BEA Working Paper Series, WP2022-5

Economies of Scope and Relational Contracts:

Exploring Global Value Chains in the Automotive Industry

Authors Susan Helper, Weatherhead School of Management, Case Western Reserve University, and Abdul Munasib, U.S. Bureau of Economic Analysis

Author of Contact Abdul.Munasib@bea.gov
susan.helper@case.edu

Date April 2022

Abstract Most economic theories of value-chain governance examine one transaction at a time and focus on transaction type as the key determinant of governance. We instead consider several transactions jointly, suggesting that lead firms experience economies of scope in developing relational contracts with suppliers. A key determinant of governance is thus organization strategy (e.g., Toyota collaborates with all suppliers, including commodity-suppliers). Using U.S. Customs data on every component imported by vehicle manufacturers, we find that Japanese vehicle manufacturers have half as many suppliers per part as U.S. vehicle manufacturers and 70 percent longer relationships, even after controlling for product attributes.

Keywords Global value chain, firm organization, relational contracts

JEL codes D23, L2

Bureau of Economic Analysis
U.S. DEPARTMENT OF COMMERCE

November 22, 2021

Disclosure statement for "Economies of scope and relational contracts: Exploring global value chains in the automotive industry"

Each author (Susan Helper and Abdul Munasib) declares that they have no relevant or material financial interests that relate to the research described in this paper.

Our data do not involve human subjects, so we did not seek IRB approval.

Any opinions and conclusions expressed herein are those of the authors and do not represent the views of the US Census Bureau or the Bureau of Economic Analysis. The Census Bureau's Disclosure Review Board and Disclosure Avoidance Officers have reviewed this data product for unauthorized disclosure of confidential information and have approved the disclosure avoidance practices applied to this release under the Disclosure Review Board (DRB) clearance numbers CBDRB-FY21-047 and CBDRB-FY21-CED006-0003.

Susan Helper
Professor of Economics
Weatherhead School of Management
Case Western Reserve University
Cleveland, OH
susan.helper@case.edu

Abdul Munasib
Economist
Research and Methodology Group
International Directorate
Bureau of Economic Analysis
U.S. Department of Commerce
Abdul.Munasib@bea.gov

1. Introduction

Global value chains (GVCs) are a key source of competitive advantage for many firms. (Gereffi, Humphrey, and Sturgeon 2005; Baldwin and Okubo 2019). Lead firms can govern their relationships with suppliers in these chains in a variety of ways. They may buy from suppliers using spot markets or through long-term relationships, or they may own their suppliers either partially or fully. These choices affect lead firms' and suppliers' incentives to invest, to provide effort, and to coordinate with each other.

Most economic theories of value-chain governance examine a single transaction at a time. According to these theories, if "transaction hazards" such as specific assets or non-verifiable actions are present for a particular input, firms should safeguard the transaction with measures such as vertical integration, formal contracts, or relational contracts. Conversely, if an input market is characterized by perfect competition, then spot markets are optimal (Williamson 1975, 1985; Grossman and Hart 1986; Hart and Moore 2005; Gibbons and Henderson, 2012). These arguments suggest: (1) firms should govern transactions with different attributes in different ways (Bensaou and Anderson 1999; Dyer et al. 1998); and (2) all firms should conduct transactions with similar attributes in the same way.

However, real products generally require more than one intermediate input. We argue that there are important spillovers across the governance of these relationships, and that these spillovers increase both the clarity and the credibility of relational contracts, both within and between firms. To make our case, we draw on theories of supplier governance we call "organization-based" theories. These theories argue that a firm can gain competitive advantage from governing transactions all in the same way regardless of the attributes of the transaction, whether that be collaborative long-term relations like Toyota (Liker 2004) or hard-nosed bargaining like Walmart (Mottner and Smith 2009). These advantages include improved clarity and credibility of relational contracts (Gibbons and Henderson 2012) and complementarities within the buyer's organization (Helper 1991; Novak and Stern 2009). According to these theories, the key determinant of governance is thus organization strategy rather than transaction type. Since clear and credible long-term relational contracts between suppliers and customers are costly to establish, it makes sense to spread their benefits over more units. That is, these relationships are characterized by economies of scope: governing a relationship for a supplier of a second product in the same way as the first product will yield lower governance costs per unit.

We test implications of these theories using the Longitudinal Firm Trade Transactions Database (LFTTD), a U.S. Census dataset of all goods imported into the United States, for the years 1997–2015. In contrast,

most previous tests of these theories are based on small, cross-section datasets from a few firms or limited coverage of one industry, often the auto industry. See for example Monteverde and Teece (1982a and 1982b), Argyres and Bigelow (2010).

For tractability and comparison with previous literature, we focus on the automotive industry. We examine goods imported into the United States by U.S. and Japanese-owned vehicle manufacturers (VMs), that is, firms that assemble cars and trucks in the United States. We can identify the vehicle manufacturer that imported every component into the United States. and the foreign manufacturer that supplied it. The components are grouped into detailed 10-digit Harmonized Tariff Schedule (HTS) categories (e.g., "Vulcanized gaskets," "Washers and other seals," "Mountings, fittings and similar articles, of base metal").

We find that while attribute-based measures are statistically significant, organization-based measures have greater explanatory power. For example, the effect of being a Japanese vehicle manufacturer is 13 times greater than that of a one standard deviation change in a product's R&D intensity in explaining the number of suppliers per part (see Figure 2), and 16 times greater in explaining the level of vertical integration. Even after controlling for product attributes, Japanese vehicle manufacturers have fewer than half as many suppliers per part as the U.S. vehicle manufacturers, almost 70 percent longer relationships, and nearly 25 percent greater vertical integration.[1] Organization strategy and other buyer characteristics thus matter a great deal in determining supplier governance.

The focus of our paper is on the nature of dyadic ties between buyers and sellers (i.e., whether relationships are long-term, exclusive, etc.). Our goal is to understand determinants of the nature of these ties; we do not investigate whether they are efficient. In contrast, other papers look at the process of matching buyers with suppliers (that is, of establishing ties and building a network). For example, Kranton and Minehart (2001) show that efficient relationships can arise in a network of buyers and suppliers, and Ostrovsky (2008) shows that ties between firms in supply networks can be stable. Acemoglu et al. (2012) and Carvalho et al. (2021) show, respectively, that disruptions to sectors and firms in such networks can propagate macroeconomic shocks. These papers, however, do not examine the nature of relationships between individual buyers and sellers, and only Carvalho (2021) has firm-level data.

[1] These approximate calculations are based on the estimates reported in column 5 of table 2, and columns 3 and 6 of table 3, where the regressions are evaluated at sample means.

2. Literature Review and Propositions

2.1. Supply chain governance and the auto industry

Economic analysis of markets usually starts from a benchmark of perfect competition, in which there are many buyers and sellers, perfect information, homogeneous products, and no externalities. There are no barriers to entry for new suppliers; for customer firms, switching suppliers to get a better deal is costless. In this situation, using spot markets is a profit-maximizing policy for customer firms.

Scholars have noticed that supply chains in the real world usually do not operate under these conditions. Suppliers and customers often work together to optimize the design of products, processes, and components, developing tacit knowledge that creates substantial switching costs. Sometimes these actions are observable, and facilitated by long-term contracts enforceable by courts. In other cases, actions are not contractible, or are very costly to enforce. In the auto industry, for example, components are designed specifically for a particular model; finding the best design often requires input from both the supplier and the automaker. A lighter-weight latch assembly is cheaper but may not withstand the force that will be placed on it in a particular application—something that is often determined only when the design of all surrounding parts is known. Most of these actions are not contractible; for example, it would be hard for a court to judge whether the latch supplier has taken sufficient action, in a sufficiently timely manner, to design the best latch for a particular application. In addition, ownership of partly finished designs is unclear (Helper and Henderson 2014; Bernstein and Peterson 2021).

The transaction-cost approach predicts that when transaction hazards such as these exist, firms' behaviors deviate from those predicted by the competitive model and they turn to other methods of governance: long-term contracts enforced by courts (Joskow 1987); relational contracts enforced by the prospect of on-going profits from a relationship (Gibbons and Henderson 2012); equity ownership, either full vertical integration (Williamson 1975, 1985) or a partial equity stake (Ahmadjian and Oxley 2011).

Some automakers do base their sourcing strategy on the nature of the component. They may cultivate a long-term sole-source relationship with a supplier of an R&D-intensive product (e.g., Chrysler shared knowledge and test data with Mahle GmbH to develop an innovative crankshaft over many years, to be used in its most advanced vehicles (Automotive News 2008)). Meanwhile, Chrysler has many suppliers of small stampings, which the automaker considers a commodity.

This approach, however, does not explain the sourcing behaviors of all firms. Toyota, for example, maintains long-term relationships with almost all of its suppliers and has only a few suppliers per part, even for commodity parts like stampings (Liker 2004).

The story of Kojima Press exemplifies many of these points. In the late 1930s, Hamakichi Kojima, owner of a small company, made repeated multi-hour trips by train to visit Toyota, hoping for work, even though "the firm had no processing technology with the precision to manufacture automobile parts" (Wada 1991; Wada 2020). Eventually, his tenaciousness was rewarded with an order —for "sand buckets" (for fire protection), not a prestigious product, but Kojima did the best he could. "Then, Toyota ordered other parts, like washers and additional parts for a truck radiator grill. Toyota guided and trained manufacturers, such as Kojima, which did not have high technical capabilities." Today, Kojima supplies metal and plastic parts to Toyota from subsidiaries around the world (Wada 2020). This history reflects longstanding Toyota policies, in particular, that Toyota offered its suppliers (not just Kojima) a "permanent deal", of long-term contracts and technical assistance – even for commodity parts (Wada 1992, 1998).

This story raises a number of questions from a transaction cost point of view: Why give business to a firm that lacks technical capability, and pay to help them develop it? Why establish a long-term relationship for a commodity product, one with few "transaction hazards"?[2] Our answer, developed below, is rooted in examining spillovers across transactions, rather than considering a single transaction at a time.

These spillovers increase both the clarity and the credibility of relational contracts, both within and between firms. For example, having all parts made by suppliers that (like Kojima) are tenacious in problem-solving improves Toyota's quality, because even if the search for a problem's root cause leads to a simple part, Toyota can be confident that its supplier will be willing and able to solve it. Suppliers learn over time, and from each other, about the very high levels of effort and specific techniques Toyota expects when it asks suppliers to "Please try" and "Do your best" (Liker 2004). Because of these spillovers, Toyota uses a firm-wide strategy for governance, i.e., long-term collaboration, with all

[2] An additional question is, "Why give new parts to an existing supplier that does not specialize in making those parts? " However, we leave this issue for future research. In this paper our focus is on the economies of scope experienced by the customer, i.e., spillover benefits to the customer from consistency in governance even if each supplier provides only one part. In future work, we will investigate implications for suppliers, i.e., benefits of "multimarket contact" in the context of a supplier that provides several parts to the same customer (Bernheim and Whinston 1990; Argyres, Gil, Zanarone 2021).

suppliers, even of commodities. Clarifying the meaning of these requests also requires a per-supplier investment, which Toyota amortizes by having few suppliers per part.

2.2 Propositions

Below we first discuss transaction-cost theory as a baseline explanation of when and how organizations deviate from spot markets. We then draw on organization-based theories to explore the implications of considering economies of scope across transactions.

