993), we find no evidence suggesting that the IIA assumption is violated in our sample.

Table IV

Models of Vertical Integration, Alliances, and Equity Stakes in Relationships

Asymptotic standard errors are reported under the coefficient estimates. The estimates in columns 1 and 2 are from a multinomial logit model in which each relationship is treated as a single observation and the sample period is from 1999 to 2001. In this model, we include all nonintegrated relationships in which a supplier sells at least 10% of their output to the customer. We also include all integrated relationships in which we can identify that one segment of the firm sells more than 10% of their output to the rest of the firm. The estimates in column 1 are for the relative likelihood of observing partial equity ownership versus no disclosed ownership. The estimates in column 2 are for the relative likelihood of observing full integration versus no disclosed ownership. In these columns, all explanatory variables for the nonintegrated relationships are defined as in Table III, but are measured as of the first time during the 1999 to 2001 period that we observe the relationship. The explanatory variables for the integrated relationships are defined in the text. The estimates in column 3 are for a logit model in which the dependent variable (alliance) assumes a value of 1 if the firms in a relationship had a formal alliance agreement in place as of the first year during the sample period that we detect their trading relationship, and 0 otherwise. The column 3 estimates are derived over the sample of all nonintegrated relationships from 1988 to 2001, with each relationship treated as a single observation. The estimates in columns 4 and 5 are for a logit model in which the dependent variable assumes a value of 1 if the customer takes an equity stake in the supplier at some point during the relationship, and 0 otherwise. Each relationship is treated as a single observation. The estimates in column 4 (column 5) are derived over the sample of all relationships from 1988 to 2001 that were not (were) formalized by an alliance agreement. All explanatory variables in columns 3–5 are defined as in Table III. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Dependent Variable	(1) Partial Equity Stake	(2) Full Integration	(3) Alliance	(4) Partial Equity Stake	(5) Partial Equity Stake
Supplier R&D intensity	2.49***	−13.21***	5.13***	3.22***	0.13
	(0.73)	(2.32)	(0.32)	(0.50)	(0.77)
Supplier sales dependence	2.30***	4.64***	1.90***	2.18***	1.52***
	(0.48)	(0.37)	(0.21)	(0.31)	(0.40)
Supplier age	−0.06***	0.04***	−0.03***	−0.09***	−0.04*
	(0.02)	(0.01)	(0.01)	(0.01)	(0.03)
Log supplier assets	0.19***	0.13***	0.34***	0.39***	−0.02
	(0.07)	(0.04)	(0.03)	(0.04)	(0.09)
Supplier free cash flow ≤ 0	1.17***	−0.28	0.47***	0.45***	0.51
	(0.32)	(0.18)	(0.12)	(0.16)	(0.32)
Year	−0.33**	−0.32**	0.01	−0.10***	−0.11***
	(0.17)	(0.13)	(0.01)	(0.02)	(0.04)
Constant	−1.63	−0.88	−5.51***	−5.16***	−1.21
	(1.95)	(1.49)	(0.21)	(0.27)	(0.58)
Estimation method	Multinomial logit	Multinomial logit	Logit	Logit	Logit
Which relationships	All: 1999–2001	All: 1999–2001	All: 1988–2001	No alliance	Alliance
Number of observations	2,396	2,396	8,182	7,716	466
Log likelihood	−816.41	−816.41	−1,522.91	−873.49	−214.59
Pseudo R^2	21.24%	21.24%	14.82%	10.70%	9.46%

more likely to be characterized by partial equity positions, they also appear to be relatively less likely to be characterized by full integration. This suggests that in these relationships where cooperation and sharing are likely to be important and where incentives must be delicately managed, a relatively balanced power structure is often optimal (i.e., some ownership, but not complete integration). A more thorough analysis of this interesting possibility awaits richer and more complete data on vertically integrated relationships.

As a final check of how vertical integration possibilities may affect our results, we examine a subsample of relationships for which we believe vertical integration is not likely to be feasible, and therefore issues of conditioning on nonintegration are unlikely to be important. In particular, we select observations in which suppliers have another customer who purchases more from the supplier than the customer under consideration during the observation year. It would appear very unlikely in these cases that the supplier and smaller customer would be candidates for full integration. We then estimate the baseline logit model predicting partial equity versus no ownership on this subsample, using relationship-years rather than relationships as the unit of observation.

While the subsample here is much smaller than our original sample, the estimates (not reported) are largely consistent with our earlier findings. In particular, the coefficients on the R&D intensity variable and alliance variable remain positive and highly significant. The coefficient on the sales dependence variable remains positive and falls slightly in significance to the 6% level ($t = 1.93$), while the coefficient on the negative cash flow variable becomes insignificant ($t = 1.34$). These findings again suggest that our interpretations of the earlier findings are robust to concerns about sample selection arising from the vertical integration choice.

D. Multiple Relationships

As we report in Table I, many suppliers have relationships with multiple large customers. The presence of other partners may change the bargaining dynamics in any given relationship, which in turn may change the need for equity ownership.[18] For example, a supplier with multiple relationships may be less dependent on any single customer, and thus an equity tie may be less important. To investigate, we experiment with including in our baseline logit model of equity stakes (specification 4, Table III) a dummy variable indicating whether a supplier is involved in more than one relationship during the observation year. Given the time-varying nature of this variable, all regressions concerning multiple relationships are run at the relationship-year level rather than the relationship level.

