Vertical Integration and the Sourcing Style*

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Abstract

I build a relational contract model of global sourcing under asset ownership to show how vertical integration and sourcing systems are complementary. I show that, given that both "Japanese"-style and "American"-style sourcing ensure similar quality levels, vertical integration and "Japanese"-style sourcing are complementary. Sourcing from related parties is more likely to result in a long-term relationship with high-frequency shipments and small shipment sizes. Complementarity is stronger when the upstream firm's assets are more valuable and when the upstream firm is in an industry with greater quality differentiation. Combining the ORBIS data, which provides large-scale firm-to-firm ownership information, with the Panjiva data, which includes all the maritime firm-to-firm transaction records, I provide empirical evidence consistent with these theoretical predictions.

Keywords: supply chain; vertical integration; global sourcing; incentive

JEL Codes: F1, L14, L22

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1 Introduction

In recent decades, global supply chains have become increasingly important in international trade. Downstream firms source inputs from upstream firms through various contractual forms. For example, in the automotive industry, American automakers like General Motors typically select the lowest bidder each year. At the same time, Japanese automobile firms, such as Toyota, sign long-term contracts with high-performing suppliers and frequently conduct just-in-time transactions with them. Firms typically choose between American-style (A style) sourcing—large, infrequent shipments with mandatory inspections—and Japanese-style (J style) sourcing—small, frequent shipments, and long-term relationships. The A style relies on spot contracts and inspection for quality control, while the J style uses relational contracts and repeated interactions to incentivize quality. (Taylor and Wiggins, 1997) Recent studies show a shift towards J style sourcing as trade environments stabilize and competition from low-income countries rises. (Heise, Pierce, Schaur and Schott, 2024; Fernandes and Tang, 2020; Ortiz, 2022) This paper studies how vertical integration of suppliers complements J style sourcing, making integrated firms more likely to adopt frequent, small-quantity shipments.

This paper combines the partial equilibrium trade model of Heise et al. (2024)[1] with the idea of asset ownership from Grossman and Hart (1986). By allowing either the downstream or the upstream firm to own the assets—and thus the right to resell them—buyers face a tradeoff between the benefits and costs of vertical integration when choosing a sourcing system.

In my model, non-integration means the upstream firm owns the asset, while vertical integration transfers ownership to the downstream firm. Because the asset owner can sell it and receive a one-time benefit, non-integration gives the upstream firm a greater outside option, and the downstream firm must therefore work harder to incentivize high-quality production.

Under A style sourcing, buyers use spot contracts and inspect each shipment, so the supplier's asset ownership does not affect the buyer's choice as long as monitoring costs are exogenous. Under J style, however, the buyer must ensure that the net present value of the long-term relationship exceeds the supplier's one-time gain from defaulting. Suppliers with assets therefore require higher premiums to be incentivized. My model formalizes this logic and shows a complementarity between vertical integration and J style sourcing. The complementarity mainly comes from the extensive margin—firms change their sourcing style

[1] Heise et al. (2024) extends the model of Taylor and Wiggins (1997) by adding a parameter ρ to the discount rate to measure policy uncertainty and forcing buyers who choose A style to monitor each transaction with 100% probability.

from A to J when they are vertically integrated. I also show that the complementarity is stronger when the upstream firm's asset value is higher or when the upstream firm is in a more quality-differentiated industry.

Next, I combine transaction-level US import data from Panjiva with ownership data from ORBIS, a global firm-level database maintained by Moody's.[2] I match the two datasets using cleaned firm names and countries, and classify transactions between matched firm pairs with ownership links as related-party trade. This study lacks a micro-level exogenous shock to identify a causal relationship between sourcing patterns and vertical integration, but the detailed transaction-level data allow me to construct variables that closely fit the model and to demonstrate a relationship that is robust across multiple specifications and fixed effects.

My empirical results confirm the model's predictions: related parties trade more frequently and ship smaller quantities per transaction than non-related parties conditional on the totaol trade volume, consistent with J style sourcing. I also provide supportive evidence that the complementarity between vertical integration and J style sourcing is stronger when the upstream firm is more valuable or operates in an industry with a larger quality gap. Specifically, among related parties, those whose subsidiary's asset value ranks in the top quartile ship even more frequently than those with less valuable subsidiaries. Similarly, related parties trading in industries with larger quality gaps exhibit even higher shipping frequency. These results are robust across different specifications and fixed effects.

This paper contributes to three strands of literature. First, it extends the research on firms' adoption of different procurement styles by incorporating the interaction between sourcing systems and organizational structures. As Milgrom and Roberts (1990) proposed, a firm's various strategies are complementary and should be analyzed together. Since firms often acquire their suppliers when importing inputs, procurement strategy and organizational form naturally interact. Yet since Taylor and Wiggins (1997) first used a partial equilibrium model to characterize A and J style sourcing, few studies have explored the relationship between sourcing systems and organizational forms in depth. Heise et al. (2024) extends the model to examine how policy uncertainty affects sourcing style, but focuses on arm's-length trade. I instead focus on how firms' integration choices interact with their procurement system choices.

Second, it contributes to the understanding of how vertical integration shapes global supply chains. As Fort (2023) documents, in-house production outside the domestic country is becoming more prevalent. Antràs and Helpman (2006) argue that vertical integration reduces contractual frictions, and that integration is more beneficial when contractibility of an input

[2]I process the ORBIS data following the method suggested by Kalemli-Ozcan, SSrensen, Villegas-Sanchez, Volosovych and Yesiltas (2015).

is provided by the supplier. Building on this property rights framework, Antràs and Chor (2013) and Alfaro, Antràs, Chor and Conconi (2019) incorporate sequential production and show that the integration decision depends on the substitutability of inputs along the supply chain and the elasticity of demand. In contrast to the property rights approach, Forbes and Lederman (2009) and Costinot, Oldenski and Rauch (2011) argue that integration enhances ex-post adaptation capabilities. Berlingieri, Pisch and Steinwender (2021) emphasizes the technological importance of inputs, while Grossman and Helpman (2004) highlights the role of productivity and monitoring ability. These studies all focus on when firms endogenously choose to integrate. My study instead examines how a firm's organizational form interacts with its sourcing system when vertical integration is exogenously given.

Third, this paper contributes both theoretically and empirically to the literature on relational contracts within firms. Baker, Gibbons and Murphy (2002) build a theoretical model of four organizational forms[3] that arise from the joint choice of relational contracts and vertical integration. They show that the key differences in relational contracts, both between and within firms, stem from the parties' motivations to default. My paper embeds these four situations in a global sourcing framework and confirms that vertical integration can strengthen relational contracts. I also provide empirical evidence using detailed firm-level trade data and foreign ownership data.

The paper proceeds as follows. Section 2 describes the data and the construction of key variables. Section 3 presents the motivating facts. Section 4 introduces the theoretical model and derives the main predictions and comparative statics. Section 5 presents the empirical results. Section 6 concludes.

2 Data

In this section, I introduce the datasets I use, which primarily consist of trade data and ownership data. I describe how to match these two datasets to identify trade between related parties. I also describe the construction of the main variables used in the empirical analysis.

2.1 Firm-to-firm Trade Data

I use the US Bills of Lading data from 2007 to 2020, provided by Panjiva, which contains all maritime import transactions of US companies. Panjiva provides the names and unique

[3] Baker et al. (2002) classify organizational and contractual forms into four categories: spot outsourcing, spot employment, relational outsourcing, and relational employment. They use "outsourcing" to refer to non-integration, "employment" to refer to integration, "spot" to refer to spot contracts, and "relational" to refer to relational contracts. The details are in their Figure 1.

IDs of the consignees (the US firm) and the shippers (the foreign firm) for each shipment record, the addresses of both parties, the arrival date of each shipment, the Harmonized System (HS) product code in six digits, the weight of the product in kilograms,[4] and the total quantity of each shipment,[5] etc. Panjiva data provide rich information on firm-to-firm trade, enabling me to conduct micro-level analysis.

2.2 Ownership Data

I use ORBIS, the global firm-level database maintained by Moody's, to construct all the potential cross-country related party pairs. The controlling shareholder (csh) files from this database provide all the levels of controlling shareholders and the end subsidiary. Following the definitions of foreign multinational enterprises (MNEs) and US MNEs in Antràs, Fadeev, Fort and Tintelnot (2022), I identify foreign MNEs and US MNEs using csh files from 2011 to 2017.[6]

The csh files in the ORBIS data include all controlling shareholder–subsidiary pairs, the total and direct ownership percentages between them, and the csh level of each controlling shareholder. Using this structure, I can identify all business groups: the subsidiary in the csh data is the entity at the end of each "ownership tree," and the ultimate owner is the one with the highest csh level. I then classify foreign and US MNEs based on the location of their ultimate owners. Details and examples are provided in Appendix B.1.

After identifying all business groups containing foreign MNEs or US MNEs, I define cross-country related parties as any US firm–foreign firm pair within the same business group.

2.3 Matching Panjiva Data and ORBIS Data

To investigate whether related parties exhibit different patterns in global sourcing, I need to combine firm-to-firm trade data with ownership relationships.

The Panjiva and ORBIS datasets do not share a unified identifier, so I match them using cleaned firm names and countries. To be consistent with the ORBIS data, I restrict the trade data to 2011–2017. I first standardize firm names in both datasets and then perform exact

[4]Panjiva provides both tons and kilograms as units for shipment records, but I use kilograms in this analysis to prevent rounding errors.

[5]The quantities in the raw data have units such as CTN (carton/cartons), PCS (piece/pieces), PKG (package/packages), etc. Different units may be used for the same product in different shipment records.

[6]Antràs et al. (2022) divides firms that are not purely US domestic firms into foreign MNEs and US MNEs. Foreign MNEs are US firms that are majority-owned by foreign firms, while US MNEs are US firms that have a majority-owned foreign affiliation and are majority-owned by US firms. They use the firm's ultimate owners to make the designation.

matches: if the cleaned name and country coincide across the two datasets, I treat them as the same firm. The matching process is described in detail in Appendix B.2.

To assess how much attrition this matching approach generates, I compare descriptive statistics of the matched sample with those reported in Antràs et al. (2022).

Table 1 of Antràs et al. (2022) shows that in 2007, there were 273,000 non-MNE importers, 7,600 foreign MNEs, and 2,800 US MNEs in the United States, with foreign MNEs and US MNEs accounting for 33% and 36% of total imports, respectively. As Table 1 shows, the Panjiva-ORBIS matched data yield similar counts: on average 261,334 non-MNE importers, 7,500 foreign MNEs, and 3,978 US MNEs per year. The import shares of foreign MNEs and US MNEs in the matched data capture about 60% and 42% of the corresponding shares in official US trade data. The gap is not surprising: the two datasets use different firm name formats, which leads to inevitable attrition even after name cleaning; Panjiva covers only maritime trade and measures shipments by weight rather than value; and my definition of MNE does not exactly coincide with that of Antràs et al. (2022). Despite these differences, the matched sample recovers a substantial share of aggregate related-party trade and is well suited to test the model's predictions.