2.2.1. Transaction-based theories (TB)

These theories analyze supplier/customer relations on a transaction-by-transaction basis. A key attribute of a transaction is the nature of the product being bought and sold. If a product has low complexity and requires few specific assets, encouraging competition among many sellers is a profit-maximizing policy for customer firms. The reason is that such attributes make it easy for new suppliers to enter, and customers can leave immediately if another supplier offers a better deal. These low switching costs lead to greater numbers of suppliers, and higher supplier turnover, all else equal (Williamson 1974).

However, if assets needed to make the product are specific to the transaction, their value depends on the continued existence of the buyer/seller relationship. The party that has not invested may appropriate some of the value of the investment by threatening to end the relationship. If investors cannot be assured of realizing a return on their investment, they may not invest, resulting in higher costs for both parties. The transaction cost literature has shown that the extent to which transaction hazards are present varies significantly by product (Monteverde and Teece 1982 a and 1982b; Masten 1984; Macher and Richman 2008).

Antràs argues that a product's upstreamness also affects its governance by affecting investment incentives of suppliers up and down the chain. If demand for the final product is elastic and inputs are not easily substitutable for each other (as is true for autos), then inputs are "sequential complements, in that the marginal incentive of a supplier to undertake relationship-specific investments is higher, the larger are the investments of upstream suppliers. In this case, the firm finds it optimal to integrate only the most downstream stages." (Alfaro, Antràs, Chor, and Conconi 2019, p. 2–3; Antràs, Fort, and Tintelnot 2017).

Proposition T1: *Product attributes are a significant determinant of supply chain governance*.

Transaction hazards are likely to be especially great for product categories in which there is a lot of innovation, for two reasons. First is supplier market power; relatively few firms have the capability to compete in a market characterized by high spending on research and development (R&D). Similar conditions are likely for differentiated products; relatively few firms are likely to have the ability to make a given variant of a particular product.

Second, innovation by definition is not routine, and non-routine behavior is harder to monitor than routine behavior (Langlois 1992). There is a high return to joint discussion about how to improve the product. Multi-period relations allow for the possibility of future payoff: encouraging increased buyer-specific investment, learning, and effort. Thus, as these discussions are conducted over a long period, they become increasingly valuable (Helper, Sabel, MacDuffie 2000). However, holding each of these discussions incurs a per-supplier cost, limiting the number of suppliers that it is optimal to have such discussions with (Aoki and Wilhelm 2017; Liker and Choi 2004).

Proposition T2: *Vehicle manufacturers do less spot buying when a product category is characterized by a higher level of R&D or product differentiation*.

Frequency and volume of trade is a key transaction attribute. If trade is larger, more suppliers can achieve minimum efficient scale; it will also be easier for a vehicle manufacturer to recoup the cost of bringing a transaction in-house (Williamson 1985).

Proposition T3: *Vehicle manufacturers will employ more suppliers per part and will vertically integrate more, when the scale of purchases is higher*.

Another important attribute of a transaction is the institutional environment in which it takes place. For example, Macchiavello and Morjaria (2015) suggest that relational contracts are more likely in developing countries where parties often cannot rely on courts for enforcement. On the other hand, Zaheer and Zaheer (2006) argue that in countries characterized by low trust a partnership is likely to "dissolve into an arms-length relationship" or an "immediate market transaction" if interdependence between the parties is low. Yet another perspective is offered by Poppos and Zenger (2002), who argue that formal contracts are complements to relational governance. Despite this disagreement about the direction of the effect, scholars agree that country effects are likely to be significant.

Proposition T4: *Country characteristics are a significant determinant of supply chain governance*.

2.2.2. Organization-based theories

These theories look at the buying organization as a whole and argue that attributes of the transactors do and should affect governance of relationships. A conclusion of much of this literature is that a firm governs relationships with all its suppliers in a similar way (e.g., Toyota is cooperative with all). Underlying this argument is a view (usually implicit) that there are spillovers across relationships.

In the Monteverde and Teece (1982) paper that was an early and influential test of transaction cost theory, the most significant variable is the dummy for the automaker (GM or Ford). That is, even though "both firms faced the same environment and transactional hazards," these "unobserved firm effects were the dominant influence on the make-buy decision" (Kogut and Zander 1992, p. 394). Why are these firm effects so important?

Dyer and Singh (1998) and Barney (2012) argue that supply-chain management can be a source of sustained competitive advantage, i.e., a source of rare, hard to imitate, and sustainable capabilities. They don't say whether organizations should focus on one kind of relationship. However, a variety of accounts profile firms that have chosen to manage supplier relations in a unified manner, arguing that this strategy has led to long-term success. See for example Nishiguchi (1994), Liker and Choi (2004), Aoki and Wilhelm (2017) on Toyota; Nelson et al. (1998) and MacDuffie and Helper (1999) on Honda; Dyer (2000) on Chrysler in the 1990s; and Helper and Levine (1992) on GM and Ford in the mid-20th century. Outside the auto industry, authors have praised Dell for its "extended enterprise" strategy (Dyer 2000; Dell), IBM for modularity (Baldwin and Clark 2000); and Walmart for tough bargaining (Mottner and Smith 2009).

Few of these accounts discuss explicitly why the firms needed to specialize in one kind of relationship. However, four key reasons emerge.

Establishing the credibility of the relational contract. How do parties know if one firm really will take a future action to benefit the other? A survey of Japanese suppliers showed that a key function of supplier associations established by Japanese automakers is to provide a forum where suppliers can monitor the behavior of their customer (Sako 1996). The value of reputational spillovers a lead firm receives from this activity would be much diluted if the automaker is acting according to several different standards of fairness depending on the product. Consistent with this result, Levin (2002) shows theoretically that multilateral contracts (commitments to suppliers as a group) bind the firm more strongly to implicit commitments (thus improving supplier motivation), because many suppliers will quit at once if they

perceive that one of them has been treated unfairly. However, this same feature makes the contracts more difficult to adjust in response to changes in the environment, so bilateral contracts are better for firms in unstable environments.

Firms that want to maintain a more arm's-length relationship with suppliers have a different credibility problem, which is maintaining a viable threat of exit. Having it be known that suppliers with high prices will in fact lose business is valuable.

Clarifying the elements of the relational contract the lead firm is proposing (Gibbons and Henderson, 2012). Suppliers and customers face complex tradeoffs between cost and quality, innovation and standardization; it is often not clear what kind of action constitutes cooperation and what is reneging on an implicit agreement. Companies such as Honda say that they aspire to "zero defects," but how far should a supplier go toward this impossible goal, while remaining competitive on costs? When Honda began manufacturing in the United States in the 1980s, it spent millions of dollars conveying what it meant by "the Honda Way" to suppliers and to its own staff. It would have been even more complicated to have tried to communicate one Way for strategic parts and another Way for commodities, especially given that the concepts are things like "self-reliance" and "proceed always with ambition and youthfulness." (It would be hard for a court to decide if a supplier had acted with sufficient "ambition and youthfulness.") (MacDuffie and Helper 1999; Helper and Henderson 2014).

Promoting complementarities across functions in the buyer's organization. A key implication of a firm's sourcing strategy is the relationship between its purchasing department and its other departments. For example, key to maintaining a spot market relationship with suppliers is maintaining the ability to make "apples to apples" comparisons among them. For U.S. automakers in the past, this meant funneling almost all communications with suppliers through the purchasing department, and blocking suppliers from going directly to design engineers with ideas to avoid the possibility that the engineer will specify products that only that supplier can make. (Helper 1991). Purchasing agents frequently rotated among commodities, to avoid capture by suppliers; due to a faith that market competition would lead to low prices, purchasing agents often did not need to have engineering backgrounds.

In contrast, Japanese automakers have sought a richer flow of information with suppliers, though the strategy differs somewhat by automaker. Toyota teaches suppliers the Toyota Production System within the same department (the Operations Management Consulting Division) that helps its in-house suppliers. Separately, the Purchasing Department is responsible for teaching suppliers Total Quality Management. In contrast, Honda and Nissan teach these skills in a unified manner through their

Purchasing Departments, offering suppliers a single point of contact, but reducing learning opportunities between their internal divisions and their suppliers (Sako 2004).

Spillovers of sourcing decisions are not limited to the purchasing department. Novak and Stern (2009) found that contracting decisions across the subsystems in luxury cars were not independent. Instead, decisions by automakers to vertically integrate one system caused them to integrate other systems as well, to facilitate the exchange of proprietary information and ease coordination in a complex environment. Contracting decisions may also be linked because they affect firms' ability to protect their rents from hold-up by suppliers. Since development of costly relational contracts reduces buyers' ability to switch suppliers, firms with more final-product market power will choose both more vertical integration and more spot-market relationships with suppliers, even if these choices mean lower relationship-specific rents (Helper and Levine 1992).

Believing that most transactions in fact have similar attributes. Management may have a view about the predominant nature of the transactions they engage in; this view may be different even in the same industry. For example, Honda believes that continuous improvement is possible in any product, meaning that few products are commodities. The automaker does not believe that market competition is the way to maximize this improvement; instead, it has long provided extensive technical assistance to experienced suppliers of such old-technology products as stampings and wiring harnesses (Stevens, MacDuffie, Helper 2018). Similarly, Toyota believes that "an exploratory, long-term perspective is critical even for exploitation-oriented suppliers to keep up with environmental changes by continuously conducting process innovation" (Aoki and Wilhelm 2017). Toyota's use of "knowledge overlap" (Takeishi 2002) between its engineers and its suppliers' engineers not only allowed for better problem-solving, but also helped Toyota ensure that its suppliers remained near the production frontier.

In contrast, many at General Motors believed that most components were commodities. As a top GM purchasing manager explained in 1993: "GM doesn't need to understand the technologies that our suppliers use—we let the market tell us" (Helper and Henderson 2014). Similarly, according to Bob Lutz (legendary head of product development at both GM and Chrysler): "The operations portion of the automobile business has been thoroughly optimized over many decades, doesn't vary much from one automobile company to another, and can be managed with a focus on repetitive process. It is the 'hard' part of the car business and requires little in the way of creativity, vision or imagination." (Wall Street Journal 2011).

As Lutz's comment suggests, U.S. vehicle manufacturers have an organization-based strategy (of maintaining arm's-length relationships), even though supplier governance is more differentiated by

product attributes than in the Japanese case. Thus, we can see economies of scope in the U.S. case as well, for example in the discussion above about efforts to maintain low costs of switching suppliers, which has implications for which functions suppliers should have access to, and the career path of purchasing agents.

Proposition O1: *U.S. vehicle manufacturers are more likely to engage in spot buying compared to the Japanese, even after controlling for product attributes*.

Because Japanese vehicle manufacturers tend to believe that continuous improvement is always possible, having responsive, knowledgeable suppliers is very important. Such suppliers "know that as long as they make a good-faith effort to perform as they should, the assembler will ensure that they receive a reasonable return on their investment" (Womack, Jones, and Roos 1990). As long as they continued to meet the automaker's expectations, suppliers could count on the relationship continuing indefinitely. Smitka (1991) describes these arrangements as "governance by trust."

Proposition O2: *Japanese vehicle manufacturers are more loyal to their suppliers than are U.S. vehicle manufacturers. In particular, the Japanese are less likely to exit a relationship when the exchange rate rises in the nation in which a supplier produces*.

In the above discussions, specific companies were mentioned, solely to motivate hypotheses about governance that vary by national ownership. In what follows we test these hypotheses, but our use of these examples does not imply that the companies used in the discussions are also in our samples.