When we estimate this logit model, the coefficient on the multiple-relationship variable is negative and significant at the 1% level (estimates not

[18] It may also be that the potential for other trading opportunities affects the likelihood of observing an equity tie. However, when we add to the baseline model sales-based Herfindahl indices measuring concentration in the customer's and supplier's four-digit industries, the coefficients on these indices are small and insignificant.

reported). The coefficient implies that the probability of a customer holding a stake in the supplier drops from 2.55% to 1.56% as the supplier moves from single to multiple relationships, holding all other variables at the mean. This effect of multiple relationships on equity stakes could reflect a variety of phenomena. For example, once a single customer has taken an equity stake, the other customers may free-ride off of this customer's financing or monitoring capabilities. Alternatively, when there are multiple customers, there may be strategic interactions among customers, which result in an outcome whereby either all customers have equity stakes or else none do.

To examine these possibilities, we estimate our baseline logit model restricted to cases in which suppliers are in multiple relationships. We include in this model a dummy variable indicating whether or not any other customer has an equity stake. The coefficient (estimates not reported) on this variable is positive and significant (1% level), implying that the likelihood of taking an equity stake increases from 1.10% to 8.12% when another customer holds equity. This suggests that customers do pay close strategic attention to other customers' equity purchase decisions. Alternatively, we may be picking up unobserved supplier-specific characteristics. Either of these possibilities is consistent with a generalized version of our contracting hypothesis. In any event, the data here do not support a simple free-riding story with regard to multiple relationships.

The presence of multiple relationships also provides us an opportunity to revisit our earlier tests. In particular, it allows us to hold supplier characteristics constant and then to predict which of the supplier's multiple partners takes equity. To conduct this analysis, we use Chamberlain's (1980) fixed effects logit approach. Specifically, we restrict attention to cases in which the supplier has multiple relationships, at least one customer has a stake, and at least one does not; and then we estimate models predicting which customer has the ownership position (estimates not reported). We include in these models the year the relationship started, the sales dependence of the supplier on the customer, and a dummy variable for formal alliances. We then add the following customer characteristics: R&D intensity, age, size (log assets), and a negative free cash flow dummy variable. The coefficients on supplier sales dependence, customer R&D intensity, and the alliance variable are all positive and significant (at the 1%, 5%, and 10% levels, respectively). The customer cash flow dummy variable, while negative, is insignificant. These estimates appear broadly consistent with our earlier findings.

E. Equity Stakes and Formal Alliances

As we report above, the correlation between alliances and equity stakes is particularly strong. Despite this relation, it is worth noting that most equity stakes are made without an alliance agreement and most alliance agreements do not include equity stakes. Since alliances themselves can be viewed as a form of relationship governance, it is informative to further investigate the link between these two governance devices.

To understand the factors motivating alliances, we estimate a logit model predicting alliances as a function of the same explanatory variables used above

in our analysis of equity stakes. As we report in column 3 of Table IV, many of the factors that increase the likelihood of observing an equity tie also increase the likelihood of an alliance. In particular, the estimated coefficients on R&D intensity, sales dependence, and the negative cash flow dummy variable are all positive and highly significant.[19] This suggests that alliances and partial equity stakes are both chosen to solve similar types of contracting and financing problems.

In Table IV, column 4, we return to predicting equity stakes, but we restrict our attention to relationships that are not formalized by an alliance. The results here are informative. The coefficients in column 4 are similar to our earlier Table III estimates for the entire sample. In particular, in the absence of alliances, there is a strong relation between equity stakes and R&D intensity, sales dependence, and the negative cash flow dummy. This confirms that our earlier results on equity stakes hold independent of the alliance effect.

In column 5, we turn to predicting equity stakes in relationships with alliances. This subsample should be more similar to prior studies that choose their samples based on the existence of an alliance agreement. Similar to our earlier findings, the coefficient estimate on the sales dependence variable in this model is positive and highly significant. However, the estimated coefficients on R&D intensity and the cash flow variable in this model are insignificant. This is perhaps not too surprising, as the sample of alliances is small and there is little variation in these variables once we restrict our attention to alliances.

Taken as a whole, our evidence suggests that alliances and equity stakes both play a role in solving underlying relationship conflicts. These two devices often appear together, but there is clearly an independent dimension to each. Even without the presence of an alliance, the variation in equity stakes appears highly consistent with the notion that these positions help alleviate underlying contractual and financing difficulties.

F. The Size of Equity Stakes

We now turn to examining the size of observed equity blocks. As we discuss above, the relationship between contracting problems and the size of equity blocks is less clear. In particular, in delicate contracting environments, there may be a dark side to high levels of equity ownership that arise from fears of excessive control or diluted incentives. Evidence in support of this notion has been found in some other contexts (e.g., Fee (2002)).

To investigate, we first divide the sample into three groups, namely, the no ownership group (no disclosed block), the moderate ownership group (a disclosed block with ownership $\leq$25%), and the high ownership group (ownership $>$25%).[20] Summary statistics for each group are reported in Panel A of Table V.

[19] These results complement the evidence of Chan et al. (1997), who find that the market reaction to alliance announcements is particularly positive for R&D/technology-related alliances.

[20] Our choice of 25% to define high ownership is somewhat arbitrary, but follows the convention first developed by Morck, Shleifer, and Vishny (1988). Control issues are likely to become important around this ownership level.