Table 1: Aggregate Statistics for US-based Firms using Panjiva-ORBIS Data

Year	# Non-MNE Importers	# Foreign MNEs	# US MNEs	Import Share of Foreign MNEs	Import Share of US MNEs
2011	238588	5879	3507	0.206	0.248
2012	257492	6715	4304	0.188	0.167
2013	251747	7521	4076	0.161	0.177
2014	268450	8807	3884	0.188	0.108
2015	267497	8463	4167	0.230	0.117
2016	273435	9312	4496	0.189	0.111
2017	269613	8321	3410	0.219	0.092
Average	260975	7860	3978	0.197	0.146

Notes: A firm in the ORBIS data is a firm_name–bvd_id–country combination. A firm in the Panjiva data is a firm_name–panjiva_id–country combination. The two datasets are matched by cleaned firm name and country. Both matched firms not identified as MNEs and unmatched Panjiva firms are classified as non-MNE importers.

3 Motivating Facts

In this section, I present the motivating facts about the relationship between sourcing patterns and related party trade using matched Panjiva-ORBIS data.

Table 2 reports summary statistics at the firm-pair level for 2011, split by related party status. Related parties account for a small fraction of all firm pairs, but they trade larger total quantities, ship far more frequently, maintain longer active trading windows within

the year, and have shorter intervals between shipments—all consistent with J style sourcing. The unconditional quantity per shipment is similar across the two groups because related parties also trade much larger volumes overall. Conditional on the same total trade volume, the quantity per shipment does differ; the regression analysis in Section 5 controls for total trade volume to isolate this difference.

Table 2: Summary Statistics by Related Party Status, 2011

	Related Party	Unrelated Party
Observations	1,896	803,959
Total Quantity Traded (Kg)	3,639,686.71	561,717.21
	(36268029.96)	(31680724.80)
# Shipments	51.76	5.61
	(286.62)	(39.22)
Quantity per Shipment (Kg)	136,741.36	116,301.09
	(1,690,945.99)	(2,294,108.75)
Weeks between First and Last Shipments	27.70	12.17
	(20.79)	(16.85)
Weeks between Shipments	4.88	7.89
	(6.40)	(8.09)

Notes: Unit of observation is a firm pair in 2011. Standard deviations are in parentheses. "Weeks between Shipments" is defined only for pairs with more than one shipment. Total quantity is measured in kilograms. The patterns are similar in other years.

Figures 1 and 2 further illustrate these differences by plotting the distributions of two key measures. Figure 1 shows the kernel density of log shipping frequency in 2011 for related and unrelated party trade. The distribution for unrelated parties is concentrated at low values, while the distribution for related parties is more spread out and shifted to the right. This pattern suggests that related parties are more likely to adopt J style sourcing, which is characterized by higher shipping frequency.

Figure 1: Kernel Density of Log # Shipment, 2011

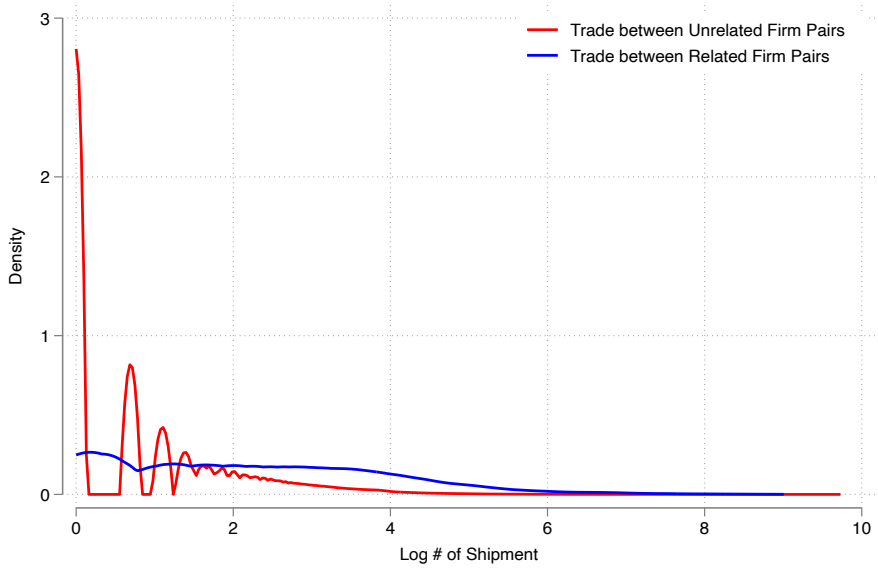
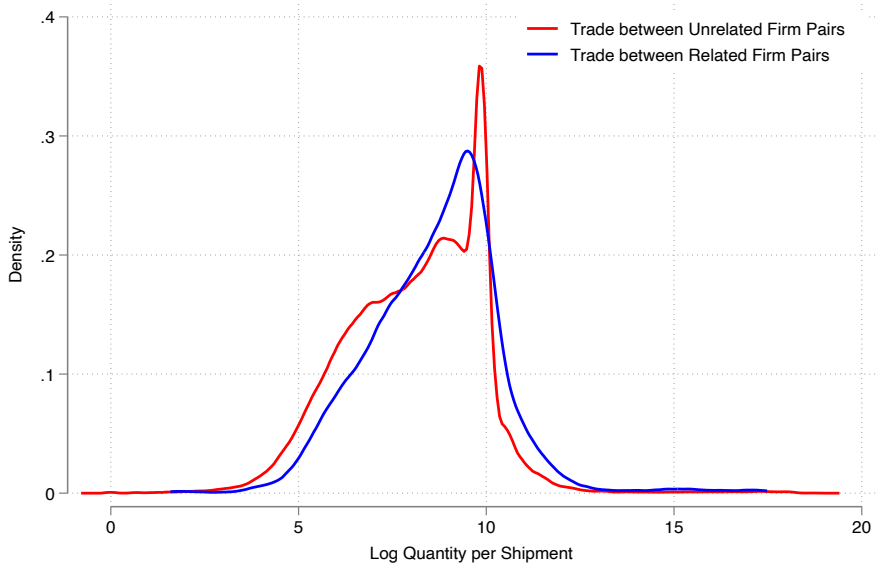


Figure 2 shows the kernel density of log quantity per shipment. Although the unconditional mean is similar across the two groups, the distribution for related parties peaks at a lower value, indicating that related parties ship smaller quantities per transaction. Together, these patterns document that related party trade is characterized by high-frequency, small-quantity shipments—consistent with J style sourcing.

Figure 2: Kernel Density of Log Quantity per Shipment, 2011



4 Theoretical Model

In this section, I build a repeated game model with asset ownership and global sourcing under different systems to rationalize the observed facts. My model combines the asset ownership idea from Grossman and Hart (1986) and the repeated game model introduced by Taylor and Wiggins (1997) and extended by Heise et al. (2024).

4.1 Sourcing Style with Asset Ownership

There is a country with a continuum of homogeneous sellers who can produce the same goods. These sellers need to produce a quantity x for each shipment. I assume that an asset and labor are the only inputs required for production. The resale value of the asset is v. The alternative use value of the product is 0. ω is the productivity of the seller; I normalize the productivity to one without loss of generality. θ is the quality of the product. The output for each shipment is $x = \frac{1}{\theta}l$. There are two types of quality: high quality and low quality, $\theta \in \{\bar{\theta}, \underline{\theta}\}$. The cost of producing low-quality products is lower, so sellers may produce low-quality products to reduce costs, which makes it necessary for buyers to solve the "quality control" problem. In the meantime, sellers also face a reputation problem: once a seller produces and sells a low-quality product, its product will no longer be sold in the market in the next period, since the defection will be exposed after buyers receive the goods. However, the seller can resell the asset to obtain a one-time benefit of v. The shipment requires f units of labor. The total cost, including production and delivery for the seller, is $x\theta + f$. Buyers possess all the bargaining power and can choose to integrate with the seller or not. If they choose to integrate, they will own the asset and the resale value v. If they do not integrate, they will only have the right to distribute the products produced by the sellers to the final consumers, and the resale value v is owned by the seller.

Under A style sourcing, buyers ensure quality by inspecting each shipment.[7] Buyers pay the inspection cost m_A and know the information of quality with certainty. To ensure the feasibility of the analysis, I make three assumptions: First, $\frac{f+\frac{\bar{\theta}}{\omega}x_A}{1-e^{-r\frac{x_A}{q}}} \geq v$, which guarantees that the present value of production payments weakly exceeds the asset resale value v, so all sellers prefer to produce rather than exit and sell the asset, and buyers who choose A style sourcing do not need to pay any premium beyond the production cost—otherwise no seller would participate and A style sourcing would be infeasible; second, the value of a

[7] Taylor and Wiggins (1997) allows buyers to inspect with a probability $\bar{\alpha} = \frac{\bar{\theta}x - \underline{\theta}x}{f + \bar{\theta}x}$ instead of inspecting every shipment. As x_A is large, the asymptotic value of $\bar{\alpha}$ is $\frac{\bar{\theta}x - \underline{\theta}x}{\bar{\theta}x} = 1 - \frac{\underline{\theta}}{\bar{\theta}}$. When the gap between quality is large, the inspection probability goes to 1. Therefore, I assume that buyers who choose A style sourcing monitor every shipment with 100% probability. This is consistent with the special case of Taylor and Wiggins (1997) and makes subsequent analysis tractable.

low-quality product is zero for both sellers and buyers; third, if buyers integrate sellers by owning the asset as well as the resale value v, reselling the asset is less profitable than selling a high-quality product to consumers. Based on these assumptions, the minimum wage that buyers are willing to pay for sellers to participate when choosing A style is

$$v_A(x_A, \bar{\theta}) = f + \bar{\theta} x_A. \tag{1}$$

The total cost, including inspection, for each shipment is

$$c_A(x_A, \bar{\theta}) = f + \bar{\theta} x_A + m_A. \tag{2}$$

Note that the resale value v does not appear in equation (2). Under A style sourcing, the buyer uses spot contracts with a competitive market of homogeneous sellers. If any seller exits to resell the asset, the buyer simply finds another seller from the market. The seller's outside option of reselling the asset therefore provides no bargaining leverage, so v does not affect the buyer's cost under A style.

If the buyer integrates the seller, then the resale value v and the usage right are owned by the buyer. Baker et al. (2002) point out that without inspection, sellers would predict that, since buyers own the assets and the right to use the final products, even if they produce high-quality products, buyers would only keep the products without paying, so sellers would only produce low-quality products. However, in my setting, buyers bear inspection costs to verify product quality, which makes it unprofitable for sellers (buyers) to produce (get) low-quality products. Therefore, asset ownership does not change the behaviors of buyers and sellers compared with the original model in Heise et al. (2024), which means buyers will still pay as equation (1) shows, their cost is also equation (2), and sellers are incentivized by inspection to produce inputs with high quality.

When the total quantity q is fixed, the larger the quantity per shipment x, the smaller the number of shipments $\frac{q}{x}$, and the smaller the average cost in each cycle for buyers who choose A style sourcing.

Unlike A style sourcing, J style sourcing ensures quality by providing incentives via long-term repeated contracts instead of inspecting each shipment. Therefore, if sellers provide a low-quality product to buyers, they can still receive payment $v_J(x_J, \bar{\theta})$ as well as the resale value v and break the relational contract. Sellers who deviate in this way also permanently exit the market for this product due to reputation concerns.

