

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 renegeing 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,

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

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), 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 (RPTO).¹¹

The vector 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 R_{vpt} is a combination of elements of X_{vpt} and 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 RPTO is excluded from X_{vpt} when the outcome is vertical integration.

¹² While 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.

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

where the subscript c denotes country, 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 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 R_{vcpt} is a combination of elements of X_{vcpt} , Y_{pt} and 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:

$$(1)' \quad L_{vp} = \alpha + \beta J + \delta X_{vp} + \theta Y_p + \gamma(J * R_{vp}) + \pi + \varepsilon_{vp},$$

$$(2)' \quad L_{vcp} = \alpha + \beta J + \delta X_{vcp} + \theta Y_p + \mu Z_c + \gamma(J * R_{vcp}) + \varphi + \pi + \varepsilon_{vcp},$$

where, the variables in $\{Y_p, Z_c\}$ 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. Results¹⁵

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?

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Figures

Figure 1. Importance of Foreign Sourcing in U.S. Manufacturing¹⁸

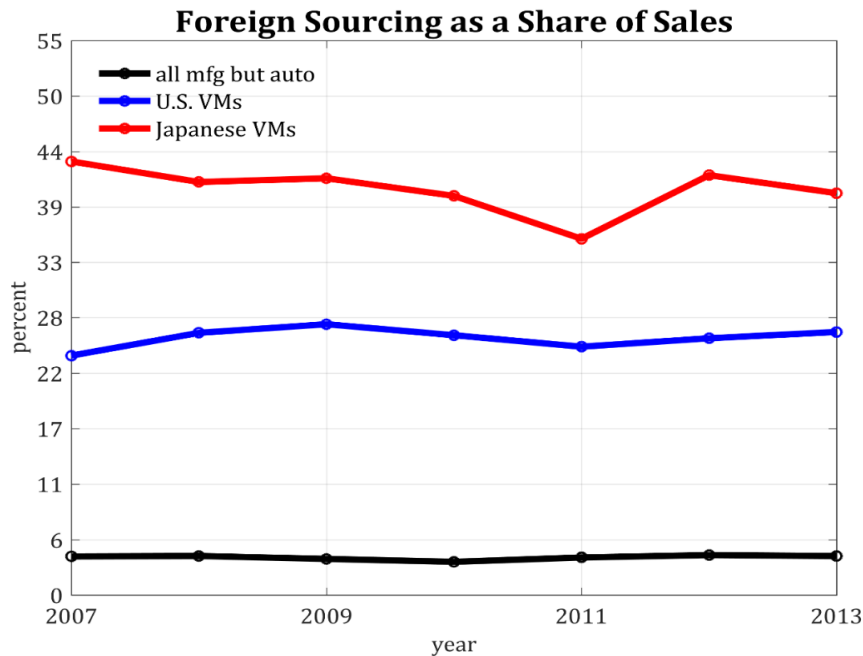
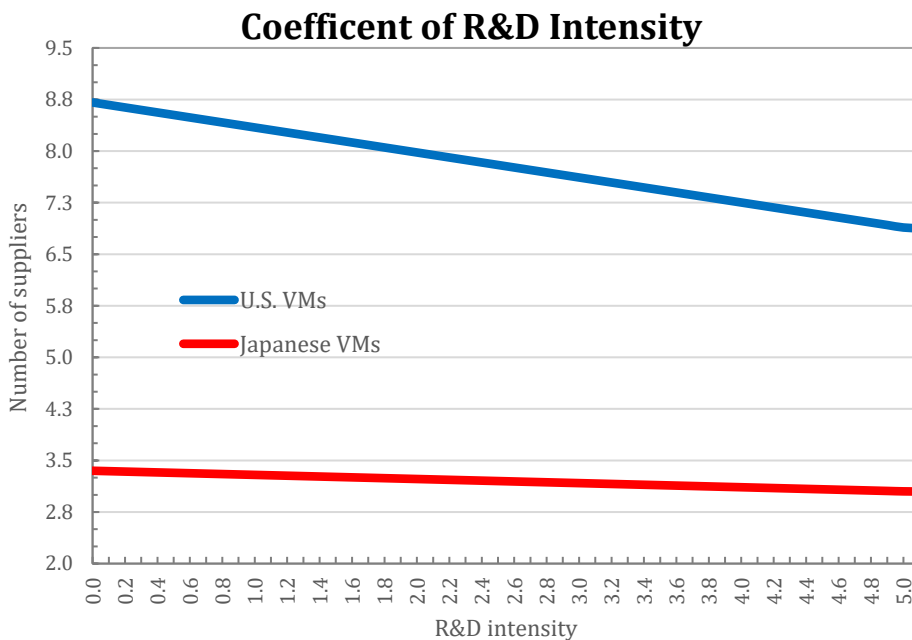