Table V

Summary Statistics on Firm and Relationship Characteristics and the Size of Equity Stakes

The size of an equity stake is the percentage of the supplier's equity held by the customer in the first year over the sample period 1988 to 2001 in which the firms have an observed trading relationship and the customer is revealed to be a 5% blockholder. We exclude from this table a small number (14) of relationships in which the size of a customer's equity stake is missing. In this table, all relationships in which the customer is never listed as a blockholder are assumed to have zero ownership. In Panel A, we assign each customer–supplier relationship to one of the three columns based on the size of the equity stake held by the customer in the supplier and report the mean of each indicated variable for the firms in the assigned column. The asterisks in Panel A indicate significant differences between firms in the indicated column and the relationships in the no equity column using a *t*-test. In Panel B, we report the mean level of ownership (in percent) for subsamples created based on the criteria listed in each row. The relationships with equity column considers only those sample relationships in which the customer has an equity stake in the supplier. The all relationships column considers all sample relationships. The asterisks in Panel B indicate significant differences between the respective subsamples (i.e., no alliance vs. alliance) as assessed using a *t*-test. Supplier R&D intensity is a firm's annual R&D expenditures divided by total assets. Missing values for R&D are treated as 0 and the R&D intensity variable is winsorized. Supplier sales dependence is the percentage of supplier sales that are made to the customer. Alliance is a dummy variable that takes a value of 1 if the firms in a relationship had a formal alliance agreement in place as of the first year during the sample period that we detect their trading relationship and 0 otherwise. Supplier age is the number of years since the firm first has book assets reported by Compustat. Supplier assets are in millions of 2001 dollars. Supplier free cash flow ≤ 0 is a dummy variable that takes a value of 1 if a supplier's free cash flow is less than or equal to 0. Supplier free cash flow is a firm's income before extraordinary items plus depreciation and amortization less capital expenditures. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Panel A: Mean Firm and Relationship Characteristics by the Size of Equity Stakes

	No Equity Stake	5% ≤ Equity Stake < 25%	25% ≤ Equity Stake
Supplier R&D intensity	0.0705	0.1812***	0.0779
Supplier sales dependence	0.1867	0.3752***	0.2201*
Alliance	0.0425	0.3697***	0.0814*
Supplier age	8.86	4.03***	5.94***
Supplier assets	619.89	229.21*	2,848.19***
Supplier free cash flow ≤ 0	0.5191	0.7830***	0.4940
Number of observations	9,873	238	86

Panel B: Mean Size of Equity Stake by Other Sample Characteristics

	Relationships with Equity	All Relationships
Supplier R&D intensity ≤ median	36.52%	0.57%
Supplier R&D intensity > median	17.29%***	0.83%**
Supplier sales dependence ≤ median	29.22%	0.71%
Supplier sales dependence > median	18.69%***	0.91%
No alliance	25.90%	0.61%
Alliance	12.72%***	2.35%***
Supplier age ≤ median	20.52%	0.94%
Supplier age > median	25.58%*	0.47%***
Supplier assets ≤ median	19.28%	0.60%
Supplier assets > median	24.66%**	0.80%*
Supplier free cash flow ≤ 0	17.49%	0.75%
Supplier free cash flow > 0	32.44%***	0.64%

The differences between the no ownership group and the moderate ownership group are similar to our earlier comparisons between relationships with and without equity ties. In particular, the moderate ownership group has significantly higher average values for the variables measuring R&D intensity, sales dependence, alliances, and financing needs. In contrast, the high ownership group is more similar to the no ownership group than the moderate ownership group along these dimensions.

To explore further, we present in Panel B, figures on the average size of ownership positions grouped by firm and relationship characteristics. The figures in the first column are calculated over the set of relationships with a disclosed equity block. These figures indicate that R&D intensity, sales dependence, alliances, and external financial needs are negatively related to the size of ownership stakes conditional on observing a stake. However, if we look at all relationships, most of which have no disclosed equity block, the figures in the second column suggest that these variables are positively related to ownership levels. The natural explanation for these findings is that these variables are positively related to the presence of a stake, as we document above, but negatively related to the size of a stake, conditional on observing a stake. In the overall sample, the first effect appears to dominate the second.

This univariate evidence indicates that the mechanism governing the presence of an equity stake is quite different from that which governs the size of observed stakes. If this were the case, a Tobit model of equity stakes would be inappropriate. Using the test outlined by Greene (1993, p. 701), we are able to formally examine whether the Tobit model should be rejected in favor of separate models of the presence of a stake and the size of a stake conditional on observing one. Using the explanatory variables from our baseline logit model above (column 4 of Table III), this test provides strong evidence in favor of rejecting the Tobit model ($\chi^2 = 188.6$), indicating that the mechanisms governing the presence and size of stakes are quite different.

To explore the size of equity stakes in a multivariate context, we report in column 1 of Table VI, estimates from an ordinary least squares regression where the dependent variable is the size of the equity stake. With the exception of the size and year variables, all of the explanatory variables have opposite signs to those we observe in our earlier logit models predicting the presence of a stake, and in some cases the coefficients are significant.[21] Thus, conditional on the existence of an equity tie, the mechanism governing the size of the stake is in many ways opposite of that which governs the stake's presence.

To tie these results together in a simple unconditional model, we estimate a multinomial logit model predicting which of the three ownership groups (no, moderate, and high) a relationship will fall into. The estimates in column 2 of Table VI, indicate that the factors determining the relative likelihood of observing moderate ownership rather than no ownership are similar to those

[21] Similar results obtain if we use a log transformation of ownership as the dependent variable. As Wooldridge (2002, p. 536) discusses, using logs of the dependent variable is common in these types of empirical models.