3. Data Description and Regression Specifications

3.1. LFTTD Data

We use U.S. merchandise import transactions information from the U.S. Census Bureau's Longitudinal Firm Trade Transactions Database (LFTTD). LFTTD compiles, by firm, transaction-level data collected by U.S. Customs and Border Protection.[3] The source data consists of information from customs forms filled out by U.S. firms with import shipments above $2,000 (Kamal and Monarch 2018). The International Trade Data Management Division of the Census Bureau processes this information. Then the Center for Economic Studies (CES) of the Census Bureau obtains this data and links its individual trade transactions to the U.S. firms that make them, thus compiling the LFTTD. We aggregate the data into annual firm-level observations covering the period 1997–2015.

LFTTD includes information about the foreign supplier in the form of a *Manufacturer ID* (MID for short) associated with a transaction. MID consists of an alphanumeric code that is constructed using the foreign seller's name and address.[4] MID has a maximum length of 15 characters; we use the first 8 characters of MID to identify the supplier. The first two characters of MID are the two-digit ISO country code of the supplier, the next three characters are the start of the first word of the supplier's name, and the next three characters are the start of the second word of the supplier's name. We aggregate all the establishments within a country that belong to the same supplier.[5]

Transactions are characterized by the 10-digit Harmonized Tariff Schedule (HTS), e.g., "Vulcanized gaskets," "washers and other seals," "Mountings, fittings and similar articles, of base metal." In this paper, we refer to these transactions as parts, products, or components that the suppliers supply to vehicle manufacturers (VMs) operating in the United States.

We isolate the imports of the U.S.- and Japanese-owned VMs.[6] We pool these transactions into two broad categories of VMs—U.S.-owned and Japanese-owned. Since we do not have data on purchases from U.S. suppliers for U.S.-owned VM's (or for any other VM), we exclude suppliers located in Japan.

---

[3] See https://www.census.gov/ces/dataproducts/datasets/lfttd.html for further detail.

[4] Our description of MID is based on Kamal and Monarch (2018). The next-to-last four characters of the MID contain the beginning of the largest number of the exporter's street address, and the last three characters are the start of their city.

[5] This aggregation does not affect our results.

[6] We omit VMs owned by firms of other nationalities.

Thus, purchases from the VM's home country are excluded for both types of VMs.[7] We retain in our sample all countries that both VM groups imported from for at least 5 years, and all 10-digit HTS categories that both VM groups imported in for at least 5 years, over the period 1997–2015. Our final sample covers 44 countries and 600 products.

We can identify imports of every component by each VM into the United States. Using the MIDs we identify the foreign suppliers and create the following measures of supplier governance: number of suppliers that supplied in an HTS-10 product category in a given year (*number of suppliers*), and average number of years suppliers supply to the VM in an HTS-10 category (*longevity of relationship with suppliers*).[8]

Additionally, we calculated the VM group's degree of vertical integration using the share of related party imports in an HTS-10 category for a given year. U.S. customs data identifies if a transaction is a related party trade (Ruhl 2015), which appears as a binary identifier in the LFTTD data. The Census related-party trade data are compiled from the U.S. customs documentation with a yes/no question that asks if the shipment is between related parties (Ruhl 2013, 2015).[9]

Once these variables are constructed for each VM, we compute weighted averages with individual VM imports as weights to obtain values for the two VM groups (Japan and U.S.); we interpret them as values for the "representative" Japanese or U.S. VM.

As independent variables, we include several measures of transaction attributes:

R&D intensity. We use Nunn and Trefler's (2013) R&D intensity for 2005 imports of all countries. The measure is the ratio of industry-level R&D expenditures to sales. This index is concorded to the six-digit Harmonized System (HS-6) product level.

---

[7] Our findings are robust to inclusion of suppliers located in Japan into our sample (see section 3.3 below).

[8] We calculate the import-value weighted number of years a VM imports in an HTS-10 category.

[9] Title 19 of USC Chapter 4, Section 1401a (g)(1) of the Tariff Act of 1930, defines related-party trade import transactions between parties with various types of relationships including "Any person directly or indirectly owning, controlling, or holding with power to vote, 5 percent or more of the outstanding voting stock or shares of any organization and such organization" (https://www.census.gov/foreign-trade/Press-Release/2019pr/aip/related_party/rp19-techdoc.pdf). The original language of the Tariff Act regarding related parties can be found at https://www.govinfo.gov/content/pkg/USCODE-2011-title19/pdf/USCODE-2011-title19-chap4-subtitleIII-partI-subparta-sec1401a.pdf. For U.S. exports, the threshold is 10 percent (see Ruhl 2013 and Ruhl 2015 for further details).

US import trade elasticities*.* As a measure of product differentiation, we use estimates of the elasticity of substitution parameter from Broda and Weinstein (2006) to capture differences in substitutability across products. We converted them to HS-6 level.

Product "upstreamness". We use a measure of the product's average distance from final use developed by Antràs et al. (2012), who use the 2002 U.S. Bureau of Economic Analysis (BEA) Benchmark Use table to construct the upstreamness index for 2002. We replicate their methodology and use all the BEA Benchmark Use tables between 1997 and 2015 to construct the index for each benchmark year; for non-benchmark years, the latest benchmark was used.

Import share is the share of imports in total trade (exports plus imports); we use LFTTD data to calculate this share at the six-digit HS level. We include this in some specifications to deal with concerns relating to the lack of data on U.S.–based suppliers. We included the share of imports to see if perhaps supplier governance differs for products that are largely made in the United States. We also performed a robustness check in which we included only products in the top quartile of import shares. Neither variable affected the results.

All the above indexes are at the HS-6 level. For all the variables measuring product characteristics, over-time HS-6 concordance tables were also used as needed.[10] We also include the following control variables:

Value of purchase*.* To control for different amounts of each good purchased by the VM groups, we include the VM group's log of total imports (in 2009 US$) in an HTS-10 product category. The number of suppliers variable thus reflects the number of suppliers per dollar purchased of each part.

Length of purchase*.* To scale our longevity variable (i.e., to control for the number of years the VM bought a product), we include the number of years the VM made a purchase in an HTS-10 product category, during our analysis period (1997–2015).

Related party trade (RPT)*.* In practice, U.S. vehicle manufacturers tend to have either 0 or 100 percent stakes in their suppliers, while minority equity ownership is common in Japan, especially among

[10] U.S. HS codes are based on the Harmonized System established by the World Customs Organization (WCO), which assigns six-digit codes for general categories, and then countries define their own codes to capture commodities at more detailed levels (Pierce and Schott 2012). The WCO makes adjustments to the HS to reflect developments in technology and changes in trade patterns. Concordance tables track these changes to make HS-6 codes comparable over time.

automakers (Ahmadjian and Oxley 2005, 2011). Because of this difference in practice, we sometimes include RPT as a control variable when the outcome variables are the number of suppliers or longevity of relationship with suppliers. Our results are not affected by whether RPT is included.

3.2. Specifications

Our main analysis is conducted at the annual VM group and HTS-10 product category level. Consider the regression,

$$(1) \qquad M_{vpt}^{j} = \alpha + \beta J + \boldsymbol{\delta X_{vpt}} + \boldsymbol{\theta Y_{pt}} + \boldsymbol{\gamma}\left(J * \boldsymbol{R_{vpt}}\right) + \pi + \tau + \varepsilon_{vpt},$$

where, M_{vpt}^{j} is the *j*-th measure of supplier governance for VM group v, in 10-digit HTS product p, at time t. The intercept is denoted by α while τ denotes the time fixed effects. With $j = \{1,2\}$, our outcome variables are: number of suppliers and vertical integration (i.e., share of related party trade).

In equation (1), $\boldsymbol{X_{vpt}}$ denotes a vector of control variables that includes: the VM group's log of total imports (2009 US$) in an HTS-10 product category (i.e., log value of purchase), length of purchase (the number of years the VM purchased the product over our period), and the share of related party trade in deviation from mean form (RPT0).[11]

The vector $\boldsymbol{Y_{pt}}$ includes the following product characteristics: upstreamness, elasticity, R&D intensity, and import share; in some specifications we instead include product fixed effects.[12] The term $\boldsymbol{R_{vpt}}$ is a combination of elements of $\boldsymbol{X_{vpt}}$ and $\boldsymbol{Y_{pt}}$ to test hypotheses involving various interaction terms with the variable J that represents the dummy variable for the Japanese VM group.

To test our hypotheses regarding features of supplier locations that affect transaction attributes, we include specifications where our sample is allowed to have a country dimension. That is, the analysis is conducted at the annual country, 10-digit HTS product category, and -VM group level,

[11] RPT0 is excluded from $\boldsymbol{X_{vpt}}$ when the outcome is vertical integration.

[12] While $\boldsymbol{Y_{pt}}$ is technically time varying, over-time variations in these variables are not sufficient for them to be identified in the presence of product fixed effects. We, therefore, use Y_{pt} and π alternatively.

$$(2) \qquad M_{vcpt}^{j} = \alpha + \beta J + \boldsymbol{\delta X_{vcpt}} + \boldsymbol{\theta Y_{pt}} + \boldsymbol{\mu Z_{ct}} + \boldsymbol{\gamma}\left(J * \boldsymbol{R_{vcpt}}\right) + \varphi + \pi + \tau + \varepsilon_{vcpt},$$

where the subscript *c* denotes country, $\boldsymbol{X_{vcpt}}$ denotes the vector of control variables (such as log value of input purchase, etc.) that are now defined at the VM group-product-country level; φ denotes the country fixed effects.

In the country-level regressions, we included the following country-level variables in the vector $\boldsymbol{Z_{ct}}$: log of per capital GDP, percent change in exchange rate, and an index of generalized trust in the country.[13] We use the Penn World Table to obtain GDP and exchange rate information. We also experimented with various alternative specifications such as interacting the Japan dummy with the time fixed effects. Additional robustness tests are described in the results section. The term $\boldsymbol{R_{vcpt}}$ is a combination of elements of $\boldsymbol{X_{vcpt}}$, $\boldsymbol{Y_{pt}}$ and $\boldsymbol{Z_{ct}}$ to test hypotheses involving various interaction terms with the Japan dummy.

Finally, the same regressions are also run for the outcome variable – average longevity of relationship with suppliers (L_{vp} denoting the average number of years of relationship between the VM group v and its suppliers in product category p). Since there is no time dimension to this sample, the following adjustments are made:

$$(1)' \qquad L_{vp} = \alpha + \beta J + \boldsymbol{\delta X_{vp}} + \boldsymbol{\theta Y_{p}} + \boldsymbol{\gamma}\left(J * \boldsymbol{R_{vp}}\right) + \pi + \varepsilon_{vp},$$

$$(2)' \qquad L_{vcp} = \alpha + \beta J + \boldsymbol{\delta X_{vcp}} + \boldsymbol{\theta Y_{p}} + \boldsymbol{\mu Z_{c}} + \boldsymbol{\gamma}\left(J * \boldsymbol{R_{vcp}}\right) + \varphi + \pi + \varepsilon_{vcp},$$

where, the variables in $\{\boldsymbol{Y_{p}}, \boldsymbol{Z_{c}}\}$ are averages over the observed time horizon.

