

# Using Hostages to Support Exchange: Dependence Balancing and Partial Equity Stakes in Japanese Automotive Supply Relationships

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We examine the use of partial equity stakes and volume-based dependence balancing in Japanese automotive supply relationships. Building on Williamson's (1983) hostage model, we argue that the robustness of different types of hostage arrangement depends on the *value, durability, and observability* of the underlying hostages involved. In Japan, strong norms of obligation associated with equity affiliation, along with significant obstacles to equity divestment, make a partial equity stake a robust hostage-based arrangement. Volume-based dependence balancing—whereby an assembler skews purchase quantities toward suppliers that commit more of their capacity to serving that assembler's needs—constitutes a less robust form of hostage in this context. Volume-based dependence balancing may nonetheless be an effective arrangement when contracting hazards are more moderate. Our empirical analysis provides support for these arguments: We find evidence that Japanese auto assemblers hold equity stakes in those suppliers that would otherwise be particularly vulnerable to assembler opportunism; in relationships without equity investments, assemblers systematically manage their purchase volumes in a manner that is also consistent with efforts to make credible commitments to otherwise vulnerable suppliers.

“The Japanese pattern [of relations between manufacturing firms and their suppliers] is directly at odds with transaction cost theory.”  
(Holmstrom and Roberts, 1998:81)

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## 1. Introduction

Despite years of study by scholars of management and economics, there is still marked disagreement about the organizing logic of Japanese supply networks. In contrast to their American counterparts, Japanese manufacturers tend to rely heavily on a small number of outside suppliers, and relationships are characterized by intense cooperation. At the same time, there is a notable lack of detailed, contingent contracts or formal partnership agreements. Noting this pattern, some researchers identify pervasive trust as the central feature of Japanese supply relationships (e.g., Dore, 1983; Sako, 1992); others focus on the role of reciprocity, repeated interaction, and reputation effects in sustaining cooperation (Smitka, 1991; Holmstrom and Roberts, 1998; Klein, 2000). A common thread linking these diverse perspectives is the notion that Japanese supply networks are either completely or partially at odds with the logic of transaction cost economics (TCE).

Missing from the debate surrounding the relevance of TCE in this context is a careful examination of the extent to which Japanese supply relationships exhibit *discriminating alignment* between the characteristics of particular supply transactions and the governance mechanisms employed (Williamson, 1985).<sup>1</sup> This reflects a more general inattention by transaction cost economists to the types of arrangements commonly observed in the Japanese system of governance, particularly minority equity stakes.

In this paper, we develop a conceptual framework that builds on Williamson's (1983) hostage model of exchange and use it to analyze supply relationships in the Japanese automotive industry in the 1980s. We argue that Japanese automobile assemblers use partial equity stakes and volume-based dependence balancing as hostage-based governance mechanisms to make credible commitments to otherwise vulnerable suppliers. Further, we argue that institutional features of the Japanese economy, which lead to a *de facto* inability of assemblers to easily sell their equity stakes in suppliers, increase the value and durability of the implied hostage that an assembler posts when it takes an equity position in a supplier. As a result, in contrast to the United States and other institutional environments, even very small partial equity stakes constitute relatively robust hostages in the Japanese context.

Empirical analysis of supply transactions linking the eleven major Japanese automobile assemblers and a broad cross section of their suppliers provides evidence supportive of our theoretical arguments. Auto assemblers hold partial equity stakes in their suppliers in situations where suppliers are likely to be most vulnerable to assembler opportunism. We also observe the systematic use of volume-based dependence balancing, but this occurs primarily in supply relationships without an equity tie. This is consistent with our argument that

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1. Prior empirical studies on Japanese supply networks have relied primarily on general comparisons of supply relationships in Japan and the United States (e.g., Cusumano and Takeishi, 1991; Dyer, 1996) or on managerial case studies of Japanese manufacturer-supplier interactions (e.g., Smitka, 1991; Nishiguchi, 1994).

dependence balancing embodies a less costly but less robust hostage than an equity tie in the Japanese context.

The remainder of the paper is organized as follows: Section 2 presents our arguments regarding the robustness of different types of hostages in supporting exchange and advances hypotheses regarding the discriminating use of minority equity stakes and dependence balancing in the Japanese automotive industry. Section 3 describes the sample and methods used in the empirical analysis. Results are presented and discussed in Section 4, and Section 5 concludes.

## 2. Using Hostages to Support Exchange

Williamson's (1983) hostage model is based on the fundamental insight that "the investments made by suppliers are influenced by the incentives experienced by the buyers" (Williamson, 1983:520). More concretely, in situations where production efficiency requires that a supplier of intermediate products invest in relationship-specific assets, uncertainty regarding final demand can undermine the credibility of buyer's promises to maintain purchase volumes as a way of compensating a supplier for its investment. As a result, the supplier is likely to underinvest in specific assets. Williamson shows that efficient investment levels can be sustained if the buyer posts an appropriate "hostage" that is sacrificed in the event of premature termination of the contract.<sup>2</sup>

Williamson's fundamental insight regarding the role of hostages in supporting exchange has proved useful in understanding the general contours of trading relationships in many different contexts (e.g., Anderson and Weitz, 1992; Bensaou and Anderson, 1999; Koss, 1999). However, the simple model does not allow us to compare different types of hostage with each other. How do different hostages (such as different types of reciprocating specific investments, or a minority equity stake) compare in their ability to manage disturbances that arise during the course of exchange? How does this ability, which we term the "robustness" of the hostage-based arrangement, vary depending on the institutional environment in which it is embedded? These are critical issues, since the larger the disturbance that can be accommodated in a trading relationship without prompting the customer to breach the contract, the more willing a supplier will be to invest in transaction-specific assets in support of efficient production.

In the following, we analyze the hostage features of two commonly observed governance arrangements in the Japanese automotive context: minority equity stakes and volume-based dependence balancing. We argue that the robustness of these and other hostage-based arrangements depends on three key hostage features, *value*, *durability*, and *observability*, and that these features in turn depend critically on elements of the legal and cultural environment in which the trading relationship is embedded.