Table VI

Estimated Models of Equity Stake Size

The dependent variable in column 1 is the size of the customer's equity stake in its supplier. The size of an equity stake is the percentage of the supplier's equity held by the customer in the first year during the sample period when the firms have an observed trading relationship and the customer is revealed to be a blockholder. All relationships in which the customer is never listed as a blockholder are assumed to have no ownership. The regression in column 1 is an ordinary least squares regression (with heteroskedasticity-consistent standard errors) estimated over the set of all relationships in which we observe the presence and size of the customer's equity stake. Columns 2 and 3 report multinomial logit estimates derived from the sample of all relationships. In these specifications, we group relationships into three categories based on whether the customer's stake is above 25% (the high ownership group), between 5% and 25% (the moderate ownership group), or below 5% (the no disclosed ownership group). Estimates reported for column 2 (3) are for the relative likelihood of observing moderate ownership versus no (high) ownership. Asymptotic standard errors are reported in parentheses. Supplier R&D intensity is a firm's annual R&D expenditures divided by total assets. Missing values for R&D are treated as 0 and R&D intensity is winsorized. Supplier sales dependence is the percentage of supplier sales that are made to the customer. Alliance is a dummy variable that takes a value of 1 if the firms in a relationship had a formal alliance agreement in place as of the first year during the sample period that we detect their trading relationship and 0 otherwise. Supplier age is the number of years since the firm first has book assets reported by Compustat. Log supplier assets is the natural logarithm of supplier total assets. Supplier free cash flow ≤ 0 is a dummy variable that takes a value of 1 if a supplier's free cash flow is less than or equal to 0. Supplier free cash flow is a firm's income before extraordinary items plus depreciation and amortization less capital expenditures. The year variable is set equal to the first sample year in which we observe a relationship minus 1988. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Model	(1) Ordinary Least Squares Regression of Equity Stake Size	(2) Multinomial Logit: Moderate Ownership versus No Ownership	(3) Multinomial Logit: Moderate Ownership versus High Ownership
Supplier R&D intensity	−7.16	2.54***	1.12
	(6.88)	(0.49)	(1.14)
Supplier sales dependence	−7.82**	2.06***	1.19*
	(3.79)	(0.28)	(0.66)
Alliance	−7.46***	1.71***	1.27***
	(2.10)	(0.17)	(0.45)
Supplier age	0.08	−0.10***	−0.03
	(0.22)	(0.02)	(0.02)
Log supplier assets	2.15**	0.30***	−0.09
	(1.03)	(0.05)	(0.08)
Supplier free cash flow ≤ 0	−9.63***	0.82***	0.94***
	(3.18)	(0.18)	(0.29)
Year	−0.30	−0.09***	−0.01
	(0.31)	(0.02)	(0.03)
Constant	26.61***	−5.36***	0.31
	(5.47)	(0.30)	(0.51)
Number of observations	299	8,171	8,171
Log likelihood		−1,216.53	−1,216.53
Pseudo R^2	19.88%	16.40%	16.40%

we find above when predicting the presence of an equity stake. This indicates that our contracting and financial frictions variables are significantly related to the decision to take on a moderate equity stake. The estimates in column 3 of Table V, which indicate the relative likelihood of observing moderate rather than high ownership, have a different character. The estimated coefficients on R&D intensity, sales dependence, alliance, and negative cash flow variables are all positive, and the latter three significantly so (at the 10%, 1%, and 1% levels, respectively). This indicates that when contracting and financing frictions are elevated, it is more likely that we will observe moderate ownership rather than high ownership.

Taken as a whole, our evidence on the size of ownership stakes presents a picture whereby factors that we associate with high levels of contractual difficulties and financial frictions lead to relationships in which a customer takes a moderate stake in its supplier. The presence of high ownership in relationships appears to be much less driven by these factors, if at all.[22] This evidence is consistent with moderate ownership stakes being chosen in order to delicately balance incentives between trading parties and to provide funding to financially constrained suppliers without ceding control.

IV. Equity Ownership and the Dynamics of Relationships

A. Equity Ownership and the Duration of Trading Relationships

Our preceding results suggest that partial equity ownership is chosen in anticipation of its effect on the subsequent evolution of a product market relationship. To complement this analysis, it would be informative to determine whether any of these effects can be detected. This is difficult, however, as equity ownership is likely to affect variables that are inherently hard to observe (pricing, relationship-specific investments, information sharing, etc.). As a more modest goal, we consider whether partial equity ownership is related to relationship durability. If ownership has the effect of easing contractual frictions and encouraging cooperation, we expect that relationships with partial ownership, all else equal, would last longer on an average.

Our empirical approach is to use duration analysis techniques to estimate a hazard function describing the length of a typical relationship (see Kiefer (1988)). The estimation procedure adjusts for censoring in the data. We define the start year (end year) of each relationship to be the first year (last year) the two firms are linked together in the Compustat files.[23] In cases in which we can confirm that both firms are still listed on Compustat immediately after the end year, we assume that the relationship's completed length is equal to

[22] If we estimate the multinomial logit equation predicting high ownership versus no ownership, the coefficients on the contracting and financial frictions variables are all insignificant.