3.3. Representativeness

Some readers may be concerned that excluding home country purchases eliminates a key part of the sample. We address this concern in four ways. First, we add back in imports from Japan; this change does not affect our results. Second, we show that direct foreign sourcing by vehicle manufacturers in the United States is significant, accounting for at least one-quarter of sales in the case of U.S.-headquartered vehicle manufacturers and over 40 percent of sales of foreign-headquartered vehicle manufacturers (See figure 1).

---

[13] From the World Values Survey (http://www.worldvaluessurvey.org/WVSContents.jsp). The generalized trust is not time-varying.

Third, we draw on 2011 survey data (Helper, Krueger, and Wial 2012) that shows that automakers operating in the United States use similar supplier governance practices when buying from suppliers located in the United States as they do when buying from suppliers located abroad.

Fourth, we draw on an industry survey conducted every year since 2002 of North American suppliers to the six largest automakers in the North American market, regarding their "working relationship" with their customers (a combination of questions about trustworthiness, paying on time, handling of engineering changes, price pressure, communication).[14] Toyota has consistently scored the highest, with Honda not far behind. There is significant variation among the Detroit Three, but all score below the Japanese average.

[14] The survey is described in Yenyurt et al. (2014); see also https://www.plantemoran.com/explore-our-thinking/insight/2021/05/auto-supplier-oem-working-relations-insights-from-the-2021-wri-study.

4. Results[15]

Our findings are summarized in tables 2, 3, and 4. The appendices report additional details. Our results are robust to many specifications (e.g., with and without related party trade, product fixed effects, supplier country fixed effects, supplier country characteristics, etc.).

We find that the Japanese vehicle manufacturers have fewer than half as many suppliers per part as the U.S. vehicle manufacturers, almost 70 percent longer relationships, and nearly 25 percent greater vertical integration, even when buying the same parts and selling in the same market.[16]

While we find support for both transaction-based and organization-based theories, the coefficients for the organization-based theories, in general, are several times larger. Figure 2 gives an example of this result based on the estimates presented in column 5 of table 2. Consistent with transaction cost analysis, as R&D intensity increases, the number of suppliers per part decreases for U.S. VMs, from 8.3 suppliers at the mean of R&D intensity to 7.3 at two standard deviations above the mean (an 11 percent decline). There is also a (slight) decline for Japanese VMs, from 3.3 to 3.1 suppliers (a 5 percent decline). The organization variable is far more important, however. U.S. VMs have at least twice as many suppliers as do Japanese VMs, even comparing Japanese VMs' governance of the least R&D-intensive products to that of the United States for the most R&D-intensive products.

Transaction-based theories. The product fixed effects are jointly significant for each of our supplier governance practices (number of suppliers, supplier longevity, and related party trade), supporting proposition T1. (See the last row of table 2). As predicted by proposition T2, R&D-intensive and differentiated products have more non-spot governance. Upstreamness, however, is not significant. Consistent with Proposition T3, transaction volume is correlated with more suppliers per part, more related-party trade, and longer relationships (tables 2 and 3).

We included the import share of each product as a check on whether import-intensive industries are different in their governance; they are not. We also performed a robustness check in which we included

[15] We use company names only to motivate the results without implying that these companies are in our samples. The objective is to motivate the behaviors determined by their respective countries of ownership (we also address, in our analyses reported in table 5, the issues of company versus country cultures). We do not disclose the companies that are in our samples.

[16] These approximate calculations are based on the estimates reported in column 5 of table 2, and columns 3 and 6 of table 3, where the regressions are evaluated at sample means.

only products in the top quartile of import shares. Results for import share are never economically significant, usually not statistically significant; including or excluding this variable does not affect other results.

Country fixed effects are highly significant, consistent with proposition T4 (see table 4). The number of suppliers per part increases with per capita GDP, an effect that is largely explained by greater generalized trust (column 2). This result is consistent with Macchiavello and Moraria (2005), since it appears that buyer firms can rely in such countries more on general institutions and less on relational contracts with individual suppliers. Vertical integration is also greater in high income countries, but this effect is significant only when trust is controlled for.

When a country's currency appreciates, the number of suppliers per part in that country falls (as the VM exits to find cheaper sources), while the share of related party trade rises, suggesting that VMs disproportionately leave independent suppliers when prices rise. (This result is robust to a variety of specifications, including leaving out the trust variable).

Organization-based theories*.* We find strong support for the organization-based propositions. Japanese-owned VMs have fewer suppliers, engage in more related-party trade, and have longer relationships. The coefficient on the Japan dummy is not reduced by the addition of controls for transaction attributes, and Japan interactions with transaction attributes always serve to reduce the absolute value of these variables. These results suggest that Japanese VMs heed less the prescriptions of transaction-cost analysis than do U.S. VMs (tables 3 and 4).

Turning to the country-level results in table 4, we find that the Japanese VMs are less price-sensitive (they drop fewer suppliers in a country if exchange rates in that country rise). We interpret this result to mean that the Japanese are more loyal to their suppliers; they are more likely to stick with them despite adverse events. We also find that Japanese VMs are less sensitive to the institutional environment; the Japan interactions with country characteristics such as per capita GDP and generalized trust always act to reduce the absolute value of the main effect.

Robustness checks*.* We experimented with using related party share as an independent variable, because of our concerns (discussed above) that this variable may capture different phenomena for U.S. and Japanese VMs. However, controlling for the extent of related party trade in a product, nation, or year bucket has very little impact on other results. These results are surprising if one expects VMs to integrate more when there are transaction hazards, which would suggest that related party trade would absorb some of the variation that is attributed to other independent variables when RPT is absent. We

also looked for time trends, partitioning the product-level sample into 5-year blocks; we did not find such trends, in particular for the Japan dummy.

To preserve confidentiality, we run our regressions by combining all U.S. vehicle manufacturers to construct a "representative" U.S. VM, and all Japanese VMs to construct the "representative" Japanese VM. We then use a "Japan" dummy in the regressions. We experimented with instead using dummies for individual automakers instead of a single Japan dummy; the sign and significance of these dummies strongly support the sign and significance of the Japan dummy (table 5).

Importance of economies of scope in supplier governance. Comparing the explanatory power of the two theories, we note that differences in U.S. and Japanese automakers can be seen in the sample means. For the product level sample, on average the Japanese vehicle manufacturers have 1.2 suppliers/part, significantly less than the U.S. figure of 8.2 suppliers per part (table 1).

As mentioned above, we find statistical significance for most of the transaction attributes in explaining supplier governance. However, the economic impact of these attributes is much lower than that of the Japan dummy. The effect of being a Japanese vehicle manufacturer is 13 times greater than that of a one standard deviation change in the level of R&D in explaining the number of suppliers per part, and 16 times greater in explaining the level of vertical integration. Adding product controls does not reduce these coefficients.

Figure 2 illustrates the relative impact of organizational vs. transaction cost variables, for the case of R&D intensity. Consistent with transaction cost theory, as a product's R&D intensity increases from its mean to 3 times its standard deviation, the number of suppliers for the U.S. VM group falls from 8.96 to 7.55; for the Japanese VM group, it falls from 3.32 to 3.09. But organization-based theories have much more explanatory power: for the greatest level of R&D intensity, the U.S. VM group has twice as many suppliers as does the Japanese VM group at the lowest level. We find similar results for other variables.

As shown above, the average Japanese VM governs suppliers quite differently from the average U.S. VM, suggesting that national cultures matter a lot in this regard. In table 5, we tested the hypotheses that U.S. VMs are not significantly different from each other in their numbers of suppliers, and vertical integration; these hypotheses were rejected. Similar hypotheses for Japanese VMs were also rejected. These results suggest that corporate culture as well as national culture plays a strong role in firms' supplier governance practices.

5. Conclusions and Future Research

We find evidence consistent with the idea that lead firms and suppliers experience economies of scope in developing clear and credible relational contracts; considering these spillovers across relationships adds significant explanatory power to our understanding of inter-organizational governance. That is, across all the components they buy, firms and nations have distinct and stable strategies for value chain governance, such as the length of relationships with suppliers, number of suppliers per part, and degree of vertical integration.

Other things equal, a smaller supply base allows a lead firm to spend more resources on each supplier, building deeper trust and greater capability. Providing larger contracts to suppliers encourages them in turn to dedicate more resources to improve their performance (Dyer 2000; Liker and Choi 2004). On the other hand, lead firms are more dependent on these fewer suppliers,[17] and less able to adjust contracts in response to a shock (Levin 2002).

We also find support for transaction cost theory. Both U.S. and Japanese vehicle manufacturers vary their sourcing strategy by component to some extent, for example, to have more suppliers in technologically simpler product categories. Even though VMs that value collaboration may find their relational contracts less credible or clear as a result, the increased bargaining power from having more suppliers appears valuable to them.

An alternative explanation of our findings is that perhaps Japanese VMs do less spot buying because they make more luxury vehicles, vehicles that have a greater return to coordination. That is, final product attributes, not organization strategy, determines supplier governance. Although Novak and Stern (2009) find that luxury car makers with more complex products vertically integrate more, this relationship is unlikely to explain our results. The reason is that it is U.S. VMs who have more luxury vehicles in their product mix. The Japanese still import many luxury vehicles, rather than assemble them in the United States.

Returning to the story of Kojima Press, we can answer the questions we raised initially, about why Toyota would give business to a firm that lacks technical capability, and pay to help them develop it,

[17] Li (2013) argues that by concentrating purchases asymmetrically among suppliers, buyers can have the best of both worlds. The buyer provides those receiving the larger share with the incentive to invest in cost reduction (which increases the total surplus available to be split), while using the competitive fringe to gain the benefit of supplier competition (which increases the customer's share of that surplus).

why the automaker would establish a long-term relationship for a commodity product, one with few "transaction hazards," and why it would award new parts to an existing supplier that does not specialize in making those parts.

Our answer to these questions is that Toyota acted to maximize spillovers across transactions in a way that would help build clear, credible relational contracts with its suppliers. Having a small supply base in which all suppliers (including those of commodity parts) had long-term collaborative relations both reduced the costs of maintaining these relational contracts and increased their benefits, compared to having a larger supply base with more differentiated relationships.

In contrast, U.S. firms have had higher discount rates, have been more concerned to avoid hold-up and lock-in in the case of a shock, and have had more faith in market generation of capabilities (Helper and Henderson 2014). These factors have caused U.S. automakers to govern their supplier relations in a way that reduced the costs of switching suppliers. Buying products, even those with significant transaction hazards, in a relatively arm's length way also allowed them to maintain clearer employee evaluation criteria and complementary relationships across internal functions.

We have barely scratched the surface of the LFTTD data's potential to identify customer-supplier dyads on a large scale over time. There is much more we can do in future research to examine spillovers across relationships in the auto industry and beyond. For example, we plan to explore the determinants of the number of parts that each supplier provides. We can do more to unpack what the fixed effects are standing in for. Can we measure attributes (e.g., integrality of overall strategy) that predict organizations' sourcing strategies? We also plan to explore the extent to which national-level attributes (such as rule of law, trust levels, wealth, and capability) are complements to, or substitutes for, relational contracts. How do these factors affect the nature of spillovers across transactions?

References

Ahmadjian, Christina L., and Joanna E. Oxley. 2011. “Vertical relationships, hostages, and supplier performance: evidence from the Japanese automotive industry.” *The Journal of Law, Economics, & Organization* 29(3): 485–512. https://doi.org/10.1093/jleo/ewr006.

