Trade Costs and Global Sourcing: Evidence from Importers' Use of Customs Brokers*

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Abstract

Frequent trade disruptions require firms to adjust their supply chains, and intermediary service-providers play a key role in facilitating these adjustments. This paper introduces a new dataset mapping U.S. import transactions to foreign sources, domestic importers, and customs brokers for the first time. As shown in these data, customs brokers expedite shipping, are predominantly used by smaller importers, and are chosen for transactions of lesser value but incurring higher shipping charges. Firms engaging brokers are more likely to shift which countries they source their products from. To better understand this source-switching behavior, I estimate a structural dynamic discrete choice model of supplier switching that yields estimates of switching costs and responsiveness to price and quality. Additionally, using a dynamic difference-in-differences methodology, I analyze how responses to the U.S.–China trade war differed between firms using and those not using customs brokers. The findings suggest that customs brokers play a key role in firms' adaptive sourcing decisions during trade disruptions.

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1 Introduction

World trade peaked in 2008, following a decades-long period of trade liberalization and global openness to trade. Since then, beginning with the Great Recession and corresponding trade collapse, trade volume has stagnated, and there have been increasingly frequent trade disruptions. Large economies have started to turn towards protectionism, as evidenced by the United Kingdom's exit from the European Union and the US–China trade War; this geopolitical and geoeconomic fragmentation has been catalyzed by the Russo-Ukrainian War, leading to large-scale realignments and uncertainty in the global trade regime (Shekhar et al., 2023).

In response to these changes, firms continue to seek alternative sourcing options. Surveys of CEOs conducted by management consulting firms confirm that new sourcing strategies are front of mind for executives: in a global survey, 43% of CEOs polled stated that supply chain disruption will impact profitability over the next decade to a large or very large extent, and 46% reported considering adjusting their supply chains in the next 12 months to ameliorate their exposure to geopolitical conflict (PwC, 2023). In a survey of CEOs in the United States, 41% responded that they are currently adjusting their supply chains (EY, 2023).

Despite this widespread desire to adapt, firms' trade relationships are persistent and costly to maintain and adjust: firms pay not only traditional trade costs of duties and shipping but also administrative, legal, and regulatory costs in establishing and maintaining their sourcing networks (Anderson and van Wincoop, 2004). In some cases, firms will consult third-party firms with expertise in importing to assist them in adjusting their supply chains and reducing information costs and avoidable delays; customs brokers are one type of third party that importers might rely upon for expertise in trade (U.S. CBP, 2023). Customs brokers are individuals and firms licensed by U.S. Customs and Border Protection (U.S. CBP) to assist importers with all regulatory and legal requirements of conducting trade. As disruptions to supply chains have mounted, customs brokers have been assisting importers in making changes to reduce the impact of trade disruptions (Horsley, 2019).

I open the black box of firm trade transactions to understand better the mechanisms by which importers choose their input sources and reduce the frictions associated with these choices; in doing so, I provide additional insight into the costs associated with firms' engaging in trade and adjusting their supply chain decisions. In traditional datasets on U.S. imports, even in cases where an intermediary is involved in the transaction, transaction records specify only two parties: the importer and the exporter. This representation, however, neglects the crucial role of intermediaries that facilitate cross-border transactions. To address this gap, I construct a dataset that identifies a third-party entity—the customs broker—within U.S. Census trade transactions. The addition of this information allows us to derive a more nuanced and detailed view of the import process, reflecting customs brokers' integral function in ensuring compliance with regulatory demands, navigating complex tariff structures, and optimizing the logistics of entry, which are important yet underrepresented aspects of international trade flows. By considering the customs broker in the dataset, we can gain richer insights into the mechanics of trade, the networks of trade relationships, and the value added by trade-related service providers.

Using these data, I document key facts on customs brokers themselves and the firms and shipments that use them. I then show empirically that firms using customs brokers are more likely to adjust their supply chains by ending existing trade relationships and beginning new ones. Then, using a dynamic difference-in-differences methodology, shown in Appendix C.2, I will show the policy implications of broker use by comparing the trade war responses of importers who use brokers with those of importers who do not. Finally, I will estimate a dynamic discrete choice model of supply chain adjustment, found in Appendix A, and find that switching costs are [lower/higher] for firms using brokers.

This work supports existing evidence that substantial heterogeneity exists in the modalities by which firms engage in international trade, and it proposes an explanation for the value of trade-related services that firms provide to importers. Better understanding the microstructure of trade and the costs associated with firms adjusting their supply chains is essential for policymakers to understand the response of U.S. firms to trade disruptions, develop strategies to encourage supply chain flexibility, and avoid adverse outcomes for firms and consumers at home when implementing trade policy. This work supports existing evidence that substantial heterogeneity exists in the modalities by which firms engage in international trade and proposes an explanation for the value of trade-related services that firms provide to importers. Better understanding the microstructure of trade and the costs associated with firms adjusting their supply chains is essential for policymakers to understand the response of U.S. firms to trade disruptions, develop strategies to encourage supply chain flexibility, and avoid adverse outcomes for firms and consumers at home when implementing trade policy.

2 Literature

This paper speaks to prior work on importing and supplier selection (Antràs et al., 2017; Monarch, 2022; Antràs and Chor, 2022; Antràs and Helpman, 2006). Monarch (2022) builds and estimates a dynamic discrete choice model of sourcing in the context of U.S. importers choosing among individual manufacturers in China. I apply a similar model that differs in two key ways: I focus only on the geographic component of switching costs in the choice of source country, and, as necessitated by cross-country comparisons, I consider duty-inclusive prices.

Customs brokers serve as a type of trade intermediary, facilitating transactions on behalf of the parties buying and selling the goods. There is an extensive body of literature on the role of intermediaries in international trade (Bernard et al., 2015; Ganapati, 2018; Akerman, 2018; Ahn et al., 2011; Utar, 2017; Abel-Koch, 2013; Bernard et al., 2019; Blum et al., 2018), and this work emphasizes the importance of intermediaries in global supply chains. However, most prior work focuses on merchant wholesalers acting as trade intermediaries by purchasing, reselling, and distributing imported or exported goods. In contrast, customs brokers, the firms identified in this paper, operate as service providers who ease the frictions of participating in global markets by assisting firms in the administrative and logistical tasks of importing. Customs brokers, and trade service providers in general, are an understudied component of international trade networks. Theoretical literature on middlemen provides frameworks for understanding the role that service-providing intermediaries such as customs brokers might play in sourcing. Petropoulou (2008) and Li (1998) describe informational intermediaries that ease frictions through their access to information. Biglaiser (1993) and Biglaiser and Friedman (1994) model middlemen as offering a form of quality assurance due to their expertise.

Customs brokers and other service providers facilitate trade through a mechanism similar to that driving the effects of trade promotion and customs modernization: their efforts reduce the frictions and administrative burden associated with participating in global markets, reducing the costs of information and customs clearance (Bondarenko et al., 2017; Pastor et al., 2015). Medin (2021) studies customs brokers in Norwegian data and finds that firms' use of brokers decreases with firm import value, consistent with my findings in U.S. data. Prior literature suggests that services are important for success in international trade: Debaere et al. (2013) find that local availability of services predicts a greater level of outsourcing for Irish firms. Unlike Debaere et al. (2013), who rely on importers' geographical proximity to service-providing firms, I link importers directly to the service providers whom they use to facilitate trade, document new facts about the importers, brokers, and transactions themselves, and show that brokers facilitate supply chain adjustments.

I also contribute to the broad literature on creation, record linkage, and improvement of U.S. Census Bureau trade data (Jarmin et al., 2009; Kamal and Monarch, 2018; Kamal and Ouyang, 2020). I build upon the methods described in Kamal and Ouyang (2020) to construct an establishment-level data crosswalk that links both importers and customs brokers in the import transactions to firm characteristics in other U.S. Census datasets.

3 Data and Background Facts

I use data from the U.S. Census Bureau Longitudinal Firm Trade Transactions Database (LFTTD) for the period 2007–2019. I also use the Business Register (BR) to construct an establishment crosswalk between both importer and broker firms in the LFTTD to link the transactions to individual firm characteristics in the Longitudinal Business Database (LBD). The LFTTD contains the universe of import transactions exceeding $2,500 in value.

For each shipment that enters the United States, customs entry Form 7501 must be filed with U.S. CBP within ten days of release of the shipment. This form, shown in Figure 1, collects a variety of information on an import transaction, including the value, quantity, weight, origin, and firms/parties involved in the transaction. As part of a slate of customs improvement measures enacted in 2001, U.S. CBP clarified policy on the parties that must be listed on Form 7501 (**?**): importers are required to include both the end user and the individual with legal liability for the shipment. Beginning in 2007, the LFTTD began including the "ultimate consignee" variable in addition to the "importer of record" variable that existed in prior versions.

These variables are crucial to my analysis, as their legal definitions allow me to identify brokers in the trade transactions. The ultimate consignee is defined as "the party in the United States, to whom the overseas shipper sold the imported merchandise." (**?**). The importer of record is the party legally responsible for managing the shipment, including ensuring that it is properly classified, that it follows all regulations related to entry into the United States, and that all duties and fines are paid. The importer of record and the ultimate consignee are often the same party; however, when they are different firms and both can be linked to firms operating in the United States, the importer of record must be a licensed customs broker. Throughout, in cases where the ultimate consignee and importer of record differ, I refer to the former as the importer and the latter as the customs broker or broker.

Figure 1: Customs Entry Form 7501


DEPARTMENT OF HOMELAND SECURITY
U.S. Customs and Border Protection

OMB APPROVAL NO. 1651-0022
EXPIRATION DATE 01/31/2021

ENTRY SUMMARY

1. Filer Code/Entry Number	2. Entry Type	3. Summary Date	4. Surety Number	5. Bond Type	6. Port Code	7. Entry Date
8. Importing Carrier	9. Mode of Transport	10. Country of Origin				11. Import Date
12. B/L or AWB Number	13. Manufacturer ID	14. Exporting Country				15. Export Date
16. I.T. Number	17. I.T. Date	18. Missing Docs	19. Foreign Port of Lading		20. U.S. Port of Unlading	
21. Location of Goods/G.O. Number	22. Consignee Number	23. Importer Number			24. Reference Number	

25. Ultimate Consignee Name *(Last, First, M.I.)* and Address
Street
City State Zip

26. Importer of Record Name *(Last, First, M.I.)* and Address
Street
City State Zip

27. Line No.	28. Description of Merchandise: 29. A. HTSUS No. B. AD/CVD No.	30. A. Gross Weight B. Manifest Qty.	31. Net Quantity in HTSUS Units	32. A. Entered Value B. CHGS C. Relationship	33. A. HTSUS Rate B. AD/CVD Rate C. IRC Rate D. Visa Number	34. Duty and IR Tax: Dollars Cents

Other Fee Summary *(for Block 39)*
35. Total Entered Value
$
Total Other Fees
$

CBP USE ONLY		TOTALS
A. LIQ Code	B. Ascertained Duty	37. Duty
REASON CODE	C. Ascertained Tax	38. Tax
	D. Ascertained Other	39. Other
	E. Ascertained Total	40. Total

36. Declaration of Importer of Record (Owner or Purchaser) or Authorized Agent

I declare that I am the ☐ Importer of record and that the actual owner, purchaser, or consignee for CBP purposes is as shown above, **OR** ☐ owner or purchaser or agent thereof. I further declare that the merchandise ☐ was obtained pursuant to a purchase or agreement to purchase and that the prices set forth in the invoices are true, **OR** ☐ was not obtained pursuant to a purchase or agreement to purchase and the statements in the invoices as to value or price are true to the best of my knowledge and belief. I also declare that the statements in the documents herein filed fully disclose to the best of my knowledge and belief the true prices, values, quantities, rebates, drawbacks, fees, commissions, and royalties and are true and correct, and that all goods or services provided to the seller of the merchandise either free or at reduced cost are fully disclosed.
I will immediately furnish to the appropriate CBP officer any information showing a different statement of facts.

