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JAPANESE FIRMS IN TRANSITION: RESPONDING TO THE GLOBALIZATION CHALLENGE

EDITED BY

THOMAS ROEHL

Western Washington University, USA

ALLAN BIRD

University of Missouri-St. Louis, USA

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SAME RULES, DIFFERENT GAMES: VARIATION IN THE OUTCOMES OF “JAPANESE-STYLE” SUPPLY RELATIONSHIPS

Glenn Hoetker

ABSTRACT

Our understanding of Japanese supply relationships comes primarily from studying the automobile industry. This paper identifies three elements of the automobile industry that, although generally assumed to be widespread, are largely absent in the notebook computer industry, leading to a different pattern of supply relationships: a sizable pool of external suppliers; the feasibility of shukko and cross-shareholding to strengthen supply relationships; and the adequacy of these means to manage external supply relationships. This finding debunks the myth of a monolithic model of “Japanese-style” supply relationships and illustrates the importance of idiosyncratic elements of an industry’s environment on its supply relationships.

Precisely because Japanese supply chain practice has acquired this standing [worldwide “best practice”], however, it tends to be viewed as all the same. How Japanese companies and industry vary in the supply relations is seriously understudied (Lincoln & Ahmadjian, 2000, p. 1).

INTRODUCTION

In the 1980s, relations with long-term suppliers were seen as a key Japanese competitive advantage (Dyer, 1996b). As Japan's economy soured, however, these same close buyer-supplier ties were seen as limiting the flexibility of Japanese manufacturers to respond to changing market conditions (Lincoln, 2001). Whether a blessing or a curse, these ties have been studied primarily in one industry – automobiles.¹ Given the importance of this industry and Japan's rapid rise to competitive parity and even superiority, this is not surprising. This concentration has allowed in-depth exploration into the effect of differences in national institutions and management practices. However, it begs the question: How representative of Japanese supply relationships is the automotive industry?

Scholars have increasingly drawn attention to the importance of understanding heterogeneity in supply relationships across Japanese industries (Guillot & Lincoln, 2005; Smitka, 1991). Despite these calls, our understanding of supply relationships outside of the automotive industry remains limited.²

Based on observations of the automobile industry, practices such as buyer-supplier shareholding have become part of the commonly held picture of Japanese supply relationships. Given the scarcity of observations in other industries, the widespread presence of such practices has been generally assumed. In this paper, I argue that key elements of "Japanese-style" supply relationships are, in fact, absent in other Japanese industries, resulting in very different patterns of supply relationships across industries. I use the notebook computer industry as one example in which three important elements found in the automobile industry are largely absent: the existence of a sizable pool of external suppliers, the feasibility of *shukko* and manufacturer-supplier shareholding as a means of strengthening supply relationships, and the adequacy of these means to manage the governance and communications difficulties inherent in procuring components externally.

In Japan, both the automobile and notebook computer industries prefer long-term suppliers over new suppliers, especially in the presence of uncertainty. In the automobile industry, long-term relationships have permitted manufacturers to engage in extensive outsourcing, providing cost savings, flexibility, and greater innovation than otherwise possible (Dyer, 1996b). However, in the notebook computer industry, Japanese firms engage in very little outsourcing, even to long-term suppliers. They do so even at the cost of not accessing superior technical capabilities available from external suppliers.

This finding has three implications. First, it debunks the myth of a monolithic model of "Japanese-style" supply relationships. Second, it shows that supply relationships are not the inevitable outcome of the larger institutional environment in which they occur. Third, it highlights the need to focus on the role of

idiosyncratic elements in an industry's competitive environment that influence the development of supply relationships. Understanding the role of these elements helps us predict under what conditions long-term relationships are most beneficial. Such predictions are especially relevant given efforts in the United States to move from confrontational supply relationships to more Japanese-style collaborative, long-term relationships (Dyer, 1996b; Helper, 1991).

In the next section, I review prior research on Japanese supply relationships, paying special attention to the role played by three elements found in the oft-studied automobile industry: the existence of a sizable pool of external suppliers, the feasibility of *shukko* and manufacturer-supplier shareholding as a means of strengthening supply relationships, and the adequacy of these means to manage the governance and communications difficulties inherent in procuring components externally. I then discuss the notebook computer industry as a contrasting venue for exploring supply relationships. Finally, I present evidence that relationships in the notebook computer industry differ in important ways from the conventional wisdom about supplier relationships in Japan and relate these differences to variation in three elements of each industry's competitive environment.

PRIOR RESEARCH ON JAPANESE SUPPLY RELATIONSHIPS

Prior research has found that a cluster of inter-related traits characterize Japanese supply relationships: concentration of transactions to a small number of suppliers, many of which become long-term partners; support of these relationships by shareholding and the transfer of employees; and heavy reliance on suppliers for the design and development of new components. I examine each of these points in turn and discuss the theoretical explanations put forward for each.

In the automobile industry, it is not unusual for a firm and its main suppliers to have transacted for over 30 years without interruption (Japan Fair Trade Commission [Kosei Torihiki Iinkai], 1993 quoted in Ahmadjian and Lincoln, 2001). Japanese manufacturers rarely change suppliers (Dyer & Ouchi, 1993; Helper, 1991). Dyer and Chu (2000) found the rate at which automotive suppliers won renewal of their contracts averaged 91% across manufacturers, with little variance. In contrast, the re-win rate for suppliers to Korean and U.S. manufacturers averaged 77 and 71%, respectively, with considerable variation across manufacturers.

Some of these relationships are further supported by shareholding. Japanese automakers surveyed by Dyer and Chu (2000) reported holding an average of 11% of their suppliers stock. A broader survey by the Japanese Fair Trade Commission

found that each Japanese automaker dealt with an average of 392 suppliers, of which 16.1% were affiliated by shareholding (Dodwell Marketing Consultants, 1995). In some cases, manufacturers held a large portion of a supplier's stock: over 20% in almost a third of affiliated shareholdings. In over 60% of affiliated suppliers, however, the manufacturer held under one-tenth of the supplier's stock. Consistent with this, Gerlach (1992) argues that manufacturers hold stock in suppliers as a symbol of their relationship, rather than to exercise economic control.