Assume that in order to maintain a relational contract, the buyer will pay the seller before receiving the goods and observing the quality of the goods.[8] Therefore, when r is the

[8]Even if the buyer has all the bargaining power, in actual long-term international trade, it is rare for

interest rate for each period and discounting is continuous, the per-shipment payment needs to satisfy the participant constraint and the incentive compatibility constraint:

$$v_J(x_J, \bar{\theta}) - f - \bar{\theta} x_J \geq 0, \tag{3}$$

and

$$\frac{v_J(x_J, \bar{\theta}) - f - \bar{\theta} x_J}{1 - e^{-r\frac{x_J}{q}}} \geq v_J(x_J, \bar{\theta}) - f - \underline{\theta} x_J + v. \tag{4}$$

Equation (3) ensures that the seller can at least get the payment to cover the cost of producing a high-quality product. The left-hand side of the inequality (4) is the net present value of the payment within the shipment cycle, and the right-hand side is the expected benefit of deviating from the contract and delivering a low-quality product. The resale value v does not appear on the left-hand side of inequality (4) because the specific asset will not be sold until the end of the relationship without breaking the contract, which means the present value of the asset from the future is expected to be zero. Inequality (4) ensures that revenue from a long-term relationship exceeds the one-time benefit of breaking the contract.

The optimal payment is given by taking equation (4) as binding. The right-hand side of inequality (4) must be greater than 0, otherwise the supplier will never deviate from a contract, which ensures the participant constraint (3) is satisfied. For the incentive compatibility constraint, the buyer can keep reducing the payment amount $v_J(x_J, \bar{\theta})$ until the left and right sides of equation (4) are equal. Any payment greater than the $v_J(x_J, \bar{\theta})$ that makes the left and right sides of equation (4) equal is not optimal for the buyer. When equation (4) is binding, the payment per shipment under J style sourcing is

$$c_J(x_J, \bar{\theta}) = v_J(x_J, \bar{\theta}) = f + \bar{\theta} x_J + (e^{r\frac{x_J}{q}} - 1)(\bar{\theta} - \underline{\theta}) x_J + (e^{r\frac{x_J}{q}} - 1)v. \tag{5}$$

Compared to equation (2), equation (5) omits the monitoring cost m_A but adds two

the buyer to receive the goods before paying. Without monitoring, the buyer provides incentives to the seller by paying in advance. At the same time, in a long-term relationship, whether the first payment occurs before or after the goods are received has little effect on the present value of long-term benefits. Therefore, whether J style purchases are paid before or after quality is observed does not affect the subsequent analysis. From a mathematical perspective, if the buyer pays after observing the quality of the product, the following conditions must be met:

$$\frac{v_J(x_J, \bar{\theta}) - f - \bar{\theta} x_J}{1 - e^{-r\frac{x_J}{q}}} \geq -f - \underline{\theta} x_J + v,$$

which means the payment $c_J(x_J, \bar{\theta}) = v_J(x_J, \bar{\theta}) = f + \bar{\theta} x_J + (1 - e^{-r\frac{x_J}{q}})(v - f - \underline{\theta} x_J)$. If $v - f - \underline{\theta} x_J \leq 0$, the maximum cost of J style is the same as the cost of A style when the monitoring cost m_A is 0, then J style will dominate A style, which means that all firms will choose J style, which is inconsistent with reality and is not the scope of interest of this paper. As long as $v - f - \underline{\theta} x_J > 0$, the subsequent analysis of A style vs J style will not be affected by whether the transaction is paid first or later, because there must be a critical value that makes firms choose different styles around this point.

additional premiums: the first is the quality-control premium $(e^{r\frac{x}{q}}-1)(\bar{\theta}-\underline{\theta})x_J$. The second is the asset-control premium $(e^{r\frac{x}{q}}-1)v$, which guarantees that suppliers will deliver goods rather than sell the assets if they own them. If the buyer chooses to integrate the seller, the seller will not have the choice to sell the asset, so the last term changes to zero. Buyers choose either the A style or the J style sourcing and maximize the expected profit:

$$\pi_s = \frac{\left[\int_0^{\frac{x_s}{q}} e^{-rt} pq \mathrm{d}t - c_s(x_s, \bar{\theta})\right]}{1 - e^{-r\frac{x_s}{q}}},\ s \in \{J, A\}. \tag{6}$$

4.2 Impact of Integration under Each Sourcing Style

The optimal quantity per shipment solves the first-order condition:

$$\frac{c_s'(x_s, \bar{\theta})}{1 - e^{-rx_s/q}} = \frac{c_s \frac{r}{q} e^{-rx_s/q}}{\left(1 - e^{-rx_s/q}\right)^2},\ s \in \{J, A\}, \tag{7}$$

which means that the optimal x_s is such that the present value of the higher costs caused by the increase in order size (left-hand side) is equal to the cost savings from pushing these larger orders further into the future, thereby increasing the discount rate (right-hand side). The average cost is also the market price under each style:

$$p_s = AC_s(x_s, q) = \frac{r}{q}\frac{c_s}{1 - e^{-rx_s/q}},\ s \in \{J, A\}. \tag{8}$$

The only difference between my setting and theirs is that c_J includes a term $(e^{r\frac{x}{q}}-1)v$ when sellers own the asset.

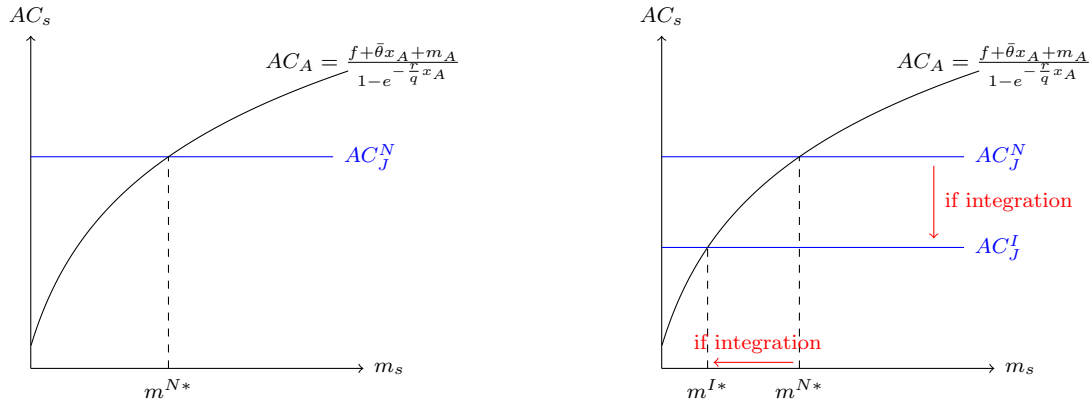
When $m_A = 0$, the A style dominates the J style because the payment per shipment is lower for the A style when the inspection cost disappears. The average cost of the A style increases in m_A, while the average cost of the J style is independent of m_A. Thus, there is always a threshold value $m^* \in (0, \infty)$ such that the average cost under both styles is the same, as Figure 3a shows. Buyers will choose the A style when $m < m^*$ and choose the J style when $m > m^*$.

When the buyer integrates the seller, the last term in (5) vanishes to zero, and the average cost of J style decreases. As Figure 3b shows, integration shifts AC_J^N to AC_J^I, which makes the critical value of m change from m^{N*} to m^{I*}. Since the firm will choose the J style when $m > m^*$, a decrease in m^* makes it easier for the firm to choose the J style, which means that integration makes it easier for the firm to switch from the A style to the J style. Owning assets allows sellers to get both a period of payment and a profit from the resale of

assets before breaking the relational contract. They are more likely to choose to produce a low-quality product. Buyers need to spend more to give sellers incentives to obtain a high-quality product. Integration allows buyers to have the right to use and sell assets, and the benefits that sellers can get from breach of contract are reduced. Compared with the case of non-integration, J style is easier to ensure product quality after integration, so integration and J style are complementary.

Proposition 1 *Vertical integration between downstream firms and upstream firms makes it easier for buyers to choose Japanese style sourcing. The average quantity per shipment x in the market will decrease.*

Figure 3: The Change of Average Cost in m



(a) Non-Integration (b) Integration

Notes. The figure shows the change in the average cost under J style and the change in the m^* after the downstream firm integrates the upstream firm. When $m > m^{N*}$, integrations enable buyers to maintain the option of choosing J style sourcing. When $m < m^{I*}$, integrations enable buyers to maintain the option of choosing A style sourcing. Only when $m^{I*} < m < m^{N*}$, integrations will cause buyers who originally chose A style sourcing to switch to J style sourcing. Therefore, I need to analyze the changes in x_s under all three cases in order to prove that changes in the average x_s of the whole market decrease after integrations.

In the empirical analysis, I use the size of quantity per shipment x_s to distinguish J style from A style, and J style has a smaller x_s. Therefore, I now prove that when v decreases to 0, the average x_s decreases.

Proof. See Appendix A.1. ■

The main effect of integration operates on the extensive margin: integration reduces the average cost under J style sourcing, which induces some firms to switch from A style to J style. These switchers experience a large decrease in quantity per shipment x_s, driving the market average downward. As shown in the proof (Appendix A.1), the switching effect dominates for any distribution of m as long as $r\frac{x_J^*}{q}$ is sufficiently small, so the overall market average x_s decreases after integration.

4.3 Comparative Statics and Additional Predictions

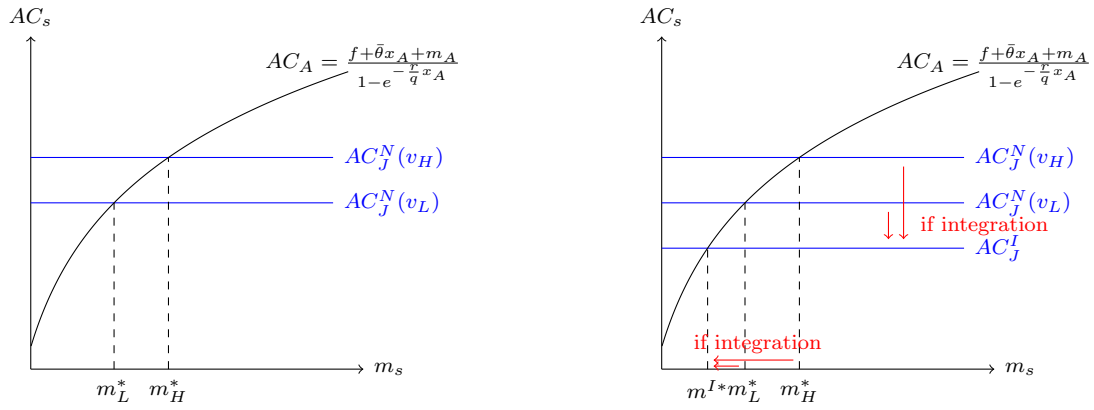
The preceding analysis shows that the main factor affecting the downstream firms' choice between A style and J style procurement is the upstream firms' incentive to deviate. This section examines whether the complementarity between J style sourcing and integration is stronger or weaker under different determinants of upstream firms' deviation incentive.

4.3.1 The Impact of Resale Value

The resale value v directly determines the seller's one-time gain from deviating and therefore affects the strength of complementarity between J style sourcing and integration. Holding other factors fixed, the larger v is, the more likely the seller is to produce low-quality products and break the contract to exit the market. Integration has a larger effect on sellers' deviation incentive and reduces the buyer's cost under J style by more. Therefore:

Proposition 2 *When the resale value of the asset v is larger, the complementarity between Japanese style sourcing and integration is stronger. Integration leads more firms to switch from A style to J style, which reduces the average quantity per shipment x in the market.*

Figure 4: The Change of Average Cost for Different v



(a) Non-Integration (b) Integration

Notes. The figure shows the change in the J style average cost and the threshold m^* after the downstream firm integrates the upstream firm, for different resale values v_H and v_L.