41. Declarant Name *(Last, First, M.I.)* Title Signature Date

42. Broker/Filer Information Name *(Last, First, M.I.)* and Phone Number
43. Broker/Importer File Number

CBP Form 7501 (5/22) Page 1 of 3

Source: U.S. Customs and Border Protection resources for making entry.

To create the dataset used for the empirical analysis and estimation, I follow a process similar to that used by the U.S. Census Bureau to create firm identifiers in the LFTTD, described in Kamal and Ouyang (2020). I first consider the text listed in the ultimate consignee field and attempt to find an employer identification number (EIN) match for this establishment. The prioritization of candidate EINs for the ultimate consignee (UC) is as follows:

- For UC EINs that are nine digits, take the full EIN to perform the attempted match.
- For UC EINs longer than nine digits, the prioritization is as follows:
    1. The first nine digits
    2. The second nine digits
    3. The last nine digits

Similarly, for each importer of record (IOR):

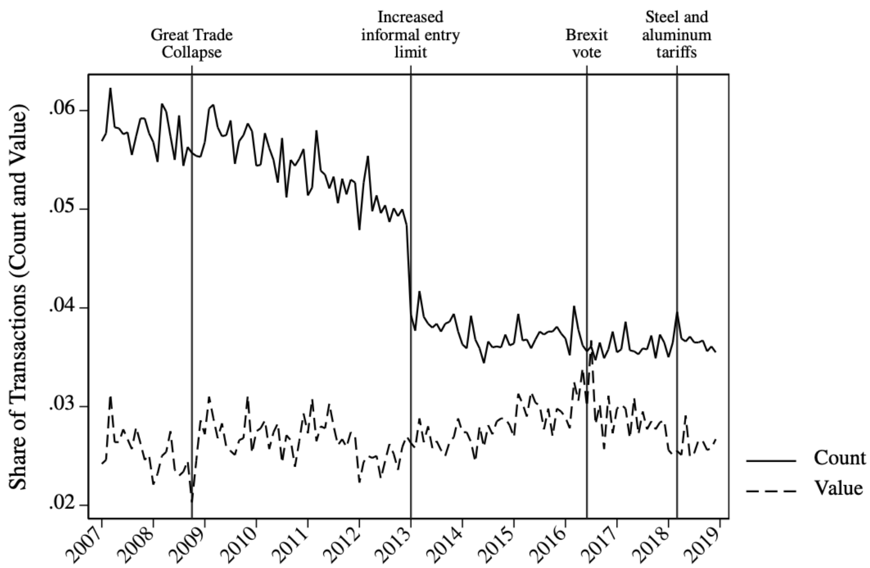
- For IOR EINs that are nine digits, take the full EIN to perform the attempted match.
- For IOR EINs longer than nine digits, the prioritization is as follows:
    1. The first nine digits
    2. The second nine digits
    3. The last nine digits

For each candidate EIN for both the UC and the IOR, I attempt to find a match for the EIN in the Business Register in the following order of prioritization:

1. Same-year match
2. Prior-year match
3. Next-year match
4. $t-2$ to 1976 matches for those remaining unmatched

For the EINs for which a match is found, I check whether the firm associated with the EIN is a single- or multi-unit firm. I assign `firmid` values according to Chow et al. (2021). That is, for single-unit firms, I construct the firm identifier such that `firmid` is equal to "0" followed by the highest-priority matched EIN. For multi-unit firms, the `firmid` is equal to the matched `alpha` followed by "0000". I consider transactions to have involved a broker if the `firmid` associated with the importer of record is not equal to the `firmid` associated with the ultimate consignee. If the EINs differ but the establishments are within the same firm, I do not consider these to be brokered transactions.

Figure 2: Broker Share of Imports



Notes. Share of total transactions (by both count and value) facilitated by customs brokers. Source. Author's calculations using monthly U.S. Census LFTTD data from from 2007-2019.

Over the sample period, brokers facilitate approximately three percent of import value and five percent of import transactions, as shown in Figure 2. There was a substantial drop in the share of transactions facilitated by brokers in January 2013 as a result of a change in U.S. CBP customs policy. Prior to 2013, shipments above $2,000 in value had to be accompanied by a surety bond, a completed entry form, and a minimum processing fee of $25. Effective January 7, 2013, as part of the Beyond the Border Initiative to harmonize policy between the United States and Canada, this limit increased to $2,500. Firms importing shipments below this limit are not required to hold a customs bond; they pay a reduced processing fee and do not appear in the LFTTD import data. The share of import value facilitated by brokers increased in 2016, which may have been a result of both the trade policy uncertainty surrounding the United Kingdom's withdrawal from the European Union and reduced freight and shipping rates caused by a precipitous drop in oil prices.[1] Despite the brokered share of imports constituting only approximately three percent of trade value, brokers remain an important importing technology. As shown in Table 1, over the entirety of the sample, 55%-64% of firms use a broker at least once in a given year. Reflecting the pattern in the number of transactions in Figure 2, the share of firms using brokers drops in 2013.

Table 1: Share of "Ultimate Consignee" Firms that Use a Broker at Least Once Each Year

Year	Share
2007	0.6151
2008	0.6178
2009	0.6049
2010	0.6302
2011	0.6308
2012	0.6383
2013	0.5557
2014	0.5642
2015	0.5668
2016	0.5483
2017	0.5479
2018	0.5537

Notes. Share of Ultimate Consignee firms that use a customs broker at least once in a given year. Source. Author's calculations using annual U.S. Census LFTTD data from from 2007-2018.

3.1 Broker choice

There are numerous reasons why firms may choose to employ the services of a customs broker as their importer of record. The first is for speed and convenience: international couriers and express delivery services automatically use customs brokers to clear goods on behalf of

[1]Further discussion of international freight prices and the relationship with broker use found in Appendix D.

the importer (U.S. CBP, 2023). This allows the courier to handle the shipment from origin to destination and reduces potential lags in communication between parties.

Brokers may also serve as the importer of record in situations of high complexity, when customs procedures are particularly difficult or when additional federal regulations on importation apply. This reduces the potential for delays and fines due to administrative mistakes.

A customs broker may also serve as the importer of record in cases when the importer itself is unwilling or unable to obtain its own customs bond.[2] Importers of record must hold a customs bond through a licensed surety for a shipment to enter the United States. Customs bonds may be single-transaction bonds or continuous bonds. Single-transaction bonds are for one-time importation only and are in an amount equal to the value of the merchandise plus duties, taxes, and fees. Continuous bonds apply over multiple transactions and are for an amount equal to 10% of the duties, taxes and fees paid by the importer during the previous 12 months. Brokers often hold continuous bonds that may be applied to transactions for which they serve as importer of record (Chaplin, 1981).

Finally, a customs broker often serves as importer of record in cases where the buyer and seller agree to the transaction under Delivered Duties Paid (DDP) Incoterms. Under these terms, the seller is required to take responsibility for customs clearance and payment of all duties and fees. This is a complex task, particularly for foreign firms that may not be familiar with domestic customs procedures, so a customs broker may serve as the importer of record to navigate this process on the seller's behalf (Neville, 2014).

Because it cannot be determined from the data whether the broker is chosen for reasons related to speed of processing, complexity, access to financial instruments, or access to the domestic market by foreign importers, I choose to remain agnostic on the broker choice

[2] A customs bond is a type of surety bond. A surety bond is a three-party contract by which one party (the *surety*) agrees to be to be liable for the debt, default, or failure of another (the *principal*), protecting a third party (the *obligee*) against losses due to this failure.

In the case of customs bonds, sureties issue customs bonds to safeguard the U.S. Treasury (the *obligee*) against losses if an importer (the *principal*) does not pay duties, taxes, and any related fines or fees on their imports. U.S. CBP maintains a list of surety companies that specialize in customs bonds and have been certified by Treasury to act in this capacity.

mechanism. Instead, I leverage importer size, as measured by employment and import value, as a predictive factor for the likelihood of utilizing customs broker services.

3.2 Broker characteristics

It is crucial to discern whether firms I identify by comparing the UC and IOR indeed fulfill customs brokers' functions. Per CBP regulations, any party serving as the IOR that is neither the owner nor the purchaser must be a licensed customs broker. Customs brokerage services are often integrated within the operations of freight forwarders, shipping and logistics companies, or performed by importers managing logistics internally.

Under NAICS 2017, customs brokers are categorized within industry 488510, alongside freight forwarders and shipping agents, and are linked to 541614 for consulting services in logistics. Express couriers, classified under 492110, frequently undertake brokerage roles, as indicated by their promotional materials and U.S. CBP documentation.[3]

Analysis of the LFTTD import data reveals that 55.2% of broker-mediated imports involve an IOR associated with these industries, compared to just 10.7% for nonbrokered imports. Among UCs in brokered transactions, 7.7% have employment in these categories vs. 10.7% in nonbrokered transactions. These data suggest that entities acting as IORs in brokered transactions are likely to offer brokerage services and that UCs not employing the services of customs brokers may perform these tasks in-house.

Furthermore, examining the NAICS codes for firms acting as UCs and IORs, whether as brokers or not, reveals notable patterns. The Spearman rank correlations for 2017 presented in Table 2 indicate significant differentiation between brokers and other IORs, while UCs exhibit similar characteristics regardless of broker use. These findings imply a significant differentiation in the services provided by brokers and highlight the tendency of importers to manage brokerage services internally when not employing external brokers.

[3]Full descriptions of these NAICS categories can be found in Appendix E

Table 2: Spearman Rank Correlation of NAICS Codes

	Importer of Record, No Broker	Importer of Record, Broker	Ultimate Consignee, No Broker	Importer of Record, Broker
Importer of Record, No Broker	1.0000	——	——	——
Importer of Record, Broker	0.4175	1.0000	——	——
Ultimate Consignee, No Broker	1.0000	0.4175	1.0000	——
Ultimate Consignee, Broker	0.7949	0.4454	0.7949	1.0000

Notes. Pairwise Spearman rank correlation calculated by comparing top NAICS6 codes by import value for firms in each category. Source. Author's calculations using annual U.S. Census LFTTD data from from 2007-2018 combined with U.S. Census LBD for NAICS6 concordance.