Supply relationships are also often accompanied by *shukko*, the exchange of personnel between companies (Asanuma & Kikutani, 1992). One role of *shukko* is to allow the manufacturer to shift surplus employees to suppliers, rather than laying them off. However, it is most important as a means of developing new capabilities and supporting technology transfer. As such, it is often reciprocal. Engineers from the manufacturer may visit a supplier both to learn about a supplier's technology and to teach the supplier new techniques. The supplier may send engineers to the manufacturer in order to better understand the manufacturer's technology (Lincoln & Ahmadjian, 2000).

Supply relationships characterized by long-term affiliation, cross-shareholding and *shukko* are concentrated among a small number of suppliers. Asanuma (1992) found that a typical Toyota plant had only 125 suppliers, compared to 800 for the typical General Motors plant. At the firm level, Toyota had approximately 224 suppliers, compared to over 5500 for General Motors. Japanese manufacturers concentrate their purchases among relatively few suppliers to maximize economies of scale. Through management of long-term supply relationships, they avoid many of the difficulties that would otherwise accompany dependence on a small number of suppliers.³

Relying on close relationships, Japanese manufacturers rely heavily on suppliers for the design and development of new components (Asanuma, 1992; Wasti & Liker, 1999). They also outsource the production of many components. Dyer and Ouchi (1993) estimate that Japanese automobile manufacturers make only 27% of their components in-house, while U.S. firms produce 54% in-house. Data from 1987 on all manufacturing industries show that internally produced components are only 31% of total cost of goods sold for Japanese manufacturers, relative to 45% for U.S. firms. Nor is outsourcing limited to simple, standardized components; Japanese manufacturers outsource complex inputs as well (Morris & Imrie, 1992).

The prevalence of outsourcing had led to Japanese firms having lower employee to sales ratios than on average than U.S. firms (Asanuma & Kikutani, 1992; Sako, 1992). The large number of quasi-integrated subcontractors, each serving primarily one manufacturer, means that the average Japanese supplier is also smaller than its U.S. counterpart. Even though the Japanese automotive industry

produces one-third of the world's total output, only 19 of the world's top 100 automotive parts suppliers are Japanese (Smitka, 2002).

These practices benefit Japanese manufacturers. Japanese automotive manufacturers obtain a better new product development performance working with external suppliers (Clark & Fujimoto, 1991). Additionally, external suppliers provide higher-quality or lower-cost components than would otherwise be available, even for complex components (Cusumano & Takeishi, 1991; Nishiguchi, 1994).

Theoretical explanations for these practices and the performance advantages they generate focus on their role in improving governance and communication. Manufacturers benefit if their suppliers make relationship-specific investments in physical or human capital (Dyer, 1996a; Parkhe, 1993). Because these investments expose the supplier to potential opportunism, they will only be made when the ensuing governance problem can be solved efficiently (Williamson, 1985).

Long-term relationships, shareholding, and *shukko* all reduce the perceived likelihood of opportunism. Interactions between individuals over a long period of time build trust (Ring & Van de Ven, 1994), which can become institutionalized, thereby increasing inter-organizational trust (Zaheer, McEvily & Perrone, 1998). Consistent with this finding, Sako and Helper (1998) find that Japanese automobile suppliers are more trusting of customers with whom they have transacted for a long time, reducing the supplier's fear of opportunism. By creating more opportunities for managers and engineers from the buyer and supplier to interact over an extended period, *shukko* contributes to building trust. *Shukko* also represents a form of technical assistance from the buyer to the supplier, which Dyer and Chu (2000) and Sako and Helper (1998) found increased a supplier's trust of a customer. Stock ownership can align the economic incentives of a buyer and supplier (Cusumano, 1985; Gerlach, 1992), as well as serving as a public symbol of a relationship, creating conditions for trust to develop (Gerlach, 1987).⁴ As a result, Japanese suppliers make greater investments in relationship-specific human capital (Carroll & Hannan, 2000) and physical capital (Asanuma, 1998; Gilson & Roe, 1993) than non-Japanese suppliers.

Even in the absence of opportunism, successful buyer-supplier collaboration depends on timely, accurate communication of technical details. Long-term relationships contribute to this through the development of communication routines (Mitchell & Singh, 1996) and a common language for discussing technical issues (Buckley & Casson, 1976). By giving employees direct exposure to their partner firm, *shukko* also supports the transmission of tacit knowledge (Lincoln & Ahmadjian, 2000; Nonaka & Takeuchi, 1995). The role of stock ownership is more tenuous, but any sense of shared destiny it may create enhances communication in much the same way belonging to the same organization does (Kogut & Zander, 1996).

Informal means of managing potential opportunism are especially valuable when other mechanisms, particularly formal ones such as contracting, are ineffective (Johnson, Levine & Woodruff, 2002). At least three factors make Japan such an environment: low labor mobility, a low level of generalized trust, and scarcity or ineffectiveness of transaction costs engineers, such as attorneys.

Limited Labor Mobility

One effect of so-called "lifetime employment" in Japan is limited employee mobility between companies. This complicates both governance and communication between a buyer and supplier.

When there is labor mobility between firms in an industry, buyers are more likely to know employees at potential suppliers by virtue of contact in earlier positions, which provides a basis for trust. This is less likely to occur in Japan.

The lack of employee movement leads to the development of distinctive technical cultures within companies, each with its own language and problem-solving approaches. This raises the cost of communication between companies, especially in the case of leading-edge technology, which is associated with uncodified, tacit knowledge. In contrast, firms in the United States rely on hiring workers from other companies to break down these barriers (Ettlie, 1985). The general taboo on mid-level hiring removes that option for most Japanese companies.⁵

Shukko is a direct response to this limitation. When it is not possible to hire an employee, firms try to gain the same benefits through the exchange of employees (Lincoln & Ahmadjian, 2000).