Ahmadjian, Christina, and Joanna Oxley. 2005. “Using hostages to support exchange: Dependence balancing and partial equity stakes in Japanese automotive supply relationships.” *Journal of Law, Economics, and Organization* 22(1): 213–233. https://doi.org/10.1093/jleo/ewj003.

Alfaro, Laura, Pol Antràs, Davin Chor, and Paola Conconi. 2019. “Internalizing Global Value Chains: A Firm-Level Analysis.” *Journal of Political Economy*, 127(2): 000–000. https://doi.org/10.1086/700935.

Antràs, Pol, Davin Chor, Thibault Fally, and Russell Hillberry. 2012. "Measuring the upstreamness of production and trade flows." *American Economic Review* 102(3): 412-16. https://doi.org/10.1257/aer.102.3.412.

Antràs Pol, and Alonso de Gortari. 2017. “On the Geography of Global Value Chains.” NBER Working Paper No. 23456 (May). https://www.nber.org/papers/w23456.

Antràs, Pol. 2003. “Firms, contracts, and trade structure.” *The Quarterly Journal of Economics* 118(4): 1375–1418. https://doi.org/10.1162/003355303322552829.

Antràs, Pol. 2005. “Incomplete contracts and the product cycle.” American Economic Review, 95(4): 1054–1073. http://dx.doi.org/10.2139/ssrn.694387.

Antràs, Pol, and Davin Chor. 2013. “Organizing the global value chain.” *Econometrica* 81(6): 2127–2204. https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA10813 .

Antràs, Pol, and Davin Chor. 2018. “On the measurement of upstreamness and downstream-ness in global value chains.” No. 24185. National Bureau of Economic Research. https://scholar.harvard.edu/files/antras/files/upstream_ac_29dec2017_withtables.pdf.

Antràs, Pol, Teresa C. Fort, and Felix Tintelnot. 2017. “The Margins of Global Sourcing: Theory and Evidence from U.S. Firms.” *American Economic Review* 107 (9): 2514–64. https://scholar.harvard.edu/antras/publications/margins-global-sourcing-theory-and-evidence-us-firms.

Aoki, Katsuki, and Miriam Wilhelm. 2017. “The Role of Ambidexterity in Managing Buyer–Supplier Relationships: The Toyota Case.” *Organization Science* 28(6): 1080–1097. https://doi.org/10.1287/orsc.2017.1156 .

Argyres, N., J. Bercovitz, and G. Zanarone. 2020. “The role of relationship scope in sustaining relational contracts in interfirm networks.” *Strategic Management Journal 41*(2), 222–245.

Argyres, Nicholas, and Lyda Bigelow. 2010. “Innovation, modularity, and vertical deintegration: Evidence from the early U.S. auto industry.” Organization Science, 21(4): 842–853. https://doi.org/10.1287/orsc.1090.0493.

Automotive News. 2008. "2008 – PACE Award Winner: Chrysler LLC with MAHLE." https://www.autonews.com/awards/2008-winner-chrysler-group-camincam.

Baldwin, Richard, and Toshihiro Okubo. 2019. "GVC journeys: Industrialisation and deindustrialisation in the age of the second unbundling." *Journal of the Japanese and International Economies* 52:53-67. https://doi.org/10.1016/j.jjie.2019.02.003.

Baldwin, C.Y., and K.B. Clark. 2000. Design rules: The power of modularity (Vol. 1). MIT press.

Barney, Jay B. 2012. "Purchasing, supply chain management and sustained competitive advantage: The relevance of resource-based theory." *Journal of supply chain management* 48(2): 3–6. https://doi.org/10.1111/j.1745-493X.2012.03265.x.

Barresse, Glenn, Fariha Kamal, Jaiver Miranda, and Wei Ouyang. 2016. "Business Dynamics of U.S. Exporters: Integrating Trade Transactions Data with Business Administrative Data." Working Paper. U.S. Census Bureau.

Bensaou, M., and Erin Anderson. 1999. "Buyer-supplier relations in industrial markets: when do buyers risk making idiosyncratic investments?" Organization Science, 10(4): 460–481. https://pubsonline.informs.org/doi/abs/10.1287/orsc.10.4.460 .

Bernheim, B. Douglas, and Michael D. Whinston. 1990. "Multimarket contact and collusive behavior." *The RAND Journal of Economics*. 21(1): 1–26. https://doi.org/10.2307/2555490.

Bigelow, L.S., and N. Argyres. 2008. "Transaction costs, industry experience and make-or-buy decisions in the population of early U.S. auto firms." *Journal of Economic Behavior & Organization*, 66(3-4): 791–807.

Bloom, Nicholas, and Raffaella Sadun. 2012. "The organization of firms across countries." *The quarterly journal of economics* 127(4): 1663–1705. https://econpapers.repec.org/article/oupqjecon/v_3a127_3ay_3a2012_3ai_3a4_3ap_3a1663-1705.htm.

Bloom, Nicholas, and John Van Reenen. 2007. "Measuring and explaining management practices across firms and countries." *The Quarterly Journal of Economics* 122(4): 1351–1408. https://doi.org/10.1162/qjec.2007.122.4.1351.

Bloom, Paul N., and Vanessa G. Perry. 2001. "Retailer power and supplier welfare: The case of Wal-Mart." *Journal of Retailing* 77(3): 379–396. https://doi.org/10.1016/S0022-4359(01)00048-3.

Broda, C., and D.E. Weinstein. 2006. "Globalization and the Gains from Variety." *The Quarterly journal of economics* 121(2): 541–585.

de Figueiredo, John M., and Brian S. Silverman. 2017. "On the genesis of interfirm relational contracts." *Strategy Science* 2(4): 234–245. https://doi.org/10.1287/stsc.2017.0050.

Duffy, Rachel S. 2008. "Towards a better understanding of partnership attributes: An exploratory analysis of relationship type classification." *Industrial Marketing Management* 37(2): 228–244. https://doi.org/10.1016/j.indmarman.2007.09.005.

Duffy, Rachel, and Andrew Fearne. 2004. "The impact of supply chain partnerships on supplier performance." *The International Journal of Logistics Management* 15(1): 57–72. https://doi.org/10.1108/09574090410700239.

Dyer, J.H., and K. Nobeoka. 2000. “Creating and managing a high-performance knowledge-sharing network: the Toyota case.” *Strategic management journal* 21(3): 345–367.

Dyer, Jeffrey H. 1996. “Specialized supplier networks as a source of competitive advantage: Evidence from the auto industry.” *Strategic Management Journal* 17(4): 271–291. https://doi.org/10.1002/(SICI)1097-0266(199604)17:4<271::AID-SMJ807>3.0.CO;2-Y.

Dyer, Jeffrey H. 2000. “Collaborative advantage: Winning through extended enterprise supplier networks.” Oxford University Press. https://www.amazon.com/Collaborative-Advantage-Extended-Enterprise-Supplier/dp/0195130685

Dyer, Jeffrey H., Dong Sung Cho, Wujin Cgu. 1998. “Strategic supplier segmentation: The next ‘best practice’ in supply chain management.” *California management review* 40(2): 57-77. https://doi.org/10.2307%2F41165933

Dyer, Jeffrey H.; Singh, Harbir. 1998. “The relational view: Cooperative strategy and sources of interorganizational competitive advantage.” Academy of management review 23(4): 660-679. https://doi.org/10.2307/259056

Gereffi, Gary. 1999. “A commodity chains framework for analyzing global industries.” Institute of Development Studies, 8(12): 1–9. https://www.researchgate.net/publication/228810211_A_Commodity_Chains_Framework_for_Analyzing_Global_Industries.

Gereffi, Gary, John Humphrey, and Timothy J. Sturgeon. 2005. “The governance of global value chains.” *Review of international political economy*, 12(1): 78–104. https://doi.org/10.1080/09692290500049805.

Gibbons, Robert, and Rebecca Henderson. 2012. “What Do Managers Do? Exploring Persistent Performance Differences among Seemingly Similar Enterprises.” In The Handbook of Organizational Economics. Robert Gibbons, John Roberts, eds. Princeton University Press. https://www.jstor.org/stable/j.ctt1r2ggg.21.

Grossman, Sanford J., and Oliver D. Hart. 1986. “The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Ownership.” *Journal of Political Economy* 94: 691–719. https://dash.harvard.edu/handle/1/3450060.

Hart, Oliver D. and John Moore. 2005. “On the Design of Hierarchies: Coordination Versus Specialization.” *Journal of Political Economy* 113: 675–702. http://nrs.harvard.edu/urn-3:HUL.InstRepos:3448676.

Helper, Susan R., and Rebecca Henderson. 2014. “Management practices, relational contracts, and the decline of General Motors.” *Journal of Economic Perspectives*, 28(1): 49–72. https://www.aeaweb.org/articles?id=10.1257/jep.28.1.49.

Helper, Susan. 1991. “How much has really changed between U.S. automakers and their suppliers?” MIT Sloan Management Review, 32(4): 15. https://search.proquest.com/openview/11345f68d1461a1681e5d98e79457df5/1.

Helper, Susan. 1991. “Strategy and irreversibility in supplier relations: the case of the U.S. automobile industry.” *Business history review* 65(4): 781–824. https://doi.org/10.2307/3117265.

Helper, Susan, and David I. Levine. 1992. “Long-term supplier relations and product-market structure.” *Journal of Law, Economics & Organization* 8(3): 561–581.

https://www.researchgate.net/profile/David_Levine6/publication/5214362_Long-Term_Supplier_Relations_and_Product-Market_Structure/links/0912f5106eeeba3036000000.pdf.

Helper, Susan, John Paul MacDuffie, and Charles Sabel. 2000. "Pragmatic collaborations: advancing knowledge while controlling opportunism." *Industrial and corporate change* 9(3): 443-488. https://doi.org/10.1093/icc/9.3.443.

Helper, Susan, and Mari Sako. 2010. "Management innovation in supply chain: appreciating Chandler in the twenty-first century." *Industrial and Corporate Change* 19(2): 399–429. https://doi.org/10.1093/icc/dtq012.

Helper, Susan, Timothy Krueger, and Howard Wial. 2012. "Locating American Manufacturing: Trends in the Geography of production." Metropolitan Policy Program at Brookings. https://www.nist.gov/system/files/documents/2017/05/09/Brookings_locating_american_manufacturing_report.pdf.

Hofstede, Geert. 2010. "The GLOBE debate: Back to relevance." *Journal of International Business Studies* 41(8): 1339-1346. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.831.4097&rep=rep1&type=pdf.

Jacobides, Michael G. 2006. "The architecture and design of organizational capabilities." Industrial and Corporate Change, 15(1): 151–171. https://academic.oup.com/icc/article-abstract/15/1/151/691395.

Jacobides, Michael G. 2007. "The inherent limits of organizational structure and the unfulfilled role of hierarchy: Lessons from a near-war." *Organization Science* 18(3): 455–477. https://doi.org/10.1287/orsc.1070.0278.

Jann, Ben. 2008. "The Blinder–Oaxaca decomposition for linear regression models." *The Stata Journal* 8(4): 453–479. https://doi.org/10.1177/1536867X0800800401.

Joskow, Paul L. 1987. "Contract duration and relationship-specific investments: Empirical evidence from coal markets." *The American Economic Review* 77(1): 168–185. https://www.jstor.org/stable/1806736.

Joskow, Paul L. 1988. "Price adjustment in long-term contracts: the case of coal." *The Journal of Law and Economics* 31(1): 47–83. https://www.jstor.org/stable/725453.