I then consider IORs who serve as a broker at least once in a given year versus those who never act as brokers. A summary of the sizes of these firms in Census years 2012 and 2017 is shown in Table 3. IORs acting as brokers are substantially larger than non-broker IORs. This suggests they may offer benefits of economies of scale to their importing customers (UCs) compared to their non-broker counterparts.

Table 3: Employment of the Importer of Record

Importer of Record				
	No Broker		Broker	
VARIABLES	**Mean**	**S.D.**	**Mean**	**S.D.**
Employment 2012	243.4	6229	1932	22030
Employment 2017	219.2	4443	2053	23430
Log Employment 2012	2.616	1.803	3.570	2.651
Log Employment 2017	2.581	1.798	3.656	2.709

Notes. Employment for Importers of Record in Census years 2012 and 2017. Source. U.S. Census LBD.

Perhaps counterintuitively, when considering UCs who ever use the services of brokers versus those who never use these services (shown in Table 4), UCs who use brokers are also substantially larger than those who do not. This evidence suggests that brokers provide their cost-reducing services to large firms in addition to small firms.

Table 4: Employment of the Ultimate Consignee

Ultimate Consignee				
	No Broker		Broker	
VARIABLES	**Mean**	**S.D.**	**Mean**	**S.D.**
Employment 2012	38.71	881.6	443.1	8,012
Employment 2017	44.45	663.5	538.4	8,661
Log Employment 2012	2.105	1.470	3.019	1.972
Log Employment 2017	2.148	1.506	3.115	2.040

Notes. Employment for Ultimate Consignees in Census years 2012 and 2017. Source. U.S. Census LBD.

3.3 Shipment-Level Statistics

3.3.1 Shipping Time

I first provide statistics on broker use at the greatest degree of granularity possible: the individual shipments. Shipping time is calculated as the difference between the dates of export and import, that is, the dates when the shipment leaves the foreign port and arrives in the domestic port. Then, I estimate the following ordinary least squares (OLS) specification:

$$\begin{aligned}\ln(\text{Shipping Time}_{ijmt}) = \beta_0 + \beta_1 \mathbb{1}\left\{\text{Broker}_{ijmt}\right\} + \beta_2 \ln(\text{Employment}_{mt}) \\ + \beta_3 \left(\mathbb{1}\left\{\text{Broker}_{ijmt}\right\} \times \ln(\text{Employment}_{mt})\right) \\ + \mu_i + \gamma_j + \tau_t + \epsilon_{ijmt}\end{aligned} \tag{1}$$

The results, summarized in Table 5, reveal several key insights into the relationship between shipping time, the use of customs brokers, and employment levels. The coefficients for the binary indicator variable $\mathbb{1}\left\{\text{Broker}^m_{x,j,t}\right\}$ are negative and statistically significant across all specifications. This suggests a robust inverse relationship between the use of brokers and shipping time. Specifically, employing a broker is associated with a reduction in shipping time, with other factors held constant. This finding aligns with the hypothesis that brokers, by virtue of their expertise and networks, can expedite the shipping process. Employment is positively correlated with shipping time, indicating that larger firm size is associated with longer shipping times. Similarly, the interaction between broker and employment yields positive coefficients. This result implies that the effect of using a broker on shipping time varies with the level of employment. Notably, while brokers generally reduce shipping time, this beneficial effect diminishes or reverses at higher employment levels.

Table 5: Determinants of shipping time at the transaction level

	Dependent Variable: ln(Shipping Time)					
$\mathbb{1}\left\{\text{Broker}^{m,x}_{c,j,t}\right\}$	-0.1042***	-0.1339***	-0.1364***	-0.1382***	-0.1397***	-0.1361***
	(3.234e-04)	(3.423e-04)	(3.407e-04)	(3.428e-04)	(3.465e-04)	(3.447e-04)
ln(Employment$^{m}_{t}$)	0.004057***	0.001156***	9.574e-04***	8.252e-04***	0.001076***	0.001022***
	(1.021e-05)	(1.559e-05)	(1.553e-05)	(1.559e-05)	(1.597e-05)	(1.589e-05)
$\mathbb{1}\{Broker^{m,x}_{c,j,t}\}$	0.02268***	0.02592***	0.02602***	0.02605***	0.02589***	0.02535***
$\times$ln(Employment$^{m}_{t}$)	(3.204e-05)	(3.498e-05)	(3.483e-05)	(3.498e-05)	(3.537e-05)	(3.519e-05)
Constant	1.303***	1.325***	1.326***	1.327***	1.326***	1.326***
	(7.716e-05)	(1.138e-04)	(1.135e-04)	(1.138e-04)	(1.164e-04)	(1.158e-04)
Observations	400000000	400000000	400000000	400000000	400000000	400000000
R-squared	0.873	0.875	0.877	0.878	0.88	0.882
Fixed effects						
Country	✓	✓	✓	✓	✓	✓
Date	✓	✓	✓	✓	✓	✓
HS4	✓	✓	✓	✓	✓	✓
Mode	✓	✓	✓	✓	✓	✓
NAICS		✓	✓	✓	✓	✓
Country x Date			✓	✓	✓	✓
HS4 x Date				✓	✓	✓
NAICS x Date					✓	✓
Mode x Date						✓

Notes. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses. Observation counts rounded in accordance with U.S. Census disclosure avoidance procedures.

3.3.2 Shipping Charges

For each shipment, I calculate shipping rates as a ratio of total shipping, insurance, and freight charges to weight of the shipment. I then estimate the following specification with a variety of fixed effects:

$$\ln\left(\frac{\text{Shipping Charges}^{m,x}_{c,j,t}}{\text{Weight}^{m,x}_{c,j,t}}\right) = \beta_0 + \beta_1 \mathbb{1}\{Broker^{m,x}_{c,j,t}\} + \gamma_t + \overrightarrow{\gamma_j} + \gamma_c + \gamma_{c,t} + \varepsilon^{m,x}_{c,j,t} \tag{2}$$

Table 6: Determinants of shipping rates at the transaction level

	Dependent Variable: $\ln\left(\frac{\text{Shipping Charges}^{m}_{x,j,t}}{\text{Weight}^{m}_{x,j,t}}\right)$					
$\mathbb{1}\{Broker^{m}_{x,j,t}\}$	1.082***	1.078***	1.074***	1.077***	1.072***	1.067***
	(3.727e-04)	(3.830e-04)	(3.823e-04)	(3.816e-04)	(3.825e-04)	(3.810e-04)
Constant	-1.573***	-1.574***	-1.574***	-1.574***	-1.574***	-1.574***
	(7.484e-05)	(7.419e-05)	(7.397e-05)	(7.335e-05)	(7.254e-05)	(7.220e-05)
Observations	400000000	400000000	400000000	400000000	400000000	400000000
R-squared	0.608	0.62	0.622	0.629	0.638	0.641
Country FE	✓	✓	✓	✓	✓	✓
Date FE	✓	✓	✓	✓	✓	✓
HS4 FE	✓	✓	✓	✓	✓	✓
Mode FE	✓	✓	✓	✓	✓	✓
NAICS FE		✓	✓	✓	✓	✓
Country x Date FE			✓	✓	✓	✓
HS4 x Date FE				✓	✓	✓
NAICS x Date FE					✓	✓
Mode x Date FE						✓

Notes. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses. Observation counts rounded in accordance with U.S. Census disclosure avoidance procedures.

The estimate of β_1, the association between broker use and shipping rates, is consistently positive and statistically significant across all specifications. This suggests a robust relationship between the use of brokers and higher shipping charges per unit weight. The large magnitude of the coefficient implies that the presence of a broker is associated with an increase in shipping costs, when measured as a ratio of shipping charges to weight.

3.3.3 Broker Probability

I now consider the firm characteristics and trade environment that impact the likelihood of using a broker at the shipment level. To measure firm age, I follow the procedure provided in prior literature (Becker et al., 2007; Davis et al., 2012; Decker et al., 2020; Haltiwanger et al., 2010): in a given year, calculate the age of the firm as the difference between the current year and the year that the oldest establishment in the firm first appears in the LBD. Employment is also taken from firm employment in the LBD. I estimate a linear probability model specification of the form:

$$\Pr\Big(\text{Broker}^m_{x,j,t} = 1\Big) = \beta_0 + \beta_1 \ln(\text{Employment}^m_t) + \beta_2 \ln(\text{Age}^m_t) + \beta_3 \text{FTA}^m_{c,t} + \gamma_t + \vec{\gamma_j} + \gamma_c + \varepsilon^{m,x}_{c,j,t} \tag{3}$$

Table 7: Determinants of broker use at the transaction level

	Dependent Variable: $\mathbb{1}\{Broker^m_{x,j,t}\}$				
$\ln(\text{Employment}^m_t)$	-0.008838***	-0.008892***	-0.008421***	-0.007449***	-0.01398***
	(4.249e-06)	(4.254e-06)	(4.509e-06)	(4.439e-06)	(6.351e-06)
$\ln(\text{Age}^m_t)$	-0.01475***	-0.01368***	-0.01444***	-0.01324***	-0.002853***
	(1.839e-05)	(1.866e-05)	(1.866e-05)	(1.830e-05)	(1.898e-05)
$\text{FTA}^m_{c,t}$	-0.003432***	0.004275***	0.01082***	0.01258***	0.01292***
	(1.267e-04)	(1.282e-04)	(1.251e-04)	(1.226e-04)	(1.186e-04)
Constant	0.1564***	0.1504***	0.1471***	0.1356***	0.1472***
	(6.853e-05)	(7.035e-05)	(6.988e-05)	(6.860e-05)	(7.221e-05)
Observations	400000000	400000000	400000000	400000000	400000000
R-squared	0.04	0.04	0.09	0.126	0.188
Country FE	✓	✓	✓	✓	✓
Date FE		✓	✓	✓	✓
HS4 FE			✓	✓	✓
Mode FE				✓	✓
NAICS FE					✓

Notes. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses. Observation counts rounded in accordance with U.S. Census disclosure avoidance procedures.

The results in Table 7 suggest that as employment increases, the probability of using a broker decreases. Similarly, older firms are less likely to use brokers. The effect of a free trade agreement or preferential trade agreement between the U.S. and source country is less clear, but controlling for relevant fixed effects, there is a positive relationship between $\text{FTA}^m_{c,t}$ and broker use, suggesting that brokers may be more useful in utilizing the benefits of free trade trade agreements.[4]

3.4 Aggregated Statistics

3.4.1 Quality estimation

I estimate the quality of supplier countries following the instrumental variables approach of Khandelwal (2010).

$$\ln\left(s_{cht}\right) - \ln\left(s_{0t}\right) = \lambda_{1,ch} + \lambda_{2,t} + \alpha p_{cht} + \sigma \ln\left(ns_{cht}\right) + \lambda_{3,cht},$$

where h is a Harmonised System 8-digit (HS8) variety and c is the import country of origin. "Quality" is the sum of the λ terms, $\lambda_{1,ch} + \lambda_{2,t} + \lambda_{3,cht}$, where s_{cht} is variety ch's market share and ns_{cct} is its market share within product h or the nest share. The outside variety (domestic variety) share is s_{0t}.