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2. The simplest hostage mechanism involves the posting of a monetary bond that is delivered to the supplier if the contract is terminated prematurely. However, this arrangement is vulnerable to problems of induced breach (Williamson, 1983:526–27). In-kind hostages such as reciprocating specific investments that are not exchanged upon contract termination avoid this problem.

## 2.1 Hostage Arrangements in the Japanese Automotive Supply Industry

The Japanese automotive industry in the 1980s offers an interesting context for a study of hostage-based governance of supply relationships. Because vertical integration was low and external suppliers provided a wide variety of components, from simple screws to complex, customized parts such as engines and transmission systems, supply transactions tended to involve higher average levels of specific investments than similar relationships in the United States or Europe. Suppliers developed specific knowledge through intense collaboration with their customers by, for example, dispatching their own engineers to the assembler's production lines and development facilities. These relationship-specific investments contributed to the low cost production, high flexibility, and rapid development times that characterized the Japanese auto industry during this period (Clark and Fujimoto, 1991; Nishiguchi, 1994; Dyer, 1996).

This high level of specific investment occurred within a context of significant power asymmetry between buyers and sellers. While both buyers and suppliers made relationship-specific investments, the nature of Japanese economic organization meant that suppliers were particularly vulnerable to hold-up. Despite their increasing technical sophistication, suppliers tended to be "small and underdeveloped" (Asanuma, 1989: 12), while automakers were "inherently powerful" and thus faced a "great temptation to misbehave opportunistically" (Holmstrom and Roberts, 1998:82).<sup>3</sup>

The overall structure of auto parts supply networks also reinforced the asymmetry between buyers and suppliers. Auto assemblers had networks of several hundred first-tier suppliers and, even if they were highly dependent on one or two suppliers for a particular part, usually had alternative sources. The situation was quite different for a supplier. An auto assembler would place large and regular orders with a supplier only after a long and careful vetting process. In addition, assemblers adjusted purchase volumes relatively frequently, based in part on supplier performance. Assemblers' ability to monitor suppliers and adjust purchase volumes to reward good behavior (and punish bad behavior) appears to have been an effective mechanism for curbing supplier opportunism (Holmstrom and Roberts, 1998). This mechanism, however, would seem to exacerbate rather than ameliorate the vulnerability of suppliers to *assembler* opportunism.

Given this context, the lack of detailed contingent contracts and formal partnership agreements in automotive Japanese supply networks during the 1980s is something of a puzzle. By way of explanation, Gilson and Roe (1993) point to idiosyncrasies of the Japanese legal system and the fact that it was time-consuming and difficult to write and enforce contracts.<sup>4</sup> Meanwhile, it was quite common for an assembler to hold a partial equity stake in a supplier.

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3. Automakers were powerful in part because they were much larger than their suppliers. Larger firms had deeper pockets, enabling them to withstand crises resulting from supply disruptions, including those caused by supplier misbehavior. This advantage was reinforced by the fact that, in Japan, larger firms enjoyed much better access to capital.

4. This was in part due to a scarcity of lawyers. There was also a more general reluctance to use detailed contracts in business relationships, due to a combination of a cultural antipathy to contracts and an acknowledgment of enforcement difficulties.

Because the majority of these ties involved very low equity shares, commonly less than 5% of supplier equity, previous research on Japanese industrial organization has often downplayed the governance role of such ties (e.g., Imai, 1990; Gerlach, 1992). However, as argued below, application of the hostage framework suggests that partial equity stakes may have been a key mechanism by which Japanese automobile assemblers could craft credible commitments in their dealings with otherwise vulnerable suppliers to induce productivity-enhancing investments. Following our discussion of partial equity stakes, we also examine how assemblers could manage their own dependence on particular suppliers to effect credible commitments.

## 2.2 Partial Equity Stakes

At first sight, small partial equity stakes do not look like effective hostage arrangements. When a buyer purchases an equity stake in a supplier, the buyer's incentives to behave opportunistically are reduced, as the potential gain from opportunistic action is weighed against potential harm to the supplier and consequent reduction in the value of the equity stake (Riordan, 1991). However, the extent to which buyer opportunism is constrained depends on the size of the equity share: If the buyer's minority holding represents a small fraction of a supplier's total equity (as was commonly the case in the Japanese automotive industry), then the buyer's direct gain from opportunistic behavior is likely to dwarf the negative impact on the value of the equity holding at risk. This implies that the financial value of the hostage created by the equity purchase is quite small.

An even more salient problem with the use of a minority equity stake as a constraint on buyer behavior is the low durability of these arrangements in most institutional contexts. As long as equity markets are liquid, an investor can usually sell off equity holdings without suffering any significant loss of value; only in the case of quite substantial holdings are large losses likely to result from "dumping" the stock.<sup>5</sup> This opens up the possibility that a buyer that holds an equity stake in a supplier may simply liquidate the equity and then renege on its agreement with the supplier.

In sum, because the value and durability of the hostage represented by a minority equity investment is very low in efficient equity markets, a small partial equity stake is unlikely to enhance the credibility of a buyer's commitments regarding future purchases in most institutional contexts.<sup>6</sup> However, features

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5. It is conceivable that the buyer could contractually commit to hold an equity stake in the supplier for the duration of the supply agreement to increase the durability of the hostage. However, it is unclear whether such a contract could be effectively enforced.

6. Some prior work posits that minority equity stakes may act as a mechanism by which suppliers are disciplined by buyers (Flath, 1996). However, our reading of the institutional environment in Japan during the 1980s is at odds with the assumptions of such a model. Furthermore, there is ample evidence that supplier opportunism was not the focal problem in the Japanese automotive context during this period. Assemblers had other mechanisms at their disposal to keep suppliers in line, most prominently the ability to modify purchase volumes to reward good behavior and punish poor performance.

of the Japanese institutional environment serve to increase both the hostage value and durability of partial equity stakes, thus increasing the robustness of this hostage-based arrangement.