Figure 2. The 'Japan' Effect Versus the R&D Effect¹⁹



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.
<u>VM group-product-year sample</u>									
Japan	23,500	0.50	0.50	11,500	0.00	0.00	11,500	1.00	0.00
<i>Outcome variables</i>									
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
<i>Product characteristics</i>									
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
<i>Control variables</i>									
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
<u>Additional variables in the VM group-product-country-year sample</u>									
<i>Country characteristics</i>									
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
<u>Outcome variable in the VM group-product sample</u>									
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 [-4.94]	10.62 [10.72]	10.94 [2.24]	0.47 [7.70]	1.39 [13.03]	1.52 [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 [-9.203]	-0.040 [-3.564]	-0.126 [-3.987]	1.439 [13.61]	2.615 [15.72]	1.253 [4.739]	0.188 [16.18]	0.260 [14.72]	0.370 [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 [3.804]	0.006 [1.816]	0.063 [3.748]	0.010 [0.072]	0.327 [9.145]	0.019 [0.141]		-0.005 [-1.099]	
Japan * pcGDP	-0.012 [-3.247]	0.000 [-0.083]	-0.007 [-2.228]	-0.734 [-17.75]	-0.519 [-12.72]	-0.756 [-18.24]		0.007 [1.322]	
Exchange rate change (xchage)	-0.016 [-1.61]	-0.031 [-2.279]	-0.015 [-1.565]	0.288 [3.834]	0.602 [7.272]	0.287 [3.811]		-0.332 [-9.532]	
Japan * xchange	0.028 [2.25]	0.031 [2.268]	0.028 [2.194]	-0.185 [-1.926]	-0.260 [-2.672]	-0.185 [-1.912]		0.300 [4.939]	
Generalized trust (gentrust)		0.001 [4.672]			0.042 [9.894]			0.004 [7.831]	
Japan * gentrust		-0.002 [-4.737]			-0.039 [-8.718]			-0.004 [-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 [-9.203]	-0.040 [-3.564]	-0.126 [-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 [3.804]	0.006 [1.816]	0.063 [3.748]
Japan * pcGDP	-0.012 [-3.247]	0.000 [-0.083]	-0.007 [-2.228]
Exchange rate change (xchage)	-0.016 [-1.61]	-0.031 [-2.279]	-0.015 [-1.565]
Japan * xchange	0.028 [2.25]	0.031 [2.268]	0.028 [2.194]
Generalized trust (gentrust)		0.001 [4.672]	
Japan * gentrust		-0.002 [-4.737]	
Value of purchase (vp)	0.447 [13.74]	0.463 [13.6]	0.448 [13.21]
Japan * vp	-0.309 [-8.772]	-0.303 [-8.939]	-0.321 [-8.452]
Length of purchase (lp)	-0.171 [-8.512]	-0.177 [-8.596]	-0.164 [-8.207]
Japan * lp	0.154 [8.266]	0.154 [8.343]	0.176 [8.243]

Continued...

	(1)	(2)	(3)
RPT share demeaned (RPT0)	-0.004 [-4.139]	-0.004 [-3.93]	-0.004 [-4.183]
Japan * RPT0	0.001 [0.705]	0.000 [0.043]	0.001 [0.925]
Constant	0.195 [6.444]	0.140 [5.979]	0.291 [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.