Transsshipment Hubs, Trade, and Supply Chains*

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September 2024

Abstract

Transportation in international trade often involves transshipment by entrepôt hubs as part of the global hub-and-spoke shipping network. We investigate the returns from being a hub country—the impact of global transshipment activity by these hubs on their own international trade flows and supply chains over a 10-year period. We establish that the majority of US imports–especially those from smaller origin countries—are transshipped via a select few hub countries, and transshipment activity is positively correlated with the hub country's total trade, particularly through its exports. We then unpack how transshipment activity contributes to exports. Exploiting the indirect nature of trade, we find that transshipment activity increases the hub country's imports from the origin country and its exports of downstream goods. This novel trade channel from transshipment activity highlights the important link between global value chains and transportation, and a potential venue for developing countries to further participate in global value chains.

Keywords: trade costs, scale, hubs, transport costs, transportation networks, international trade, shipping

JEL Classification: F10, F13, F14

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1 Introduction

Do countries grow by becoming hubs for international trade? The economic rise of East Asian entrepôts, Hellenic Alexandria, Central Asian empires along the Silk Road, and even New York City are all associated with their emergence as trading hubs which engage in commercial activities facilitating global trade (Seyrig, 1950; Glaeser, 2005; Bernstein, 2009; Blaydes and Paik, 2021; Ahmad and Chicoine, 2021). Among the various potential mechanisms behind this link, serving as a trade hub could foster growth by promoting financial development, expanding logistics-related services, or enhancing import penetration by increasing market access.

In this paper, we revisit the hypothesized historical connection between hubs and development by examining a modern aspect of trade-related commercial activities, the transshipment of containerized trade. Transshipment is defined as the routing of a shipment from its origin through an intermediate country prior to its ultimate destination (Census Bureau). In practice, containers are unloaded at hubs after being transported from their origins, then reloaded onto different containerships bound for their final destination. With no direct impact on national accounts, these shipments ostensibly have little impact on welfare (Arkolakis, Costinot and Rodríguez-Clare, 2012). While governments investing in and competing to capture transshipment activity argue that it fosters development through access to intermediate inputs and global supply chains (Government of Malta, 2019; Government of Jamaica, 2022), the recent backlash against globalization and the trend of reshoring supply chains have raised doubts on continued relevance of this connection (Alfaro and Chor, 2023; Goldberg, 2023).

Using a decade of bills of lading for containerized US imports, we establish that the majority of US imports are transshipped–especially those from smaller origin countries—and that transshipment is concentrated among a select number of hub countries. Additionally, we find these hubs tend to trade more themselves as their transshipment activities increase. This relationship is driven by large effects at the bilateral-product level: increases in transshipment volumes through a country increase the volumes of imports of that product from the exporter by 10% over 10 years. However, we do not find evidence that transshipment affect market-access in general: increased transshipment volumes in one product category do not increase the likelihood of importing in other product categories. These results are consistent with a model of trade where fixed costs in shipping generate economies of scope in export: if a firm is selling *through* Singapore, it might as well sell *to* it. Further, increased transshipment of a given product is associated with greater exports in downstream industries, suggesting that transshipment can affect comparative advantage through access to intermediate inputs.

Our paper makes three contributions. First, we establish three stylized facts on transshipment trends in the modern container shipping network over a 10-year period. By compiling the universe of bills of lading for all containerized US imports from 2008 to 2017, we observe shipments' volume (number of twenty-foot equivalent containers; TEUs), Harmonized System (HS) product information,[1] origin, transshipment country, and US destination. Transshipment is omitted from international trade statistics, as such do not contribute to imports or exports at these intermediate ports. Our first stylized fact demonstrates that the majority, 70%, of US imports are transshipped via an intermediate country and this share is relatively stable over the past ten years. Smaller US trading partners consistently tend to transship more relative to larger countries. Our second stylized fact highlights that transshipment activity is persistently concentrated in a small number of countries over the past ten years, where the top five hubs account for more than half of total transshipment activity and the top ten account for more than 70%. By merging this bills of lading data with product-level international trade data between the origin country and these intermediate ports, we establish our third stylized fact: transshipment activity is correlated with positive increases in the hub country's total trade between 2008 and 2017 and this link is relatively is primarily through exports.

To motivate our findings, we present a three country model of trade where transshipment generates market access. In the model, exporters simultaneously decide on export destinations and shipping arrangements for their products. They key mechanism is a fixed shipping cost, which links export decisions across destinations through the shipping decision (Dickstein and Morales, 2018). Because fixed shipping costs must only be paid once, entrepôt usage and export to that country are complementary behaviors. While some exporters would not export to a destination on its own, transshipping through the country induces exports to it. This mechanism posits that transshipment generates market access at the firm and product level, as opposed to country level. Increased transshipment may not lead to more trade in general, but more trade in the products being transshipped in particular. As in Goldberg et al. (2010), access to transshipped intermediates reduces

[1] Codes are at the six digit US Harmonized Tariff Schedule level, which we convert to the HS system.

production costs and generates exports at hubs.