Several legal distinctions that fix the control exercised by shareholders in the Japanese system are of particular relevance to automobile assemblers and their suppliers. Large equity stakes confer *de jure* managerial control: A stake of 33.4% means that the shareholder has veto power over board decisions, although stakes of this size are relatively rare in Japanese automotive supply networks. Smaller equity stakes do not confer any specific control rights, but if an assembler owns a 20% stake in a supplier, the supplier attains *kanren gaisha* (“affiliate company”) status, an important sign of affiliation: Many large firms have *kanren gaisha* departments, which devote themselves to assisting affiliated companies—for example, in developing strategy and acquiring technology. Equity stakes below 20% do not bring any legal rights or responsibilities, but they nonetheless indicate membership in a particular automobile assembler’s *keiretsu*,<sup>7</sup> viewed as a public and visible commitment to an ongoing relationship. Furthermore, a small industry in Japan is devoted to publishing directories that map the equity links between firms.

In the Japanese context, assemblers are held to a higher standard of behavior vis-à-vis their *keiretsu* suppliers relative to unaffiliated suppliers. For example, prior research suggests that automobile assemblers actively bail out troubled firms in whom they have made equity investments (Ahmadjian, 1997). Furthermore, failure to make good on commitments to affiliated suppliers can have a real impact on a firm’s reputation (Hill, 1995), implying that the value of the hostage created by the purchase of an equity stake is significantly larger than the direct financial cost.

Ironically, it is difficult to find examples of auto assemblers that have broken an equity tie with a supplier or have refused to come to a supplier’s rescue and subsequently suffered a drop in reputation, since broken ties and unfulfilled obligations are so rare.<sup>8</sup> The president of an auto parts supplier interviewed by one of the authors suggested that because the reputation costs of breaking an equity tie to a supplier were so high, such ties were simply not broken: If a CEO decided to break a tie, it would show that “the guy is a bad guy . . . and can’t be trusted.” A senior executive of another major auto assembler told one of the authors that an equity stake in a supplier is “like a wedding ring,” adding that divorce is not looked upon favorably.

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7. In the English-language literature on Japanese business organization, any interlinked group of firms may be referred to as *keiretsu*. In Japanese, however, the term *keiretsu* refers almost exclusively to a large firm and the web of suppliers and other affiliates in which it holds equity stakes. Other types of groups, such as the constellations of large firms centered around banks and trading companies, exemplified by the Mitsubishi and Mitsui groups, tend to be called *kigyō shūdan* or *guruupu* (Gerlach, 1992).

8. This situation has changed somewhat since the 1990s with the rise in foreign ownership and the adoption of more “Western” management practices, typified by the acquisition of Nissan by Renault in 1999 and the subsequent dismantling of Nissan’s *keiretsu* network (Ahmadjian and Lincoln, 2001).

Taken together, these arguments suggest that in the Japanese automotive industry, a partial equity stake has significantly higher value and durability than one would expect if one were to extrapolate directly from the U.S. context and that, as a result, even a small equity stake can constitute a robust hostage. In addition, because an onerous set of responsibilities and consequent reduction in flexibility accompany equity ownership in this context, it is also a costly governance structure. We therefore expect that assemblers will extend equity ties selectively, reserving them for exchange relationships that have the highest need for credible commitments to suppliers. This reasoning leads to our first hypothesis:

*Hypothesis 1.* Assemblers hold partial equity stakes in suppliers when supplier vulnerability to assembler opportunism is high.

### 2.3 Dependence Balancing

A striking feature of the Japanese automotive industry is that despite the understandable focus on the dependence and vulnerability of suppliers, assemblers are themselves often highly dependent upon one or a handful of suppliers for some parts. When an assembler purchases a large percentage of its requirements for a particular part from a single supplier, any disruption in supply can cripple production, at least in the short term. The magnitude of the costs imposed on the assembler by such a disruption suggests that assembler dependence may be a potentially valuable and visible form of hostage in relationships with otherwise vulnerable outside suppliers.

Dependence balancing via reciprocal specific investments is perhaps the most widely studied hostage-based governance arrangement, with applications documented in a variety of settings, including industrial distribution (Anderson and Weitz, 1992; Fein and Anderson, 1997), retail insurance (Anderson et al., 1998), automobiles (Bensaou and Anderson, 1999), and fisheries (Koss, 1999). This prior research illustrates both the value and the limits inherent in such arrangements. In a survey of firms involved in industrial distribution agreements, for example, Anderson and Weitz (1992) find that manufacturers and distributors make reciprocal specific investments in training, personnel, and order processing systems and that these reciprocal investments, when observed by the transacting partner, increase commitment to the relationship. However, the survey also shows that the correlation between a distributor's valuation of the manufacturer's specific investment and the manufacturer's *own* valuation of its specific investment is very low. As a result, there is only a weak relationship between the actual value of the hostage posted by the manufacturer and the value that enters the distributor's calculus regarding the efficiency-enhancing specific investments it is willing to make. Thus the limited observability of many specific investments limits the robustness of hostage-based arrangements based on such investments.

Some types of specific investments are more observable, and thus may be more robust as hostages. For example, Fein and Anderson (1997) document the

discriminating use of selectivity in distribution channels (a form of dedicated asset investment or volume-based dependence balancing) consistent with a hostage model and argue that because information on the degree of selectivity is readily available and salient to the transacting partners, this type of hostage is more observable than many other types of specific asset investment. A more important limit to the robustness of this type of hostage-based arrangement is limited durability: If additional distributors (or, in our case, suppliers) can be added relatively easily, then little reliance will be placed on hostages backed by selectivity and volume-based dependence balancing.

Our observation of contracting practices in the Japanese automotive industry suggests that limited durability of the hostage created by volume-based dependence balancing is indeed likely to limit the robustness of this arrangement. An assembler typically contracts with a supplier to provide a given part during the life of a model—approximately four years. In the process of new model development, assemblers solicit new bids from their suppliers and are able to reset the degree of dependence on any supplier for the next model cycle. Thus, while a disruption in supply may be quite costly in the short run, an assembler is able to adjust its dependence on a supplier fairly flexibly in the longer term.<sup>9</sup> Suppliers are unable to match this flexibility by quickly picking up business from another assembler because of the long vetting process alluded to earlier.