Figure 4 shows how average cost varies with m for different values of v. Holding other variables fixed, without integration, the only difference across values of v is the J style average cost. The larger v is, the greater the J style average cost, and thus the greater m^*. Integration reduces the J style average cost in both cases to the same level, and both m_L^* and

m_H^* fall to m^{I*}. The different thresholds divide the range of m into four regions: First, when $m > m_H^*$, the inspection cost is so high that A style is more expensive. Without integration, buyers choose J style. Integration further lowers the J style average cost, so they remain with J style. Second, when $m_L^* < m \leq m_H^*$, without integration, buyers trading with v_H sellers prefer A style (since $m \leq m_H^*$), while buyers trading with v_L sellers prefer J style (since $m > m_L^*$). Integration switches the sourcing style from A to J for v_H sellers, while the style for v_L sellers remains J. Third, when $m^{I*} < m \leq m_L^*$, without integration, A style is cheaper regardless of the seller's asset value. Integration causes buyers to switch to J style in both cases. Finally, when $m \leq m^{I*}$, the inspection cost is so low that buyers choose A style regardless of v and regardless of whether integration occurs.

As shown in the proof of Proposition 1, only the firms that switch from A style to J style significantly affect the average x in the market. Based on Figure 4 and the discussion above, buyers who integrate a supplier with a high asset value switch from A style to J style when $m^{I*} < m_A \leq m_H^*$. However, if they integrate a supplier with a lower asset value, they switch only when $m^{I*} < m_A \leq m_L^*$. Since the switching region for high v is strictly wider, buyers who integrate sellers with higher asset values are more likely to switch from A style to J style. Therefore, the higher the asset value, the stronger the complementarity between vertical integration and J style sourcing, and the smaller the quantity per shipment x.

Proof. See Appendix A.2. ■

4.3.2 The Impact of Quality Gap

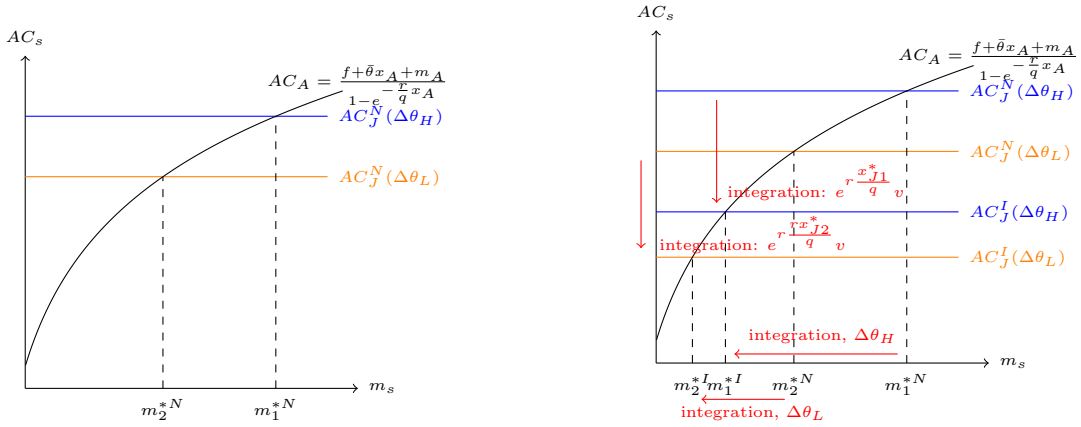
Buyers face the quality control problem because there are quality gaps for sourced inputs. In general, an increase in the quality gap $\Delta\theta \equiv \bar{\theta} - \underline{\theta}$ can come from a rise in $\bar{\theta}$, a fall in $\underline{\theta}$, or both. Let $\gamma \in [0, 1]$ denote the fraction of a change in $\Delta\theta$ that comes from $\bar{\theta}$ (so $d\bar{\theta} = \gamma \cdot d(\Delta\theta)$ and $d\underline{\theta} = -(1-\gamma) \cdot d(\Delta\theta)$). These two channels have very different effects. Under A style, buyers inspect every shipment, and the inspection catches defects regardless of $\underline{\theta}$, so AC_A does not depend on $\underline{\theta}$. Under J style, however, quality is ensured through relational contracts, and the incentive premium depends directly on sellers' temptation to cheat. A decrease in $\underline{\theta}$ makes low-quality production cheaper, which increases this temptation and raises the J-style moral hazard premium—precisely the premium that integration eliminates. A rise in $\bar{\theta}$, by contrast, increases production costs under both A and J styles by nearly the same amount and barely changes the relative advantage of integration. Therefore, the quality gap affects the integration benefit primarily through the $\underline{\theta}$ channel. In Appendix A.3, I show that the result holds for all $\gamma < \bar{\gamma} \equiv \frac{1}{1+\frac{3}{2}\frac{rx_J}{q}}$. $\bar{\gamma}$ goes to 1 when $\frac{rx_J}{q}$ is sufficiently small, which is true since the discount rate r and $\frac{x_J}{q} = \frac{1}{\#\text{ shipments}}$ are both small. In cross-sectional variation across industries, quality gaps differ partly because some industries offer cheaper ways to

compromise on quality (lower $\underline{\theta}$) and partly because some demand more expensive quality standards (higher $\bar{\theta}$). The condition requires only that the quality gap increase is not driven entirely by a rise in the high quality standard.

For simplicity, I illustrate the analysis in the figures and table below under the special case $\gamma = 0$ (only $\underline{\theta}$ varies, $\bar{\theta}$ fixed). This keeps the AC_A curve unchanged across the two cases and simplifies the diagrams. When $\bar{\theta} - \underline{\theta}$ is small, sellers save less by producing low-quality products, and buyers face less pressure to control quality. The incentive premium under J style is also smaller. However, when $\bar{\theta} - \underline{\theta}$ becomes larger, sellers' gain from deviation increases, and buyers need stronger incentives to ensure quality. They must pay higher premiums, and the gain from integration is larger, as it reduces sellers' incentive to deviate and lowers the average cost per period. Therefore:

Proposition 3 *When the quality gap $\bar{\theta} - \underline{\theta}$ is larger, the complementarity between Japanese style sourcing and integration is stronger. Integration leads more firms to switch from A style to J style, which reduces the average quantity per shipment x in the market.*

Figure 5: The Change of Average Cost for Different $\Delta\theta$



(a) Non-Integration

(b) Integration

As in the analysis of resale value, Figure 5b shows that integration reduces m^* for both large and small $\bar{\theta} - \underline{\theta}$. However, unlike the resale value case, vertical integration reduces the J style average cost to different levels depending on the quality gap, making the analysis more involved. Table 3 summarizes how integration changes the sourcing style under high and low quality gaps.

Table 3: Change of Sourcing Style after Integration for Different $\Delta\theta$

	$(\bar{\theta}-\underline{\theta})_H$	$(\bar{\theta}-\underline{\theta})_L$
$m > m_1^{*N}$	J style $\rightarrow$ J style	J style $\rightarrow$ J style
$m_2^{*N} < m \leq m_1^{*N}$	A style $\rightarrow$ J style	J style $\rightarrow$ J style
$m_1^{*I} < m \leq m_2^{*N}$	A style $\rightarrow$ J style	A style $\rightarrow$ J style
$m_2^{*I} < m \leq m_1^{*I}$	A style $\rightarrow$ A style	A style $\rightarrow$ J style
$m \leq m_2^{*I}$	A style $\rightarrow$ A style	A style $\rightarrow$ A style

The strength of the complementarity between integration and J style depends largely on the fraction of buyers who switch from A style to J style. Specifically, the relative sizes of $m_1^{*N}-m_1^{*I}$ and $m_2^{*N}-m_2^{*I}$ determine which case exhibits stronger complementarity. To prove Proposition 3, it suffices to show $m_1^{*N}-m_1^{*I} > m_2^{*N}-m_2^{*I}$ and that the average quantity per shipment decreases.

Proof. See Appendix A.3. ■

5 Empirical Results

In this section, I present empirical evidence on the relationship between sourcing style and vertical integration. I first report the baseline results on the complementarity and then show the heterogeneous effects of resale value and quality gap.

5.1 Baseline Results

To formalize the motivating facts and establish supportive evidence for Proposition 1, I estimate a regression with various fixed effects and controls for total trade volume. Using higher shipping frequency with smaller quantity per shipment as a measure of J style sourcing, the regression equation is as follows:

$$Y_{ijt} = \beta_1 \mathbb{1}\left\{\text{Related Party Trade}_{ijt}\right\} + \beta_2 \log(TotQuantity_{ijt}) + \delta_{it} + \delta_{jt} + \delta_{it'} + \delta_{jt'} + \epsilon_{ijt} \quad (9)$$

where t is the year from 2011 to 2017, and Y_{ijt} is either the number of shipments or the quantity per shipment. The variable of interest is $\mathbb{1}\left\{\text{Related Party Trade}_{ijt}\right\}$, an indicator equal to one if two firms are identified as related parties using the method described in Section 2. I control for firm size by including the total quantity of trade $\log(TotQuantity_{ijt})$ between the two firms, since larger firms trade more. δ_{it} is the importer-year fixed effect and δ_{jt} is the exporter-year fixed effect. $\delta_{it'}$ is the importer-first-transaction-month fixed effect

and $\delta_{jt'}$ is the exporter-first-transaction-month fixed effect. I control for the month of the first transaction to account for the length of time each firm pair has been active within a given year—partners that begin trading in December mechanically have fewer transactions than those starting in January, even if their trading frequency is the same. This control avoids bias from different starting times of trade. ϵ_{ijt} is the error term.

Proposition 1 predicts that vertical integration makes it easier for buyers to adopt J-style sourcing. Testing this complementarity requires comparing sourcing patterns between related and unrelated pairs. In the data, related-party status exhibits little within-pair variation: most pairs remain either related or unrelated throughout the sample period. The relevant variation is therefore primarily between pairs, making a cross-sectional comparison the natural empirical design. Accordingly, I do not include importer-exporter pair fixed effects, which would absorb this between-pair variation and leave too few status changes to identify statistically significant effects. Instead, I control flexibly for each partner's time-varying characteristics using δ_{it} and δ_{jt}. In addition, because integration effects may take time to materialize, I smooth Y_{ijt} and $\log(TotQuantity_{ijt})$ using a moving average that includes the current year and the next two years.

Table 4 reports the regression results. The first two columns report results for the number of shipments, and the last four columns for the quantity per shipment. Columns (3) and (4) directly apply the moving average to quantity per shipment, while columns (5) and (6) take the ratio of moving-average quantity to moving-average shipments.

Column (1), which includes each fixed effect separately, shows that related parties have significantly more shipments than unrelated parties. The positive effect remains significant in column (2) after adding more stringent fixed effects. After controlling for the time varying characteristics of both partners and the timing of the first transaction, the estimated effect is even larger, indicating that related parties are more likely to adopt J style sourcing.

Conversely, the last four columns show that related parties have lower quantity per shipment. Columns (3)–(4) compute quantity per shipment first and then apply the moving average, more closely approximating the average lagged response over the current year and the next two years. Columns (5)–(6) take the ratio of moving-average quantity to moving-average shipments; by construction, their coefficients are the negatives of those in columns (1)–(2). I use the definition in columns (3)–(4) in subsequent analyses. Both sets of results demonstrate that, conditional on the same total trade volume, related parties have lower quantity per shipment than independent firms.