Low Generalized Trust

Debate exists as to whether trust is high in Japanese society. Fukuyama (1995) argues that aspects of Japanese culture make Japanese society high in trust. However, Yamagishi and his co-authors (Yamagishi, 1988; Yamagishi, Cook & Watabe, 1998) use surveys and experimental data to argue that trust is very low in Japan when monitoring and sanctioning do not exist. Consistent with Yamagishi's findings, other survey data reveal that general levels of trust are lower in Japan than in the United States (La Porta, Lopez-de-Silanes, Shleifer & Vishny, 1997).

To the degree that trust in Japan depends on monitoring and sanctioning, long-term relationships accompanied by *shukko* and shareholding will be

particularly privileged relative to other relationships because they provide the requisite monitoring and sanctioning mechanisms. Besides the obvious impact on governance, communication will also be relatively impeded outside of close relationships. Information in Japan flows freely within groups, but only narrowly outside groups' bonds of trust and familiarity (Lincoln, 2001, p. 131).

Scarce, Ineffective Transaction-Costs Engineers

The idea that Japanese interfirm relationships are a response to an inefficient legal structure goes back at least to 1984 (Cooter & Landa, 1984). An often-cited element of this inefficiency is the lack of lawyers. Japan has only 17,000 licensed attorneys, compared to 900,000 in the United States.⁶ Beyond this, there is also a relative lack of other professionals, such as accounting firms and credit-rating agencies (Milhaupt & West, 2000).

Despite assertions, both serious and facetious, that a shortage of attorneys has advantages, it can also be disadvantageous. Attorneys and similar professionals play an important role as "transaction costs engineers," devising efficient mechanisms to deal with market imperfections (Gilson, 1984). Milhaupt and West (2000) show that their absence creates an environment in which organized crime can assume this role and flourish. In the commercial setting, their absence creates at least two difficulties.

First, the ability of firms to perform due diligence and to design legally complex contracts at the beginning of a relationship is curtailed, with lawyers having little involvement in drafting contracts (Smitka, 1994). Second, if a dispute does arise, there are fewer legal resources available with which to pursue litigation. The slow rate at which litigation moves in Japan is a further disincentive to resolve disputes via the legal system (Miyazawa, 1995). Given these disincentives, it is not surprising that the litigation rate in Japan is much lower than in the United States (Hamada, 2000).

A network externality compounds the second difficulty. With limited experience in adjudicating commercial disputes, the courts miss out on the opportunity to develop expertise. Just as "Widely used laws are likely to be well serviced by lawyers and judges" (Milhaupt & West, 2000, p. 95), little used laws are likely to be poorly serviced.⁷

The partial foreclosure of the legal system as an effective way to structure a complex relationship or resolve disputes makes working with an unfamiliar supplier on a complex, uncertain project a daunting task. A trusted long-term supplier or an internal supplier is more attractive.⁸

PROPOSITIONS

The supply relationships described above are premised on the existence of several elements. These include the existence of a sizable pool of external suppliers, the feasibility of employee transfer (*shukko*) and manufacturer-supplier shareholding as a means of strengthening supply relationships, and the adequacy of these means to manage the governance and communications difficulties inherent in procuring components externally.

To explore the impact of these elements, I form several propositions reflecting the supply relationships past research would lead us to expect in other Japanese industries. I then test whether they hold in notebook computers, an industry where these elements do not exist to the same degree. The propositions serve as a framework for comparing the notebook computer industry to the conventional wisdom and are not meant as hypotheses to be falsified or confirmed.

Propositions 1a and 1b relate to Japanese manufacturers' use of long-term suppliers. Long-term suppliers offer easier governance and communication than other external suppliers. Unless another supplier offered some offsetting advantage over a long-term supplier, such as lower price or higher quality, long-term suppliers are more attractive.

Proposition 1a. All else being equal, Japanese firms will prefer long-term suppliers to other external suppliers.

By limiting the number of suppliers with which they trade for a given component, Japanese manufacturers can maximize scale economies. Through their management of long-term supply relationships, they avoid many of the difficulties that would otherwise accompany dependence on a small number of suppliers.

Proposition 1b. Japanese suppliers will use fewer suppliers for a component than will non-Japanese firms.

Propositions 2a and 2b concern Japanese manufacturers' ability to avoid vertical integration through superior relationships with long-term external suppliers. Japanese manufacturers rely heavily on external suppliers. They produce a smaller proportion of their inputs internally, whether measured by the number or value of those inputs.

Proposition 2a. Japanese firms will rely less on internal supply than non-Japanese firms.

This difference is amplified under high uncertainty. When a transaction is beset by high uncertainty, contracts with an external supplier will be expensive

to write, likely to leave many contingencies unaddressed, and unlikely to be satisfactorily resolved by the court system (Masten, 1984). Absent mechanisms to control opportunism, very-high-uncertainty transactions would not occur outside the firm. However, relying on the benefits of long-term relationships, Japanese manufacturers can carry out complex, uncertain transaction with "quasi-integrated" long-term external suppliers (Cusumano & Takeishi, 1991).

Proposition 2b. Japanese manufacturers' use of long-term external suppliers will be less impacted by high uncertainty than non-Japanese firms.

THE NOTEBOOK COMPUTER INDUSTRY

Manufacturers in the notebook computer industry source a wide array of components. Rather than explore supply relationships broadly, across all components, I examine in depth manufacturer relationships with flat display providers.

I begin by providing background on displays and the interaction that occurs between a notebook computer maker and its display suppliers. Displays are a particularly salient component to study because they are central to the user's overall experience with a notebook computer. They are also among the most expensive components in the computer. Notebook manufacturers therefore take great care in choosing a display supplier.

Competitive pressures compel notebook manufacturers to constantly focus on the next generation of displays, larger and higher resolution than the current generation. For example, when the largest extant notebook display was 12 inches, engineering work was under way for computers with a 13-inch display. The move to a larger display requires at least 9–12 months of engineering effort. Two types of difficulties must be overcome during this period. First, the display itself must be manufactured. Second, the display must be integrated into the new notebook computer.

Manufacturing larger or higher-resolution displays demands new handling equipment and processes. For example, larger displays require applying processes such as vapor deposition or photolithography uniformly over an ever-increasing surface area. Higher-resolution displays require more circuitry on the same-size display, which demands reduced line-widths, tighter tolerances, and more driver chips with more challenging packaging.