Given these limits to the robustness of hostages based on dependence balancing, we expect auto assemblers to limit their use of this mechanism to supply relationships where supplier vulnerability is relatively low. In this case, we should observe that the level of assembler dependence on any particular supplier is an increasing function of that suppliers' vulnerability to assembler hold-up, i.e., on its level of dependence on the assembler. However, because this form of hostage is not robust to large disturbances, at higher levels of contracting hazards we expect that dependence balancing will give way to (or be used in combination with) governance via a partial equity stake. Thus we have the following hypothesis:

*Hypothesis 2.* Assemblers manage their volume dependence to balance the dependence of the supplier; use of this mechanism alone is limited to transactions where supplier vulnerability is relatively low.

### 3. Data and Measures

#### 3.1 Empirical Sample and Dependent Variables

The empirical sample encompasses a large number of supply transactions for all automobile assemblers operating in Japan in 1987. The data set consists of

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9. Data on the structure of supply relationships in 1984 and 1987 for our sample of assemblers and suppliers provide further evidence of the ability of assemblers to adjust their dependence on particular suppliers, as well as evidence of the relative durability of equity ties: All of the assembler–supplier dyads that have an equity tie in 1984 also have an equity tie in 1987, and vice versa. In contrast, almost three quarters of the dyads show a change in assembler dependence, many by significant amounts.

1443 assembler–supplier dyads, representing 11 assemblers and 434 suppliers of 160 different part types.

Data on parts transactions come from *Jidōsha Buhin no 160 Hinmei no Seisan Ryūtsū Chōsa* (“A Survey of Manufacture and Distribution of 160 Auto Parts”) (IRC, 1987). This report includes the name of each supplier and the number of units sold to each assembler for 160 parts categories, encompassing most major parts and subassemblies. These data provide the basis for one of our dependent variables: *Assembler dependence* is the proportion of an assembler’s purchases of a specific part type that comes from a particular supplier.

We compiled shareholding information for 146 publicly listed suppliers from *Kaisha Nenkan*, a volume of annual corporate reports for fiscal year 1987, published in 1989 by *Nihon Keizai Shimbun* [the *Japan Economic Journal*]. Similar data for 125 unlisted (i.e., privately held) firms come from the companion volume, *Kaisha Sōkan*, a directory of annual reports for selected unlisted firms. Supplementary data from annual reports of some unlisted firms not included in *Kaisha Sōkan* were obtained from *Kaisha Sōran*, published in 1989 by Diamond Publishing.<sup>10</sup>

*Kaisha Nenkan* reports equity holdings of the top ten shareholders (by size of equity stake). Reports for unlisted firms in *Kaisha Sōkan* tend to show equity holdings for fewer than the top ten shareholders. We are nonetheless confident that our data include all equity holdings by the major automobile assemblers, as suppliers have an incentive to report all such stakes as evidence of affiliation. Furthermore, the concentrated ownership of many suppliers means that the equity holdings captured in these data extend in most instances to stakes smaller than 5% of total equity (see Table 1b, below). Together these data allow us to construct both binary and continuous measures of assemblers’ equity stakes in suppliers (*equity tie* and *stake*, respectively).

### 3.2 Independent Variables: Contracting Hazards and Controls

*Supplier dependence* is the proportion of a supplier’s output of a part type that it sells to a single assembler. This is a strong indication of the supplier’s vulnerability to hold up. Suppliers whose sales of a particular parts class are highly focused on one assembler can reasonably be expected to have accumulated a high degree of relationship-specific investment in production equipment and, more importantly, in design, inventory, and logistics interfaces with the assembler. Furthermore, even if all of the assets used in production of a part are general purpose, there are significant barriers to rapid initiation or expansion of supply relationships with alternative buyers. Thus a supplier is largely limited to existing customers, at least in the short to medium term.

In addition to supplier dependence on a particular assembler *within* parts classes, suppliers also vary in the number of different part types that they supply to a given assembler. As the number of different part types traded between

10. For the remaining unlisted firms, we were able to obtain a binary measure of assembler equity stakes through the IRC report (IRC, 1987).

a supplier and an assembler increases, the intensity and complexity of the trading relationship also increases.<sup>11</sup> This again implies a higher level of relationship-specific investment by the supplier. We therefore include a count of the number of different part types transacted in a buyer-supplier dyad (*# part types*).<sup>12</sup>

We also include a dummy variable, *model specificity*, which takes the value of 1 if a part is specific to a given model of automobile (0 if a part is interchangeable across models). Conversations with Japanese automotive engineers suggest that model-specific parts are more likely to be produced using assets that are customized to this particular use (and to this particular customer), such as specialized tools and dies. Thus *model specificity* is an indicator of physical asset specificity.

Prior research in transaction cost economics (e.g., Monteverdi and Teece, 1982) suggests “engineering intensity” as another indicator of asset-specific investment that may increase supplier vulnerability to assembler opportunism. However, since suppliers of sophisticated parts are often also the most technically sophisticated, their services are likely to be particularly in demand, lessening their dependence on current customers, *ceteris paribus*. We therefore include *manufacturing difficulty* as a control but do not make predictions regarding the sign. This ordinal variable ranges from 1, for very simple to manufacture parts, to 3, for parts that are complex, require high levels of skill, and have very stringent specifications (e.g., tight tolerances).<sup>13</sup>

The last part-related variable is *# suppliers*, a total count of suppliers for a particular part type across all assemblers in the sample. This variable captures the availability of alternative sources of supply. An increase in the number of suppliers available enhances the ability of an assembler to switch suppliers, making the supplier more vulnerable to assembler opportunism in the presence of relationship-specific investments.