Our second contribution is to estimate the impact of transshipment volumes of US imports on bilateral trade. By adopting the instrument of Ganapati, Wong and Ziv (2021) to a dynamic setting, we generate a variant of a shift share instrument using transshipment behavior in other industries and industry-specific demand shocks measured as changes in US demand (leaving out the origin). Using our instrument we find a 10% elasticity of trade to transshipment: increasing transshipment volumes by 10% increases bilateral trade in that product category by 3% over 3 years and 4% over 9 years, though we find no contemporaneous effect. Constructing a "placebo," we examine the effects of transshipment more broadly by measuring the effect on imports of transshipment in *other* product categories. Here, we find no effects, implying the stylized relationship between trade and transshipment (most directly) occurs within specific product categories.

Our third contribution is to assess the dynamic effects and supply chain implications of transshipment. We explore the potential for dynamic effect using the inter-temporal specification of Jordà (2005).[2] The effect is most pronounced after three years, implying some time passes before the additional trade develops with the transshipment country. Moreover, we find no contemporaneous effect. This timing corroborates our instrumental variable results which imply reverse causation is not a large part of our story.

Finally, we find evidence that transshipment has supply chain implications. Greater transshipment leads to greater export, but only in product categories which are downstream of the transshipped product category. Regressing transshipment in industry k on exports from the transshipment country in industry l interacted with the share of industry l's inputs coming from industry k, we find a positive coefficient only on the interaction term. This suggests that transshipment can influence the comparative advantage of countries by increasing access to the intermediate inputs required for production in those industries.

Our paper is related to several strands of literature at the intersection of international trade, transportation, and growth. We investigate how transshipment activities through hub countries impact their international trade flows and supply chains over time. By compiling 10 years of transshipment data for containerized US imports matched to product-level international trade data and developing a shift-share instrument based on aggregate US demand, we study both the static and dynamic effects of transshipment on

[2] See a similar application in Boehm, Levchenko and Pandalai-Nayar (2023).

international trade over the short-, medium-, and long-runs.

Seaborne international trade statistics typically exclude transshipment cargoes, which makes it challenging to study effects of transshipment activity via the hub country on its own economic outcomes (Jones et al., 2020; Andriamananjara, Arce and Ferrantino, 2004; Talley and Riggs, 2018). The papers within this literature have either focused on specific ports where data is available or imputed estimates of transshipment. Feenstra and Hanson (2004) shows that more than half of Chinese exports were re-exported via Hong Kong from 1988-1998, and Hong Kong traders shift income to Hong Kong from high-tax destination countries via transfer pricing. Xu and Itoh (2018) finds positive impacts of increased container traffic flows to and through the port of Busan, South Korea, on its economic activity. At the more aggregate-level and using limited UN COMTRADE data on re-exports—distinct from transshipment—Andriamananjara, Arce and Ferrantino (2004) imputes that the re-exports share of global exports was about 5% in the 1980s and has increased more than three-fold by 2004 (about 17%). We contribute to this literature by putting together 10 years of detailed transshipment data for US imports, allowing our paper to establish stylized facts on the level of transshipment shares for US imports, the intermediate hub countries globally that is facilitating this transshipment, the link between trade and transshipment for these hub countries, and show how trade statistics under-count transportation usage (Ganapati and Wong, 2023). We also identify a novel channel for how transshipment activity impact the hub countries' own trade flows and supply chains.[3]

We are also related to the literature on trade and transportation, specifically within the context of hub countries.[4] Recent literature tend to focus on the network effects of transportation and their implications for international trade (Brancaccio, Kalouptsidi and Papageorgiou, 2020; Heiland et al., 2019; Wong, 2018; Coşar and Demir, 2018; Bernhofen, El-Sahli and Kneller, 2016; Rua, 2014). The container shipping network is a hub-and-spoke network, driven by the presence of scale economies (Ganapati, Wong and Ziv, 2021). We highlight how the network effects of transportation have evolved over the past 10 years, and highlight a novel mechanism on how this network can directly impact hubs within it.[5]

[3]Focusing on semiconductors, Jones et al. (2020) also find that re-export volumes are higher in sectors with strong global value chain presence.

[4]We do not explicitly explore non-transportation reasons for the rise of hub countries. For example, Fisman, Moustakerski and Wei (2008) studies how entrepôts can facilitate tariff evasion.

[5]Flaaen et al. (2021) use bills of lading data to examine the effects of COVID-19 on supply chains,

Third, we help bridge the research on market access to the work done on trade and growth. It is well established that locations that are geographically advantageous for commerce and trade tend to grow (Barjamovic et al., 2019; Bleakley and Lin, 2012). Increased access to international trade, via changes in the transport network or technology, has positive and significant impacts on income (Feyrer, 2021, 2019). Specifically, the introduction of containerization has also induced population growth near containerized ports due to increased market access (Brooks, Gendron-Carrier and Rua, 2021), although these gains can be offset by local costs of port development (Ducruet et al., 2020). We highlight a different mechanism for market access to trade, which is transshipment activity. We find that greater transshipment lead to greater export in the specific product categories corresponding to the transshipment, as well as exports of goods that use those specific products as inputs.