[23] Since our sample period starts in 1988, relationships in existence as of 1988 will be biased toward longer length relationships. We adjust for this delayed entry by using observations that enter the sample with a tenure of n, only to make inferences about the hazard function in the region pertaining to a tenure of n or more.

end year minus start year. In the remaining cases, we lose the ability to detect a relationship's status after some year because one of the two firms disappears from Compustat. In such instances, we record the relationship's censored length as end year minus start year. In these cases, we know that the relationship lasted at least as long as the censored length.

In columns 1–4 of Table VII, we present estimates from proportional hazard-type models. These models jointly estimate an underlying hazard function and the role of selected explanatory variables in proportionally shifting the hazard function. A coefficient above 1 (below 1) implies that the indicated variable shifts the hazard function upward (downward), thus indicating that the variable decreases (increases) average relationship length. In column 1, we present estimates from the Cox proportional hazard model, with ownership as the only explanatory variable. This model places no parametric structure on the hazard function, but it allows the explanatory variables to shift the function up or down in a parametric way. The estimated coefficient on the ownership dummy variable in this model is significantly less than 1 at the 1% level. This provides strong initial evidence that relationships accompanied by equity ownership tend to have lower hazard functions and longer average durations.

In column 2 of Table VII, we estimate the same model, but add our usual set of explanatory variables. We also add a quadratic term for sales dependence, since the requirement that firms report customers that are responsible for 10% or more of sales is likely to generate some nonlinearities with respect to this variable.[24] The estimated coefficient on ownership in this model remains significantly below 1 at the 5% level, again indicating that ownership is associated with more durable relationships. Many of the other explanatory variables are also significantly different from 1, suggesting that there is substantial systematic variation in relationship lengths.

To confirm these results in a parametric framework, we also estimate models that assume the hazard function follows the (fairly flexible) Weibull distribution. These results, which we report in columns 3 and 4 of Table VII, are even stronger than our prior results based on the Cox model. The coefficient on ownership in both specifications is significantly below 1 at the 1% level, further suggesting that relationships with equity ties have longer average durations.

Finally, we report in columns 5 and 6 of Table VII, results from a logit model predicting whether a relationship breaks up in a given year as a function of whether the firms had an equity tie at some point in the past. We include in these models the tenure of the relationship as of the start of the year, as relationships with longer past tenures may be more durable in the future. All other explanatory variables are measured as of the start of the year. In both columns, the coefficient on the ownership variable is negative and highly significant. This indicates that equity ties are associated with a significantly smaller

[24] Some relationships that we assume have ended are likely to be situations in which sales fall below the 10% reporting threshold. Our duration results should still be informative, as the length of an intense trading partnership is an important quantity in its own right, and is likely highly correlated with the length of time the parties trade.

Table VII

Estimated Models of Relationship Duration

The sample period is from 1988 to 2001. The specifications in columns 1–4 treat each relationship as a single observation and estimate models of the hazard function describing relationship lengths. The dependent variable in columns 1–4 is the length of the observed customer–supplier relationship in years. We assume that a relationship starts in the first year the customer–supplier relationship is observed in the Compustat industry segment file (1978 to 2001). Relationships first observed in 1978 are excluded from this analysis since the actual starting year for the relationship cannot be observed. If a relationship ends because one of the firms becomes inactive in Compustat or if a relationship lasts up to the last year of the sample period, we treat the length of that relationship as right censored. We use data on all relationships in existence from 1988 to 2001, and our estimation adjusts for the fact that some relationships enter the sample with positive tenure (i.e., we adjust for delayed entry for observations existing at the start of the sample period). The estimates in columns 1 and 2 are from a Cox proportional hazards model with robust standard errors reported in parentheses. The estimates in columns 3 and 4 are from a Weibull distribution model with robust standard errors in parentheses. In columns 1–4, the equity stake variable assumes a value of 1 if the customer takes an equity stake in the supplier at some point during the relationship and 0 otherwise. For relationships with equity stakes, we only make inferences on the hazard function using the period after the formation of the stake. All other independent variables in columns 1–4 are coded based on firm or relationship characteristics in the first year that we observe the relationship during the sample period. In columns 5 and 6, we treat each relationship-year as the unit of observation and estimate a logit model predicting whether the relationship ends in the subsequent year. Asymptotic standard errors are reported in parentheses. In these columns, the dependent variable is set equal to missing if either of the firms in a customer–supplier pair disappears from the Compustat universe. In columns 5 and 6, the equity stake dummy takes a value of 1 only when the relationship has been characterized by equity at some point in the past and the alliance variable is defined as of the relationship's first appearance during the sample period. All other explanatory variables in columns 5 and 6 are measured as of the start of the observation year. The tenure of a relationship is the number of years the relationship had been in existence as of the start of the observation year. All other variables are defined in the earlier tables. Significance levels in columns 1–4 (5–6) refer to differences between the estimated coefficient and 1 (0). *** and ** denote significance at the 0.01 and 0.05 levels, respectively.