The regressions also include several firm-level characteristics of suppliers that may affect their vulnerability to assembler opportunism: *Listed* indicates whether a supplier’s equity is publicly traded; *supplier size* is measured as the log of total assets in millions of yen; and *supplier age* is logged years since establishment (these variables come from *Kaisha Nenkan* for listed companies and *Kaisha Sōkan* for selected unlisted companies). We expect that smaller and younger suppliers are more vulnerable to assembler opportunism as they are

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11. To the extent that this measure also correlates with the total monetary value of the goods transacted within the relationship (something on which we do not have data), then this also implies greater switching costs for the supplier should the existing relationship be severed.

12. Given the high degree of skewness in the distribution, we use the natural log of the number of part types; use of the unlogged variable does not significantly change the empirical results, although it does reduce model fit in some cases.

13. This variable was coded by a research assistant who was an engineer formerly employed in parts procurement by a Japanese assembler. He asked three engineers, responsible for parts procurement for three Japanese assemblers in the United States, to evaluate the specificity and difficulty of manufacture of each of the 160 parts in our sample. Each engineer evaluated those parts with which he had most experience. The research assistant examined the responses and resolved any conflicts.

less able to absorb losses due to order cancellation or the like. As a result, the need for credible commitments by assemblers is greater for these suppliers, and we expect that assemblers are more likely to hold an equity stake in a small or young supplier, *ceteris paribus*. Unlisted suppliers are also more vulnerable to assembler opportunism, as they are more liquidity constrained than their listed counterparts. However, since equity ties to unlisted firms are less observable, their robustness as hostages may be proportionately lower, attenuating their relative benefits in these relationships.

#### 4. Methods

Equity relationships are dyadic structures; it is not feasible for an assembler to adjust the size of an equity stake to suit the properties of each individual part type transacted with a particular supplier. As such, the appropriate unit of analysis for exploring the use of this governance arrangement is the assembler-supplier dyad. We aggregate parts characteristics to the dyad level (in cases where an assembler sources more than one part type from a particular supplier) by averaging our measures of parts characteristics across all part types transacted in the dyad. (Analysis using the maximum value in place of the average produces similar results.)

In contrast to the case of equity, adjustments to the level of assembler dependence on a particular supplier are made at the level of the individual part. We therefore use the individual part type as the unit of analysis for our exploration of dependence balancing. In this analysis we account for potential endogeneity of equity ties and assembler dependence by estimating a two-stage selection model (Heckman, 1979; Maddala, 1983). All of our regressions include assembler fixed effects and are estimated with robust standard errors and clustering on suppliers.

### 5. Results and Discussion

#### 5.1 Descriptive Statistics

Table 1a summarizes the overall propensity of the eleven Japanese automotive assemblers to hold shares in their suppliers. Each assembler is represented roughly equally in our sample of assembler-supplier dyads. The shareholding data indicate that on average, assemblers hold shares in 20% of the suppliers in the sample, but this varies considerably by assembler. Toyota and Nissan hold stakes in over 40% of their suppliers, while shareholding rates are far lower for the smaller assemblers. There is also inter-assembler variation in the size of equity stakes: The median size of Toyota's stakes in its suppliers, for example, is 10%, while Honda's is 18% and Nissan's is 23%.

Table 1b shows the overall size distribution of equity stakes relative to the thresholds associated with varying levels of control. Less than a quarter of the ties reach the 33.4% threshold that confers *de jure* control through veto power over board decisions. The majority (58%) of equity stakes held by assemblers are below the 20% threshold for *kanren gaisha* status and, perhaps most striking, fully one third of the equity ties involve stakes of less than 5%.

Table 1a. Japanese Auto Assemblers' Equity Holdings in Suppliers

<i>Assembler</i>	1. # of Assembler–Supplier Dyads in Sample	2. % of Suppliers for which Assembler is a Top 10 Shareholder	3. Average Size of Equity Stake, % (dyads with ties only)	4. Median Size of Equity Stake, % (dyads with ties only)
Toyota	129	41	17	10
Nissan	131	42	25	23
Honda	134	19	24	18
Mitsubishi	170	23	17	7
Mazda	150	20	14	7
Isuzu	131	19	16	8
Fuji	117	7	3	2
Suzuki	133	9	10	10
Daihatsu	125	1	32	26
Nissan Diesel	117	4	7	7
Hino	106	17	22	13

Table 1b. Distribution of Equity Stakes by Size of Stake (All Assembler–Supplier Dyads)

Size of Equity Stake	% of Assembler–Supplier Dyads with Stakes in this Range (dyads with ties only)
0% < stake < 5%	33
5% < stake < 10%	15
10% < stake < 20%	10
20% < stake < 33.4%	19
33.4% < stake < 50%	15
50% < stake	8
Total	100

Table 2 presents descriptive statistics for the entire sample, for the subsample of firms for which we have complete data on transactions and equity stakes, and for the subsample of listed firms only. Assembler and supplier dependence both vary from less than 1% to 100%, and there is significant variation in part and supplier characteristics. There is general consistency in the dyad characteristics across subsamples except that, as we would expect, unlisted suppliers tend to be slightly younger, smaller, and more dependent on a particular assembler. Assemblers are also slightly more likely to hold equity in the unlisted suppliers.

## 5.2 Equity Stakes

Our first set of analyses looks for evidence of discriminating alignment between transaction characteristics and assemblers' equity holdings in suppliers. Table 3 displays the results. Column 1 shows results of a binomial logit