Kamal, Fariha. and Wei Ouyang. 2020. "Identifying U.S. Merchandise Traders: Integrating Customs Transactions with Business Administrative Data." Center for Economic Studies (CES) Working Paper number CES-20-28 (September).

Kamal, Fariha, and Ryan Monarch. 2018. "Identifying Foreign Suppliers in U.S. Import Data." *Review of International Economics*, 26(1): 117–139. https://www.researchgate.net/publication/319211151_Identifying_foreign_suppliers_in_US_import_data.

Kanematsu, Yuichiro. 2017. "Foxconn, Apple and the partnership that changed the tech sector: The pair is basking in shared success — and facing shared risks." *Nikkei Asian Review* (July 13). https://asia.nikkei.com/magazine/20170713/On-the-Cover/Foxconn-Apple-and-the-partnership-that-changed-the-tech-sector.

Kogut, Bruce, and Udo Zander. 1992. "Knowledge of the firm, combinative capabilities, and the replication of technology." *Organization science* 3(3): 383–397. https://doi.org/10.1287/orsc.3.3.383.

Kugler, Maurice, and Eric Verhoogen. 2012. "Prices, Plant Size, and Product Quality." *The Review of Economic Studies* 79(1): 307–339. https://ideas.repec.org/a/oup/restud/v79y2012i1p307-339.html.

Kukharskyy, Bohdan. 2016. "Relational contracts and global sourcing." Journal of International Economics, 101: 123–147. https://doi.org/10.1016/j.jinteco.2016.04.002.

Langlois, Robert N. 1992. "Transaction-cost economics in real time." *Industrial and corporate change* 1(1): 99–127. https://doi.org/10.1093/icc/1.1.99.

Li, Cuihong, "Sourcing for Supplier Effort and Competition: Design of the Supply Base and Pricing Mechanism," Management Science (June 2013)

Liker, Jeffrey K. 2004. The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer. McGraw-Hill Education. https://www.amazon.com/Toyota-Way-Management-Principles-Manufacturer/dp/0071392319 .

Liker, Jeffrey K., and Thomas Y. Choi. 2004. "Building deep supplier relationships." *Harvard business review*, 82(12): 104–113. https://mycourses.aalto.fi/pluginfile.php/675796/course/section/117679/Liker%20et%20Choi%20-HBR-Deeper%20supplier%20relationships-1.pdf.

Macchiavello, Rocco, and Ameet Morjaria. 2015. "The value of relationships: evidence from a supply shock to Kenyan rose exports." *American Economic Review* 105(9): 2911–45. https://www.aeaweb.org/articles?id=10.1257/aer.20120141.

MacDuffie, John Paul, and Susan Helper. 1999. "Creating lean suppliers." In *Remade in America: Transplanting and transforming Japanese management systems*, edited by W. Mark Fruin, Jeffrey K. Liker, and Paul S. Adler. Oxford University Press on Demand.

Macher, Jeffrey T.; Richman, Barak D. 2008. "Transaction cost economics: An assessment of empirical research in the social sciences." *Business and politics* 10(1): 1–63. https://doi.org/10.2202/1469-3569.1210.

Masten, Scott E. 1984. "The organization of production: Evidence from the aerospace industry." *The Journal of Law and Economics* 27(2): 403–417.

Monteverde, Kirk, and David J. Teece. 1982a. "Supplier switching costs and vertical integration in the automobile industry." *The Bell Journal of Economics* 13(1): 206–213. https://www.jstor.org/stable/3003441.

Monteverde, Kirk, and David J. Teece. 1982b. "Appropriable rents and quasi-vertical integration." *The Journal of law and Economics* 25(2): 321–328. https://www.jstor.org/stable/725261.

Mottner, Sandra, and Steve Smith. 2009. "Wal-Mart: Supplier performance and market power." *Journal of Business Research* 62(5): 535–541. https://www.academia.edu/16335519/Wal-mart_Supplier_performance_and_market_power.

Nelson, D., R. Mayo, and P.E., Moody, 1998. "Powered by Honda: developing excellence in the global enterprise." Wiley.

Neumark, David. 1988. “Employers’ discriminatory behavior and the estimation of wage discrimination.” *Journal of Human Resources* 23: 279–295. http://www.jstor.org/stable/pdfplus/145830.

Nishiguchi, Toshihiro. 1994. “Strategic industrial sourcing: The Japanese advantage.” Oxford University Press on Demand. https://www.amazon.com/Strategic-Industrial-Sourcing-Japanese-Advantage/dp/0195071093/.

Novak, S., and S. Stern. 2009. “Complementarity among vertical integration decisions: Evidence from automobile product development.” *Management Science* 55(2): 311–332.

Nunn, N., and D. Trefler. 2013. “Incomplete contracts and the boundaries of the multinational firm.” *Journal of Economic Behavior & Organization* 94: 330–344.

Oaxaca, Ronald L., and Michael R. Ransom. 1994. “On discrimination and the decomposition of wage differentials.” *Journal of Econometrics* 61: 5–21. https://doi.org/10.1016/0304-4076(94)90074-4.

Pierce, Justin R., and Peter K. Schott. 2012. "Concording U.S. Harmonized System Codes over Time." *Journal of Official Statistics* 28(1): 53–68.

Poppo, Laura, and Todd Zenger. 2002. “Do formal contracts and relational governance function as substitutes or complements?” *Strategic management journal* 23(8): 707–725. https://doi.org/10.1002/smj.249.

Richardson, James. 1993. “Parallel sourcing and supplier performance in the Japanese automobile industry.” *Strategic management journal* 14(5): 339–350. https://doi.org/10.1002/smj.4250140503.

Ruhl, Kim J. 2013. “An Overview of U.S. Intrafirm-Trade Data Sources.” Note. Bureau of Economic Analysis. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2351169.

Ruhl, Kim J. 2015. “How Well Is U.S. Intrafirm Trade Measured?” *American Economic Review* 105(5): 524–529. https://www.aeaweb.org/articles?id=10.1257/aer.p20151045.

Sako, Mari. 1996. “Suppliers’ associations in the Japanese automobile industry: collective action for technology diffusion.” *Cambridge Journal of Economics* 20(6): 651–671. https://doi.org/10.1093/oxfordjournals.cje.a013643.

Sako, Mari. 2004. “Supplier development at Honda, Nissan and Toyota: comparative case studies of organizational capability enhancement.” *Industrial and corporate change* 13(2): 281–308. https://doi.org/10.1093/icc/dth012.

Smitka, Michael. 1991. “Competitive ties: Subcontracting in the Japanese automotive industry.” Columbia University Press. https://cup.columbia.edu/book/competitive-ties/9780231072823.

Stevens, Merieke, John Paul MacDuffie, and Susan Helper. 2015. “Reorienting and recalibrating inter-organizational relationships: Strategies for achieving optimal trust.” *Organization Studies* 36(9): 1237-1264. https://doi.org/10.1177/0170840615585337.

Sturgeon, Timothy J. 2002. “Modular production networks: a new American model of industrial organization.” *Industrial and corporate change* 11(3): 451–496. https://doi.org/10.1093/icc/11.3.451.

Takeishi, Akira. 2002. “Knowledge partitioning in the interfirm division of labor: The case of automotive product development.” *Organization Science* 13(3): 321–338. https://doi.org/10.1287/orsc.13.3.321.2779.

Wada, K., 1992. “The development of tiered inter-firm relationships in the automobile industry: a case study of Toyota Motor Corporation.” *Japanese Yearbook on Business History* 8: 23-47.

Wada, K., 1998. “The Formation of Toyota’s Relationship with Suppliers: A Modern Application of the Community Mechanism.” In *Toward the rural-based development of commerce and industry: Selected Experiences from East Asia*, edited by Y. Hayami. Washington, DC: World Bank.

Wada, Kazuo. 2020. *The Evolution of the Toyota Production System*. Singapore: Springer.

Wall Street Journal. June 11, 2011.

Williamson, Oliver E. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications*, New York, NY: Free Press. https://www.amazon.com/Markets-Hierarchies-Analysis-Antitrust-Implications/dp/0029347807

Williamson, Oliver E. 1985. *The Economic Institutions of Capitalism*. New York: Macmillan. https://archive.org/details/economicinstitut0000will.

Womack, James P., Daniel T Jones, and Daniel Roos. 1990. *The Machine That Changed the World*. Simon and Schuster. https://www.amazon.com/Machine-That-Changed-World-5-Million-Dollar/dp/0892563508/.

Zaheer, Srilata, and Akbar Zaheer. 2006. “Trust across borders.” *Journal of international business studies* 37(1): 21–29. https://link.springer.com/article/10.1057/palgrave.jibs.8400180.

Figures

Figure 1. Importance of Foreign Sourcing in U.S. Manufacturing [18]

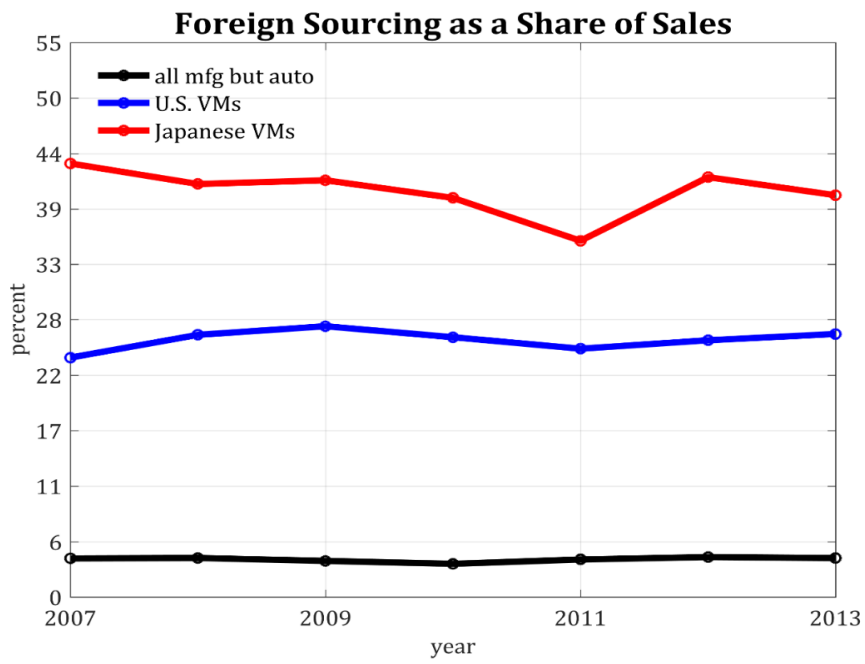
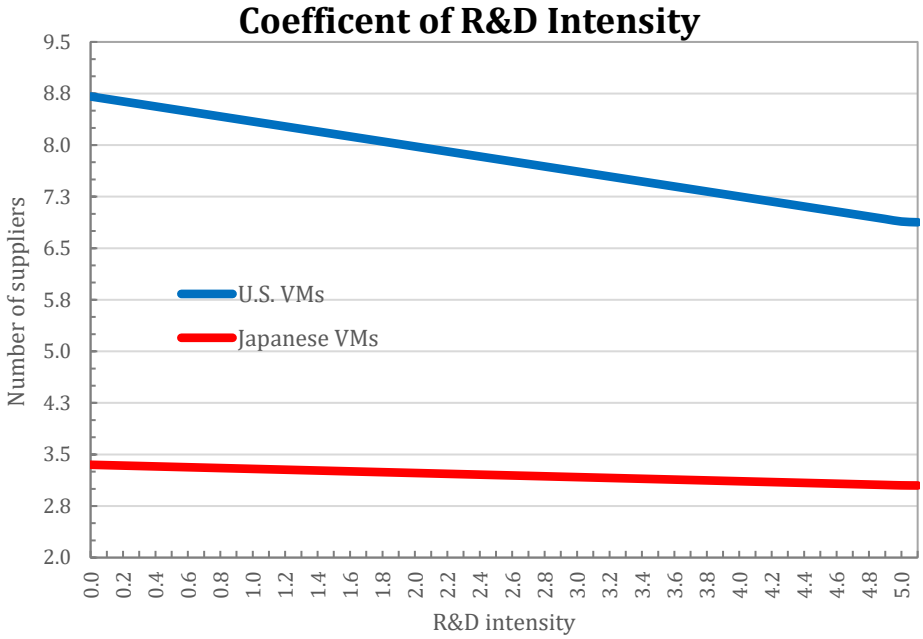


Figure 2. The 'Japan' Effect Versus the R&D Effect [19]



[18] Source. Bureau of Economic Analysis (BEA). The data underlying this picture come from the annual data from the Surveys of Multinational Enterprises conducted by BEA: *U.S. Direct Investment Abroad* and *Foreign Direct Investment in the U.S.* Some additional information also comes from *Compustat*.