Regression	(1) Cox	(2) Cox	(3) Weibull	(4) Weibull	(5) Logit	(6) Logit
Equity stake	0.85***	0.86**	0.79***	0.80***	−0.34***	−0.34***
	(0.05)	(0.06)	(0.06)	(0.06)	(0.08)	(0.10)
Supplier R&D intensity		1.59***		1.89***		0.90***
		(0.16)		(0.25)		(0.16)
Supplier sales dependence		0.04***		0.02***		−8.49***
		(0.007)		(0.004)		(0.31)
(Supplier sales dependence)^2		16.86***		32.84***		7.26***
		(4.00)		(10.11)		(0.35)
Alliance		1.04		1.04		−0.01
		(0.05)		(0.07)		(0.08)
Supplier age		0.99***		0.99***		−0.005**
		(0.001)		(0.002)		(0.002)
Log supplier assets		0.90***		0.87***		−0.20***
		(0.007)		(0.009)		(0.01)
Supplier free cash flow ≤ 0		1.17***		1.26***		0.36***
		(0.03)		(0.04)		(0.04)

(*continued*)

Table VII—*Continued*

Regression	(1) Cox	(2) Cox	(3) Weibull	(4) Weibull	(5) Logit	(6) Logit
Tenure of relationship						−0.05***
						(0.01)
Year		0.99**		1.06***		0.07***
		(0.004)		(0.004)		(0.01)
Constant					−0.90***	−144.81***
					(0.02)	(10.26)
Number of observations	10,062	8,056	10,062	8,056	22,406	18,596
Pseudo R^2					0.07%	9.19%
Log likelihood	−52,776.37	−3,9574.27	−11,092.62	−8,335.20	−13,398.85	−9,775.10

likelihood of a relationship breakup in any given year. Holding all control variables at their sample means, the estimates in column 6 imply that the annual probability of a breakup for a relationship without equity is 24.11%, falling to 18.41% when there has been an equity tie.

Taken as whole, the evidence here appears fairly convincing that the presence of equity ownership is associated with longer lived relationships. A natural interpretation of this finding is that an ownership tie helps ease contracting frictions and disagreements, thus nurturing the relationship and allowing it to last for a longer period of time. If one wants to be more cautious with regard to causality, at the very least we can view this as another piece of evidence indicating that ownership is elevated when contracting frictions are magnified (i.e., in more permanent relationships).

B. Equity Ownership and Mergers

An alternative way for an independent trading relationship to end is for the trading parties to merge. Our preceding analysis assumes that partial equity ownership is a unique form of relationship governance that is at times preferable to full vertical integration. Certainly much of the variation in the data appears consistent with this view. However, it is possible that equity stakes are typically just a step in a dynamic process toward full integration.

To explore this possibility, we use the SDC mergers and acquisitions database to determine whether the parties in our sample relationships eventually merge together. Interestingly, we find that only 55 of these 10,211 relationships (0.54%) end in a merger. Thus, it appears that intense trading relationships only rarely result in mergers. In the subsample of relationships with an equity tie, the propensity to eventually merge climbs to a still modest 7.10% (24 out of 338).[25] Thus, while equity investments are occasionally preludes to outright

[25] The rate of mergers in our partial ownership relationships is smaller than what others report for firms with toeholds (e.g., Mikkelson and Ruback (1985), Choi (1991), Bethel, Liebeskind, and Opler (1998)).

integration, in the vast majority of cases they are not. This helps confirm the idea that partial ownership is a unique form of relationship governance that is quite distinct from full vertical integration.

C. Equity Ownership and Board Representation

While our preceding evidence suggests that equity stakes help ease contractual frictions and nurture relationships, we have little evidence regarding exactly how this occurs. To provide some relevant evidence, we examine whether equity stakes are related to the buyer's presence on the supplier's board. Specifically, we identify all relationships with equity stakes at the midpoint of our sample, 1996, and a matching size-industry sample of nonequity relationships. In the matching sample, only 3.80% of relationships have a buyer's affiliate on the supplier's board. In contrast, this figure is 43.75% for relationships with equity. The difference across the samples is highly significant. Moreover, this large difference remains when we conduct a multivariate analysis controlling for variables used in our earlier regressions (estimates not reported). This suggests that obtaining a seat on the board is one channel through which equity ownership helps buyers and suppliers sort out delicate control issues and ease contractual frictions.

V. Conclusions

We study the causes and consequences of the decision to take an equity stake in a trading partner by examining blockholdings by customers in their suppliers. In most of our sample relationships, there is no such equity investment. This indicates that many trading partnerships can be effectively governed without equity participation. However, the presence of a partial equity stake does systematically vary with several explanatory variables, suggesting that equity can at times play a role in relationship governance.

Our results indicate that factors related both to contractual incompleteness and financial market frictions are related to the equity stake phenomenon. With regard to contracting-related problems, we find that the likelihood of an equity stake is strongly positively related to whether the supplier is an R&D-intensive firm, whether a large fraction of the supplier's sales are made to the customer, and whether there is a formal alliance agreement between the trading partners. We argue that these findings are consistent with equity ownership easing contractual frictions that arise in a world of incomplete contracts in which trading parties are concerned about possible expropriation problems and incentive conflicts arising over time.

With regard to financial frictions, we find that suppliers who are cash constrained in the sense that they exhibit negative free cash flow are more likely than other firms to have equity blocks held by their major customers. This suggests that part of the equity stake phenomenon reflects behavior whereby customers serve as informed sources of capital to ease financial constraints at the supplier level. We also find that customers who have a relationship with

the supplier at the time of the supplier's IPO are more likely to own equity, suggesting that customers help ease financial constraints of suppliers who do not have access to public equity markets.