The remainder of the paper proceeds as follows. Section 2 provides an overview of the datasets utilized to conduct our analysis, and establishes three stylized facts that describes the patterns of transshipment activity for US imports over the past decade as well as the link between transshipment activity and trade for these hubs. In Section 3, we present our theoretical model of trade and transshipment. Section 4 discusses our instrumental strategy, empirical designs, and findings, while Section 5 concludes.

2 Data and Stylized Facts

In this section, we first describe the datasets we employ to conduct our analysis and establish three stylized facts that describes the transshipment activity for US imports, the hub countries responsible for these transshipment activities, how these patterns have evolved over the past 10 years and the relationship between transshipment activities and trade for these hubs.

2.1 Data

Bills of Lading The data we use is the US Customs bills of lading data for all containerized imports into the US from 2008-2017.[6] For each shipment, we observe three main locations. First, we observe the origin country of the shipment. Second, we observe the port of lading where the shipment is loaded onto a containership bound for the US—

but do not consider transshipment.

[6]Sourced through Panjiva (Now operating as a division of S&P Global). Similar data is used by (Flaaen et al., 2021) to study supply chain disruptions.

which can be the same country as the origin or a different country entirely. Third, we see the US destination port where the shipment is unloaded. If the transshipment country is different from the origin country, we define this shipment as being transshipped. We acknowledge that the term transshipment can be applied for changes in transport modes when the origin and transshipment ports are in the same country.[7] For example, a container shipment from the interiors of China to the US is mostly likely transported by rail or truck to its ports, placed onto a containership there and then shipped to the US. In this paper, we would not count this as a transshipment. In this sense, our transshipment activity measure is an under-estimate. Additionally, we observe the shipment's container volume (TEUs) and HS product information for the primary good at the 6-digit level. Over this 10 year period, we see US imports from 224 origin countries which are loaded onto US-bound containerships in 123 intermediate hub countries.

International Trade Flows In order to establish the link between transshipment activities and trade for these hubs, we match the origin and transshipment countries in our bills of lading data to their international trade flows data from CEPII BACI (Gaulier and Zignago, 2010). Since we observe HS6 product-level details in the bills of lading data, we can use this information to match both data sets for trade between the origin country and transshipment country.

World Input-Output Tables (WIOT) We use input-output tables from the World Input-Output Database (WIOD) 2013 Release to calculate the share of intermediate inputs for each sector (Timmer et al., 2015). This allows us to study the link between transshipment and trade along the supply chain. Since trade flows and transshipment activities are recorded at the HS 6-digit level while input-output data consist of 2-digit sectors according to the International Standard Industrial Classification of All Economic Revision 3 (ISIC Rev. 3), we map HS-6 commodities to ISIC Rev. 3 sectors using the World Integrated Trade Solution (WITS) concordance table.

2.2 Stylized Facts

We now present three stylized facts showing how transshipment activity has evolved over this 10-year period. As mentioned previously, we define a containerized shipment as being transshipped if the intermediate hub country (port of lading), the country where

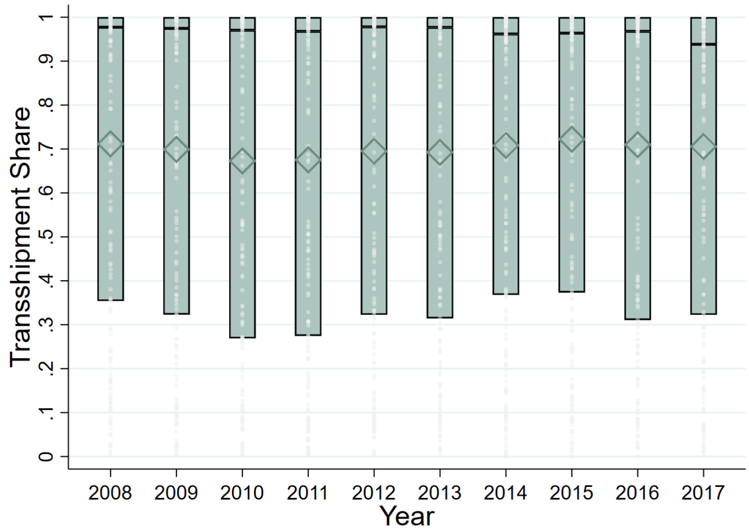
[7] See, for instance, Fuchs and Wong (2022) which studies the US multimodal transport network where goods are transshipped between different transport modes

the shipment is loaded onto a containership bound for its final US destination, is different from the origin country. This is an under-estimate of the overall amount of transshipment because of two reasons: (1) we do not observe the shipment's journeys before it gets to the origin port and after it leaves the destination port and it could be transshipped further during both journeys, and (2) we do not observe the shipment's journey between the origin and the intermediate countries and it could be transshipped further during that journey as well.