Total industry output is:

$$MKT_t = \sum_{ch \neq 0} q_{cht} / \left(1 - s_{0t}\right),$$

The imported variety market share is:

$$s_{cht} = q_{cht} / MKT_t.$$

Because p_{cht} is likely correlated with ns_{cht} or $\lambda_{3,cht}$, the unobserved component of quality, an instrumental variables approach is necessary. Specifically, I instrument for price using variety-specific transportation costs and for ns_{cht} with the number of varieties within product h and the number of varieties exported by country c. I use NBER–CES domestic production

[4] Despite the presence of Free Trade Agreements and Preferential Trade Legislation, utilization rates of these special programs remain quite low. Across all such programs, the utilization rate in FY2022 was approximately 27%. That is, of all eligible U.S. imports, only 27% of the value of those imports entered under a free trade agreement or other special program (U.S. CBP, U.S. CBP). Utilization is costly (Ulloa and Wagner, 2012).

data to construct the "outside option" and LFTTD import and export data at the HS4 level.

3.4.2 Probability of using a broker

I estimate the following linear probability model to provide evidence on the characteristics that impact broker use:

$$\begin{aligned}\mathbb{1}\left\{\text{Broker}^m_{c,j,t}\right\} = {} & \beta_0 + \beta_1 \ln\left(\text{Value}^m_{c,j,t}\right) + \beta_2 \ln(\text{Weight}^m_{c,j,t}) + \beta_3 \lambda_{c,j,t} \\ & + \beta_4 \ln\left(\text{Employment}^m_t\right) + \beta_5 \mathbb{1}\left\{\text{Related}^m_{c,j,t}\right\} \\ & + \beta_6 \mathbb{1}\left\{\text{NTM}_{c,j,t}\right\} + \beta_7 \mathbb{1}\left\{\text{USDA}_j\right\} \\ & + \beta_8 \mathbb{1}\{\text{HITECH}_j\} + \beta_9 \tau_{c,j,t} \\ & + \gamma_t + \gamma_c + \gamma_j + \gamma_m + \varepsilon_{cjtm},\end{aligned} \tag{4}$$

where $\text{Value}^m_{c,j,t}$ is the value of imports of product j that firm m purchases from country c, $\text{Weight}^m_{c,j,t}$ is the total log weight of firm m imports of product j from country c, $\lambda_{c,j,t}$ is the estimated quality of product j from c, Employment^m_t is the employment of firm m, $\text{Related}^m_{c,j,t}$ is an indicator denoting related-party trade flows, $\text{NTM}_{c,j,t}$ is a binary variable equal to one when there is a nontariff measure affecting product j from country c, USDA_j indicates whether j is an agricultural product, HITECH_j indicates whether j is classified as an advanced technology product,[5] and $\tau_{c,j,t}$ is the iceberg-equivalent duty rate. The results of this regression are reported in Table 8.

[5] Advanced Technology Product classifications are listed in detail in Appendix F.

Table 8: Determinants of Broker Use at the Firm-Country-HS8-Year Level

	Dependent Variable: $\mathbb{1}\left\{\text{Broker}^m_{c,j,t}\right\}$					
$\ln(\text{Value}^m_{c,j,t})$	0.04305***	0.04314***	0.05343***	0.06211***	0.04314***	0.04993***
	(0.001643)	(0.001637)	(0.003744)	(0.003454)	(0.001637)	(0.001761)
$\ln(\text{Weight}^m_{c,j,t})$	-0.05339***	-0.05339***	-0.07466***	-0.07816***	-0.05339***	-0.05495***
	(0.001522)	(0.001522)	(0.003315)	(0.003444)	(0.001522)	(0.001497)
$\ln(\text{Employment}^m_t)$	-0.003619***	-0.003642***	-0.01248***	-0.01482***	-0.003668***	-0.005944***
	(9.569e-04)	(9.516e-04)	(0.003088)	(0.003110)	(9.569e-04)	(6.006e-04)
$\text{Related}^m_{c,j,t}$	-0.1290***	-0.1290***	-0.1884***	-0.2065***	-0.1290***	-0.1438***
	(0.008084)	(0.008095)	(0.01237)	(0.01654)	(0.008097)	(0.01137)
$\ln(1+\tau_{c,j,t})$		0.1426***	0.1905***	0.2708***	0.1428***	0.1751***
		(0.03295)	(0.07804)	(0.1088)	(0.03295)	(0.04519)
$\text{NTM}_{c,j,t}$	-0.01098**	-0.01085**			0.00118	0.02554**
	(0.005425)	(0.005447)			(0.02600)	(0.01152)
USDA_j	0.03786***	0.04190***	0.02149***	0.03707***	0.02073***	
	(0.006751)	(0.01138)	(0.006786)	(0.006484)	(0.003881)	
HITECH_j	0.006868	0.01795	0.06615***	0.006926	0.06367***	
	(0.007288)	(0.01192)	(0.03255)	(0.007353)	(0.01399)	
$\lambda_{c,j,t}$					2.53e-04***	0.06368***
					(8.197e-05)	(0.01397)
Constant	0.2224***	0.2121***	0.2971***	0.2124***	0.2119***	0.1354***
	(0.01293)	(0.01200)	(0.03380)	(0.03089)	(0.01200)	(0.01765)
Observations	228000000	228000000	858700000	858700000	858700000	858700000
R-squared	0.513	0.513	0.292	0.290	0.292	0.290
Fixed effects						
t	✓	✓	✓	✓	✓	✓
c	✓	✓	✓	✓	✓	✓
j	✓	✓	✓	✓	✓	✓
m	✓	✓			✓	✓

Notes. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses. Observation counts rounded in accordance with U.S. Census disclosure avoidance procedures.

$NTM_{c,j,t}$, $USDA_j$, $HITECH_j$, and $\tau_{c,j,t}$ are all measures of trade costs, and all are associated with a higher probability of broker use. $\ln(wt^m_{c,j,t})$, $\ln\left(v^m_{c,j,t}\right)$, and $\ln\left(emp^m_t\right)$ are measures of import size or firm size. Higher values of $\ln(wt^m_{c,j,t})$ and $\ln\left(emp^m_t\right)$ are associated with a lower probability of broker use, while higher values of $\ln\left(v^m_{c,j,t}\right)$ are associated with a higher probability of broker use.

3.4.3 Shipping charges

I construct a measure of shipping charges as follows:

$$cif^m_{c,j,t} = ln\left(1 + \frac{charges^m_{c,j,t}}{v^m_{c,j,t}}\right). \tag{5}$$

I then estimate the following OLS specification:

$$\begin{aligned} cif^m_{c,j,t} = \beta_0 + \beta_1 \mathbb{1}\{Broker^m_{c,j,t}\} + \beta_2 \tau_{c,j,t} \\ + \beta_3 \ln(wt^m_{c,j,t}) + \gamma_t + \gamma_c + \gamma_j + \varepsilon_{cjtm}. \end{aligned} \tag{6}$$

The results of this regression are reported in Table 9.

Table 9: Determinants of shipping charges at the Firm-Country-HS8-Year Level

	Dependent Variable: $cif_{c,j,t}$			
$\ln(Weight^m_{c,j,t})$	-0.006097***	-0.006066***	-0.006064***	-0.002707***
	(3.192e-04)	(3.208e-04)	(3.212e-04)	(1.637e-04)
$\ln(1+\tau_{c,j,t})$		0.06477***	0.06466***	0.07952***
		(0.008411)	(0.008385)	(0.007277)
$\mathbb{1}\{Broker^m_{c,j,t}\}$	0.04634***	0.04628***	0.04627***	0.01278***
	(0.007607)	(0.007597)	(0.007600)	(0.002320)
$NTM_{c,j,t} \in \{0,1\}$			-0.008266*	-0.01133***
			(0.004360)	(0.003695)
$HITECH_{j,t} \in \{0,1\}$			0.001860	0.008595
			(0.006181)	(0.005314)
$USDA_{j,t} \in \{0,1\}$			0.01482**	-3.067e-06
			(0.006643)	(0.003061)
$\lambda_{c,j,t}$				-5.427e-05**
				(2.188e-05)
Fixed Effects:				
t	✓	✓	✓	✓
c	✓	✓	✓	✓
j	✓	✓	✓	✓
m	✓	✓	✓	✓
Constant	0.1094***	0.1060***	0.1053***	0.07886***
	(0.002032)	(0.001985)	(0.001952)	(0.001413)
Observations	18910000	18910000	18910000	7031000
R-squared	0.285	0.285	0.285	0.284

Notes. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors in parentheses, clustered at the product–year level. Observation counts rounded in accordance with U.S. Census disclosure avoidance procedures.

4 Empirical Analysis of Supply Chain Adjustment

To measure the potential outcomes of an importer–country relationship, I construct three binary outcome variables: $Stay^m_{j,t}$, $NewSource^m_{j,t}$, and $Reallocate^m_{j,t}$. Let $v^m_{j,t} = \sum_c v^m_{c,j,t}$ or the sum of importer m's value of imports of product j in time t over all countries. Let $c^m_{j,t}$ be m's primary source for product j in time t. That is, if m imports j from only one country, $c^m_{j,t}$ is that country. If m imports j from multiple countries, $c^m_{j,t}$ is the country with the highest share $v^m_{c,j,t}$ of $v^m_{j,t}$.

4.1 Staying with the same source country

I first construct an indicator of staying with one's primary supplier:

$$Stay^m_{j,t} = \begin{cases} 1, & \text{if } c^m_{j,t} = c^m_{j,t-1} \\ 0, & \text{otherwise} \end{cases}$$

and estimate:

$$\begin{aligned} Stay^m_{j,t} = {} & \beta_0 + \beta_1 \mathbb{1}\{Broker^m_{c,j,t-1}\} \\ & + \boldsymbol{\beta_2} \mathbb{1}\{Broker^m_{c,j,t-1}\} \times \left\{ln(p^m_{c,j,t-1}) + \tau_{c,j,t-1} + \lambda_{c,j,t-1} + ln(v^m_{c,j,t-1})\right\} \\ & + \boldsymbol{\beta_3} \left(1 - \mathbb{1}\{Broker^m_{c,j,t-1}\}\right) \times \left\{ln(p^m_{c,j,t-1}) + \tau_{c,j,t-1} + \lambda_{c,j,t-1} + ln(v^m_{c,j,t-1})\right\} \\ & + \gamma_t + \gamma_j + \varepsilon_{c,j,t}. \end{aligned} \tag{7}$$

As shown in Table 10, I find that firms using brokers are less likely to stay with their primary supplier in general and that this affect is more pronounced with higher duty rates.