Turning to the size of equity positions, we find that many of the factors that are positively associated with observing the presence of an equity block are unrelated or negatively related to the size of a block if it is observed. This suggests that there are limits to equity ownership, perhaps because suppliers are concerned about customers having too much control over their operations if the customer's stake grows beyond a certain level. Thus, in settings in which incentives must be delicately managed, notably, relationships entailing high levels of R&D, a large fraction of supplier sales to the customer, or explicit alliance agreements, it appears that an equity stake is more likely to be established, but the size of the stake will be moderate.

Finally, we provide evidence that equity stakes are related to the dynamics of trading relationships. In particular, we find that relationships with equity ties are typically longer lived than other relationships. In addition, customers with an ownership position frequently place a representative on the supplier's board. These findings suggest that ownership has a substantive effect on relationship governance, providing firms with a valid motivation to carefully consider the costs and benefits of adopting this organizational form. Partial equity stakes do not appear to serve as a prelude to full vertical integration, as mergers between customers and suppliers are rare in our sample, even when an equity tie is present.

Taken as a whole, our evidence is consistent both with the general notion that tensions exist in close trading relationships, and with the specific idea that equity can play a role in alleviating these tensions. It would be interesting to identify more precisely the mechanisms through which equity positions affect relationship governance, and to assess the relative importance of relationship governance considerations in explaining the general phenomenon of intercorporate equity holdings. Our findings on financial frictions and partial equity stakes add to the literature that suggests that external capital market imperfections have an important influence on financing choices. With regard to alleviating financial constraints, it would be interesting to compare the equity investments we study with other potential sources of partner financing; for example, loans, leases, and trade credit. We leave these questions for future research.

Appendix

Our initial source of ownership data is the Compact Disclosure CDs. We examine two CDs per year, one near the start of each calendar year (usually January) and the other near the middle of the year (typically July). If the customer is listed as owning a block in the supplier, we record the indicated size of the block (when available) and the date of the filing. Most (over 95%) of these filings are the firm's annual proxy statement. We then match the ownership data with the most recent fiscal year-end that precedes the filing date, unless the filing date precedes the fiscal year-end by less than 10 days, in which case

we match the ownership data with the fiscal year-end that follows the filing date.

If our first procedure reveals that the customer ever has an equity stake in the supplier, we also examine the blockholder section of the firm's proxy statement in the Lexis/Nexis database for all available years. This database is fairly comprehensive starting in the early/mid 1990s, but coverage is sparse in the late 1980s. Using the same timing conventions to match proxy filings with fiscal years, we use ownership data from these electronic filings to supplement the information from the Compact Disclosure CDs. We record the ownership percentage number listed in the blockholder table, with no special adjustments for any considerations noted in the footnotes. In cases in which our two data sources indicate different ownership percentages, we choose the number in the proxy over the number in Compact Disclosure, unless the proxy lists no ownership by the customer, in which case we use the Compact Disclosure figure. Fortunately, the overlap between the two data sources is quite high. Occasionally, these data sources differ in the timeliness of their information, and sometimes they differ in how they record special equity-like claims such as convertibles or warrants. We believe our procedures provide a practical way to collect reliable information on ownership for a large set of firms.

There are a few cases in which either Compact Disclosure or the proxy statement indicates that a customer is a blockholder without indicating the size of their stake. These blocks are often accompanied by text explaining the nature of the stake, frequently with references to certain option-like features associated with the position. We code these relationships as having an equity tie, but we do not record or use the size of the equity stake in our analysis. In a handful of cases, Compact Disclosure or the proxy statement lists an ownership figure slightly below 5%. To create a consistent truncation point, we recode ownership for these cases to 5% in the analysis of Table VI.

In the few cases in which firms have two classes of voting stock, we record from the proxy the percentage of equity held by the blockholder for the class that corresponds to the Compact Disclosure record, or, when this is not available, the percentage of shares held of the class with most shares outstanding. Consistent with the observations of Anderson and Lee (1997), we find that Compact Disclosure usually records ownership numbers for this class.

REFERENCES

Aghion, Philippe, and Jean Tirole, 1994, The management of innovation, *Quarterly Journal of Economics* 109, 1185–1209.

Allen, Jeffrey W., and Gordon M. Phillips, 2000, Corporate equity ownership, strategic alliances, and product market relationships, *Journal of Finance* 55, 2791–2815.

Anderson, Ronald C., and D. Scott Lee, 1997, Ownership studies: The data source does matter, *Journal of Financial and Quantitative Analysis* 32, 311–329.

Athey, Susan, and Scott Stern, 2003, An empirical framework for testing theories about complementarity in organizational design, Working paper, Stanford University.

Barclay, Michael, Clifford Holderness, and Dennis Sheehan, 2003, Dividends and dominant corporate shareholders, Working paper, University of Rochester.

Bethel, Jennifer E., Julia Porter Liebeskind, and Tim Opler, 1998, Block share purchases and corporate performance, *Journal of Finance* 53, 605–634.

Burkart, Mike, Denis Gromb, and Fausto Panunzi, 1997, Large shareholders, monitoring, and the value of the firm, *Quarterly Journal of Economics* 112, 693–728.

Chamberlain, Gary, 1980, Analysis of covariance with qualitative data, *Review of Economic Studies* 47, 225–238.

Chan, Su Han, John Kensinger, Arthur Keown, and John Martin, 1997, Do strategic alliances create value? *Journal of Financial Economics* 46, 199–221.

Choi, Dosoung, 1991, Toehold acquisitions, shareholder wealth, and the market for corporate control, *Journal of Financial and Quantitative Analysis* 26, 391–407.