The notebook maker and display supplier must communicate continuously during the 9–12 months required to develop a new display and simultaneously design a notebook computer to incorporate that display. The subjective nature of

many display specifications drives this communication. For example, it is possible to specify and measure a display's absolute brightness, but designers can determine consumer acceptance of a given brightness only in the context of other parameters, including color matching, brightness uniformity and brightness leakage. As a result, even though the initial specifications from the notebook manufacturer are usually very demanding, the manufacturer and supplier will negotiate compromises during development on a wide spectrum of specifications including driving method, driving voltage, input signal, the dimension of the module, and connector shapes. The changes affect both the display and the design of the computer in which it will ultimately reside.

Because of the time required and the challenges to be overcome, a manufacturer must choose a supplier to develop a new display when the required technology does not yet exist and the parameters of the final product are not known. This means both the selection of a supplier and the development of the new display will be highly uncertain.

There is also an active market for notebooks with displays several generations behind the leading edge. For example, Apple successfully introduced the iBook with a 12.1-inch display in 2001, despite widespread availability of notebooks with displays larger than 15 inches. Lower prices attract some consumers to the smaller display notebooks; their lighter weight and more compact form attract others. Because the technology to build older-generation displays already exists, uncertainty is much lower. However, it is not a spot market because circuitry and dimensions are not standardized. For example, Samsung supplies worldwide but has five different specifications for its 13-inch display. The lack of standardization creates a need for joint engineering effort, even for notebooks using older-generation displays. Once this engineering is accomplished, manufacturers are reluctant to switch suppliers because of the associated cost and delay in re-engineering.

Data

My primary data source for understanding relationships between notebook computer manufacturers and their display suppliers was the COMTRAK database compiled by Stanford Resources, one of the industry's leading consulting firms. For each model produced by a notebook manufacturer, COMTRAK provides the size and resolution of the display, as well as the firm that supplied it. Stanford Resources compiled the information in COMTRAK from interviews with display suppliers and notebook manufacturers from 1992 to 1998. I augmented these data with other data gathered from the trade press and issues of *Laptop Handbook and*

Buyer's Guide. I also interviewed notebook computer and display manufacturers and other industry participants in the United States and Japan.

The result of this effort was a complete inventory of a notebook manufacturer's relationships with each display supplier. This inventory allowed for the identification of notebook models with new displays, those for which the required technology did not exist when the manufacturer chose a display supplier for that model, thereby allowing me to examine supplier relationships under varying levels of uncertainty.

The data include information on 995 different notebook computer models by 22 manufacturers. Six Japanese manufacturers manufactured 310 of the 995 models. There were 116 models for which the manufacturer had to choose a supplier before technology required to produce the new display existed.

An additional advantage of the COMTRAK data was that it allowed me to calculate several measures of a manufacturer's relationship with a supplier at the time the manufacturer was choosing a supplier. I calculated the length of the relationship, that is, the number of years in which the manufacturer had purchased at least one notebook computer display from the supplier. I also measured whether the supplier was a current supplier to the manufacturer when it was chosen or if it had previously supplied that manufacturer when it was chosen (see Table 1).

Manufacturers are more likely to choose a supplier with strong technical capabilities, all else being equal (Hoetker, 2001). To control for this, I followed common practice (Hall, Jaffe & Trajtenberg, 2000) and measured a supplier's technical capability by the number of granted display-related U.S. patents it had applied for in the previous 5 years. This figure is updated annually. I defined

Table 1. Descriptive Statistics and Correlations.

Variable	M	S.D.	Min	Max
Experience with supplier (years)	0.94	1.31	0	5
Current supplier	0.45	0.50	0	1
Past supplier, current or not	0.47	0.50	0	1
Display related patents	446.34	256.04	1	926
Internal supplier	0.21	0.41	0	1
	1	2	3	4
				5
Experience with supplier (years)	1.00			
Current supplier	0.76	1.00		
Past supplier, current or not	0.77	0.96	1.00	
Display related patents	0.34	0.27	0.27	1.00
Internal supplier	0.35	0.16	0.14	0.00
				1.00

display-related patents as those containing the terms "liquid crystal display" or "LCD" or classified in International Patent Classification section G02F 1/-, G09G 3/-, G09F 9/3-, or G09F 13/-. I selected these patent classifications according to Spencer (1997) and confirmed that they were the classifications common to all patents selected for inclusion in the "Liquid Crystal Display" section of *Industry and Technology Patents Profiles: Electronic Displays and Display Applications*, published by Derwent Information/Thompson Scientific, a leading publisher of patent information. Unreported analyses using display-related patents in the last year and total display-related patents yield the same results as this measure.

FINDINGS

The actual behavior of Japanese notebook computer manufacturers is more complex than that described in Propositions 1 and 2. Consistent with Propositions 1a and 1b, Japanese manufacturers favor a small pool of long-term suppliers over other suppliers. Contrary to Propositions 2a and 2b, however, Japanese firms are more reliant on internal development than are U.S. firms, even at the cost of not accessing external technical capabilities. Uncertainty affected their ability to work with external suppliers as strongly as it affected non-Japanese firms.

Use of Long-Term Suppliers

Consistent with Proposition 1a, Japanese notebook computer manufacturers had longer-term, more continuous relationships with their suppliers than did non-Japanese manufacturers. Table 2 shows that in 54% of procurement decisions, Japanese manufacturers chose a current supplier, compared to 44% for non-Japanese manufacturers.⁹ On average, Japanese manufacturers bought from a supplier with whom they had an average of 2.65 years' prior experience, while non-Japanese firms had only 1.16 year of prior experience with the suppliers from whom they chose to buy (Table 3).¹⁰

Table 2. Number and Percentage of Notebook Models Using Displays from (Non)-Current Suppliers, 1992–1998.^a

	Non-Current Supplier	Current Supplier
Japanese	124 (46.1%)	145 (53.9%)
Other	392 (57.5%)	290 (45.5%)

^ap (Japanese use of current supplier > other's use of current supplier) < 0.001.

Table 3. Average Length of Past Relationship With Suppliers, 1992–1998.^a

Notebook Manufacturer Nationality	Average Length of Past Relationship With Suppliers (S.E.)
Japanese	2.65 (0.13)
Other	1.16 (0.07)

^ap (Japanese > other) < 0.001.