Table 10: Determinants of Staying with Source Country

	Broker	Dependent Variable: $Stay^m_{j,t}$				
$\mathbb{1}\{Broker^m_{c,j,t-1}\}$		-0.0241***	-0.0030	-0.2089***	-0.1702***	-0.1311***
		(0.0043)	(0.0046)	(0.0094)	(0.0086)	(0.0107)
$\ln(p^m_{c,j,t-1})$	0	-0.0283***	-0.0284***	-0.0274***	-0.0275***	-0.0205***
		(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0006)
	1	-0.0254***	-0.0246***	-0.0219***	-0.0215***	-0.0149***
		(0.0012)	(0.0011)	(0.0011)	(0.0011)	(0.0009)
$\lambda_{c,j,t-1}$	0	0.0041***	0.0040***	0.0037***	0.0036***	0.0003*
		(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0001)
	1	0.0039***	0.0041***	0.0034***	0.0036***	0.0001
		(0.0005)	(0.0005)	(0.0004)	(0.0005)	(0.0002)
$\tau_{c,j,t-1}$	0		-0.2607***		-0.2384***	-0.5148***
			(0.0309)		(0.0317)	(0.0403)
	1		-0.8523***		-0.6901***	-0.8123***
			(0.0555)		(0.0511)	(0.0598)
$\ln(\text{Value}^m_{j,t})$	0			0.0089***	0.0091***	0.0037***
				(0.0004)	(0.0004)	(0.0003)
	1			0.0268***	0.0248***	0.0186***
				(0.0008)	(0.0007)	(0.0006)
$\ln(\text{Value}_{c,j,t})$	0					0.0282***
						(0.0005)
	1					0.0286***
						(0.0007)
$\ln(\text{N}_c)$	0					-0.0005***
						(0.0001)
	1					-0.0012***
						(0.0001)
Constant		0.9060***	0.9185***	0.8097***	0.8194***	0.4650***
		(0.0060)	(0.0055)	(0.0049)	(0.0045)	(0.0082)
Observations		2182000	2182000	2182000	2182000	2182000
R-squared		0.0803	0.0821	0.0868	0.0880	0.1071

Note: Standard errors are clustered at the firm-HS8 level. All specifications include HS8 and year fixed effects. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Notes. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses. Observation counts rounded in accordance with U.S. Census disclosure avoidance procedures.

4.2 Shifting to a new source country

Analogously, I construct an indicator of beginning to import from a new country:

$$NewSource^m_{j,t} = \begin{cases} 1, & \text{if } c^m_{j,t} \neq c^m_{j,t-1} \text{ \& } v^m_{c,j,t-1} = 0 \\ 0, & \text{otherwise} \end{cases} \tag{8}$$

and estimate:

$$\begin{aligned} & NewSource^m_{j,t} = \beta_0 + \beta_1 \mathbb{1}\{Broker^m_{c,j,t-1}\} \\ & + \boldsymbol{\beta_2} \mathbb{1}\{Broker^m_{c,j,t-1}\} \times \left\{ln(p^m_{c,j,t}) + \tau_{c,j,t-1} + \lambda_{c,j,t-1} + ln(v^m_{c,j,t-1})\right\} \\ & + \boldsymbol{\beta_3} \left(1 - \mathbb{1}\{Broker^m_{c,j,t-1}\}\right) \times \left\{ln(p^m_{c,j,t-1}) + \tau_{c,j,t-1} + \lambda_{c,j,t-1} + ln(v^m_{c,j,t-1})\right\} \\ & + \gamma_t + \gamma_j + \varepsilon_{c,j,t}. \end{aligned} \tag{9}$$

Table 11: Determinants of Importing from a New Source Country

		Dependent Variable: $NewSource^{m}_{j,t}$				
	Broker					
$\mathbb{1}\{Broker^{m}_{c,j,t-1}\}$		0.0248***	0.0073**	0.2377***	0.2129***	0.2082***
		(0.0031)	(0.0034)	(0.0088)	(0.0085)	(0.0099)
$\ln(p^{m}_{c,j,t-1})$	0	0.0206***	0.0207***	0.0187***	0.0188***	0.0151***
		(0.0006)	(0.0006)	(0.0005)	(0.0005)	(0.0004)
	1	0.0211***	0.0205***	0.0154***	0.0152***	0.0111***
		(0.0008)	(0.0008)	(0.0007)	(0.0007)	(0.0006)
$\lambda_{c,j,t-1}$	0	-0.0028***	-0.0027***	-0.0020***	-0.0020***	-0.0001
		(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0001)
	1	-0.0028***	-0.0029***	-0.0019***	-0.0020***	-0.0000
		(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0001)
$\tau_{c,j,t-1}$	0		0.2181***		0.1559***	0.3082***
			(0.0182)		(0.0195)	(0.0251)
	1		0.7078***		0.4444***	0.4819***
			(0.0378)		(0.0324)	(0.0379)
$\ln(\text{Value}^{m}_{j,t})$	0			-0.0217***	-0.0218***	-0.0191***
				(0.0004)	(0.0004)	(0.0003)
	1			-0.0427***	-0.0415***	-0.0374***
				(0.0008)	(0.0008)	(0.0008)
$\ln(\text{Value}_{c,j,t})$	0					-0.0149***
						(0.0003)
	1					-0.0175***
						(0.0005)
$\ln(\text{N}_c)$	0					-0.0001
						(0.0001)
	1					0.0006***
						(0.0001)
Constant		0.0458***	0.0353***	0.2808***	0.2744***	0.4782***
		(0.0040)	(0.0037)	(0.0035)	(0.0035)	(0.0065)
Observations	2182000	2182000	2182000	2182000	2182000	
R-squared		0.0659	0.0678	0.0998	0.1005	0.1093

Note: Standard errors are clustered at the firm-HS8 level. All specifications include HS8 and year fixed effects. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Notes. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses. Observation counts rounded in accordance with U.S. Census disclosure avoidance procedures.

Results in Table 11 suggest that the use of a broker in $t-1$ is associated with a higher likelihood of importing from a new country as the firm's primary source of good j.

4.3 Reallocating import sourcing

In some cases, an importer may shift its primary source of product j from the primary source in $t-1$ to another country the firm imported from in time $t-1$. I construct an indicator for a firm's changing its primary source of product j to a source it imported from in $t-1$:

$$Reallocate^m_{j,t} = \begin{cases} 1, & \text{if } c^m_{j,t} \neq c^m_{j,t-1} \text{ \& } v^m_{c,j,t-1} > 0 \\ 0, & \text{otherwise} \end{cases} \tag{10}$$

That is, $Reallocate^m_{j,t}$ is set to 1 if the firm changes its primary source of product j at time t to a different country, conditional on having had some imports from that country in the previous period ($v^m_{c,j,t-1} > 0$).

I then estimate:

$$\begin{aligned} &Reallocate^m_{j,t} = \beta_0 + \beta_1 \mathbb{1}\{Broker^m_{c,j,t-1}\} \\ &+ \boldsymbol{\beta_2} \mathbb{1}\{Broker^m_{c,j,t-1}\} \times \left\{ln(p^m_{c,j,t-1}) + \tau_{c,j,t-1} + \lambda_{c,j,t-1} + ln(v^m_{c,j,t-1})\right\} \\ &+ \boldsymbol{\beta_3} \left(1 - \mathbb{1}\{Broker^m_{c,j,t-1}\}\right) \times \left\{ln(p^m_{c,j,t-1}) + \tau_{c,j,t-1} + \lambda_{c,j,t-1} + ln(v^m_{c,j,t-1})\right\} \\ &+ \gamma_t + \gamma_j + \varepsilon_{c,j,t}. \end{aligned} \tag{11}$$

	Broker	*Dependent Variable* : $Reallocate^{m}_{j,t}$				
$\mathbb{1}\{Broker^{m}_{c,j,t-1}\}$		-0.0007	-0.0043**	-0.0288***	-0.0428***	-0.0771***
		(0.0019)	(0.0019)	(0.0040)	(0.0041)	(0.0045)
$\ln(p^{m}_{c,j,t-1})$	0	0.0077***	0.0077***	0.0087***	0.0087***	0.0055***
		(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)
	1	0.0042***	0.0041***	0.0065***	0.0063***	0.0038***
		(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0004)
$\lambda_{c,j,t-1}$	0	-0.0013***	-0.0013***	-0.0017***	-0.0017***	-0.0002***
		(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
	1	-0.0011***	-0.0012***	-0.0015***	-0.0016***	-0.0001**
		(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)
$\tau_{c,j,t-1}$	0		0.0426**		0.0825***	0.2066***
			(0.0170)		(0.0167)	(0.0189)
	1		0.1445***		0.2457***	0.3304***
			(0.0232)		(0.0241)	(0.0269)
$\ln(\text{Value}^{m}_{j,t})$	0			0.0128***	0.0128***	0.0154***
				(0.0003)	(0.0003)	(0.0003)
	1			0.0159***	0.0166***	0.0188***
				(0.0004)	(0.0004)	(0.0005)
$\ln(\text{Value}_{c,j,t})$	0					-0.0132***
						(0.0002)
	1					-0.0111***
						(0.0003)
$\ln(\text{N}_{c})$	0					0.0006***
						(0.0001)
	1					0.0006***
						(0.0001)
Constant		0.0482***	0.0462***	-0.0905***	-0.0938***	0.0568***
		(0.0021)	(0.0021)	(0.0036)	(0.0036)	(0.0054)
Observations		2182000	2182000	2182000	2182000	2182000
R-squared		0.0224	0.0225	0.0352	0.0356	0.0448

Note: Standard errors are clustered at the firm-HS8 level. All specifications include HS8 and year fixed effects. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Notes. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses. Observation counts rounded in accordance with U.S. Census disclosure avoidance procedures.

4.4 Discussion

The totality of the results and stylized facts provide a picture of the complexity and heterogeneity in the ways that firms import. Smaller firms are more likely to rely on customs brokers to mitigate the costs associated with engaging in global markets, though large firms do also utilize the resources of third party brokers. An analysis of source switching behavior suggests that importers using brokers may face lower costs of switching source countries and are substantially more responsive to the duty component of international prices. The interaction terms in each of the specifications in Section 4 highlight how brokers affect the impact of price, duty rates, quality, and import value on the decisions to stay or switch sources, suggesting that trade flows facilitated by customs brokers differ in crucial ways from trade conducted directly by importers themselves. These findings support a framework in which switching costs, responsiveness to price and quality differences, and by construction, trade elasticities, are estimated separately for these two modalities of trade. Differences in the responsiveness to the duty component of prices also suggests that firms using brokers may differ in their responsive to tariff shocks compared to their counterparts that do not use brokers.

5 Conclusion

This paper constructs a novel dataset that maps individual U.S. import transactions to their corresponding foreign sources, domestic importers, and notably, to customs brokers. This unique contribution allows me to explore customs broker usage within the United States, shedding light on the operational choices of domestic firms engaged in international trade.

I document that larger firms, while less likely to engage customs brokers, still maintain significant usage, suggesting nuanced decision-making processes that may balance in-house capabilities with the specialized services that brokers provide. Moreover, I provide empirical evidence that brokers facilitate faster shipping times, indicating that customs brokers provide value for firms prioritizing speed in their supply chain operations. The benefits that brokers offer are offered at a premium, as shipping charges are also higher for brokered transactions.

Further, the importance of broker usage in supply chain decisions is highlighted by the tendency of firms employing brokers to switch their import source countries more frequently. This suggests that brokers may play a strategic role in firms' supply chain adaptability, especially in a landscape marked by trade uncertainties and geopolitical shifts. In the context of the recent U.S.–China trade war, casual estimation using a dynamic difference-in-differences (described in Appendix **??**) approach analyzes whether there was a differential response among importers that utilize customs brokers versus those that do not. This variation would speak to the broader question of how services can moderate the effects of economic shocks and trade policies, providing a buffer or an accelerator for firms' adaptive measures.