Table 4: Relationship between Shipment Pattern and Related Party

Dep. Var.	$\log(Avg\ \#\ Shipment_{ijt})$		$\log(Avg\ \frac{quantity_{ijt}}{shipment_{ijt}})$		$\log(\frac{Avg\ quantity_{ijt}}{Avg\ shipment_{ijt}})$	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\}$	0.166^a	0.264^a	-0.169^a	-0.268^a	-0.166^a	-0.264^a
	(0.010)	(0.031)	(0.010)	(0.031)	(0.010)	(0.031)
$\log(TotQuantity_{ijt})$	0.461^a	0.511^a	0.536^a	0.488^a	0.539^a	0.489^a
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Importer FE	Y	N	Y	N	Y	N
Exporter FE	Y	N	Y	N	Y	N
Year FE	Y	N	Y	N	Y	N
1st Transaction Mon. FE	Y	N	Y	N	Y	N
Importer-Year FE	N	Y	N	Y	N	Y
Exporter Year FE	N	Y	N	Y	N	Y
Importer-1st Transaction Mon. FE	N	Y	N	Y	N	Y
Exporter-1st Transaction Mon. FE	N	Y	N	Y	N	Y
Observations	5562091	2516789	5562091	2516789	5562091	2516789
# of Firm Pairs	2906559	1359826	2906559	1359826	2906559	1359826
R-squared	0.826	0.900	0.928	0.950	0.929	0.951

Notes: Standard errors are clustered at the firm-pair level. Moving averages are used for the dependent variables and the control variable $\log(TotQuantity_{ijt})$. The dependent variables in columns (3)–(6) are all quantities per shipment: columns (3)–(4) directly apply the moving average to quantity per shipment, while columns (5)–(6) take the ratio of moving-average quantity to moving-average shipments. The two methods yield consistent results. Significance levels: a: 0.01, b: 0.05, c: 0.10.

Since Japanese firms are the most likely to adopt Japanese style sourcing by default, a concern is that the baseline results may be driven by Japanese firms rather than by vertical integration per se. In Appendix Table C-1, I exclude all firm pairs involving Japanese importers or exporters and re-run the baseline regressions. The results are robust to this exclusion.

5.2 Empirical Evidence on Other Model Predictions

This subsection tests additional predictions from the model. I interact supplier characteristics with the related-party indicator to examine heterogeneous effects across different types of firms. As with the baseline results, the estimates in this subsection reflect firm-level associations rather than causal effects. Although endogeneity concerns remain, I demonstrate robustness by flexibly controlling for various fixed effects.

For Proposition 2, I use the following regression specification:

$$Y_{ijt} = \beta_1 \mathbb{1}\left\{\text{Related Party Trade}_{ijt}\right\} + \beta_2 \mathbb{1}\left\{\text{Related Party Trade}_{ijt}\right\} \times \mathbb{1}\left\{\text{Large Subsidiary}\right\} \tag{10}$$

$$+ \beta_3 \log(TotQuantity_{ijt}) + \delta_{it} + \delta_{jt} + \delta_{it'} + \delta_{jt'} + \epsilon_{ijt}$$

where $\mathbb{1}\left\{\text{Large Subsidiary}\right\}$ is a dummy variable equal to one when the total assets of the subsidiary controlled by the parent firm exceed the 75th percentile across all controlled subsidiaries. I proxy each subsidiary's total assets by its total trading volume in that year, multiply by the total shareholder percentage from the ORBIS data to obtain the assets controlled by each parent firm, and then classify subsidiaries as "large" or "small". [9]

Table 5 reports the heterogeneous effects of subsidiary size. I use an indicator equal to one when trading volume × ownership share exceeds the 75th percentile in the current year to proxy for large subsidiaries, because asset size is typically very large and highly variable. The first four columns show that, among related parties, those with larger controlled subsidiaries have significantly higher shipping frequency than those with smaller controlled subsidiaries.

[9] Although the ORBIS data includes firms' operational revenue, which could serve as a proxy for asset value, this variable has many missing values, especially in earlier years. Using it directly would substantially reduce the sample size. I therefore use total trade volume to proxy for total assets. I also try computing controlled assets using direct rather than total ownership share, and the results are similar.

Table 5: Heterogeneous Effect, using the Indicator of Large Subsidiary

Dep. Var.	$\log(Avg\ \#\ Shipment_{ijt})$				$\log(Avg\ \frac{quantity_{ijt}}{shipment_{ijt}})$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\}$	0.167^a	0.066^a	0.265^a	0.156^a	-0.172^a	-0.073^a	-0.273^a	-0.166^a
	(0.014)	(0.014)	(0.043)	(0.045)	(0.014)	(0.014)	(0.043)	(0.045)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\} \times \mathbb{1}\{\text{Large Subsidiary}\}$		0.313^a		0.178^b		-0.304^a		-0.175^b
		(0.030)		(0.069)		(0.030)		(0.070)
$\log(TotQuantity_{ijt})$	0.461^a	0.461^a	0.511^a	0.510^a	0.536^a	0.536^a	0.488^a	0.488^a
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Importer FE	Y	Y	N	N	Y	Y	N	N
Exporter FE	Y	Y	N	N	Y	Y	N	N
Year FE	Y	Y	N	N	Y	Y	N	N
1st Transaction Mon. FE	Y	Y	N	N	Y	Y	N	N
Importer-Year FE	N	N	Y	Y	N	N	Y	Y
Exporter Year FE	N	N	Y	Y	N	N	Y	Y
Importer-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Exporter-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Observations	5553711	5553711	2512432	2512432	5553711	5553711	2512432	2512432
# of Firm Pairs	2905188	2905188	1358234	1358234	2905188	2905188	1358234	1358234
R-squared	0.825	0.825	0.900	0.900	0.928	0.928	0.950	0.950

Notes: Standard errors are clustered at the firm-pair level. A "large subsidiary" is defined as one with trading volume × ownership share above the 75th percentile in the current year. There are 679 firm pairs identified as related parties by the csh file but lacking ownership share information in the ORBIS data, accounting for approximately 13.86% of all related parties. I exclude these pairs from the sample—classifying them neither as related parties nor as independent firms—to prevent them from affecting the analysis. The ownership share refers to total ownership share; results are robust when using direct ownership share. The total number of observations is smaller than in Table 4 because of these excluded pairs. Significance levels: a: 0.01, b: 0.05, c: 0.10.

Unlike the previous analysis, I add a 2-digit HS product dimension s to test Proposition 3. The regression specification is:

$$Y_{ijst} = \beta_1 \mathbb{1}\left\{\text{Related Party Trade}_{ijst}\right\} + \beta_2 \mathbb{1}\left\{\text{Related Party Trade}_{ijst}\right\} \times \mathbb{1}\left\{\text{Large Ladder}_s\right\} \tag{11}$$
$$+ \beta_3 \log(TotQuantity_{ijst}) + \delta_{it'} + \delta_{jt'} + \delta_{is} + \delta_{js} + \epsilon_{ijst}$$

All variables are at the importer-exporter-HS2 product-year level, and moving averages are no longer used. [10] The quality gap is measured by the quality ladder calculated by Khandelwal (2010). The original quality ladder data is at the HS10 product level or at the 1989 Standard Industrial Classification (SIC) level, and I average the HS10-level quality ladders to the HS2 product level. Similar to the definition of large subsidiary, $\mathbb{1}\left\{\text{Large Ladder}_s\right\}$

[10] About 60% of the HS codes in Panjiva are inferred from product descriptions and may be inaccurate. As a result, few importer-exporter-HS2 product combinations appear in consecutive years, and using moving averages makes little difference.

is an indicator equal to one when the quality ladder of the product exceeds the 75th percentile across all HS2 products. δ_{is} is the importer-HS2 product fixed effect and δ_{js} is the exporter-HS2 product fixed effect. ϵ_{ijst} is the error term.

Table 6 reports the heterogeneous effects of quality ladders, paralleling the exercise in Table 5. A product is classified as having a "large quality ladder" if its quality ladder exceeds the 75th percentile in the year. Columns (1) and (3) show that even when the product dimension is added, the complementarity between related parties and J style sourcing persists, confirming the robustness of the baseline results. Columns (4) and (8) show that when the quality ladder of the traded product is larger, shipping frequency increases further and quantity per shipment decreases correspondingly.

Table 6: Heterogeneous Effect, using the Indicator of Large Quality Ladder

Dep. Var.	$\log(\#\ Shipment_{ijst})$				$\log(\frac{quantity_{ijst}}{shipment_{ijst}})$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\}$	0.295^a	0.295^a	0.098^a	0.092^a	-0.295^a	-0.295^a	-0.098^a	-0.092^a
	(0.005)	(0.005)	(0.033)	(0.033)	(0.005)	(0.005)	(0.033)	(0.033)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\} \times \mathbb{1}\{\text{Large Ladder}_s\}$		0.003		0.026^c		-0.003		-0.026^c
		(0.010)		(0.014)		(0.010)		(0.014)
$\log(TotQuantity_{ijst})$	0.290^a	0.290^a	0.515^a	0.515^a	0.710^a	0.710^a	0.485^a	0.485^a
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Importer FE	Y	Y	N	N	Y	Y	N	N
Exporter FE	Y	Y	N	N	Y	Y	N	N
HS2-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
1st Transaction Mon. FE	Y	Y	N	N	Y	Y	N	N
Importer-Year FE	N	N	Y	Y	N	N	Y	Y
Exporter Year FE	N	N	Y	Y	N	N	Y	Y
Importer-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Exporter-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Observations	8181858	8181858	2673951	2673951	8181858	8181858	2673951	2673951
# of Firm-Pair-HS2	8181834	8181834	2673949	2673949	8181834	8181834	2673949	2673949
R-squared	0.613	0.613	0.921	0.921	0.877	0.877	0.963	0.963

Notes: Standard errors are clustered at the firm-pair-HS2 level. s includes 72 2-digit HS products. A "large quality ladder" is defined as a quality ladder above the 75th percentile in the current year. The average quality ladder of these products is 1.87. Significance levels: a: 0.01, b: 0.05, c: 0.10.

Firms are unlikely to adjust their procurement strategies product by product; instead, they may adjust their sourcing strategy for each supplier as a whole. I therefore also conduct an analysis at the firm-pair level using the suppliers' industry quality ladder. The ORBIS data provides the 4-digit North American Industry Classification System (NAICS) codes of the industries in which all shareholders (who, according to my construction, may also be subsidiaries of higher-level controlling shareholders within a business tree) are located. I convert the quality ladder from Khandelwal (2010) from Standard Industrial Classification (SIC) level to 4-digit NAICS code level following Pierce and Schott (2009)[11] and link the

[11] See https://faculty.som.yale.edu/peterschott/international-trade-data/

quality ladder to each supplier's industry. One limitation is that some observations are lost because the ORBIS data lacks industry information for some bottom-level subsidiaries, but this analysis still serves as a useful robustness check. I use the following regression equation:

$$Y_{ijt} = \beta_1 \mathbb{1}\left\{\text{Related Party Trade}_{ijt}\right\} + \beta_2 \mathbb{1}\left\{\text{Related Party Trade}_{ijt}\right\} \times \mathbb{1}\left\{\text{Large Ladder}_{j(s)}\right\} + \beta_3 \log(TotQuantity_{ijst}) + \delta_{it'} + \delta_{jt'} + \delta_{j(s)t} + \epsilon_{ijt} \tag{12}$$

where $\mathbb{1}\left\{\text{Large Ladder}_{j(s)}\right\}$ is an indicator equal to one when the supplier's industry quality ladder exceeds the 75th percentile, and $\delta_{j(s)t}$ is the supplier-industry-year fixed effect to control for time-varying industry factors. Table 7 reports the results. The estimates show that vertically integrating a supplier in an industry with a larger quality ladder further increases shipping frequency relative to integrating other suppliers, indicating that a larger quality ladder strengthens the complementarity between vertical integration and J style sourcing.