Consistent with Proposition 1b, Japanese notebook computer manufacturers rely on a small number of long-term display suppliers compared to non-Japanese manufacturers. As shown in Table 4, the average Japanese manufacturer used 2.4 different suppliers over the period 1992–1998, while the average non-Japanese manufacturer used 5.0 different suppliers.¹¹ This indicates that Japanese firms concentrate on a small group of suppliers but are biased by the fact that Japanese firms were present in the data for fewer years than U.S. firms. Table 5 avoids this bias by presenting the average number of external suppliers used per year. Japanese firms used 2.19 different suppliers per year, while non-Japanese firms use an average of 2.95 manufacturers.¹² Thus, Japanese firms both spread their business less widely each year and switched suppliers less frequently year to year.

In combination, these findings support the conventional wisdom about Japanese manufacturer's relationships with external suppliers. As is the case in

Table 4. Average Number of Suppliers Used by Each Notebook Manufacturer, 1992–1998.^a

Notebook Manufacturer Nationality	Average Number of Suppliers (S.E.)
Japanese	2.66 (0.61)
Other	5.00 (0.51)

^ap (other > Japanese) = 0.006.

Table 5. Average Number of Suppliers Used Per Year by Each Notebook Manufacturer, 1992–1998.^a

Notebook Manufacturer Nationality	Average Number of Suppliers (S.E.)
Japanese	2.19 (0.24)
Other	2.95 (0.12)

^ap (other > Japanese) = 0.004.

the automotive industry, Japanese firms prefer to deal with a small number of long-term suppliers.

Interestingly, these results stand in contrast to Chesbrough's (1997) findings for the Japanese notebook computer manufacturer's procurement of 2.5-inch hard disk drives over roughly the same period. Chesbrough found that manufacturers relied on a mix of internal supply, affiliated suppliers, and U.S. suppliers, with whom they had no affiliation. Thirty-six percent of the drives procured by the four firms he studied came from affiliated firms.¹³ A potential explanation is that Japanese disk drive manufacturers lagged far behind U.S. competitors in 2.5-inch drives, making U.S. suppliers attractive until Japanese firms increased their quality. I discuss this point in more detail below.

Lincoln and Ahmadjian (2000) have also pointed out that the Japanese electronics sector in general has a history of more arm's length supply relationships and less supplier involvement in product design. It is unclear to what degree this general statement applies to specific components, so it is ambiguous how unusual the findings for displays are within the broad realm of electronic components.¹⁴

Low Level of Outsourcing

Contrary to Propositions 2a and 2b, Japanese firms rely *more* on internal suppliers than do non-Japanese firms. Of the 310 models for which Japanese firms procured displays, approximately three-quarters (71.29%) used displays from internal suppliers (Table 6). By comparison, only 6% of models from non-Japanese firms used displays from internal suppliers.¹⁵ This contradicts Proposition 2a.

To test Proposition 2b, I focus on the procurement of displays for which the necessary technology did not yet exist, since these were ones for which technical uncertainty was a major concern. If the proposition holds, Japanese manufacturers would be less affected by increasing uncertainty and would be able to continue using external suppliers when non-Japanese firms would have been forced to pursue internal production.

Table 6. Number and Percentage of Displays Procured from External/Internal Sources, 1992–1998.^a

	External Supplier	Internal Supplier
Japanese	93 (29.2%)	226 (70.8%)
Other	693 (94.3%)	42 (5.7%)

^a*p* (Japanese use of internal suppliers > other's use of internal suppliers) < 0.001.

The uncertainty posed by the development of a display depends on the degree of technical advance required to produce the desired display. Display development may be characterized as uncertain in two ways. Certain displays may be subjectively perceived as requiring more technological advances than others. To get at this perception, I employed a 5-point scale to measure "advance beyond existing technology." A researcher in a leading consulting company, an 18-year industry veteran with experience as both a product engineer and product marketing manager, provided this rating for each innovation I observed in my data. As this measure was constructed after the fact, it may be biased by knowledge of which innovations ultimately proved the most difficult. However, the current measure is likely to be closely correlated with a priori perceptions of uncertainty unless there were particular innovations that proved surprisingly difficult or simple (which my informants indicated did not occur).

Both Japanese and non-Japanese firms relied on internal supply more for displays above mean uncertainty than for those below mean uncertainty (Table 7). Non-Japanese firms procured 9.1% of their low-uncertainty displays from internal suppliers, a figure that increased to 13.1% for high-uncertainty displays. Japanese firms also increased their internal procurement for high-uncertainty innovations to 69.2%, compared to 50% for low-uncertainty innovations. Uncertainty affected Japanese manufacturers' ability to work with external suppliers as strongly as it affected non-Japanese firms.¹⁶ That is, the strength of the relationship between uncertainty and internal production is the same for Japanese and non-Japanese firms. This contradicts Proposition 2a, which predicted that uncertainty would have a weaker effect on Japanese manufacturers' use of external suppliers.

The second measure of technical uncertainty may be conceptualized as a dichotomous measure of whether suppliers could produce the display by refining existing techniques or if new techniques were necessary. A resolution increase was highly uncertain if it required new process technology or breakthroughs in metallurgy, rather than executing existing materials and processes better. A

Table 7. Impact of Uncertainty on Internal Procurement, 1992–1998 (1).^a

	Japanese Manufacturer		Other Manufacturer	
	External Supplier	Internal Supplier	External Supplier	Internal Supplier
Low uncertainty	50.0	50.0	90.9	9.1
High uncertainty	30.8	69.2	86.7	13.3

^aFigures indicate the percentage of displays sourced from each type of supplier. High uncertainty: higher than the mean ranking (2.8) based on an industry ranking of uncertainty on a scale of 1–5 according to the amount of advance beyond the current technical horizon required.

size increase was highly uncertain if it required the assembly of an entirely new fabrication line, as opposed to being possible through improvements in an existing fabrication line. It was clear before development began when the limits of current materials or production lines had been reached. A senior industry participant who worked in the display division of a firm that made both displays and notebooks suggested this measure. For each innovation I observed, he identified whether it required a new process or not.