This project reveals the pivotal role customs brokers play in foreign trade, particularly under conditions of trade disruption and policy uncertainty. Customs brokers are not merely bureaucratic facilitators or administrative service providers in trade compliance but also key agents in enabling firms, especially smaller and newer ones, to navigate complex trade environments and adjust their sourcing strategies dynamically. Understanding the role of customs brokers and the costs they mitigate for importers can guide policymakers in crafting trade policies that consider the dynamics of intermediary-facilitated trade. This is crucial for strategies aiming to enhance supply chain resilience and adaptability. Additionally, these insights can inform the development of support mechanisms for domestic firms, enabling them to engage more effectively in international trade.

Further research is warranted to investigate the mechanisms through which brokers impact trade flows and to explore the potential for policy interventions that can enhance the positive effects of their services. This study lays the groundwork for such inquiries and opens several avenues for future research. Future work will use examine customs broker use beyond brokers serving as importers of record. In understanding the importance of shipping time, further work is warranted on the role of inventory management in the choice of shipping mode and customs broker usage. In closing, this paper contributes to a deeper understanding of the logistics that underpin international trade, providing both a theoretical and empirical foundation for further inquiry into the economic implications of the use of customs brokers.

Appendix A Theoretical Model of Supply Chain Adjustment

Note: Results in appendix materials are awaiting U.S. Census Disclosure and will be available before the ASSA 2024 Annual Meeting.

A.1 Environment

Different countries supply the same product j at different prices and different duty rates, and they have heterogeneous quality. Importers decide in each period which country to import from, based on both their current supplier and information about other available price, duty, and quality menus. Switching suppliers involves payment of a per-unit switching cost. Each individual country that supplies product j at time t is denoted as $c_{j,t}$, and countries are distinguished by the price that importer m pays for product j, $p^m_{c,j,t}$, the duty rate imposed on product j, $p_{c,j,t}$, and by the quality of their individual variety, $\lambda_{c,j,t}$. If importer m chooses the country indexed $c_{j,t}$, this match is denoted $c^m_{j,t}$.

A.2 Domestic consumers

A representative consumer with constant-elasticity-of-substitution (CES) preferences over varieties maximizes their utility:

$$U = \left(\sum_{m=1}^{M} \alpha_m Q_m^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}. \tag{12}$$

This yields demand for variety m:

$$Q_m = B p_m^{-\sigma}. \tag{13}$$

A.3 Foreign suppliers

Multiple different countries produce varieties of product j. They set the price at time t based upon their own marginal cost, which also depends on their quality $\lambda_{c,t}$. The optimal price is

$$p_{c,j,t} = \mu_{c,j} MC_{c,t} = \mu_c \frac{w_{c,j,t}}{z_c} (\lambda_c),$$

where z is the idiosyncratic productivity of supplier c, w is the wage, and λ is quality. Suppliers set a constant markup μ_c.

A.4 Importer's problem

Importers must decide whether to stay with their current source country or choose a new source country based on the switching costs, price, and quality of the available menu of input sources. Selecting a new source country is associated with paying the duty-inclusive input price of that country plus the switching cost. Importer m maximizes profits by choosing a vector of countries from which to source each of its required inputs to production and by setting the optimal price of its final good variety. Each importer produces a single nontradeable final good variety m and requires labor and a bundle of J inputs to produce this variety according to a Cobb–Douglas production function:

$$Q_m = L^{\alpha} \left(\Pi_{j=1}^{J} I_j^{\gamma_j} \right)^{1-\alpha}, \tag{14}$$

where L is units of labor and $\{I_j\}_{j=1}^{J}$ denotes the quantity of intermediate inputs. Importers choose the source country based on the expected duty-inclusive price and the frictions associated with moving to a different source country.

The expected price paid for input j from a given country c is $\mathbb{E}\left[\tau_{c,j,t} p_{c,j,t}^{m}\right]$, where $p_{c,j,t}^{m}$ is the price that firm m pays for good j from county c in time t and $\tau_{c,j,t}$ is the duty rate applied to good j from country c at time t. Import prices from countries for a given good may differ by importing firm, but the duty rate does not. Importer m's expected per-unit cost of sourcing good j from country c can be written:

$$\bar{p}^m_{c,j,t} = \mathbb{E}\left[\tau_{c,j,t} p^m_{c,j,t}\right] \exp\left\{\zeta_{C,j} \mathbb{1}\left\{c^m_{j,t} \neq c^m_{j,t-1}\right\}\right\}. \tag{15}$$

Importer m pays the expected duty-inclusive price of input j at time t and also pays a per-unit adjustment cost of ζ_C, j when it sources product j from a country it did not source from at time $t-1$ (i.e, when $c^m_{j,t} \neq c^m_{j,t-1}$).

Importer m requires a bundle of inputs j to produce unique final good variety m, and $C_t = \{c_{j,t}\}^J_{j=1}$ is the vector of supplier choices for each of those inputs made by importer m at time t. The cost of the input bundle for the final good m, based on expected input prices, is:

$$c_m\left(C^m_t\right) = w^\alpha \left(\prod_{j=1}^J \left[\bar{p}^m_{c,j,t}\right]^{\gamma_j}\right)^{1-\alpha}. \tag{16}$$

The productivity of firm m depends on both the firm's productivity draw φ_m and the input-specific quality parameter λ for each of its suppliers, combined to yield $\Phi_m\left(C^m_t\right) = \varphi_m \Pi^J_{j=1} \lambda_{c,j,t}$. The marginal cost of production for importer m can be written as:

$$MC\left(C^m_t\right) = \frac{1}{\Phi_m\left(X^m_t\right)} c_m\left(X^m_t\right) \tag{17}$$

and profits as:

$$\pi^m_t = \max_{p_m, X^m_t} p_m Q_m - MC\left(X^m_t\right) Q_m \tag{18}$$

The importer must choose the country of origin for each input j and optimal price for final good m. Consumer preferences (CES) provide the profit-maximizing final good pricing:

$$p_m = \frac{\sigma}{\sigma - 1} MC\left(X^m_t\right). \tag{19}$$

Plugging in this expression for optimal price p_m and marginal cost $MC\left(X^m_t\right)$ yields:

$$\pi^m_t = \max_{X^m_t} \frac{1}{\sigma} B \left(\frac{\sigma}{\sigma - 1}\right)^{1-\sigma} \left[\Phi_m\left(X^m_t\right)\right]^{\sigma-1} c_m\left(X^m_t\right)^{1-\sigma} \tag{20}$$

Taking logs demonstrates that expected profit is separable by each input j:

$$\ln \pi_t^m = A^m + \ln \pi_{j,t}^m + \sum_{k \neq j} \ln \pi_{k,t}^m, \tag{21}$$

where

$$\ln \pi_{j,t}^m = \max_{x_t^m} v(\sigma - 1) \ln \lambda_{x,j,t} + \omega_j \left(\mathbb{E}\left[\ln \tau_{x,j,t} p_{x,j,t}^m\right] + \zeta_{X,j} \mathbb{1}\left\{x_{j,t}^m \neq x_{j,t-1}^m\right\}\right). \tag{22}$$

This separability allows me to solve the profit-maximizing source selection problem separately for each input j, so I drop the j subscripts. For each input j, the importer selects the source country x associated with the highest expected profits. Define $\bar{\pi}_t^m \left(x_t^m, \boldsymbol{\beta}\right)$ as follows:

$$\bar{\pi}_t^m \left(x_t^m, \boldsymbol{\beta}\right) = \xi \ln \lambda_{x,t} + \beta_P \mathbb{E}\left[\ln \tau_{x,t} p_{x,t}^m\right] - \beta_X \mathbb{1}\left\{x_t^m \neq x_{t-1}^m\right\}, \tag{23}$$

where

$$\xi = v(\sigma - 1), \beta_P = -(1 - \alpha)(\sigma - 1)\gamma, \beta_X = (1 - \alpha)(\sigma - 1)\gamma\zeta_X. \tag{24}$$

I want to estimate the vector of unknown parameters $\boldsymbol{\beta} = \{\beta_P, \beta_X, \xi\}$, where β_P represents the responsiveness of the importing firm to changes in price and ξ to changes in quality and β_X is the per-unit switching cost. I estimate these parameters product by product and separately for firms importing with and without brokers.

A.5 Solving the importer's problem

A.5.1 Value function

The importer's expected profit maximization problem can be expressed as a value function. Importer m knows the value of state variables c_{t-1}, the country used as m's source for a given input in the prior period, $\mathbf{p_{t-1}}$, the vector of all duty-inclusive prices for that input in time $t-1$, and $\varepsilon_{c,t}^m$, the structural shock (unobserved by the econometrician) to profit. The values of parameters β are also known to the importer at the time of its sourcing decision. Given this information, the importer chooses source country c_t^m at the beginning of period t. At the end of period t, after sourcing choices are made for all inputs, $\mathbf{p_t}$ and $\varepsilon_{c,t+1}^m$ are realized.

The solution to the importer's problem is the choice of source country c, chosen to maximize the present discounted stream of expected profits. This problem can be represented by the value function:

$$V\left(c_{t-1},\mathbf{p_{t-1}},\boldsymbol{\epsilon}_t\right)=\max_{\{c_t,c_{t+1},\dots\}}\mathbb{E}\left[\sum_{\tau=t}^{\infty}\delta^{\tau-t}\left(\bar{\pi}_\tau\left(x_\tau,\mathbf{p}_{\tau-\mathbf{1}},c_{\tau-1},\boldsymbol{\beta}\right)+\varepsilon_{c,\tau}\right)\right]. \tag{25}$$

The value function $V\left(c_{t-1},\mathbf{p_{t-1}},\boldsymbol{\epsilon}_t\right)$ can be rewritten recursively as a Bellman equation to break the dynamic optimization problem down into a sequence of single-period decisions:

$$V\left(c,\mathbf{p},\boldsymbol{\epsilon}'\right)=\max_{c'}\bar{\pi}\left(c',\mathbf{p},c,\boldsymbol{\beta}\right)+\varepsilon'\left(c'\right)+\delta EV\left(c',\mathbf{p},c,\boldsymbol{\epsilon}'\right)\,and \tag{26}$$

$$EV\left(x',\mathbf{p},x,\boldsymbol{\epsilon}'\right)=\int_{\mathbf{p}'}\int_{\boldsymbol{\epsilon}''}V\left(x',\mathbf{p}',\boldsymbol{\epsilon}''\right)h\left(\mathbf{p}',\boldsymbol{\epsilon}''\mid\mathbf{p},x,x',\boldsymbol{\epsilon}'\right)d\mathbf{p}'d\boldsymbol{\epsilon}'', \tag{27}$$

where $\mathbf{p_t}$ and ε_{t+1} are jointly distributed according to $h(\mathbf{p_t},\varepsilon_t)$.