Share of US transshipped imports We first calculate the share of exports to the United States that was transshipped from 2008 to 2017 for each country in our data. Around a third of the 224 origin countries transship all of their exports to the US. These include landlocked countries like Switzerland, Austria, and Bolivia, as well as smaller countries like Brunei, Papua New Guinea and Ethiopia. Figure 1 shows distribution of transshipment shares over the past ten years. The median transshipment share is very high throughout this period, hovering around 96-98% with a slight decrease to 94% in 2017. The average transshipment share is also relatively stable over the 10 years at around 70%. However, the box plot shows a wide distribution with the 25th percentile shares being much lower at around 30-35%. Indeed, the trade-weighted average of transshipment shares hovers around 40%-45% suggesting that there is significant heterogeneity in transshipment shares by trading size.

We next divide the origin countries into four quartiles by their trade values with the US in the first year of our data (year 2008). Figure 2 shows that there is significant differences in the transshipment share distribution by quartiles. The lower three quartile countries have relatively high transshipment shares compared to the highest quartile countries, since larger countries trade enough with the US so they can better utilize the capacity of entire ships and send their goods directly. The lowest (first) quartile countries have a median transshipment share of one for all ten years, with an average share of 79% in 2008 and decreased slightly to 74% in 2017 (Figure 2a). The second quartile countries also have a median transshipment share of one for all ten years, but with a slight increase in mean transshipment shares from 74% in 2008 to 76% in 2017 (Figure 2b). The third quartile countries have a median transshipment share that is very high (95-98 percent), and a mean share that hovers around 70% to 75% (Figure 2c). The fourth quartile countries have the lowest transshipment shares, which may be unsurprising since they trade. Here the median shares increase from 59% to 64% in 2017, dipping down to 49%

Figure 1: Average Transshipment Share from 2008 to 2017



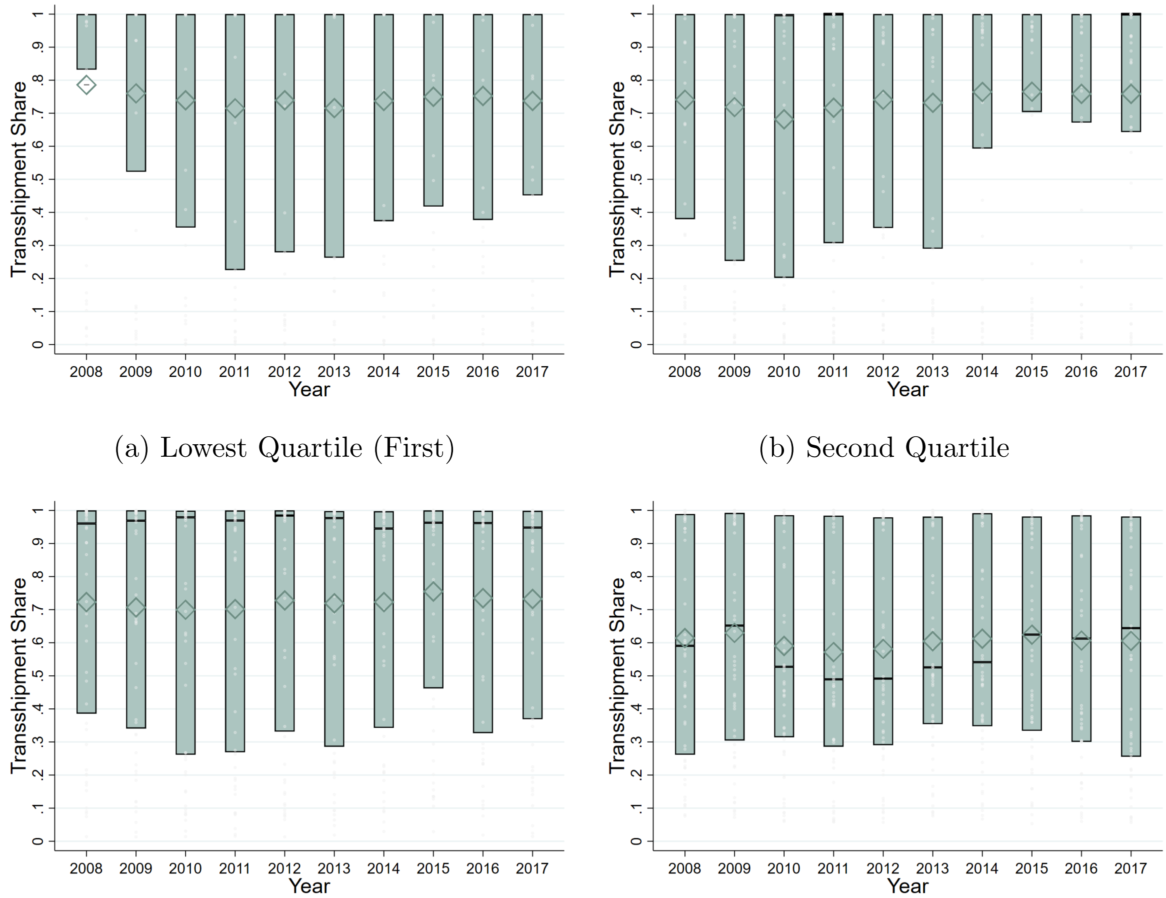
Notes: This figure plots the distribution of transshipment shares for the 224 origin countries in our data from 2008 to 2017. The 50th, 25th and 27th percentiles are indicated by a box plot. The mean is indicated by a diamond. The light gray dots are a scatter plot of the values for each year. Source: Panjiva bills of lading and authors' calculations.