[19] Figure 2 is generated from the estimates in column 5 of table 2. All covariates (except R&D intensity) are evaluated at sample mean.

Tables

Table 1. Summary Statistics

	Full Sample			USA			Japan		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
VM group-product-year sample									
Japan	23,500	0.50	0.50	11,500	0.00	0.00	11,500	1.00	0.00
Outcome variables									
Number of suppliers	23,500	4.66	13.51	11,500	8.16	18.26	11,500	1.16	2.59
RPT share	23,500	21.93	34.06	11,500	24.71	32.31	11,500	19.15	35.51
Product characteristics									
Upstreamness	23,500	2.14	0.66	11,500	2.14	0.66	11,500	2.13	0.66
R&D intensity	23,500	1.15	1.30	11,500	1.15	1.30	11,500	1.14	1.29
Import elasticity	23,500	6.76	10.64	11,500	6.78	10.65	11,500	6.75	10.62
Import share of trade	23,500	55.92	14.98	11,500	55.97	14.95	11,500	55.88	15.01
Control variables									
Value of purchase	23,500	0.00	6.74	11,500	2.60	6.19	11,500	-2.61	6.24
Length of purchase	23,500	0.00	6.78	11,500	3.20	6.55	11,500	-3.20	5.35
Additional variables in the VM group-product-country-year sample									
Country characteristics									
Per capita GDP	1,003,000	9.89	0.86	502,000	9.89	0.86	502,000	9.89	0.86
Exchange rate change	1,003,000	0.01	0.61	502,000	0.01	0.57	502,000	0.01	0.66
Generalized trust	1,003,000	29.73	14.54	502,000	29.73	14.54	502,000	29.73	14.54
Outcome variable in the VM group-product sample									
Longevity of relationship with suppliers	1,200	2.38	1.09	600	2.14	0.62	600	2.62	1.38

Note. (a) Japan = Japan dummy indicating the Japanese VM group; RPT share = related party trade (RPT) share (%); Upstreamness = upstreamness index, computed for every year using Antras et al. (2002) methodology; R&D intensity = R&D intensity index (Nunn-Trefler); Import elasticity = import elasticity (Broda-Weinstein); Import share of trade = import share of trade in HS-6 category that the product belongs to; Per capita GDP = log of per capita real GDP in constant 2011 USD; Exchange rate change = exchange rate change (%), weighted by (total country purchase of VM group / total purchase of VM group); Generalized trust = generalized trust index in the country (from World Values Survey); Value of purchase = log of imports in 2009 constant USD (deviation from mean); Length of purchase = length of purchase of the product in years (deviation from mean); Longevity of relationship with suppliers = average number of years a part supplied by suppliers. (b) Three samples were used that different in dimension: the VM group-product-country-year level sample is aggregated over all countries to obtain VM group-product-year level sample and then, by further aggregating across all years, VM group-product level sample was obtained. The time-invariant sample was necessitated by the construction of the variable, average longevity of relationship with suppliers. (c) Rounding rules were applied to each number according to the Census Bureau's guidelines for disclosure avoidance; the number of observations for the two sub-samples thus does not sum to that of the full sample.

Table 2. Regression of number of suppliers in the annual product-level sample

	(1)	(2)	(3)	(4)	(5)
Japan	-7.01	-3.93		-6.54	-5.99
	[-11.32]	[-8.23]		[-10.74]	[-2.7]
Upstreamness					-0.22
					[-0.54]
Japan * upstreamness					0.04
					[0.1]
R&D intensity (rdi)					-0.36
					[-2.39]
Japan * rdi					0.30
					[1.98]
Import elasticity (elasticity)					-0.10
					[-4.11]
Japan * elasticity					0.09
					[3.87]
Import share of trade (imshare)					-0.02
					[-0.84]
Japan * imshare					0.02
					[0.86]
Value of purchase (vp)		0.96	0.77	1.72	1.95
		[5.68]	[6.14]	[6.76]	[5.87]
Japan * vp				-1.40	-1.73
				[-5.35]	[-5.31]
Length of purchase in HS (lp)		-0.31	-0.02	-0.83	-0.79
		[-2.19]	[-0.19]	[-4.39]	[-3.26]
Japan * lp				0.14	0.82
				[0.65]	[3.45]
RPT share demeaned (RPT0)			-0.03	-0.03	-0.05
			[-7.33]	[-4.07]	[-3.5]
Japan * RPT0				0.04	0.05
				[4.46]	[3.26]
Constant	7.86	8.07	3.79	3.56	9.38
	[10.63]	[9.78]	[5.02]	[2.16]	[4.05]
Observations	23,500	23,500	23,500	23,500	23,500
R-squared	0.07	0.17	0.48	0.58	0.25
Year fixed effects	yes	yes	yes	yes	yes
Product (HS-10) fixed effects	no	no	yes	yes	no
RMSE	13.03	12.28	9.86	8.92	11.73
Adj-R2	0.07	0.17	0.47	0.56	0.25
Goodness of fit F statistic	11.20	11.96	110.30	289.40	28.94
Goodness of Fit - p-value	0.00	0.00	0.00	0.00	0.00
Joint F statistic: year fixed effects	9.13	4.25	4.74	3.99	3.56
Joint F p-value: year fixed effects	0.00	0.00	0.00	0.00	0.00
Joint F statistic: product fixed effects			53.93	4.52	
Joint F p-value: product fixed effects			0.00	0.00	

Notes. (a) Outcome variable is the number of suppliers. (b) RPT share demeaned (RPT0) refers to related party trade share measured as deviation from mean. (c) Standard errors in parentheses are clustered at the VM group-product level.

Table 3. Regressions of vertical integration and longevity of relationship with suppliers in the annual product-level sample

	(1)	(2)	(3)	(4)	(5)	(6)
	Vertical integration (related party trade share, %)			Longevity of relationship with suppliers (in years)		
Japan	-5.51	10.62	10.94	0.47	1.39	1.52
	[-4.94]	[10.72]	[2.24]	[7.70]	[13.03]	[4.53]
Product characteristics	no	no	yes	no	no	yes
Japan * Product characteristics	no	no	yes	no	no	yes
Control variables	no	yes	yes	no	yes	yes
Japan * Control variables	no	yes	yes	no	yes	yes
Observations	23,500	23,500	23,500	1,200	1,200	1,200
Year fixed effects	yes	yes	yes	---	---	---
Product (HS-10) fixed effects	no	yes	no	no	yes	no
RMSE	33.87	28.23	31.21	1.07	0.81	0.92
Adj-R2	0.01	0.32	0.16	0.05	0.45	0.29
Goodness of fit F statistic	7.23	820.50	37.17	59.29	1025.00	39.78
Goodness of Fit - p-value	0.00	0.00	0.00	0.00	0.00	0.00
Joint F statistic: year fixed effects	5.83	3.59	1.15	---	---	---
Joint F p-value: year fixed effects	0.00	0.00	0.00	---	---	---
Joint F statistic: product fixed effects		423.20			173.50	
Joint F p-value: product fixed effects		0.00			0.00	

Note. (a) Each regression has a constant. (b) As explained in table 1, regressions of longevity of relationship do not have a year dimension. (c) The set of control variables include RPT share dev. mean (RPT0) in regressions of longevity of relationship but not in regressions of vertical integration. (d) Standard errors reported in parentheses clustered at the VM group-product level.

Table 4. Regression of number of suppliers, vertical integration and longevity of relationship with suppliers in the annual product- and country-level sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Number of suppliers			Vertical integration (related party trade share, %)			Longevity of relationship with suppliers (in years)		
Japan	-0.096	-0.040	-0.126	1.439	2.615	1.253	0.188	0.260	0.370
	[-9.203]	[-3.564]	[-3.987]	[13.61]	[15.72]	[4.739]	[16.18]	[14.72]	[11.03]
Control variables	yes	yes	yes	yes	yes	yes	yes	yes	yes
Japan * control variable	yes	yes	yes	yes	yes	yes	yes	yes	yes
Product characteristics	no	no	yes	no	no	yes	no	no	yes
Japan* product characteristics	no	no	yes	no	no	yes	no	no	yes
Per capita GDP (pcGDP)	0.064	0.006	0.063	0.010	0.327	0.019		-0.005	
	[3.804]	[1.816]	[3.748]	[0.072]	[9.145]	[0.141]		[-1.099]	
Japan * pcGDP	-0.012	0.000	-0.007	-0.734	-0.519	-0.756		0.007	
	[-3.247]	[-0.083]	[-2.228]	[-17.75]	[-12.72]	[-18.24]		[1.322]	
Exchange rate change (xchage)	-0.016	-0.031	-0.015	0.288	0.602	0.287		-0.332	
	[-1.61]	[-2.279]	[-1.565]	[3.834]	[7.272]	[3.811]		[-9.532]	
Japan * xchange	0.028	0.031	0.028	-0.185	-0.260	-0.185		0.300	
	[2.25]	[2.268]	[2.194]	[-1.926]	[-2.672]	[-1.912]		[4.939]	
Generalized trust (gentrust)		0.001			0.042			0.004	
		[4.672]			[9.894]			[7.831]	
Japan * gentrust		-0.002			-0.039			-0.004	
		[-4.737]			[-8.718]			[-7.744]	
Observations	1,003,000	1,003,000	1,003,000	1,003,000	1,003,000	1,003,000	53,000	53,000	53,000
Year fixed effects	yes	yes	yes	yes	yes	yes	--	--	--
Product (HS-10) fixed effects	yes	yes	no	yes	yes	no	yes	yes	no
Country fixed effects	yes	no	yes	yes	no	yes	yes	no	yes
Adj-R2	0.334	0.329	0.317	0.421	0.400	0.416	0.690	0.679	0.684

Note. (a) Each regression has a constant. A complete set of estimates along with the results of all the F-tests are reported in the appendix. (b) The country-level variables used in regressions (7)-(9) are not time-invariant but averaged over the time period. Therefore, they are excluded in the presence of country fixed effects. In regressions (1)-(6), the sample is time-varying and hence country-level variables can be used in the presence of country fixed effects. (c) The set of control variables include RPT share dev. mean (RPT0) in the regressions of number of suppliers and those of longevity of relationship but not in the regressions of vertical integration. (d) Standard errors in parentheses are clustered at the VM group-product-country level.