This measure also reveals that both Japanese and non-Japanese firms relied more on internal supply for highly uncertain innovations. Non-Japanese firms procured 23.1% of high uncertainty innovations internally, compared to just 8.2% of low uncertainty innovations (Table 8). The corresponding figures for Japanese firms are 85.7 and 50%. Again, the strength of the relationship between uncertainty and internal supply does not differ for Japanese and non-Japanese firms.¹⁷

Detailed examination of individual companies provides additional insight into the drivers of supply relationships. Of the 32 procurement decisions by Hitachi in the data, only one is from an external supplier (Sharp). It was for a display both smaller and of lower resolution than the state of the art. Hitachi was a technical leader during this period, ranking 3rd or 4th in terms of number of display-related patents, which may explain its preference for internal procurement.

Technical strength alone does not explain NEC's behavior, however. NEC ranked between 6th and 10th in number of display-related patents over this period, yet displays for 72 out of 85 models were procured internally. Of the 13 it procured externally, 12 were passive matrix,¹⁸ an older, less technically demanding technology, which NEC had exited. NEC sourced all of its innovative active matrix displays internally.

Toshiba is closer to the conventional image of a Japanese firm: It procured displays for almost half of its models (67 out of 148) from its only external suppliers, Sharp and Sanyo. Despite this general pattern, its behavior when procuring displays for which the necessary technology did not already exist resembled that of Hitachi and NEC. Of 12 such displays, 8 were procured internally.

Table 8. Impact of Uncertainty on Internal Procurement, 1992–1998 (2).

	Japanese Manufacturer		Other Manufacturer	
	External Supplier	Internal Supplier	External Supplier	Internal Supplier
Low uncertainty	50.0	50.0	91.8	8.2
High uncertainty	14.3	85.7	76.9	23.1

Note: Figures indicate the percentage of displays sourced from each type of supplier. High uncertainty: new production process required.

Only 1 of the externally procured displays was active matrix (procured from Sharp). Two passive matrix displays came from Sanyo and one from Sharp.

These findings are largely in keeping with other recent research. Lincoln and Ahmadjian (2000) found a higher level of vertical integration within the electronics industry in general than in the automotive industry. Chesbrough (1997) found that Toshiba depended on internal production for 63% of 2.5-inch disk drives it procured, while Fujitsu and Hitachi sourced approximately half of their 2.5-inch drives internally. The level of internalization I observe in display procurement is more extreme than either of these papers' findings.

Discussion

Long-term supply relationships with a small number of suppliers play an important role for both automobile and notebook computer manufacturers in Japan. While automobile manufacturers are able to use these relationships to delegate design and production of even complex components to external suppliers, a high degree of internal production characterizes the Japanese notebook computer industry. This is true even for companies lagging behind the technical frontier.

These two industries operate within the same economic and institutional environment. Given this, we can conclude that the pattern observed in the automobile industry is not an inevitable outcome of its Japanese institutional environment. Two inter-related differences between the automotive and notebook computer industries can explain the divergence in supply relationships: the distribution of capabilities among suppliers and the speed of technical progress. These differences affect the size of the supplier pool, the availability of shareholding and *shukko* as tools to deepen relationships, and the adequacy of these tools to manage the governance and communications difficulties inherent in procuring components externally.

Relative to most automotive components, the technical expertise required to manufacture flat panel displays is highly concentrated in a relatively few companies. Patenting activity in the United States provides several ways to gauge how widely distributed the required technical knowledge is. At a broad level, 877 companies had at least one patent in U.S. Patent Class 123 (internal combustion engines) between 1992 and 1998, 556 had a patent in Class 188 (Brakes), but many fewer, 327 firms, had a patent in Class 349 (liquid crystal displays). More revealing is the concentration of technical capabilities among industry leaders. The 10 companies with the most patents in brakes combine to make up only 23% of all brake patents, while the top 10 patenting companies in engines generate 38% of all engine patents. In flat panel displays, however, this figure is much higher, 47%.

Furthermore, the high cost of establishing a new fabrication line (up to \$1 billion) limits the possibility of new entrants. Together, these factors limit the number of potential display suppliers from which a notebook computer maker can choose.

Another important consideration is that many potential display suppliers are also manufacturers of notebook computers. The nine top patenting companies that manufacture displays also make notebook computers.¹⁹ By comparison, the top 10 engine patenting companies include Bosch, Sanshin, Nippondenso, and Caterpillar, which are not direct competitors for automotive customers. Among brake firms, only two of the top ten patenting firms produce automobiles: General Motors and Nissan. Major independent brake suppliers include Allied Signal, Westinghouse, Tokico and Eaton.

The concentration of the supply base is accompanied by a much faster rate of technical progress in the notebook computer industry than in the automobile industry. For example, Japanese automobile makers aim at major model changes every 4 years. Transmission designs have a life of approximately 8 years and engines parts a life of 7–10 years (Asanuma, 1992). By comparison, in the 6 years from 1992 to 1998, displays in notebook computers moved from being dominated by 9.5-inch monochrome VGA (640×480 pixels) passive matrix displays to 14-inch color XGA (1024×768 pixels) active matrix displays. Display area increased 299%, and resolution increased 250%. Display makers developed three new generations of fabrication equipment over 6 years to accomplish these advances.

Buyer-supplier communication is difficult under rapid technical progress because the codification of language lags behind the advance of the technical frontier. Japanese automakers use long-term relationships and *shukko* to enable collaboration with external suppliers in similar situations. This approach is less effective when dealing with a supplier that is also a competitor. *Shukko* is unlikely between competitors, given the possibility of information leakage (Lincoln & Ahmadjian, 2000). As a result, firms have fewer opportunities to build a common language and communication routines with suppliers-cum-competitors.

The same factors complicate the governance of supply relationships in the notebook computer industry. Beyond the direct effect of higher uncertainty, Japanese notebook computer makers do not have access to many of the mechanisms used by automobile manufacturers. When working with a direct competitor, firms lose access to shareholding, whether to align incentives or for symbolic purposes. Restraints on *shukko* degrade not only communication, but also the development of trust by limiting interaction between individuals at the buyer and supplier. This is consistent with Chesbrough's (1997) finding that Japanese notebook computer manufacturers purchase from non-affiliated suppliers more when the number of such suppliers increased.