in 2011 (Figure 2d). The average shares stayed around 61%, with a similar dip in 2011 to 57%. All in all, the different changes in transshipment shares across the countries in different trade quartiles have resulted in a relatively stable 70% average over the last ten years. This allows us to establish our first stylized fact:

Stylized Fact 1. *The majority of trade into the US is transshipped (70%) and this share is relatively stable over the past ten years between 2008-2017. Smaller US trading partners consistently tend to transship more relative to larger countries.*

Intermediate countries facilitating transshipment between 2008 and 2017 Next, we consider countries that conduct transshipment activities for US-bound exports. We define the percent of transshipment activities as the total of transshipped containers at these countries divided by the total of transshipped containers that year and multiplied by 100. Table 1 shows the top 10 countries with the highest percent of transshipment activity in 2017. For example, the country with the highest share of transshipment activity is China in 2017. That year, it was the intermediate hub country (port of lading) for 22.5% of transshipped containers globally (first row of Table 1). South Korea is the second highest with 10% followed up Panama, Singapore, and Belgium. These countries are established entrepôt hubs as defined by previous literature (Ganapati, Wong and Ziv, 2021; Jones et al., 2020). Additionally, we report how this list has evolved over the

Figure 2: Transshipment Share by Trade Quartiles from 2008 to 2017



(a) Lowest Quartile (First)

(b) Second Quartile

(c) Third Quartile

(d) Highest Quartile (Fourth)

Notes: This figure plots the distribution of transshipment shares for the 224 origin countries in our data from 2008 to 2017, broken down by four quartiles using their export value to the US in year 2008. Each panel indicates each trade quartile as labelled. For all panels, the 50th, 25th and 27th percentiles are indicated by a box plot. The mean is indicated by a diamond. The light gray dots are a scatterplot of the values for each year. For all years in Panel (a) and most years in Panel (b), the median is one which is why the black horizontal line within the box plot is hard to see. Source: Panjiva bills of lading and authors' calculations.

past 10 years. Column (4) in Table 1 reports the transshipment activity rank of the same ten countries in 2008 while Column (5) reports their share. While there hasn't been much change in rank of some countries like China, South Korea, and Singapore, a number of countries saw larger changes in their rankings including Hong Kong, Taiwan, and Panama. Hong Kong used to be ranked second in 2008 but ten years later it is sixth. Taiwan has seen a similar decline from being ranked fourth in 2008 to eighth ten years later. Panama, however, has improved its rank from 8th in 2008 to 3rd in 2017.[8]

Additionally, global transshipment activity is highly concentrated in a small number of countries and this concentration level has remained stable between 2008 and 2017. Figure

[8]For the list of top 30 countries involved in transshipment activities, see Appendix Table A.1.

Table 1: Top 10 Countries by Percent of Transshipment Activity, 2017 compared to 2008

(1) Country	(2) 2017 Hub Rank	(3) 2017 Transship. (%)	(4) 2008 Hub Rank	(5) 2008 Transship. (%)
China	1	22.49	1	26.71
South Korea	2	10.06	3	7.35
Panama	3	6.24	8	3.97
Singapore	4	6.05	5	6.13
Belgium	5	5.81	7	4.09
Hong Kong	6	5.50	2	8.76
Germany	7	5.50	6	4.47
Taiwan	8	3.45	4	6.41
Netherlands	9	3.29	10	3.45
Spain	10	3.06	12	2.79

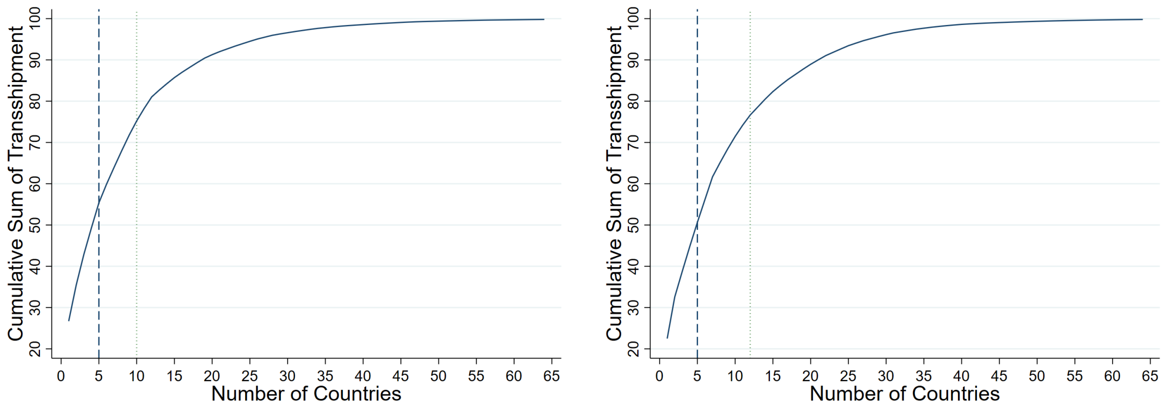
***Notes*:** This table lists the top 10 countries by percent of transshipment activity in year 2017 and compares the same list of countries to their rank ten years ago in 2008. The percent of transshipment activity is defined as the total of transshipped containers at these countries divided by the worldwide total of transshipped containers that year and multiplied by 100. Column (1) lists the country names while Column (2) lists the rank of these countries in 2017. Column (3) reports the percent of transshipment activity in 2017. Columns (4) and (5) report the rank of the same countries as well as their transshipment activity in 2008 respectively.