Table 7: Heterogeneous Effect, using the Indicator of Suppliers' Industry Quality Ladder

Dep. Var.	$\log(\#\ Shipment_{ijst})$				$\log(\frac{quantity_{ijst}}{shipment_{ijst}})$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\}$	0.087^a	0.063^a	0.043^a	0.024	-0.087^a	-0.063^a	-0.043^a	-0.024
	(0.013)	(0.014)	(0.014)	(0.016)	(0.013)	(0.014)	(0.014)	(0.016)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\} \times \mathbb{1}\left\{\text{Large Ladder}_{j(s)}\right\}$		0.088^a		0.071^b		-0.088^a		-0.071^b
		(0.031)		(0.032)		(0.031)		(0.032)
$\log(TotQuantity_{ijt})$	0.482^a	0.482^a	0.529^a	0.529^a	0.518^a	0.518^a	0.471^a	0.471^a
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
Importer FE	Y	Y	N	N	Y	Y	N	N
Exporter FE	Y	Y	N	N	Y	Y	N	N
1st Transaction Mon. FE	Y	Y	N	N	Y	Y	N	N
Shipper Industry-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Importer-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Exporter-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Observations	207937	207937	128227	128227	207937	207937	128227	128227
# of Firm Pairs	100187	100187	58314	58314	100187	100187	58314	58314
R-squared	0.889	0.889	0.931	0.931	0.943	0.943	0.960	0.960

Notes: Standard errors are clustered at the firm-pair level. A "large ladder" is defined as a quality ladder above the 75th percentile. s includes 79 4-digit NAICS industries. The average quality ladder of these products is 1.74. Significance levels: a: 0.01, b: 0.05, c: 0.10.

I conduct several robustness checks for the comparative statics results, reported in the Appendix. For the resale value prediction, Appendix Table C-2 replaces the total ownership share with the direct ownership share when constructing the large subsidiary indicator, and

Appendix Table C-3 uses the 50th percentile instead of the 75th percentile as the threshold. For the quality gap prediction, Appendix Table C-4 uses the continuous level of the HS2 product quality ladder rather than the indicator, and Appendix Table C-5 uses the continuous level of the suppliers' industry quality ladder. The results are robust across all specifications.

5.3 Additional Evidence on Long-term Relationship of J Style Sourcing

My model predicts how quantity per shipment responds to vertical integration. In this section, I present additional facts that, while not predicted by the model, support the idea that related parties are more likely to choose J style sourcing. Under A style, buyers use competitive bidding and have no reason to maintain long-term relationships with the same supplier; under J style, buyers renew contracts with the same supplier repeatedly. Table 8 shows that related parties have shorter average time between shipments, indicating more frequent transactions with the same partner. Specifically, conditional on the same time span between the first and last transaction, A style buyers are more likely to transact sporadically with the same supplier, while J style buyers renew contracts frequently throughout the period. When two firms are vertically integrated, their trading pattern is closer to J style—they have shorter average months between shipments.

Table 8: Effect on Average Time between Shipments

Dep. Var.	Log Avg Month between Shipments			
	(1)	(2)	(3)	(4)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\}$	-0.107^a	-0.096^a	-0.108^a	-0.270^a
	(0.012)	(0.013)	(0.012)	(0.043)
$\log(TotQuantity_{ijt})$	-0.316^a	-0.337^a	-0.317^a	-0.373^a
	(0.001)	(0.001)	(0.001)	(0.001)
Importer FE	Y	N	Y	N
Exporter FE	Y	N	Y	N
Year FE	N	N	Y	N
1st Transaction Mon. FE	Y	N	Y	N
Importer-Year FE	N	N	N	Y
Exporter-Year FE	N	N	N	Y
Importer-1st Transaction Mon. FE	N	Y	N	Y
Exporter-1st Transaction Mon. FE	N	Y	N	Y
Observations	3347338	2502449	3347338	1394906
# of Firm Pairs	1401997	1047802	1401997	661617
R-squared	0.697	0.766	0.698	0.807

Notes: Standard errors are clustered at the firm-pair level. The same moving average approach is used in these regressions. The average month between shipments is calculated by $\frac{\text{last date}_{ijt} - \text{first date}_{ijt}}{30}$. I also control for year fixed effects in the empirical models to absorb the time-varying factors. Significance levels: a: 0.01, b: 0.05, c: 0.10.

In addition, importers who choose J style should have fewer suppliers per shipment and longer average relationship length with suppliers. Following Heise et al. (2024)'s definitions of supplier per shipment and average relationship length aggregated at the buyer level, I construct similar variables and find that when a buyer has a higher proportion of relational suppliers, its supplier-per-shipment ratio is lower and its average relationship length is longer, consistent with J style sourcing. The results are reported in Table 9.

Table 9: Effect on Supplier per Shipment and Average Length

Dep. Var.	Log Supplier per Shipment		Log Avg Length	
	(1)	(2)	(3)	(4)
$\frac{\#\text{ Related Supplier}_{it}}{\#\text{ Supplier}_{it}}$	-0.150^a	-0.185^a	0.170^a	0.217^a
	(0.016)	(0.020)	(0.021)	(0.023)
$\log(TotQuantity_{it})$	-0.256^a	-0.307^a	0.163^a	0.193^a
	(0.001)	(0.001)	(0.002)	(0.002)
Importer FE	Y	N	Y	N
Year FE	Y	Y	Y	Y
1st Transaction Mon. FE	Y	N	Y	N
Importer-1st Transaction Mon. FE	N	Y	N	Y
Observations	1418882	687705	840751	525931
# of Firm Pairs	360404	183686	203375	130955
R-squared	0.834	0.881	0.586	0.631

Notes: Standard errors are clustered at the importer level. The same moving average approach is used in these regressions. The supplier per shipment is the ratio of the number of suppliers to the number of shipments, which has the largest value of 1 (every shipment has a different supplier). The average length of all the suppliers is calculated by $\frac{\sum_j \text{Months between Shipments}_{jt}}{\#\text{Suppliers}_{it}}$. I also control for year fixed effects in the empirical models to absorb the time-varying factors. Significance levels: a: 0.01, b: 0.05, c: 0.10.

6 Conclusions

This paper studies the relationship between vertical integration and firms' choice of sourcing styles. I analyze the relational contract within business groups both theoretically and empirically. I build a theoretical model to show that when firms are vertically integrated, they are more likely to choose J style sourcing, which is characterized by high frequency and low volume of shipments. The model also shows that the complementarity between vertical integration and J style sourcing is stronger when the subsidiary controlled by the parent firm has larger asset values or when the quality gap of the product traded is higher. I use firm-pair level trade data combined with ownership data to verify the theoretical predictions. The empirical results show that related parties have more shipments and less quantity per shipment than independent firms, which is consistent with the theoretical model. In addition, the empirical results also support the comparative statics of the theoretical model. I also provide supportive evidence that transactions between related parties are more likely to align with the characteristics of J style sourcing, such as shorter average time between shipments, fewer suppliers per shipment for each importer, and longer average relationship length with suppliers.

The findings offer practical implications. The complementarity between integration and sourcing style suggests that firms' organizational form and procurement strategy should be considered jointly rather than in isolation. Vertical integration removes the moral hazard

distortion arising from asset ownership, enabling firms to adopt more efficient high-frequency sourcing. This benefit is particularly large when suppliers control valuable assets or when input quality is difficult to verify. Policymakers should also recognize that regulations affecting ownership structures—such as restrictions on foreign direct investment—may have indirect effects on supply chain organization and procurement efficiency.

Although I cannot use exogenous variation to identify a causal relationship between related parties and J style sourcing, the theoretical model and empirical results show that the relationship is robust across various specifications and fixed effects structures.

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Online Appendix

A Proof of Model Predictions

A.1 Proof of Proposition 1

If buyers keep choosing A style sourcing, x_A will not change regardless of integration. However, if buyers keep choosing J style sourcing, integration will change x_J:

$$\begin{aligned}\frac{\partial FOC_J}{\partial v} &= (1-e^{-r\frac{x_J}{q}})\frac{r}{q}e^{r\frac{x_J}{q}} - (e^{r\frac{x_J}{q}}-1)\frac{r}{q}e^{-r\frac{x_J}{q}} \\ &= \frac{r}{q}(e^{r\frac{x_J}{q}}+e^{-r\frac{x_J}{q}}-2)\end{aligned} \tag{A-1}$$

Because $0 < r\frac{x_J}{q} < 1$, we have $e^{r\frac{x_J}{q}} + e^{-r\frac{x_J}{q}} - 2 = (e^{r\frac{x_J}{2q}} - e^{-r\frac{x_J}{2q}})^2 > 0$, which implies that $\frac{\partial FOC_J}{\partial v} > 0$

$$\begin{aligned}SOC_J = \left(1-e^{-\frac{rx_J}{q}}\right)\left(2\frac{r}{q}\frac{\bar{\theta}-\underline{\theta}}{\omega}e^{\frac{rx_J}{q}} + \frac{r^2}{q^2}ve^{\frac{rx_J}{q}} + \frac{r^2}{q^2}\frac{x_J(\bar{\theta}-\underline{\theta})}{\omega}e^{\frac{rx_J}{q}}\right) \\ + \frac{r^2}{q^2}\left(f + v\left(e^{\frac{rx_J}{q}}-1\right) + \frac{\bar{\theta}x_J}{\omega} + \frac{x_J(\bar{\theta}-\underline{\theta})\left(e^{\frac{rx_J}{q}}-1\right)}{\omega}\right)e^{-\frac{rx_J}{q}}\end{aligned} \tag{A-2}$$

Both terms of (A-2) are larger than 0 because $1-e^{-r\frac{x_J}{q}} > 0$ ($e^{\frac{rx_J}{q}} - 1 > 0$) and $\bar{\theta}-\underline{\theta} > 0$. The summation $SOC_J > 0$. Apply the implicit function theorem:

$$\frac{dx_J^*}{dv} = \frac{-\frac{\partial FOC_J}{\partial v}}{SOC_J} < 0,$$

which means as v decreases to 0, x_J increases. Define $\delta_1 \equiv x_J^*(0) - x_J^*(v) > 0$ as this increase. Let $a \equiv \frac{rx_J}{q}$. I show $\delta_1 = O(a)$. Taylor-expanding in (A-1): since $e^a + e^{-a} - 2 = a^2 + O(a^4)$,

$$\frac{\partial FOC_J}{\partial v} = \frac{r}{q}\big(a^2 + O(a^4)\big).$$

For SOC_J, the leading contribution from the first line of (A-2) is $(1-e^{-a})\cdot 2\frac{r}{q}\frac{\bar{\theta}-\underline{\theta}}{\omega}e^a = \frac{2r(\bar{\theta}-\underline{\theta})}{q\omega}(e^a-1) = \frac{2r(\bar{\theta}-\underline{\theta})}{q\omega}\big(a+O(a^2)\big)$; the remaining terms in (A-2) are also $O\Big(\frac{r}{q}\,a\Big)$. Hence

$$\left|\frac{dx_J^*}{dv}\right| = \frac{O\Big(\frac{r}{q}\,a^2\Big)}{O\Big(\frac{r}{q}\,a\Big)} = O(a),$$

and by the mean value theorem, $\delta_1 = \left|\frac{dx_J^*}{dv}\Big|_{\tilde{v}}\right| \cdot v = O(a)$ for some $\tilde{v} \in (0, v)$. That is, δ_1 is first-order small in a.