In summary, automakers can draw upon a large pool of potential suppliers, building long-term relationships accompanied by shareholding and/or *shukko* with the most important ones. They are likely to find an appropriate supplier for a given component or innovation among its close suppliers. Even complex and innovative automotive components may have a sufficiently low uncertainty that collaboration with an unfamiliar supplier is manageable. Thus, automobile manufacturers take advantage of long-term relationships but are not limited by them.

Japanese notebook computer makers have a greater challenge and fewer Japanese-style tools to address that problem. There is a smaller pool of display suppliers from which to draw. Many of the best suppliers are also competitors, further limiting the candidates with whom a manufacturer can build strong relationships that would include *shukko* and shareholding. As a result, Japanese notebook computer makers are often unable to find the capabilities necessary for a given component or innovation among their close suppliers. Handicapped in reaching out beyond this set of suppliers, manufacturers are pushed towards internal supply. This is especially likely to be the case for breakthrough technologies and other complex transactions. In essence, each notebook computer manufacturer may be the best potential supplier of those it can easily reach.

CONCLUSION

This research addresses a major gap in our understanding of Japanese supply relationships. Despite calls for attention to the diversity of supply relationships in Japan, our understanding of these relationships still derives overwhelmingly from a single industry, automobiles.

This chapter combines prior theoretical work with a large-scale empirical study to document a pattern of supply relationships very different from the commonly accepted view of Japanese manufacturing and to derive potential explanations for that difference. Doing so provides a more nuanced view of Japanese supply relationships, and also suggests when "Japanese-style" supply relationships – long-term, predominantly relational rather than contractual – are unlikely to succeed.

The environmental constraints governing the Japanese automotive and notebook computer industries are the same: limited labor mobility, low generalized trust when sanctioning is not possible, and a shortage of transaction cost engineers such as lawyers. However, there are also distinct differences between the two industries. Compared to automobile makers, notebook computer manufacturers compete in a faster-moving industry with far fewer players. As a result, the imperatives of the Japanese institutional environment constrain them in ways that do not constrain

automobile manufacturers. Consequentially, two very different patterns of supply relationships emerge.

Several insights derive from the findings of this study. The findings reinforce and amplify the call for examining supply relationship in other industries. The findings also make clear that industry specific factors require careful consideration. Based on the display industry, the speed of technical progress and the availability of independent suppliers are likely to be important. Nevertheless, key factors will likely vary across industries.

More generally, the study emphasizes how the impact of economic and social institutions can only be understood in the context of specific industries. At the same time, we can only generalize studies of individual industries if we understand industry-specific practices in the context of macro-level economic and social factors. We cannot assume that the rules by which the companies compete are the same across industries.

The performance of the Japanese automobile industry has encouraged many non-Japanese firm to move towards "Japanese-style" supply relationships, long-term and highly collaborative (Dyer, 1996b; Helper, 1991). This study suggests limits on the usefulness of these relationships. Success will only follow if social, economic, and technical factors allow the development of supporting mechanisms, such as shareholding and the exchange of personnel.

There are also policy implications within Japan. Attempts to "rationalize" Japanese buyer-supplier relationships by deconstructing elements of the old system, such as loosening cross-shareholding ties, may succeed only to the degree that other mechanisms arise to take their place.

Lastly, the study refines our understanding of the boundaries of the firm in the face of technical progress. Keeping pace with rapid change requires firms to invest heavily and to maintain a wider range of competencies than might normally be considered optimal. It also puts the firm at risk of being integrated into a technology that is superseded by technology that draws upon different competencies (Afuah, 2001). As a result, prior work suggests that firms generally avoid vertical integration in the face of rapid technical change (Balakrishnan & Wernerfelt, 1986). However, social, economic and industry-specific factors may make this strategy impracticable. Even if a Japanese notebook manufacturer wanted to exit the display market, there would not be enough suppliers with which they could develop the close relationships necessary to deal with high uncertainty. While it may not be possible to increase the number of suppliers within an industry, factors such as the reliability of formal dispute resolution mechanisms, e.g. the courts, are within the control of policy-makers.

The diversity of supply relationships in Japan provides an opportunity to understand interfirm dynamics under different social, economic and technical

conditions. One avenue of research would be to study additional industries. From this perspective, low-technology industries and those in which Japan is not internationally competitive (e.g. textiles) may be as potentially interesting as automobiles, electronics, and biotechnology. Another avenue would be to examine relationships within a single industry in much greater depth. Consider the range of components required to make a notebook computer – hard drives, displays, batteries, hinges, keyboards, and plastic cases. Holding the end product constant would allow a better understanding of supply relationships across these highly diverse components.

NOTES

1. Early work by Asanuma on the electronics industry has not been systematically extended. Smitka (1991) drew attention to the existence of intra- and interdiversity in Japanese supply relationships and provided brief, insightful examples of diverse supply relationships in several industries. In one of the few large-scale empirical studies of supply relationships outside of the automobile industry, Chesbrough (1997) studied hard-drive procurement decisions by notebook computer-makers. His work did not, however, attempt to explain why relationships varied between the computer and automobile industries. Ahmadjian and Lincoln (2000) explored changing supply relationships in the electronics industry. Guillot and Lincoln (2005) examine relationships in the TV industry, while Cusumano (1991) discusses the software industry.

2. Under-appreciation of heterogeneity among Japanese industries and companies is not limited to supply relationships. For example, Pekkanen and Solis (2004) are among the first to explore inter- and intra-industry heterogeneity in attitudes towards trade policy.

3. Despite the attention paid to these close relationships, there is a spectrum of supply relationships, even in the automobile industry. Suppliers range from "quasi-integrated subcontractor" (Carroll & Hannan, 2000), falling between the standard definition of internal and external supplier because of its close ties to a manufacturer, to independent suppliers that sell to multiple manufacturers, even if they have some ties to a manufacturer, e.g. Denso and Toyota (Ahmadjian & Lincoln, 2001).