3 reports the cumulative sum of transshipment activity for years 2008 and 2017. In 2008, the top five largest intermediate hub countries were responsible for more than 55% of global transshipment activity (Figure 3a). These countries, in rank order, are China, Hong Kong, South Korea, Taiwan, and Singapore. The top 10 largest hub countries are responsible for more than two-thirds of global transshipment activity. Concentration is still equally high in 2017 (Figure 3b). While the top five largest hub countries are also responsible for more than 50% of global transshipment activity, there has been moderate churn in their ordering: China, South Korea, Panama, Singapore, and Belgium (Table 1). Both Hong Kong and Taiwan have dropped in rankings while Panama has improved. Our second stylized fact summarizes these findings:

Stylized Fact 2. *Global transshipment activity is concentrated in a small number of countries and has stayed concentrated over the past ten years between 2008 and 2017. The top five countries account for more than half of global transshipment activity while the top ten hub countries account for more than 70%.*

These two stylized facts are in line with the findings of Ganapati, Wong and Ziv (2021) using a shorter time horizon in 2014 and focusing on a different way of capturing indirect trade. By focusing on the number of stops a container shipment makes between its origin and destination, Ganapati, Wong and Ziv (2021) finds that the goods from smaller countries tend make more stops and these stops take place at entrepôts. While

Figure 3: Cumulative Sum of Transshipment Activity by Countries, 2008 and 2017



(a) Year 2008

(b) Year 2017

Notes: This figure plots the cumulative sum of transshipment activity for first 65 of the 123 intermediate hub countries in our data for years 2008 and 2017. For both panels, the number of countries when the cumulative sum is more than 50% and 75% is highlighted, in blue dashed and green dotted lines respectively. Source: Panjiva bills of lading and authors' calculations.

the goods from these smaller countries stay on the ship, the stops allows the ships to pick up more goods and better utilize their capacity. They further show that smaller countries, when shipping indirectly via hub countries, utilize larger ships that are similar in size to larger countries. Here we show that the majority of exports from these smaller countries then to be transshipped, suggesting that the transshipment process can help hubs can consolidate shipments onto bigger containerships in order to take advantage of cost savings from utilizing these larger ships. This suggests that hub countries can help smaller countries better access global markets by closing the ship size gap with larger countries, and the corresponding cost savings gap from using these larger ships.

International trade and transshipment at hub countries We are interested in the impact concentrating transshipment activity has on hub countries' trade. To examine the relationship between trade and transshipment activity at these hubs, we run the following specification:

$$Y_{ht} = \beta_0 + \beta \text{Transshipment Measure}_{ht} + \text{GDP}_{ht} + \delta_h + \gamma_t + \epsilon_{ht} \quad (1)$$

where Y_{ht} is log trade outcomes for hub country h in year t, Transshipment Measure$_{ht}$ is the log of our measures of transshipment activities in the same year t. We include GDP$_{ht}$, the hub country's GDP in year t, to control for time-varying changes in these countries' openness and access to trade outcomes, as well as country-level fixed effects δ_h to control for fixed country-level characteristics and year fixed effects γ_t to control for aggregate

Table 2: International Trade and Transshipment Activity at Hubs over the Long Run, between 2008 and 2017

	(1) log(Tot. Trade)	(2) log(Imports)	(3) log(Exports)	(4) log(GDP)	(5) log(Tot. Trade)	(6) log(Imports)	(7) log(Exports)
log(Transship Volume)	0.087	0.072	0.092	0.017	0.056	0.030	0.093
	(0.038)	(0.041)	(0.043)	(0.016)	(0.026)	(0.024)	(0.033)
log(GDP)					1.546	1.545	1.669
					(0.149)	(0.139)	(0.308)
log(Transship Countries)	0.110	0.101	0.087	0.001	0.093	0.069	0.104
	(0.045)	(0.052)	(0.049)	(0.024)	(0.022)	(0.024)	(0.039)
log(GDP)					1.590	1.568	1.742
					(0.148)	(0.130)	(0.334)
Observations	230	230	230	216	216	216	216
Country FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the regression coefficients based on Equation (1) and includes two years from the start and end of our sample period, 2008 and 2017. Standard errors are clustered at the country level. All variables are in natural logs. log(Transship Volume) is the natural log of total transshipment volumes through country h, measured in TEUs in year t. log(Transship Countries) is the natural log of the total number of countries that tranship through country h. Columns (1) to (4) exclude the GDP control while Columns (5) to (7) include it. Source: Panjiva bills of lading, CEPII BACI, and authors' calculations.

changes over time. To capture potential longer-run effects, we examine the correlation between trade and transshipment changes over the full 10 year period of our sample.