When a firm switches from A style to J style, its quantity per shipment decreases discretely: $x_A^*(m) > x_J^*(0)$ for all m in the switching region, as established in Taylor and Wiggins (1997)'s Proposition 3. Define $\underline{\Delta x} \equiv \inf_{m \in [m^{I*}, m^{N*}]} [x_A^*(m) - x_J^*(0)] > 0$ as the minimum switching gap.

I first illustrate the result under a uniform distribution and then extend it to general distributions. Suppose $m \sim \text{Uniform}[0, b]$ with $b > m^{N*}$. The change in the market average quantity per shipment after integration is:

$$\Delta \bar{x} = \underbrace{\delta_1 \cdot [1 - G(m^{N*})]}_{\text{existing J-style firms: small increase}} - \underbrace{\int_{m^{I*}}^{m^{N*}} [x_A^*(m) - x_J^*(0)]\, g(m)\, dm}_{\text{switchers from A to J: large decrease}}. \tag{A-3}$$

Under the uniform distribution, the first term equals $\delta_1 \cdot \frac{b - m^{N*}}{b}$, which is $O(a)$ and therefore negligible. The second term equals $-\frac{1}{b}\int_{m^{I*}}^{m^{N*}} [x_A^*(m) - x_J^*(0)]\, dm$, which is strictly negative and bounded away from zero because $x_A^*(m) - x_J^*(0) \geq \underline{\Delta x} > 0$ over the interval $[m^{I*}, m^{N*}]$ of positive length. Therefore $\Delta \bar{x} < 0$: integration reduces the average quantity per shipment.

For a general distribution with CDF G and density g on $(0, \infty)$, rearranging (A-3) yields a sufficient condition for $\Delta \bar{x} < 0$:

$$\frac{G(m^{N*}) - G(m^{I*})}{1 - G(m^{N*})} > \frac{\delta_1}{\underline{\Delta x}}. \tag{A-4}$$

The left-hand side is the ratio of the mass of switchers (firms with $m \in [m^{I*}, m^{N*}]$) to the mass of firms that already choose J style (firms with $m > m^{N*}$). This ratio is strictly positive for any distribution with positive density on the switching region. The right-hand side is $O(a)$, which is close to zero because $a = \frac{r x_J}{q}$ is the product of two small quantities: the discount rate r, which is inherently small, and $\frac{x_J}{q} = \frac{1}{\#\text{ shipments per period}}$, which is small under J style since J style features high shipping frequency. Therefore, condition (A-4) is satisfied whenever a is sufficiently small, and for any distribution of m satisfying this condition, integration reduces the average x_s in the market.

A.2 Proof of Proposition 2

Compare two cases: buyers facing sellers with asset resale values $v_H > v_L > 0$, with all other parameters fixed. Before integration, $AC_J^N(v_H) > AC_J^N(v_L)$ because higher v raises the asset-control premium $(e^{r x_J/q} - 1)v$ in J-style cost. Therefore $m_H^* > m_L^*$. After integration,

v drops out of AC_J entirely, so both cases share the same AC_J^I and the same post-integration threshold m^{I*}.

Since the post-integration state is identical regardless of the original v, the difference in the integration effect is:

$$\Delta\bar{x}_H - \Delta\bar{x}_L = E[x^{\text{before},L}] - E[x^{\text{before},H}].$$

For $\Delta\bar{x}_H < \Delta\bar{x}_L$ (stronger complementarity for high v), it suffices to show $E[x^{\text{before},H}] > E[x^{\text{before},L}]$:

$$E[x^{\text{before},H}] - E[x^{\text{before},L}] = \underbrace{\int_{m_L^*}^{m_H^*} [x_A^*(m) - x_J^*(v_L)]\, g(m)\, dm}_{\text{(I): firms using A in high-}v\text{ but J in low-}v} - \underbrace{[x_J^*(v_L) - x_J^*(v_H)] \cdot [1 - G(m_H^*)]}_{\text{(II): existing J-style firms have lower } x_J \text{ under high } v}.$$

Term (I) is positive: firms in $[m_L^*, m_H^*]$ use A style (large x_A) in the high-v scenario but J style (small x_J) in the low-v scenario. The gap $x_A^*(m) - x_J^*(v_L)$ is bounded away from zero by Taylor and Wiggins (1997)'s Proposition 3.

Term (II) is positive but first-order small in $a = rx_J/q$: letting $\delta_1^i \equiv x_J^*(0) - x_J^*(v_i)$ for $i \in \{L, H\}$, its magnitude is $x_J^*(v_L) - x_J^*(v_H) = \delta_1^H - \delta_1^L < \delta_1^H = O(a)$, by the same Taylor expansion argument as in the proof of Proposition 1.

Therefore, under condition (A-4), Term (I) dominates Term (II), so $E[x^{\text{before},H}] > E[x^{\text{before},L}]$ and integration reduces the average x_s more when v is larger.

A.3 Proof of Proposition 3

I first prove the result under the special case where only $\underline{\theta}$ changes ($\bar{\theta}$ fixed, i.e., $\gamma = 0$), then extend to the general case.

Step 1: $\frac{dx_J^*}{d\underline{\theta}} < 0$ (larger $\Delta\theta$ implies larger x_J^*)

The extent to which AC_J^N drops after integration is $\Delta AC_J = e^{r\frac{x_J^*}{q}} v$, so it depends on x_J^*. The sign of $\frac{\partial x_J^*}{\partial \underline{\theta}}$ is determined by:

$$\frac{\partial FOC_J}{\partial \underline{\theta}} = \left(1 - e^{-\frac{rx_J}{q}}\right)\left(-e^{\frac{rx_J}{q}} + 1 + \frac{rx_J e^{\frac{rx_J}{q}}}{q}\right) \tag{A-5}$$
$$= (2 - e^{\frac{rx_J}{q}} - e^{-\frac{rx_J}{q}}) + \frac{r}{q}x_J(e^{\frac{rx_J}{q}} - 1)$$

Let $a \equiv r\frac{x_J}{q}$. Taylor-expanding for small a:

$$\frac{\partial FOC_J}{\partial \underline{\theta}} = a + \frac{a^3}{2} + \frac{a^4}{6} + o(a^4) > 0. \tag{A-6}$$

Since $SOC_J > 0$ by (A-2), the implicit function theorem gives $\frac{dx_J^*}{d\underline{\theta}} < 0$. As $\underline{\theta}$ decreases ($\Delta\theta$ increases), x_J^* increases, so $\Delta AC_J(\Delta\theta_H) > \Delta AC_J(\Delta\theta_L)$.

Step 2: AC_A is concave in m (secant slope argument)

AC_A is strictly increasing in m: $\frac{\partial AC_A^*}{\partial m} = \frac{1}{1-e^{-r\frac{x_A^*}{q}}} > 0$. The growth rate decreases because an increase in m raises x_A^* (since $\frac{\partial FOC_A}{\partial m} > 0$ and $SOC_A < 0$), which increases the denominator $1 - e^{-rx_A^*/q}$ and lowers the slope. That is, AC_A is concave in m.

Step 3: $\Delta m_1^* > \Delta m_2^*$ (switching region is wider for high $\Delta\theta$)

Under $\gamma = 0$, AC_A is unchanged across the two cases. The thresholds satisfy $m_2^{*I} < m_1^{*I} < m_2^{*N} < m_1^{*N}$, and k_1, k_2, k_3 are secant slopes of AC_A over the intervals $[m_1^{*I}, m_1^{*N}]$, $[m_2^{*I}, m_2^{*N}]$, and $[m_1^{*I}, m_2^{*N}]$ respectively. By concavity of AC_A: $k_2 > k_3 > k_1$. Since $\Delta m_i^* = \Delta AC_J(\Delta\theta_i)/k_i$ and $\Delta AC_J(\Delta\theta_H) > \Delta AC_J(\Delta\theta_L)$ with $k_1 < k_2$, we have $\Delta m_1^* > \Delta m_2^*$.

Step 4: Extension to general γ

Now allow $\Delta\theta$ to increase through any combination: $d\bar{\theta} = \gamma \cdot d(\Delta\theta)$ and $d\underline{\theta} = -(1-\gamma)\cdot d(\Delta\theta)$, where $\gamma \in [0, 1]$.

When $\bar{\theta}$ changes, both AC_A and AC_J shift. By the envelope theorem:

$$\frac{\partial AC_A^*}{\partial \bar{\theta}} = \frac{r}{q} \cdot \frac{x_A^*}{1 - e^{-rx_A^*/q}}, \qquad \frac{\partial AC_J^*}{\partial \bar{\theta}} = \frac{r}{q} \cdot \frac{x_J^* e^{rx_J^*/q}}{1 - e^{-rx_J^*/q}}.$$

Since the discount rate r is small, both $b \equiv rx_A^*/q$ and $a \equiv rx_J^*/q$ are small. For small b, $1 - e^{-b} \approx b$, so $\frac{\partial AC_A^*}{\partial \bar{\theta}} = \frac{b}{1-e^{-b}} \approx 1$. Similarly, for small a, $e^a \approx 1$ and $1 - e^{-a} \approx a$, so $\frac{\partial AC_J^*}{\partial \bar{\theta}} = \frac{ae^a}{1-e^{-a}} \approx 1$. A change in $\bar{\theta}$ therefore shifts AC_A and AC_J by nearly the same

amount, so the thresholds m^{N*} and m^{I*} barely move. In contrast, $\underline{\theta}$ affects only AC_J (since $\partial AC_A/\partial\underline{\theta} = 0$), so a change in $\underline{\theta}$ shifts the switching region directly.

A Taylor expansion confirms this asymmetry: $\frac{\partial FOC_J}{\partial\bar{\theta}} \approx \frac{3}{2}a^2$, while $\frac{\partial FOC_J}{\partial\underline{\theta}} \approx a$ (from (A-6)), so the $\underline{\theta}$ channel is an order of magnitude larger. Combining:

$$\frac{dx_J^*}{d(\Delta\theta)} \approx \frac{(1-\gamma)\,a - \gamma\cdot\frac{3}{2}\,a^2}{SOC_J} > 0 \quad \text{whenever } \gamma < \frac{1}{1+\frac{3}{2}a} \equiv \bar{\gamma}.$$

With an annual discount rate $r = 0.05$ and quarterly shipment cycles ($x_J/q \approx 0.25$), $a \approx 0.0125$ and $\bar{\gamma} \approx 0.98$. Under this condition, x_J^* increases with $\Delta\theta$, the integration-induced drop $\Delta AC_J = e^{rx_J^*/q}v$ is larger, and the switching region is wider.

Step 5: Average x decreases more

Under condition (A-4), the switching effect (firms moving from A to J style, with a large decrease in x) dominates the δ_1 effect (existing J-style firms with a small increase in x). Since the switching region $\Delta m_1^* > \Delta m_2^*$, more firms switch under high $\Delta\theta$, and the average x decreases more. Therefore, the larger the quality gap, the stronger the complementarity between integration and J style.