Table 2. Descriptive Statistics for Assembler–Supplier Dyads

Variable (definition)	Complete Sample ( $N = 1443$ )		All Dyads with Complete Data Available ( $N = 1119$ )		Listed Suppliers Only ( $N = 760$ )	
	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range
Equity tie (1 if assembler has equity stake)	0.196 (0.397)	0–1	0.154 (0.362)	0–1	0.162 (0.369)	0–1
Stake (% supplier shares held by assembler)	N/A	N/A	0.028 (0.096)	0–0.91	0.019 (0.063)	0–0.431
Assembler dependence (% of requirements for this part type coming from this supplier)	0.447 (0.298)	0.002–1	0.447 (0.294)	0.002–1	0.439 (0.288)	0.002–1
Supplier dependence (% of production for this part type going to this assembler)	0.356 (0.364)	0.0002–1	0.297 (0.324)	0.0002–1	0.254 (0.286)	0.0002–1
# Part types (log of # of parts types supplied by this supplier to this assembler)	0.422 (0.620)	0–3.807	0.468 (0.655)	0–3.807	0.503 (0.691)	0–3.807
Model specificity (1 if specific to a given model)	0.366 (0.420)	0–1	0.373 (0.424)	0–1	0.393 (0.430)	0–1
Manufacturing difficulty (1–3; 3 most difficult)	1.894 (0.651)	1–3	1.920 (0.645)	1–3	1.968 (0.632)	1–3
# Suppliers (total number of suppliers of this part type in sample)	7.935 (4.007)	2–19	7.299 (3.694)	2–19	6.771 (3.354)	2–19
Supplier size (log of total assets in million yen)	N/A	N/A	10.771 (1.557)	6.497–15.215	11.376 (1.376)	7.758–15.215
Supplier age (log of # of years from firm founding to 1987)	N/A	N/A	3.778 (0.412)	1.792–4.644	3.874 (0.301)	2.833–4.644
Listed supplier (1 if shares are publicly traded and annual report appears in <i>Kaisha Nenkan</i> )	0.527 (0.499)	0–1	0.679 (0.467)	0–1	N/A	N/A

Table 3. Product and Supplier Characteristics and Equity Ties

	1 Equity tie (Logit) Full sample	2 Equity tie (Logit) Listed suppliers only	3 Equity tie (Logit) All dyads with complete data
Supplier dependence	3.770*** (.297)	3.045*** (.373)	2.659*** (.511)
# Part types (log)	0.770*** (.165)	1.088*** (.165)	1.093*** (.213)
Model specificity	0.156 (.242)	0.031 (.262)	0.035 (.358)
Mfg difficulty	0.448** (.158)	0.862*** (.179)	1.111*** (.278)
# Suppliers	0.017 (.024)	-0.056 (.031)	-0.072 (.037)
Supplier size (log)	n/a	-0.565*** (.095)	-0.857*** (.136)
Supplier age (log)	n/a	-0.025 (.300)	-0.303 (.501)
Listed supplier	0.278 (.205)	1.702*** (.316)	n/a
Constant	-4.934*** (.494)	-0.587 (1.366)	5.227* (2.45)
Assembler dummies	***	***	***
<i>N</i>	1443	1119	760
Log-likelihood	-466.11	-298.95	-194.10
Wald chi-square (d.f.)	287.9*** (16)	214.57*** (18)	162.6*** (17)
Pseudo $R^2$	0.347	0.379	0.423

\* $p < 0.05$ ; \*\* $p < 0.01$ , \*\*\* $p < 0.001$  (two-tailed tests), robust standard errors adjusted for clustering on suppliers.

estimation (dependent variable = equity) for the entire sample of 1443 dyads. Positive coefficients indicate an increased likelihood that the assembler will hold an equity stake in the supplier. Column 2 reports the estimation results for the smaller subsample of suppliers for which we also have age and size data (1119 dyads), and column 3 has results for listed firms only (760 dyads).

The results in Table 3 show strong evidence of discriminating alignment. Equity stakes are strongly and positively related to supplier dependence and to the number of parts transacted in the dyad. The estimation coefficients in column 1 imply that increasing supplier dependence from half a standard deviation below the mean to half a standard deviation above the mean increases the likelihood of an equity tie from 5.2% to 17.9% (8% to 12.2% for a similar increase in the number of parts transacted); going from the minimum to maximum observed values of supplier dependence increases the probability of an equity tie from 2.8% to 55.4% (7.3% to 59.8% for number of parts). (These changes are calculated holding all other variables at their means.) The results are consistent with the arguments that (i) assemblers hold equity stakes to

make credible commitments to suppliers that are otherwise vulnerable to assembler opportunism and (ii) equity stakes support more extensive, complex, and intense interaction within the exchange relationship.

Model specificity is not significantly related to the presence of an equity stake in any of the regressions, counter to our expectations. However, since model specificity requires primarily specific physical capital, this lack of significance is consistent with the findings of Masten et al. (1989) that specific human capital is a better predictor of governance than physical asset specificity. This interpretation is reinforced by the qualitative observation that in Japanese automotive supply relationships, specificity resides in the entire relationship rather than in particular transaction characteristics.

Manufacturing difficulty is another strong predictor of an equity tie: Holding all other variables at their mean, an increase in manufacturing difficulty from a score of 1 to 3 (the low and high score on our scale) increases the probability of an equity tie from 6.8% to 15.2%. The positive coefficient on this variable is consistent with the argument that suppliers of difficult-to-manufacture parts make greater relationship-specific investments and, as a result, are more vulnerable to assembler opportunism.

The impact of *# suppliers* on the probability of an equity tie is insignificant in all of the samples except listed firms, and here the effect is negative, counter to our expectations. Thus, an increase in the assemblers' outside options regarding supply of a particular part does not appear to influence supplier vulnerability to opportunism. However, we should not dismiss this issue too hastily: The argument is that alternative sources of supply increases supplier vulnerability *in the presence of specific investments*. To investigate this further, we estimated models that included interactions between *# suppliers* and our other indicators of specific investments (supplier dependence, number of part types, and model specificity). The results of these supplementary analyses (available from authors on request) indicate that there is indeed a significant and positive interaction between supplier dependence and the number of alternative suppliers available.<sup>14</sup> Thus for suppliers that devote a large portion of their production capacity for a particular part type to one assembler, the existence of many potentially competing suppliers significantly increases the probability of an equity tie.

The coefficients on the other control variables are also of interest. The presence of an equity tie is unrelated to the age of the supplier firm.<sup>15</sup> However, the size of the supplier (as indicated by the log of total assets) is negatively and significantly associated with equity ties (see columns 2 and 3). This is consistent with the idea that the greater liquidity constraints faced by small firms in

14. There is no similarly significant interaction between *# suppliers* and *# parts* or model specificity and the significant interaction between supplier dependence and number of suppliers is present in the analyses of the full sample, not in the sample that is limited to listed suppliers only.