Table 2 presents our results from Equation (1). The first three columns are without the GDP control while the fourth to sixth columns include it. We find a positive and significant link between total trade value and the level of transshipment activity (first panel, Columns (1) and (5)). A doubling of the volume of goods transshipped through a hub is correlated with an increase of the hub's total trade by 5.6 percent (first panel, Column (5), Table 2). We find a larger positive relationship using the number of countries transshipping through a hub country—a doubling of the number of countries transshipping their goods through a hub is linked to an increase of the hub's total trade by 9.3 percent (second panel, Column (5), Table 2).

We find that while both the hub's imports and exports are positively correlated with transshipment activity, this link is relatively stronger for exports. A doubling of the number of countries transshipping through a hub country is linked to a significant increase of the hub's exports by 10.4 percent and its imports by slightly less at 6.9 percent (second panel, Columns (6) and (5) respectively, Table 2). Using the volume of goods transshipped through the hub country, we find that similar results—exports are more highly correlated with transshipment activity compared to imports. A doubling of the volume of goods transshipped through a hub is linked to an increase of the hub's total exports by 9.3 percent while for imports it is much smaller at 3 percent and noisy (first panel, Columns

(6) and (5) respectively, Table 2). This establishes our third stylized fact below:

Stylized Fact 3. *Transshipment activity is correlated with positive increases in the hub country's total trade between 2008 and 2017 and this link is relatively stronger on the export side than imports.*

We find similar results on an annual basis between 2008-2017, although as expected these correlations are more muted due to the closer time periods (Table A.2). We continue to find a positive link between total trade and transshipment activity with the exports channel driving this link. This suggests that as countries facilitate more transshipment activity, there appears to be a link between its total trade flows globally particularly via its exports. We unpack this channel in the next section.

3 A Theory Of Transshipment and Supply Chains

In this section, we describe our trade model with roundabout production and transshipment. Fixed and variable transport costs in shipping give rise both to entrepôt usage and link export decisions across destinations.

3.1 Setup

Our model has three countries: Home (H) and two foreign destinations (A and B). Firms pay to enter, hire workers, produce domestically, and then choose to sell domestically or abroad. If they export, they further choose to export to A and/or B, as well as how to send their goods to the foreign destination(s)—shipping either directly or indirectly through the other country. In exporting, there are three types of trade costs involved. First, there are idiosyncratic fixed export costs that guarantee not all firms export to all destinations (even when firms ship through these destinations, using it as an indirect shipping location). Second, there are deterministic iceberg transport costs that make some routes more attractive than others on average. Third, there are idiosyncratic fixed transport costs which firms pay to use particular shipping routes. These fixed transport costs accomplish two goals: they link export decisions across export destinations via shipping on the same route, and guarantee heterogeneity in firms' shipping decisions. Production is roundabout, so that access to more imported varieties makes exports more competitively priced.

3.2 Demand

There are K industries in each country i, and a continuum of products within each industry. Production of product ω_l in each industry l uses labor and intermediates from other industries in a Cobb-Douglass production function with Constant Elasticity of Substitution (CES) nests:

$$q_{i,l}(\omega_l) = \prod_{k=1}^{K-1} \left[\int_{\Omega_{i,k}} q_{i,\omega}^{\frac{\sigma}{\sigma-1}} d\omega \right]^{\frac{\beta_{l,k}(\sigma-1)}{\sigma}} \cdot b(\omega_l)^{1-\sum_l \beta_{l,k}},$$

where $\Omega_{i,k}$ is the set of available goods or inputs in country i in industry k, $\beta_{l,k}$ is the Cobb-Douglas parameter governing industry l's usage of industry k's inputs, $b(\omega_l)$ is a product's labor demand, and σ is elasticity of substitution which (for convenience) is constant across industries and consumption.

The final good industry is industry $k = K$, which is consumed locally only and its demand from consumers follows a CES demand function:

$$U_i = \left[\int_{\Omega_{i,k}} q_{i,\omega_k}^{\frac{\sigma}{\sigma-1}} d\omega_k \right]^{\frac{(\sigma-1)}{\sigma}},$$

For all other industries $k = 1, ..., K-1$, demand is both domestic and foreign. Servicing foreign markets incur both shipping and non-shipping related trade costs which we is explained further in Section 3.4.

3.3 Firms

In order to enter and sell to the domestic market, firms pay a fixed cost of entry. Exporting firms further choose whether to export to one or both destination countries, and how to ship their goods to those countries. There are three types of trade costs incurred when exporting: (1) fixed export costs to the destinations, (2) bilateral iceberg transport costs between Home and the destinations, and (3) fixed transport costs to access shipping routes.