A.5.2 Distributional assumptions

Conditional independence The joint density of $\{p_{c,t},\varepsilon_{c,t+1}\}$, can be written:

$$\Pr[p_t,\varepsilon_{t+1}|\mathbf{p_{t-1}},\varepsilon_t,c_{t-1}]=\Pr[\varepsilon_{t+1}|p_t]\Pr[p_t|p_{t-1},c_{t-1}].$$

Conditional independence is a common assumption in the discrete choice literature.

IID error terms The εs are distributed i.i.d. (across choices and periods) according to the type I extreme value distribution.

$$\Pr\left(\varepsilon_{t+1}\mid p_t\right)=\Pr\left(\varepsilon_{t+1}\right).$$

A.6 Likelihood

Appendix B Preparing the Data for Model Estimation

Two primary concerns arise when I consider the sample for structural estimation of the discrete choice model. First, the selection of products must be suitable for estimation; the products must constitute a large enough share of the import market to be representative, the selection must be small enough in number to make estimation feasible given computational limits, and it must provide enough (broker and nonbroker) observations for model convergence. Second, estimation of parameters that differ for broker and nonbroker "draws" requires consideration of the firms included in the sample.

B.1 HS8 selection

B.2 Firm matching

I estimate propensity scores for assignment to customs broker usage based on observable firm characteristics that influence the likelihood of employing the services of a customs broker. For firm m at time t, these characteristics include the total imports (logtotval_{mt}), imports of product j ($\ln(v_{mtj})$), and employment ($\ln(Employment_{mt})$). The propensity score estimation facilitates the construction of a new matched dataset, representing approximately X% of the total import value. The propensity score model is specified as:

$$\log\left(\frac{P(\text{broker} = 1|\mathbf{X}_{mt})}{1 - P(\text{broker} = 1|\mathbf{X}_{mt})}\right) = \beta_0 + \beta_1 \cdot \text{logtotval}_{mt} + \beta_2 \cdot \text{logval}_{mtj} + \beta_3 \cdot \text{logemp}_{mt}, \tag{28}$$

where $\mathbf{X}_{mt}$ denotes the covariates specific to firm m at time t and $\beta_0, \beta_1, \beta_2, \beta_3$ are the parameters to be estimated.

Kernel-based matching is then applied, using the estimated propensity scores to retain in the sample those firms with nonzero match weights, while firms with a match weight of zero are excluded. This approach to sample selection ensures that the structural estimation is restricted to firms with comparable observed characteristics within the region of common support, thus enhancing the credibility of my causal inferences.

Following the selection of HS8 products and firms with comparable observed characteristics, the estimation sample comprises approximate X% of total import value.

Appendix C Empirical results pending U.S. Census Bureau disclosure

C.1 Dynamics of broker use

Table A1: 3×3 Transition Matrix for Import Behavior

	State at $t+1$		
State at t	Import with broker	Import without broker	Do not import
Import with broker	p_{11}	p_{12}	p_{13}
Import without broker	p_{21}	p_{22}	p_{23}
Do not import	p_{31}	p_{32}	p_{33}

To examine the dynamics of import behavior, I calculate firms' probabilities of transitioning between three distinct states: 1) importing with the aid of a broker, 2) importing independently without a broker, and 3) not importing or exiting. The matrix is structured such that each element p_{ij} delineates the probability of transitioning from state i at time t to state j at time $t+1$.

The diagonal elements (p_{11}, p_{22}, p_{33}) represent the probabilities of remaining in the same state across two consecutive periods, signifying the persistence of behavior. Off-diagonal elements reflect the likelihood of changing states, providing insights into firms' probability of moving between import modalities.

Interpretation of the transition probabilities offers a wealth of understanding regarding the stability of import behaviors. For instance, a high p_{11} suggests a strong propensity for firms to continue importing with a broker, potentially indicating persistence in the importer–broker relationship or ongoing complexities in import procedures that necessitate expert assistance. Conversely, a high p_{22} may imply a degree of confidence or established efficiency in handling imports without support from a customs broker. The high probabilities of transitions to "Do not import" (p_{13}, p_{23}) indicate high probabilities of exiting the import market, which implies either a switch to sourcing domestically or ceasing operations entirely.

Then, limiting the sample to only "continuers," or firms that continue importing a given product, I also calculate a 2×2 transition matrix:

$$\begin{bmatrix} p^c_{11} & p^c_{12} \\ p^c_{21} & p^c_{22} \end{bmatrix}$$

where p^c_{11} and p^c_{22} denote firms' probabilities of remaining in the same state and p^c_{12} and p^c_{21} represent their probabilities of switching between states. The analysis of this matrix offers insights into the consistency of each state and the propensity of firms to modify their importing practices. For instance, a larger p^c_{11} relative to p^c_{21} suggests that firms tend to continue employing brokers once they have initiated this practice, implying a sustained benefit from broker mediation. In contrast, a higher p^c_{22} may indicate that firms not using brokers see little reason to alter their approach to importing.

To further understand the persistence of broker use, I estimate an autoregressive model of the form:

$$\begin{aligned} \mathbb{1}\left\{\text{Broker}^m_{cjt}\right\} = \beta_0 + \beta_1 \mathbb{1}\left\{Broker^m_{cjt-1}\right\} + \beta_2 \mathbb{1}\left\{\text{Broker}^m_{c,j,t-2}\right\} \\ + \beta_3 \mathbb{1}\left\{Broker^m_{c,j,t-3}\right\} + \gamma_m + \gamma_j + \gamma_t + \gamma_c + \varepsilon^m_{cjt} \end{aligned} \tag{29}$$

I estimate the coefficients in Equation 29 to understand the relationship between lagged broker indicators, fixed effects, and the likelihood of current broker use. β_0, represents the baseline expectation of $\mathbb{1}\left\{\text{Broker}^m_{cjt}\right\}$. β_1, β_2, and β_3 capture the effects of prior broker use on current broker use, while controlling for other factors. A positive coefficient indicates that using a broker in prior years is associated with a higher likelihood of using a broker in the current year, holding all else constant. Conversely, a negative coefficient suggests a decrease in likelihood of broker use with past broker use.

From this point, I focus not on the choice of broker usage or the transition to and from broker usage. Instead, I consider the use of a broker in time $t-1$ as a characteristic of the firm-product pair and limit my focus to the impact of this characteristic on outcomes.

C.2 Empirical Application: U.S.–China Trade War

I use a dynamic difference-in-differences (DiD) methodology to estimate the effects of trade war tariffs on trade values. I limit this portion of the analysis to HS codes corresponding to goods classified as advanced technology products (ATPs), a category defined by the U.S. Census Bureau (source). By restricting the sample to these high-technology categories, I focus on a product category that was particularly affected by the U.S.–China trade war.

C.2.1 Construction of tariff treatment

I consider the environment of the trade war between the U.S. and China from 2018 to 2019 to test the implications of customs broker use for importers sourcing from China. In Figure A1, I show the rates imposed on products from China.

Following an investigation under Section 301 of the U.S. Trade Act of 1974 , tariffs were imposed on many Chinese imports. Targetted products were primarily those These tariffs were primarily at the 10% and 25% levels, generally starting at the lower rate then increasing in future tranches, as shown in Figure A2.

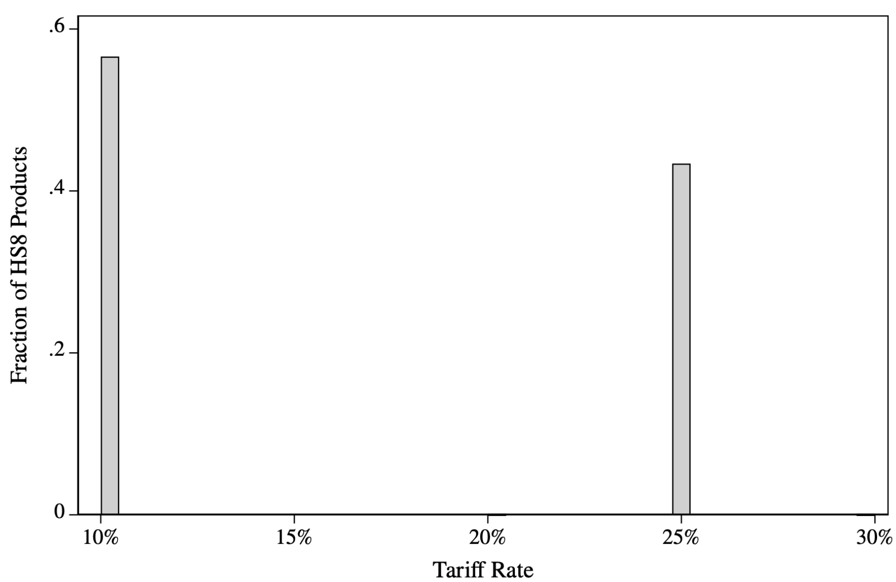


Figure A1: Values of Imposed Tariffs During 2018–2019

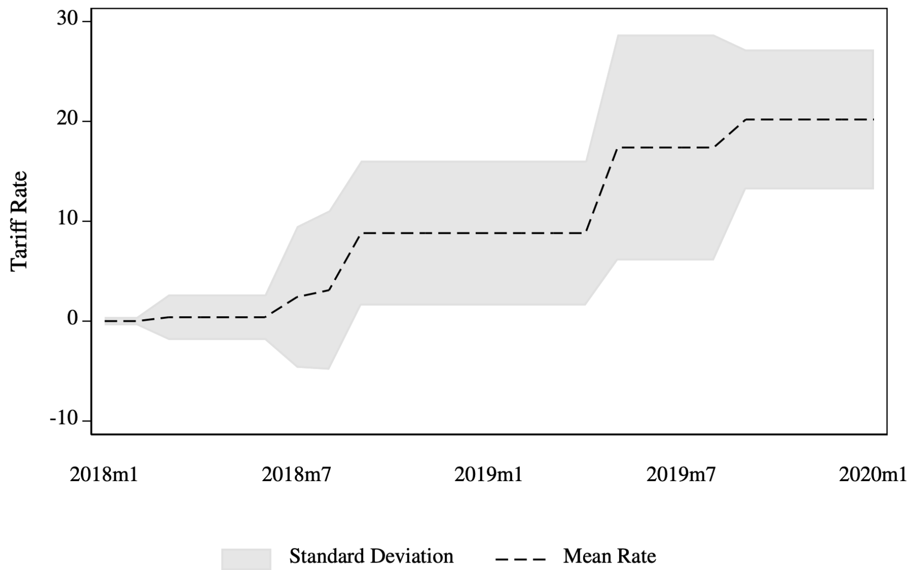


Figure A2: Trade War Tariffs Over Time

Tariffs were imposed on product categories of strategic importance to both the U.S. and China. In his testimony to the U.S. Senate Finance Committee, former United States Trade Representative Robert Lighthizer explained that these tariffs specifically targeted products benefiting from Chinese industrial policies, notably those under the "Made in China 2025" initiative, a key component of China's national industrial strategy (Levine, 2020). The selected products predominantly belonged to high-tech and advanced industries, areas deemed critical for the U.S. economy and national security. Lighthizer stated that the process to identify these products involved a collaborative effort by economic analysts, utilizing an algorithm to pinpoint sectors where China sought global dominance and which posed potential risks to U.S. economic and technological leadership. He also testified that this approach was refined to minimize potential negative impacts on the U.S. economy and consumers.