Dasgupta, Sudipto, and Zhigang Tao, 2000, Bargaining, bonding, and partial ownership, *International Economic Review* 41, 609–635.

Desai, Mihir A., C. Fritz Foley, and James R. Hines Jr., 2004, The cost of shared ownership: Evidence from international joint ventures, *Journal of Financial Economics* 73, 323–374.

Fama, Eugene F., and Kenneth R. French, 1997, Industry costs of equity, *Journal of Financial Economics* 43, 153–193.

Fee, C. Edward, 2002, The costs of outside equity control: Evidence from motion picture financing decisions, *Journal of Business* 75, 681–711.

Fee, C. Edward, and Shawn Thomas, 2004, Sources of gains in horizontal mergers: Evidence from customer, supplier, and rival firms, *Journal of Financial Economics* 74, 423–460.

Field, Laura Casares, and Dennis P. Sheehan, 2004, IPO underpricing and outside blockholdings, *Journal of Corporate Finance* 10, 263–280.

Gompers, Paul, and Josh Lerner, 2000, The determinants of corporate venture capital success: Organizational structures, incentives, and complementarities, in R. Morck, ed.: *Concentrated Corporate Ownership* (University of Chicago Press, Chicago, IL).

Greene, William H., 1993, *Econometrics* (Prentice-Hall, Englewood Cliffs, NJ).

Grossman, Sanford J., and Oliver D. Hart, 1986, The costs and benefits of ownership: A theory of vertical and lateral integration, *Journal of Political Economy* 94, 691–719.

Gulati, Ranjay, 1995, Does familiarity breed trust—The implications of repeated ties for contractual choice of alliances, *Academy of Management Journal* 38, 85–112.

Hadlock, Charles J., and Christopher M. James, 2002, Do banks provide financial slack? *Journal of Finance* 57, 1383–1419.

Harbaugh, Rick, 2001, Equity stakes and hold-up problems, Working paper, Claremont College.

Hart, Oliver D., and John Moore, 1990, Property rights and the nature of the firm, *Journal of Political Economy* 98, 1119–1158.

Hausman, Jerry, and Daniel McFadden, 1984, A specification test for the multinomial logit model, *Econometrica* 52, 1219–1240.

Hertzel, Michael, and Richard L. Smith, 1993, Market discounts and shareholder gains for placing equity privately, *Journal of Finance* 48, 459–485.

Holmström, Bengt, and John Roberts, 1998, The boundaries of the firm revisited, *Journal of Economic Perspectives* 12, 73–94.

Johnson, Shane A., and Mark B. Houston, 2000, A reexamination of the motives and gains in joint ventures, *Journal of Financial and Quantitative Analysis* 35, 67–85.

Kiefer, Nicholas M., 1988, Economic duration data and hazard functions, *Journal of Economic Literature* 26, 646–679.

Klein, Benjamin, Robert G. Crawford, and Armen A. Alchian, 1978, Vertical integration, appropriable rents, and the competitive contracting process, *Journal of Law and Economics* 21, 297–326.

Lerner, Josh, Hilary Shane, and Alexander C. Tsai, 2003, Do equity financing cycles matter? Evidence from biotechnology alliances, *Journal of Financial Economics* 67, 411–446.

Mathews, Richmond, 2003, Strategic alliances, equity stakes, and entry deterrence, Working paper, Duke University.

Mikkelson, Wayne H., and Richard S. Ruback, 1985, An empirical analysis of the interfirm equity investment process, *Journal of Financial Economic* 14, 523–553.

Morck, Randall, Andrei Shleifer, and Robert W. Vishny, 1988, Management ownership and market valuation: An empirical analysis, *Journal of Financial Economics* 20, 293–315.

Myers, Stewart C., and Nicholas S. Majluf, 1984, Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics* 13, 187–221.

Oxley, Joanne E., 1997, Appropriability hazards and governance in strategic alliances: A transaction cost approach, *Journal of Law, Economics, and Organization* 13, 387–409.

Pablo, Eduardo, and Venkat Subramaniam, 2002, When is equity more than just financing? Evidence from strategic alliances, Working paper, Tulane University.

Pisano, Gary P., 1989, Using equity participation to support exchange: Evidence from the biotechnology industry, *Journal of Law, Economics, and Organization* 5, 109–126.

Riordan, Michael H., 1991, Ownership without control: Toward a theory of backward integration, *Journal of the Japanese and International Economies* 5, 101–119.

Robinson, David, and Toby Stuart, 2001, Just how incomplete are incomplete contracts? Evidence from biotech strategic alliances, Working paper, Columbia University.

Santhanakrishnan, Mukunthan, 2003, The influence of complementarity on the performance of entrepreneurial companies, Working paper, Arizona State University.

Van den Steen, Eric, 2002, Equity participation, hold-up, and firm boundaries, Working paper, Massachusetts Institute of Technology.

Whinston, Michael D., 2003, On the transaction cost determinants of vertical integration, *Journal of Law, Economics, and Organization* 19, 1–23.

Williamson, Oliver E., 1975, *Markets and Hierarchies: Analysis and Antitrust Implications* (The Free Press, New York, NY).

Williamson, Oliver E., 1985, *The Economic Institutions of Capitalism* (The Free Press, New York, NY).

Wooldridge, Jeffrey M., 2002, *Econometric Analysis of Cross Section and Panel Data* (MIT Press, Cambridge, MA).