4. Dyer and Chu (2000) found no relationship between stock ownership and trust in a study of the Japanese automobile supply industry. They speculate that this might reflect a degradation of shareholding's importance over time, shareholding's role as a replacement for trust, or their specific definition of trust. They do not rule out stock holding having a positive impact on cooperative supply relationships.

5. Interestingly, other activities can also contribute to commonality of technical cultures across companies. Examples include interaction with a few large suppliers/customers that are common across an industry, industry associations with their standards committees, professional associations and associated meetings, and use of common specialist service providers, e.g. software or test equipment. Such activities are widespread in Japan and other countries, making it likely that limited employee mobility creates a relative disadvantage for Japanese companies in this dimension. This area is worth future exploration.

6. Milhaupt and West indicate several reasons, including the presence of quasi-attorneys in Japan, that this figure is not as striking as it might seem. Nonetheless, they argue that it remains significant. The issue has recently attracted attention in the popular press also, e.g. Magnier (2001).

7. Ramseyer and Nakazato (1989) use data on litigation after fatal car crashes to argue that the predictability of settlement amounts awarded by Japanese judges is responsible for the low rate of litigation. Because both sides of potential litigation can predict the outcome, devise a private settlement based on that outcome, and avoid the costs and delays of litigation. Whether this reasoning is generally accurate or not (see Hamada, 2000 for a rebuttal of Ramseyer & Nakazato), the complex and idiosyncratic nature of new product development makes it unlikely to apply in that setting.

8. This is not to argue that the courts are an appealing avenue for dispute resolution in high technology, even in the United States. However, multiple cases demonstrate that U.S. high-technology firms can and do use the courts to resolve a variety of conflicts. Examples include Macromedia's patent litigation against Adobe (Macromedia wins \$4.9m in Adobe patent suit, 2002), the suit and counter-suit between Tellabs and Riverstone regarding Riverstone's alleged failure to deliver a cable modem termination system of sufficient quality (Weber, 2001), and 3Dfx's suit against Sega and NEC over Sega's cancellation of its contract with 3Dfx, which had agreed to develop a 3-D graphics accelerator chipset for Sega's next-generation home game console (3Dfx sues Sega, NEC over contract, 1997). The amount of formal litigation may underestimate the difference between the importance of the courts in Japan and the U.S., since the credible threat of litigating may push parties towards private settlement.

9. p (Japanese use of current supplier > non-Japanese use of current supplier) < 0.001.

10. p (Japanese > non-Japanese) < 0.001.

11. p (non-Japanese > Japanese) = 0.006.

12. p (non-Japanese > Japanese) = 0.004.

13. Note that my results refer to all long-term suppliers, a broader set of suppliers than "affiliated suppliers."

14. Lincoln and Ahmadjian offer the relatively high modularity of electronics components, which enables "off-the-shelf" buying, as a partial explanation of more distant supplier relationships. As discussed above, displays are significantly less modular than this description. This difference may explain my finding of close supply relationships for this specific component.

15. p (Japanese > non-Japanese) < 0.001.

16. Using additive and multiplicative uniform layer models (Goodman & Hout, 1998), it is not possible to reject the null hypotheses that the relationship between uncertainty and internal innovation is the same at conventional levels of significance. The hypothesis that the relationship between uncertainty and use of external suppliers differs for Japanese and non-Japanese firms is rejected at the 0.01 level of significance.

17. Again, both additive and multiplicative uniform layer models (Goodman & Hout, 1998), fail to reject the null hypotheses that the relationship between uncertainty and internal innovation is the same. The hypothesis that the relationship between uncertainty and use of external suppliers differs for Japanese and non-Japanese firms is rejected at the 0.01 level of significance.

18. There are two dominant technologies used in flat panel displays for notebook computers, passive- and active-matrix liquid crystal displays (LCD). Passive-matrix,

although less expensive, has several drawbacks: It relies on ambient lighting, can be difficult to see from an angle, and is subject to "ghosting," the faint afterimage of a rapidly moving cursor. Active-matrix, also known as thin-film transistor liquid crystal display (TFT-LCD), is considerably more complex and expensive. However, it allows the use of a backlight, freeing the user from dependence on ambient lighting. It is also capable of a much faster display and is thus appropriate for full-motion video and other modern multimedia applications. It can also be viewed from a wider angle. Currently, almost all notebook computers use active matrix displays. Passive matrix displays appear only in applications such as PDAs and cell phones.

19. The other top 10 patenting firm, Semiconductor Energy Lab, is not a potential display supplier. It has no manufacturing capabilities and exists purely to generate and license intellectual property.

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PART III: MNCs ON FOREIGN SOIL

In this section, we examine MNCs operating outside their home country, with three papers focusing on Japanese firms overseas and one on foreign firms operating in Japan. Beechler, Pucik, Stephan, and Campbell tackle a longstanding sore spot in the international management of Japanese corporations: to explain Japanese overseas affiliate performance and Japanese expatriate staffing patterns. Their findings point to the struggle Japanese MNCs face as they strive to make a transition from “multinational” to “transnational.” They conclude by noting that the primary challenge for Japanese companies is in growing a cadre of managers possessing transnational skills through providing opportunities for local executives to develop capabilities such that they can fill the role of transnational integrators.

Yoshihara focuses on the performance deficit of Japanese MNCs as their performance in Asia declines, something he anticipated in the 1980s (Bartlett & Yoshihara, 1988). His analysis concludes that the essential elements of “Japanese style international management” – management *by* Japanese *in* Japanese from Japanese headquarters *in* Japan was successful in the past, but is now being overtaken by a newer Asian style that has more in common with Western approaches to management.

Beechler, Levy, Taylor, and Boyaçigiller, finding structural responses to globalization inadequate, turn to the development among managers of a global mindset in response to increasing pressures of international competition. After finding that perceptions of top management’s global orientation influence employee attitudes, Beechler and her colleagues note that Japanese firms may be able to overcome their management liabilities by leveraging the information sharing orientation of “traditional” Japanese management. That managerial liabilities may hold the seeds of managerial strength constitutes an insight that might also be applied to non-Japanese MNCs.