15. This would appear to further undermine previous interpretations of equity ties in Japanese supply networks as mere historical residues or meaningless symbols of old business group affiliations (Imai, 1990). Using the unlogged value of supplier age yielded qualitatively identical results.

the Japanese system make them more vulnerable to assembler opportunism, *ceteris paribus*. At the same time, controlling for supplier age and size, assemblers are more likely to hold an equity stake in listed (publicly traded) suppliers than in unlisted firms. This suggests that the greater observability of equity stakes in public firms increases the hostage value of equity stakes.<sup>16</sup> Several assembler dummies are also significant (results suppressed for readability of the tables), reflecting the different assemblers' propensities to extend equity ties reported in Table 1a.

One prominent alternative interpretation of the prevalence of equity ties linking assemblers and suppliers is that these stakes allow the assembler to exert direct managerial control over the supplier. This interpretation is consistent with several of our empirical observations: Suppliers in whom assemblers hold equity devote significant portions of their production capacity to the needs of the assembler and tend to produce difficult-to-manufacture parts, which may also be strategically important to the assembler. However, given that fully one third of the equity stakes held by the assemblers in our sample are under 5% of supplier equity, many of the observed equity ties are obviously well below any threshold associated with managerial control. Furthermore, in a multinomial logit regression (results not shown; available from the authors on request) using a categorical breakdown of equity stakes based on the legal thresholds identified earlier, plus an additional category for stakes of less than 5%, we find that regression coefficients for the under-5% category are highly significant, and the direction of effects is consistent with the results in Table 3. This suggests that even very small equity stakes signal a credible commitment by assemblers, allowing suppliers to engage in transactions that would otherwise expose them to assembler opportunism. We also can find little evidence that board membership is a crucial feature of the equity relationships in our sample.<sup>17</sup> Thus, a reasonable interpretation of our results is that the equity tie is appropriately characterized as a hostage mechanism.

### 5.3 Dependence Balancing

Table 4 reports results for our dependence balancing regressions. The dependent variable in these analyses is assembler dependence. We model the governance decision as a two-stage process whereby an assembler first acquires an equity stake and then decides on the volume of purchases to make from a particular supplier, contingent on the equity decision. To address the effect of an endogenously chosen binary treatment (an assembler's purchase of a partial equity stake in the supplier) on another endogenous continuous variable (assembler's choice of level of dependence on the supplier), we estimate a treatment effects

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16. We cannot rule out the more straightforward explanation that since unlisted firms are often family owned, with closely held shares, it is less likely that an assembler (an outsider) owns a stake in the company, *ceteris paribus*.

17. In a separate analysis (not shown; available from the authors on request), we found that the majority of equity ties (88/123) are not accompanied by a seat on the board of directors, and board seats are mainly associated with the largest equity stakes in our sample of dyads.

Table 4. Dependence Balancing

	1 Complete Sample (Treatment effects)	2a Nonequity (Heckman model)	2b Equity (Heckman model)
Equity tie	-0.025 (.042)	N/A	N/A
Supplier dependence	0.278*** (.032)	0.295*** (.035)	-.033 (.082)
# Part types (log)	0.084*** (.008)	0.089*** (.010)	0.005 (.036)
Model specificity	-0.018 (.015)	-0.023 (.017)	-0.008 (.033)
Mfg difficulty	-0.021* (.009)	-0.009 (.011)	-0.077*** (.020)
# Suppliers	-0.022*** (.002)	-0.022*** (.002)	-0.020*** (.004)
Supplier size (log)	-0.012*** (.005)	-0.029*** (.007)	0.102** (.032)
Supplier age (log)	-0.065*** (.018)	-0.072*** (.020)	-0.024 (.048)
Listed supplier	-0.021 (.018)	0.019 (.021)	-0.254** (.063)
Constant	0.852*** (.087)	1.026*** (.097)	0.292 (.239)
Assembler dummies	***	***	***
Lambda	0.067 (.023)	-0.077 (.031)	-0.212 (.078)
<i>N</i>	2413	1866	547
Log-likelihood	-1411.54	-1141.54	-832.64
Wald chi-square (18)	663.6***	497.2***	225.89***
Wald test of ( $\rho = 0$ )	8.03**	5.99*	5.97*

\* $p < 0.05$ ; \*\* $p < 0.01$ , \*\*\* $p < 0.001$  (two-tailed tests), robust standard errors adjusted for clustering on assembler-supplier dyads.

Unit of analysis is part type; dependent variable is assembler dependence. Firms with complete data only

model using the entire sample of 2413 part transactions. The results for the assembler dependence decision are reported in column 1.<sup>18</sup> This is followed by estimation of Heckman selection models of the relationship between assembler dependence and transaction and supplier characteristics for two sub-samples: assembler-supplier dyads without equity ties (column 2a) and dyads with equity ties (column 2b).

18. This sample represents all of the parts transactions in the sample of 1119 assembler-supplier dyads, described in Table 2. We do not show results of the first-stage (selection) regressions here. The selection equation for both the treatment effect and Heckman selection model is a binomial probit estimation using part-level observations (estimated with robust standard errors, clustered on assembler-supplier dyads). While this is not identical to the binomial logit regression on dyads, shown in Table 3, the results of the selection model estimation (available from the authors on request) are qualitatively identical to the Table 3 results.

Our predictions from the hostage model are that assemblers will manage their dependence on suppliers to credibly commit to the exchange relationship and mitigate suppliers' vulnerability to hold-up and that this form of dependence balancing will be less effective at higher levels of contracting hazards. Since we cannot segment the sample directly on the level of contracting hazards (which is a multidimensional construct), we instead observe how the use of dependence balancing varies in the presence or absence of an equity tie.

Focusing on column 1 of Table 4, we see that for the sample as a whole, assembler dependence is positively and significantly related to supplier dependence and to the number of parts transacted, as we would expect if assemblers use their purchasing volume to balance supplier dependence.