Table 5. Qualitative results of OEM-level regressions

	(1)	(2)
	Number of suppliers	**Vertical integration**
U.S. OEM dummy variables	Positive on average	Negative on average
Japanese OEM dummy variables	Negative on average	Positive on average
Log value of purchase – deviation from mean	yes	yes
Number of years purchased – deviation from mean	yes	yes
RPT – deviation from mean	yes	no
Constant	yes	yes
Year FE	yes	yes
HS10 FE	yes	yes
Goodness of fit	Good	Good
Year fixed effects	Jointly significant	Jointly significant
Product fixed effects	Jointly significant	Jointly significant
Group of US OEM dummies	Jointly significant	Jointly significant
Group of Japanese OEM dummies	Jointly significant	Jointly significant
H0: US OEM dummies are not different from each other	Reject	Reject
H0: Japanese OEM dummies are not different from each other	Reject	Reject

Note. (a) These regressions are run on annual product-OEM level. (b) The omitted category is a Japanese OEM. (c) Standard errors are clustered at product-OEM level.

Appendices

Appendix 1. Regression of number of suppliers in the annual product- and country-level sample

	(1)	(2)	(3)
Japan	-0.096	-0.040	-0.126
	[-9.203]	[-3.564]	[-3.987]
Upstreamness			0.009
			[1.835]
Japan * upstream			-0.009
			[-1.856]
R&D intensity (rdi)			-0.012
			[-6.312]
Japan * rdi			0.011
			[5.576]
Import elasticity (elasticity)			-0.002
			[-7.549]
Japan * elasticity			0.002
			[6.939]
Import share of trade (imshare)			-0.001
			[-2.436]
Japan * imshare			0.001
			[2.434]
Per capita GDP (pcGDP)	0.064	0.006	0.063
	[3.804]	[1.816]	[3.748]
Japan * pcGDP	-0.012	0.000	-0.007
	[-3.247]	[-0.083]	[-2.228]
Exchange rate change (xchage)	-0.016	-0.031	-0.015
	[-1.61]	[-2.279]	[-1.565]
Japan * xchange	0.028	0.031	0.028
	[2.25]	[2.268]	[2.194]
Generalized trust (gentrust)		0.001	
		[4.672]	
Japan * gentrust		-0.002	
		[-4.737]	
Value of purchase (vp)	0.447	0.463	0.448
	[13.74]	[13.6]	[13.21]
Japan * vp	-0.309	-0.303	-0.321
	[-8.772]	[-8.939]	[-8.452]
Length of purchase (lp)	-0.171	-0.177	-0.164
	[-8.512]	[-8.596]	[-8.207]
Japan * lp	0.154	0.154	0.176
	[8.266]	[8.343]	[8.243]

Continued…

	(1)	(2)	(3)
RPT share demeaned (RPT0)	-0.004	-0.004	-0.004
	[-4.139]	[-3.93]	[-4.183]
Japan * RPT0	0.001	0.000	0.001
	[0.705]	[0.043]	[0.925]
Constant	0.195	0.140	0.291
	[6.444]	[5.979]	[7.876]
Observations	1,003,000	1,003,000	1,003,000
Year fixed effects	yes	yes	yes
Product (HS-10) fixed effects	yes	yes	no
Country fixed effects	yes	no	yes
RMSE	1.103	1.106	1.116
Adj-R2	0.334	0.329	0.317
Goodness of fit F statistic	33.310	33.690	215.900
Goodness of Fit - p-value	0.000	0.000	0.000
Joint F statistic: year fixed effects	8.477	8.275	8.324
Joint F p-value: year fixed effects	0.000	0.000	0.000
Joint F statistic: product fixed effects	1.103	1.125	
Joint F p-value: product fixed effects	0.042	0.018	
Joint F statistic: country fixed effects	7.347		8.999
Joint F p-value: country fixed effects	0.000		0.000

Note. (a) Detailed results of the highlight presented in table 4. (b) Standard errors are clustered at the VM group-product-country level.

Appendix 2. Regression of vertical integration in the annual product-level and product- and country-level samples

	Product-level sample					Product- and country-level sample		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Japan	-5.512	6.435		10.620	10.940	1.439	2.615	1.253
	[-4.944]	[5.116]		[10.72]	[2.243]	[13.61]	[15.72]	[4.739]
Upstreamness					-1.599			-0.223
					[-1.697]			[-3.825]
Japan * upstream					-2.651			0.080
					[-2.059]			[1.168]
R&D intensity (rdi)					0.539			-0.004
					[1.107]			[-0.106]
Japan * rdi					-1.044			-0.006
					[-1.514]			[-0.146]
Import elasticity (elasticity)					0.169			0.019
					[2.305]			[5.005]
Japan * elasticity					-0.035			-0.015
					[-0.354]			[-3.337]
Import share of trade (imshare)					-0.032			-0.002
					[-0.678]			[-0.748]
Japan * imshare					0.056			0.001
					[0.884]			[0.282]
Per capita GDP (pcGDP)						0.010	0.327	0.019
						[0.072]	[9.145]	[0.141]
Japan * pcGDP						-0.734	-0.519	-0.756
						[-17.75]	[-12.72]	[-18.24]
Exchange rate change (xchage)						0.288	0.602	0.287
						[3.834]	[7.272]	[3.811]
Japan * xchange						-0.185	-0.260	-0.185
						[-1.926]	[-2.672]	[-1.912]
Generalized trust (gentrust)							0.042	
							[9.894]	
Japan * gentrust							-0.039	
							[-8.718]	

Continued…

	Product-level sample					Product- and country-level sample		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Value of purchase (vp)		1.539	1.881	0.954	0.641	0.731	0.604	0.761
		[9.832]	[13.64]	[5.571]	[3.243]	[8.39]	[6.555]	[8.625]
Japan * vp				1.003	1.434	1.239	1.059	1.259
				[3.96]	[4.679]	[6.855]	[5.609]	[6.854]
Length of purchase (lp)		0.599	0.177	1.069	0.974	1.768	1.884	1.718
		[3.219]	[1.182]	[5.794]	[4.653]	[26.77]	[26.89]	[25.64]
Japan * lp				0.506	-0.272	0.491	0.581	0.449
				[1.745]	[-0.664]	[2.611]	[2.951]	[2.359]
Constant	19.590	17.910	34.440	33.550	22.970	3.561	2.644	3.002
	[17.85]	[17.63]	[15.79]	[8.421]	[6.518]	[7.019]	[5.017]	[12.97]
Observations	23,500	23,500	23,500	23,500	23,500	1,003,000	1,003,000	1,003,000
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Product (HS-10) fixed effects	no	no	yes	yes	no	yes	yes	no
Country fixed effects	---	---	---	---	---	yes	no	yes
RMSE	33.870	31.540	28.700	28.230	31.210	12.170	12.380	12.220
Adj-R2	0.014	0.145	0.289	0.315	0.163	0.421	0.400	0.416
Goodness of fit F statistic	7.229	43.680	403.100	820.500	37.170	22.990	19.290	168.500
Goodness of Fit - p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Joint F statistic: year fixed effects	5.825	3.157	3.491	3.587	1.147	24.010	28.030	24.150
Joint F p-value: year fixed effects	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Joint F statistic: product fixed effects			392.000	423.200		2.289	2.311	
Joint F p-value: product fixed effects			0.000	0.000		0.000	0.000	
Joint F statistic: country fixed effects	---	---	---	---	---	61.930		61.130
Joint F p-value: country fixed effects	---	---	---	---	---	0.000		0.000

Note. (a) Detailed results of the highlight presented in tables 3 and 4. (b) Standard errors clustered at the VM group-product level for the product-level sample and at the VM group-product-country level for the product- and country-level sample.

Appendix 3. Regression of average longevity of relationships with suppliers in the annual product-level and product- and country-level samples

	Product-level sample				Product- and country-level sample		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Japan	0.474	1.102	1.385	1.519	0.188	0.260	0.370
	[7.701]	[16.11]	[13.03]	[4.533]	[16.18]	[14.72]	[11.03]
Upstreamness				0.216			0.069
				[4.073]			[9.531]
Japan * upstream				-0.174			-0.050
				[-1.468]			[-5.378]
R&D intensity (rdi)				-0.019			-0.005
				[-1.234]			[-1.462]
Japan * rdi				0.061			0.009
				[1.554]			[1.971]
Import elasticity (elasticity)				0.001			-0.001
				[0.303]			[-2.637]
Japan * elasticity				0.006			0.001
				[0.982]			[2.992]
Import share of trade (imshare)				0.002			0.001
				[1.401]			[4.766]
Japan * imshare				-0.002			-0.002
				[-0.586]			[-3.743]
Per capita GDP (pcGDP)						-0.005	
						[-1.099]	
Japan * pcGDP						0.007	
						[1.322]	
Exchange rate change (xchage)						-0.332	
						[-9.532]	
Japan * xchange						0.300	
						[4.939]	
Generalized trust (gentrust)						0.004	
						[7.831]	
Japan * gentrust						-0.004	
						[-7.744]	

Continued …

	Product-level sample				Product- and country-level sample		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Value of purchase (vp)		0.036	0.177	0.090	0.189	0.168	0.180
		[2.701]	[6.192]	[10.11]	[68.49]	[69.98]	[67.86]
Japan * vp			-0.139	-0.125	0.012	0.004	0.011
			[-5.624]	[-4.684]	[2.295]	[0.701]	[1.939]
Length of purchase (lp)		0.093	0.055	0.029	-0.016	-0.007	-0.008
		[10.68]	[4.592]	[5.817]	[-7.865]	[-3.616]	[-4.176]
Japan * lp			0.097	0.147	0.041	0.041	0.046
			[6.343]	[7.814]	[5.853]	[5.809]	[6.443]
RPT share demeaned (RPT0)			-0.002	0.002	0.005	0.006	0.005
			[-0.862]	[2.382]	[12.44]	[13.85]	[12.86]
Japan * RPT0			0.005	0.001	0.000	0.000	0.000
			[1.861]	[0.66]	[0.169]	[0.482]	[0.148]
Constant	2.144	1.829	1.801	1.369	0.535	0.388	0.322
	[85.41]	[59.55]	[25.35]	[9.921]	[16.4]	[10.93]	[12.48]
Observations	1,200	1,200	1,200	1,200	53,000	53,000	53,000
Product (HS-10) fixed effects	no	no	yes	no	yes	yes	no
Country fixed effects	---	---	---	---	yes	no	yes
RMSE	1.067	0.958	0.814	0.919	0.697	0.709	0.704
Adj-R2	0.046	0.232	0.445	0.293	0.690	0.679	0.684
Goodness of fit F statistic	59.290	129.000	1025.000	39.780	88.220	77.330	760.200
Goodness of Fit - p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Joint F statistic: product fixed effects			173.500		2.989	2.916	
Joint F p-value: product fixed effects			0.000		0.000	0.000	
Joint F statistic: country fixed effects	---	---	---	---	17.490		18.260
Joint F p-value: country fixed effects	---	---	---	---	0.000		0.000

Note. (a) Detailed results of the highlight presented in tables 3 and 4. (b) Standard errors clustered at the VM group-product level for the product-level sample and at the VM group-product-country level for the product- and country-level sample.