Tariffs were placed on product categories of strategic importance to both the U.S. and China. In testimony to U.S. Senate Finance Committee, former United States Trade Representative Robert Lighthizer stated that these measures were designed to target specific products benefiting from Chinese industrial policies, including those covered in "Made in China 2025," China's national strategic plan for industrial policy . These products were heavily concentrated in high-tech and advanced industries, sectors the administration viewed as both a threat to the U.S. economy and national security.

C.2.2 Difference-in-differences estimation

Treatment Let $D^m_{j,t}$ be the treatment for firm m importing product j from country c at time t. For all firm-product units, $D^m_{j,t} \geq 0$. Let $\mathbf{D}^m_j = (D^m_{j,1}, ..., D^m_{j,T})$, a vector stacking mj's treatments from period one to T. Then let $\mathbf{D}$, the study's "design", be a vector stacking treatments of all units over all periods such that $\mathbf{D} = (\mathbf{D}^m_j, ..., \mathbf{D}^M_J)$. Denote the set of values $\mathbf{D}^m_j$ can take as $\mathcal{D}$.

Potential Outcomes

Study Design In the context of the U.S.–China trade war, I use a staggered design with unit- and time-specific treatment intensities. That is, firm-product units begin treatment at different time periods, and the level of their treatment may vary over time and across units. $D^m_{j,t}$ measures the increase in tariff rate during the U.S.–China trade war for a given firm-product, and $\mathcal{D} = \{0, 0.1, 0.2, 0.25, 0.3\}$, the different rates imposed during the trade war.

$$D^m_{j,t} = I^m_{j,t} \times \mathbb{1}\{t \geq F^m_j\}, F^m_j \geq 2 \tag{30}$$

where $I^m_{j,t}$ is the intensity of the treatment for firm m importing product j at time t, and F^m_j is the first time period that the firm-product faces a tariff.

Estimates Separate dynamic DiD estimations are conducted for firms that utilize customs brokers (`broker == 1`) and for those that do not (`broker == 0`).

Figure A3: Event Study Plot Placeholder

C.3 Quality Estimation

Table A2: Summary Statistics for Quality Estimation

	Mean	Std Dev
OLS Price Coefficient	—-	—-
IV Price Coefficient	—-	—-
Own-Price Elasticity	—-	—-
Overidentifying Restriction Test, p-Value	—-	—-
1st Stage f-Statistic p-Value, Price	—-	—-
1st Stage f-Statistic p-Value, Nest Share	—-	—-
Conditional Market Share Coefficient	—-	—-
R^2	—-	—-
Observations per Estimation	—-	—-
Estimations with Statistically Significant ^{a} Price Coefficient	—-	—-
Observations with Statistically Significant ^{a} Price Coefficient	—-	
Total Estimations	—-	
Total Observations	—-	

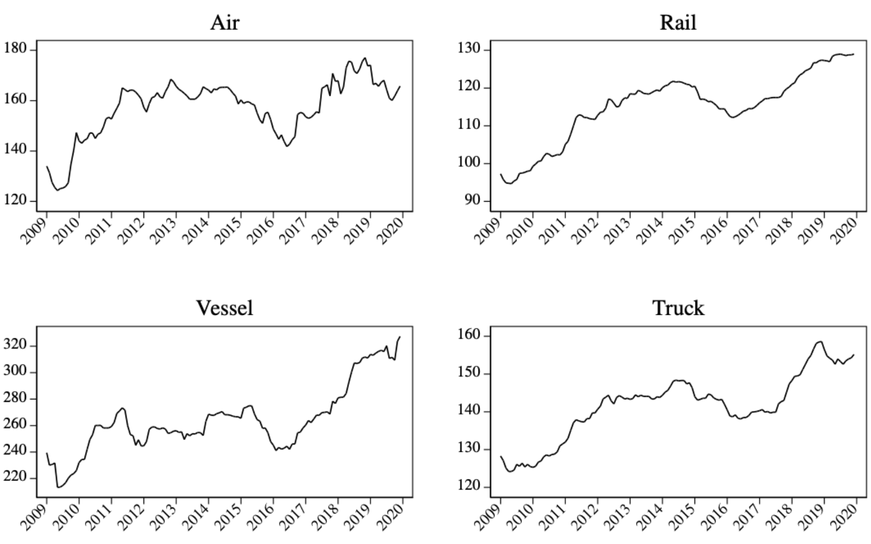
Appendix D Oil prices and international freight

Oil prices experienced a steep decline from 2014 to 2016, reaching a ten year low in early 2016 (Grigoli et al., 2019; Baumeister and Kilian, 2016). This directly affected the prices of fuel types primarily used in freight transport (diesel fuel for truck and rail, heavy fuel oils or "bunker fuel" for cargo vessels, and jet fuel for air freight), indirectly affecting freight transport prices. Figure A6 shows freight industry producer price indexes which follow a similar pattern to oil and fuel prices.

Figure A4: Global Oil Prices

Source: Bureau of Labor Statistics Producer Price Indexes

Figure A5: Producer Price Indexes for Primary Fuel Types for International Freight Transport



Source: Bureau of Labor Statistics Producer Price Indexes

Figure A6: Producer Price Indexes for Major Freight Modes

Table A3: Correlation Matrix

Variable	Broker Share	Heavy Fuel Oils	Jet Fuel	Diesel Fuel
Broker Share	1.0000			
Heavy Fuel Oils	−0.5035	1.0000		
Jet Fuel	−0.4912	0.9817	1.0000	
Diesel Fuel	−0.5073	0.9704	0.9888	1.0000

Table A3 shows that the monthly share of import value facilitated by brokers is highly correlated with fuel prices. This suggests that broker pricing follows shipping and freight pricing and that importers' demand for these services is decreasing in price.

Appendix E Broker NAICS Codes

The following descriptions of NAICS categories in which brokers might be employed are taken from the 2017 North American Industry Classification System (NAICS) Manual (United States Office of Management and Budget, 2017)

NAICS 488510

> This industry comprises establishments primarily engaged in arranging transportation of freight between shippers and carriers. These establishments are usually known as freight forwarders, marine shipping agents, or customs brokers and offer a combination of services spanning transportation modes.

NAICS 541614

> This U.S. industry comprises establishments primarily engaged in providing operating advice and assistance to businesses and other organizations in: (1) manufacturing operations improvement; (2) productivity improvement; (3) production planning and control; (4) quality assurance and quality control; (5) inventory management; (6) distribution networks; (7) warehouse use, operations, and utilization; (8) transportation and shipment of goods and materials; and (9) materials management and handling.
>
> Illustrative Examples:
>
> - Freight rate or tariff rate consulting services

- Productivity improvement consulting services
- Inventory planning and control management consulting services
- Transportation management consulting services
- Manufacturing management consulting services

NAICS 492110

Industries in the Couriers and Messengers subsector provide intercity, local, and/or international delivery of parcels and documents (including express delivery services) without operating under a universal service obligation. These articles may originate in the U.S. but be delivered to another country and can be described as those that may be handled by one person without using special equipment. This allows the collection, pick-up, and delivery operations to be done with limited labor costs and minimal equipment. Sorting and transportation activities, where necessary, are generally mechanized. The restriction to small parcels partly distinguishes these establishments from those in the transportation industries. The complete network of courier services establishments also distinguishes these transportation services from local messenger and delivery establishments in this subsector. This includes the establishments that perform intercity transportation as well as establishments that, under contract to them, perform local pick-up and delivery. Messengers, which usually deliver within a metropolitan or single urban area, may use bicycle, foot, car, small truck, or van.

Appendix F Advanced Technology Product Definitions

In the empirical analysis, the term $\mathbb{1}\{\text{HITECH}_j\}$ is assigned a value of one if the product falls into any of the following categories.

Table A4: Advanced Technology Product (ATP) Code Descriptions

Code	**Definition**
(01)	Biotechnology: Focuses on medical and industrial applications of advanced scientific discoveries in genetics to the creation of new drugs, hormones, and other therapeutic items for both agricultural and human use.
(02)	Life Science: Concentrates on the application of scientific advances (other than biological) to medical science. Recent advances, such as nuclear resonance imaging, echocardiography, and novel chemistry, coupled with new production techniques for the manufacture of drugs have led to many new products for the control or eradication of disease.
(03)	Opto-Electronics: Encompasses electronic products and components that involve the emitting and/or detection of light. Examples of products included are optical scanners, optical disc players, solar cells, photo-sensitive semiconductors, and laser printers.
(04)	Information & Communications: Focuses on products that are able to process increased volumes of information in shorter periods of time. Includes central processing units, all computers and some peripheral units such as disk drive units and control units, along with modems, facsimile machines and telephonic switching apparatus. Examples of other products included are radar apparatus and communication satellites.
(05)	Electronics: Concentrates on recent design advances in electronic components (with the exception of opto-electronic components) that result in improved performance and capacity and in many cases reduced size. Products included are integrated circuits, multi-layer printed circuit boards and surface-mounted components such as capacitors and resistors.
(06)	Flexible Manufacturing: Encompasses advances in robotics, numerically-controlled machine tools, and similar products involving industrial automation that allow for greater flexibility to the manufacturing process and reduce the amount of human intervention. Includes robots, numerically controlled machine tools and semiconductor production and assembly machines.
(07)	Advanced Materials: Encompasses recent advances in the development of materials that allow for further development and application of other advanced technologies. Examples are semiconductor materials, optical fiber cable and video discs.
(08)	Aerospace: Encompasses most new military and civil helicopters, airplanes and spacecraft (with the exception of communications satellites that are included under Information & Communications Technology). Other products included are turbojet aircraft engines, flight simulators and automatic pilots.
(09)	Weapons: Primarily encompasses products with military application. Includes such products as guided missiles and parts, bombs, torpedoes, mines, missiles, rocket launchers and some firearms.
(10)	Nuclear Technology: Encompasses nuclear power production apparatus. Includes nuclear reactors and parts, isotopic separation equipment and fuel cartridges. Excludes nuclear medical apparatus, which is included under Life Science.

Appendix G Importer of Record Number

All parties serving as an Importer of Record must submit Form 5106 to U.S. Customs and Border Protection. This form, or its electronic equivalent, creates the Importer of Record Number that appears in the LFTTD. Valid types of importer of record numbers are an Internal Revenue Service (IRS) Employer Identification Number (EIN), Social Security Number (SSN), or CBP-Assigned Importer Number (CAIN) U.S. CBP (2022). Valid formats for these numbers are as follows:

Importer of Record Number	Valid Format
IRS Number	`NN-NNNNNNNXX`
Social Security Number	`NNN-NN-NNNN`
Customs Assigned Number	`YYDDPP-NNNNN`

Note: In these codes, N = number and X = alphanumeric, YY = the last two digits of the calendar year when the number is assigned, and DDPP = the district/port code where the number is assigned. If the importer number is in EIN format, the last two-position suffix (XX) cannot be the letters O, I and/or Z.

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