The significant negative coefficient on the # *suppliers* in this regression contrasts with the results for equity ties reported in Table 3. The inference in this case is not simply that an increase in the number of alternative suppliers increases the vulnerability to assembler opportunism in the presence of specific investment, but rather that in these circumstances, dependence balancing becomes an ineffective hostage altogether. Modifications to purchase volume are unlikely to constitute credible commitments when there are many suppliers of the part already operating in the industry, as new suppliers can be brought online quite easily, further degrading the durability, and hence the robustness, of the implicit hostage.

The coefficient on *equity tie* in the treatment effects model is insignificant, suggesting that, controlling for self-selection in the purchase of partial equity stakes, there is no significant difference in assembler's average dependence on affiliated versus unaffiliated suppliers. However, when we split the sample into observations with and without equity ties, we see that the systematic variation in assembler dependence is different for the two subsamples (controlling for self-selection). In the absence of an equity tie (column 2a), customer dependence is very sensitive to the level of supplier dependence, but this relationship is insignificant when an equity tie is in place (column 2b). The effect of the number of part types on customer dependence is also significant only in the absence of equity. These results support the argument that assemblers pay less attention to their own level of volume dependence on suppliers with whom they have an equity relationship, because the equity stake is a sufficient hostage and in itself constitutes a credible commitment by the assembler.

Interpretation of some of the other results is less straightforward. For example, assembler dependence is responsive to the number of alternative suppliers, even when there is an equity tie. Also, while assembler dependence is negatively related to supplier size in the nonequity subsample—a result consistent with the notion that smaller firms are, *ceteris paribus*, more vulnerable to hold-up— assembler dependence is *positively* related to supplier size in the equity subsample. One possibility is a simple scale effect: The larger the production capacity of a supplier and the more of its capacity that it devotes to a particular customer (as indicated by higher supplier dependence and higher number of part types supplied), then the greater will be the total volume of parts traded within the relationship, and the greater will be the assembler's

dependence on that supplier in any particular parts category, all else equal.<sup>19</sup> However, this only makes the results for nonequity dyads more striking: There, assemblers are *more* dependent on *smaller* firms, i.e., on those firms with whom overall trading volumes will be lower, *ceteris paribus*. This reinforces the notion that in situations where the overall level of contracting hazards does not warrant an equity tie, assemblers actively manage purchase volumes to balance supplier dependence and infuse confidence in relationships where suppliers would otherwise be vulnerable to opportunistic recontracting.

Finally, manufacturing difficulty is negatively related to customer dependence, counter to our expectations. However, this relationship is significant *only* when the assembler holds a partial equity stake in the supplier. One plausible interpretation of this result is that suppliers that produce difficult-to-manufacture parts possess superior and idiosyncratic manufacturing capabilities, and therefore may themselves pose a hold-up threat to assemblers, particularly when assemblers' own hands are tied because of an equity relationship with the supplier. In this case the assembler may want to ensure that it is not too heavily dependent on the supplier for fulfilling its needs for a particular part.

These caveats notwithstanding, if we place the results of our analysis of assembler dependence alongside the earlier findings on the link between transaction and relational characteristics and partial equity stakes, we find strong overall support for our dependence balancing arguments. First, in the absence of an equity tie, assemblers systematically vary their purchase volumes across suppliers, as we would expect if they were attempting to counterbalance supplier dependence. Second, we can infer that balancing supplier dependence through modification of purchase volumes is inadequate at high levels of transacting hazards, because the implicit hostage is insufficiently robust. As a consequence, partial equity stakes are the preferred governance instrument in high hazard situations. Finally, the presence of an equity tie mitigates the need for further credible commitments through purchase volume adjustments, because the robust hostage represented by the equity stake is itself a more credible commitment by the assembler to refrain from hold-up.

## 6. Conclusion

In this paper we examined governance mechanisms commonly observed in supply relationships in the Japanese automotive industry through the lens of Williamson's (1983) hostage framework. Our analysis suggests that the robustness of different types of hostage arrangements depends on the *value*, *durability*, and *observability* of the underlying hostages involved and that these features in turn depend on the particulars of the institutional environment in which a supply relationship is embedded.

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19. There is a similar intuitive connection between # *suppliers* and assembler dependence: The fewer suppliers currently producing a particular part type, industry wide, the more likely it is that an assembler will be dependent on one or a few suppliers.

Our analysis of a large cross section of supply relationships in the Japanese automotive industry provides evidence consistent with this hostage framework. We find substantial evidence of a discriminating alignment in the content and governance of exchange relationships. However, the properties of the governance structures observed here—minority equity stakes and volume-based dependence balancing—are deeply rooted in the Japanese institutional context. Strong social norms of obligation associated with equity ties, along with significant obstacles to equity divestment, make partial equity stakes a robust but costly form of governance in the Japanese automotive industry. Dependence balancing provides a more flexible and less costly governance structure when hazards are lower.

Returning to the initial question of whether Japanese supply networks are “at odds with transaction cost theory” (Holmstrom and Roberts, 1998), it is noteworthy that several of the cited critiques focus on the idea that strong reputation effects, which are a central feature of the Japanese economy, negate the need for more formal governance mechanisms such as equity relationships. However, our research suggests that reputation effects and hostage arrangements may be complements rather than substitutes in this context: Because an equity tie means that an assembler has a higher level of responsibility vis-à-vis a supplier, *and* because equity ties are readily observable beyond the transacting dyad, the presence of strong reputation effects increases the hostage value of a partial equity stake.

In conclusion, while we embrace Williamson’s (2002:191) view that “these and other issues . . . are usefully examined from several lenses, of which the lens of transaction cost economics is only one,” our findings suggest that transaction cost economics is more relevant to debates about the logic of “Japanese organization” than previously acknowledged. In particular, our empirical results suggest that the general atmosphere of trust and the strong reputation effects that have been documented in the Japanese economy do not negate the need for firms to craft governance structures suited to the needs of particular transactions or relationships and to make credible commitments to induce specific investment.

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