B Data Refinement

B.1 Identifying MNEs using ORBIS Data

According to the mutual ownership relationship between firms, the magnitude of controlling shareholder levels increases successively (firms with large csh levels own firms with small csh levels). I regard the firms with the largest csh levels as the ultimate owners. Therefore, in an "ownership tree", if the firm with the largest csh level is a non-US firm, then all the US firms within the tree are defined as foreign MNEs. If the firm with the largest csh level is a US firm, then as long as there is a non-US firm within the tree with a smaller csh level, this US firm that has the largest csh level is defined as a US MNE. At the same time, if there is at least one non-US firm with a smaller csh level than other US firms in the tree, then these US firms with relative larger csh levels will also be regarded as US MNEs.[12] Because I want to study the global sourcing behavior of US firms, this approach excludes business groups that are either entirely non-US firms or entirely US domestic firms.

[12]For example, if a tree is arranged from high to low in terms of csh level as GBR1-USA1-FRA1-USA2, then USA1 and USA2 are both foreign MNEs. If it is arranged as USA1-GBR1-FRA1-USA2, then USA1 is a US MNE. If it is arranged as USA1-GBR1-USA2-FRA1, then USA1 and USA2 are both US MNEs.

B.2 Details on Matching Procedure

Two challenges need to be addressed when matching firms in two datasets by name and country: First, some studies choose to use fuzzy matching to keep observations with higher matching scores, but fuzzy matching cannot guarantee the quality of the matching. Second, the formats of firm names in different datasets are different. Even the same firm may have different spellings in the same dataset. If I want to match firm names accurately instead of using fuzzy matching, it is necessary to process the firm names to find as many firms as possible that have different spellings of their names but are actually the same firm.

Based on the pattern files provided by Wasi and Flaaen (2015), which includes common symbols, words and their corresponding abbreviations in firm names, possible forms of numbers, etc., as well as the regularities of firm names in these two datasets that I observed, I uniformly replaced and deleted certain elements, and then removed suffixes such as CO., LTD. to obtain a clean base name. Eventually, I match two datasets using the clean names and country code.

C Additional Empirical Results

C.1 Robustness Check of Main Results

Table C-1: Relationship between Shipment Pattern and Related Party, Excluding Japanese Firms

Dep. Var.	$\log(Avg\ \#\ Shipment_{ijt})$		$\log(Avg\ \frac{quantity_{ijt}}{shipment_{ijt}})$		$\log(\frac{Avg\ quantity_{ijt}}{Avg\ shipment_{ijt}})$	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\}$	0.157^a	0.234^a	-0.160^a	-0.242^a	-0.157^a	-0.234^a
	(0.012)	(0.038)	(0.012)	(0.038)	(0.012)	(0.038)
$\log(TotQuantity_{ijt})$	0.462^a	0.512^a	0.535^a	0.486^a	0.538^a	0.488^a
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Importer FE	Y	N	Y	N	Y	N
Exporter FE	Y	N	Y	N	Y	N
Year FE	Y	N	Y	N	Y	N
1st Transaction Mon. FE	Y	N	Y	N	Y	N
Importer-Year FE	N	Y	N	Y	N	Y
Exporter Year FE	N	Y	N	Y	N	Y
Importer-1st Transaction Mon. FE	N	Y	N	Y	N	Y
Exporter-1st Transaction Mon. FE	N	Y	N	Y	N	Y
Observations	5466757	2479894	5466757	2479894	5466757	2479894
# of Firm Pairs	2865368	1341896	2865368	1341896	2865368	1341896
R-squared	0.825	0.900	0.928	0.950	0.929	0.951

Notes: Standard errors are clustered at the firm-pair level. Moving averages are use for dependent variables and control variable $\log(TotQuantity_{ijt})$. The dependent variables in columns (3)-(6) are all quantity per shipment, but the third and fourth columns directly take the moving average of quantity per shipment in the corresponding years, while the fifth and sixth columns use the moving average of quantity and shipment respectively to calculate the quantity per shipment. The results of the two methods of calculating quantity per shipment are consistent with each other. Significance levels: a: 0.01, b: 0.05, c: 0.10.

C.2 Robustness Check of Additional Predictions

Table C-2: Heterogeneous Effect, using the Indicator of Large Subsidiary, Direct Ownership Share

Dep. Var.	$\log(Avg\ \#\ Shipment_{ijt})$				$\log(Avg\ \frac{quantity_{ijt}}{shipment_{ijt}})$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\}$	0.168^a	0.061^a	0.287^a	0.092^b	-0.170^a	-0.065^a	-0.287^a	-0.089^b
	(0.010)	(0.010)	(0.033)	(0.037)	(0.011)	(0.010)	(0.033)	(0.037)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\} \times \mathbb{1}\{\text{Large Subsidiary}\}$		0.346^a		0.330^a		-0.339^a		-0.335^a
		(0.023)		(0.055)		(0.023)		(0.055)
$\log(TotQuantity_{ijt})$	0.461^a	0.461^a	0.511^a	0.511^a	0.536^a	0.536^a	0.488^a	0.488^a
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Importer FE	Y	Y	N	N	Y	Y	N	N
Exporter FE	Y	Y	N	N	Y	Y	N	N
Year FE	Y	Y	N	N	Y	Y	N	N
1st Transaction Mon. FE	Y	Y	N	N	Y	Y	N	N
Importer-Year FE	N	N	Y	Y	N	N	Y	Y
Exporter Year FE	N	N	Y	Y	N	N	Y	Y
Importer-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Exporter-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Observations	5559808	5559808	2515322	2515322	5559808	5559808	2515322	2515322
# of Firm Pairs	2906008	2906008	1359309	1359309	2906008	2906008	1359309	1359309
R-squared	0.826	0.826	0.900	0.900	0.928	0.928	0.950	0.950

Notes: Standard errors are clustered at the firm-pair level. A "large subsidiary" is defined as a subsidiary with a trading volume × ownership share greater than 75 percentile in the current year. The ownership share refers direct ownership share. The results are robust when using direct ownership share. The total number of observations is smaller than that in Table 4 because there are some firms that are identified as related party by csh files but do not have share information so that I drop these pairs from the sample. Significance levels: a: 0.01, b: 0.05, c: 0.10.

Table C-3: Heterogeneous Effect, using the Indicator of Medium Subsidiary

Dep. Var.	$\log(Avg\ \#\ Shipment_{ijt})$				$\log(Avg\ \frac{quantity_{ijt}}{shipment_{ijt}})$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\}$	0.168^a	0.006	0.287^a	-0.004	-0.170^a	-0.012	-0.287^a	0.009
	(0.010)	(0.011)	(0.033)	(0.054)	(0.011)	(0.011)	(0.033)	(0.054)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\} \times \mathbb{1}\{\text{Medium Subsidiary}\}$		0.278^a		0.342^a		-0.270^a		-0.348^a
		(0.017)		(0.062)		(0.017)		(0.062)
$\log(TotQuantity_{ijt})$	0.461^a	0.461^a	0.511^a	0.511^a	0.536^a	0.536^a	0.488^a	0.488^a
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Importer FE	Y	Y	N	N	Y	Y	N	N
Exporter FE	Y	Y	N	N	Y	Y	N	N
Year FE	Y	Y	N	N	Y	Y	N	N
1st Transaction Mon. FE	Y	Y	N	N	Y	Y	N	N
Importer-Year FE	N	N	Y	Y	N	N	Y	Y
Exporter Year FE	N	N	Y	Y	N	N	Y	Y
Importer-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Exporter-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Observations	5559808	5559808	2515322	2515322	5559808	5559808	2515322	2515322
# of Firm Pairs	2906008	2906008	1359309	1359309	2906008	2906008	1359309	1359309
R-squared	0.826	0.826	0.900	0.900	0.928	0.928	0.950	0.950

Notes: Standard errors are clustered at the firm-pair level. A "large subsidiary" is defined as a subsidiary with a trading volume × ownership share greater than 50 percentile in the current year. The ownership share refers direct ownership share. The results are robust when using direct ownership share. The total number of observations is smaller than that in Table 4 because there are some firms that are identified as related party by csh files but do not have share information so that I drop these pairs from the sample. Significance levels: a: 0.01, b: 0.05, c: 0.10.

Table C-4: Heterogeneous Effect, using the Level of Quality Ladder

Dep. Var.	$\log(\#\ Shipment_{ijst})$				$\log(\frac{quantity_{ijst}}{shipment_{ijst}})$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\}$	0.295^a	0.129^a	0.098^a	-0.004	-0.295^a	-0.129^a	-0.098^a	0.004
	(0.005)	(0.026)	(0.033)	(0.049)	(0.005)	(0.026)	(0.033)	(0.049)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\} \times \text{Ladder}_s$		0.090^a		0.055^a		-0.090^a		-0.055^a
		(0.014)		(0.020)		(0.014)		(0.020)
$\log(TotQuantity_{ijst})$	0.290^a	0.290^a	0.515^a	0.515^a	0.710^a	0.710^a	0.485^a	0.485^a
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Importer FE	Y	Y	N	N	Y	Y	N	N
Exporter FE	Y	Y	N	N	Y	Y	N	N
HS2-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
1st Transaction Mon. FE	Y	Y	N	N	Y	Y	N	N
Importer-Year FE	N	N	Y	Y	N	N	Y	Y
Exporter Year FE	N	N	Y	Y	N	N	Y	Y
Importer-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Exporter-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Observations	8181858	8181858	2673951	2673951	8181858	8181858	2673951	2673951
# of Firm-Pair-HS2	8181834	8181834	2673949	2673949	8181834	8181834	2673949	2673949
R-squared	0.613	0.613	0.921	0.921	0.877	0.877	0.963	0.963

Notes: Standard errors are clustered at the firm-pair-HS2 level. s includes 72 2-digit HS products. The average quality ladder of these products is 1.87. Significance levels: a: 0.01, b: 0.05, c: 0.10.

Table C-5: Heterogeneous Effect, using the Level of Suppliers' Industry Quality Ladder

Dep. Var.	$\log(\#\ Shipment_{ijst})$				$\log(\frac{quantity_{ijst}}{shipment_{ijst}})$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\}$	0.087^a	-0.112	0.043^a	-0.043	-0.087^a	0.112	-0.043^a	0.043
	(0.013)	(0.084)	(0.014)	(0.088)	(0.013)	(0.084)	(0.014)	(0.088)
$\mathbb{1}\{\text{Related Party Trade}_{ijt}\} \times \text{Ladder}_{j(s)}$		0.090^b		0.039		-0.090^b		-0.039
		(0.038)		(0.040)		(0.038)		(0.040)
$\log(TotQuantity_{ijt})$	0.482^a	0.482^a	0.529^a	0.529^a	0.518^a	0.518^a	0.471^a	0.471^a
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
Importer FE	Y	Y	N	N	Y	Y	N	N
Exporter FE	Y	Y	N	N	Y	Y	N	N
1st Transaction Mon. FE	Y	Y	N	N	Y	Y	N	N
Shipper Industry-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Importer-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Exporter-1st Transaction Mon. FE	N	N	Y	Y	N	N	Y	Y
Observations	207937	207937	128227	128227	207937	207937	128227	128227
# of Firm Pairs	100187	100187	58314	58314	100187	100187	58314	58314
R-squared	0.889	0.889	0.931	0.931	0.943	0.943	0.960	0.960

Notes: Standard errors are clustered at the firm-pair level. s includes 79 4-digit NAICS industries. The average quality ladder of these products is 1.74. Significance levels: a: 0.01, b: 0.05, c: 0.10.