The (variable) profit of a firm making product ω_l in industry l selling either domestically or to the two foreign destinations ($n \in H, A, B$), before the export-related trade costs, is:

$$v\pi(\omega_l, n) \equiv \sum_k \beta_{k,l} X_n \left(\frac{p(\omega_l)}{P_{nk}} \right)^{1-\sigma}.$$

where X_n is the total expenditure in country n, $p(\omega_l)$ is the price of product ω_l, and P_{nk}

is the price index of industry k in country n.

For a firm selling domestically, this equation above is their variable profit from domestic sales where $n = H$ since there is no cost incurred in shipping to their home market. To export to foreign destinations A or B, seller ω_l in any industry l pays a fixed cost $f_n^e(\omega_l)$ where $n = A, B$. For simplicity all fixed export and transport costs in the model will be drawn from the same positive, continuous distribution with a known mean and standard deviation $G(x)$.

3.4 Trade Costs of Exporting and Shipping

To export their goods to the foreign destinations, firms must pay (competitive) shipping companies to transport their goods along one or both shipping routes. Contracting with shipping companies and to send a quantity of $q(\omega_l)$ exports incurs two types of costs: a deterministic bilateral iceberg component that is variable, $\{\tau_{HA}, \tau_{AB}, \tau_{HB}\}$ where all of them are larger than 1, and a fixed stochastic transport cost component for each shipping route r ($f_r(\omega_l)$, where $r \in \{HAB, HBA\}$), which we discuss below. For simplicity, we assume that the bilateral iceberg costs are symmetric ($\tau_{AB} = \tau_{BA}$). Firms can choose to ship their goods directly or indirectly, and the resultant variable and fixed transport costs will be different based on their choice.

Variable iceberg transport costs If firms export to A or B directly, then the export profits they receive *before the fixed transport costs*, are respectively

$$\underbrace{\frac{v\pi(\omega_l, A)}{\tau_{HA}} - f_A^e(\omega_l)}_{\substack{\text{Export profits to A} \\ \text{when shipping to A directly}}}, \quad \underbrace{\frac{v\pi(\omega_l, B)}{\tau_{HB}} - f_B^e(\omega_l)}_{\substack{\text{Export profits to B} \\ \text{when shipping to B directly}}}$$

If they export to A or B indirectly through B, *net of fixed shipping costs*, then they receive, respectively

$$\underbrace{\frac{v\pi(\omega_l, A)}{\tau_{HB}\tau_{AB}} - f_A^e(\omega_l)}_{\substack{\text{Export profits to A} \\ \text{when shipping indirectly via B}}}, \quad \underbrace{\frac{v\pi(\omega_l, B)}{\tau_{HA}\tau_{AB}} - f_B^e(\omega_l)}_{\substack{\text{Export profits to B} \\ \text{when shipping indirectly via A}}} .$$

note that due to our symmetry assumption for the bilateral iceberg transport costs, the cost is the same for transporting between A and B ($\tau_{AB} = \tau_{BA}$).

Without fixed transport costs and with the imposition of triangle inequality in iceberg costs, both of the export profits for indirect shipping will be dominated by the profits for direct shipping. Furthermore, without fixed transport costs, exporting to A and exporting to B will be separable decisions. However, since both indirect and direct shipping behaviors are present in our data, we include fixed transport costs in order to match our empirical observations.

Fixed transport costs In order to ship their goods to final destinations, firms have to pay a fixed cost to book the shipping routes that are offered by shipping countries. There are (for simplicity) two shipping routes Route one moves ships in a specific order from Home, to A, and then to B (termed route $r = HAB$). Route two instead moves ships from Home, to B, and then to A (termed route $r = HBA$).[9]

The total shipping cost of moving $q(\omega_l)$ from Home (H) to A directly would require booking on route HAB which in turn incurs the bilateral iceberg cost τ_{HA} and the fixed cost $f_{HAB}(\omega_l)$.

$$q(\omega_l)\tau_{HA} + f_{HAB}(\omega_l)$$

On the other hand, moving the same goods from H to B directly would require paying for the iceberg cost τ_{HB} and the fixed cost $f_{HBA}(\omega_l)$. booking route HBA.

$$q(\omega_l)\tau_{HB} + f_{HBA}(\omega_l)$$

For indirect shipping, the cost to move the same goods from H to A via B would require booking on route HBA which in turn incurs twp bilateral iceberg costs, τ_{HB} and $\tau_{BA} = \tau_{AB}$, and the fixed cost $f_{HBA}(\omega_l)$.

$$q(\omega_l)\tau_{H,B}\tau_{AB} + f_{HBA}(\omega_l)$$

Similarly, the cost to move the same goods from H to B via A would require booking route HAB which in turn incurs twp bilateral iceberg costs, τ_{HA} and $\tau_{BA} = \tau_{AB}$, and the fixed cost $f_{HAB}(\omega_l)$.

$$q(\omega_l)\tau_{HA}\tau_{AB} + f_{HAB}(\omega_l)$$

Consider a firm exporting to both A and B. Shipping to both countries directly would result in some savings on iceberg transport costs. However, to ship to both directly, firms have to pay the fixed transport costs twice, once to book route HAB, (i.e. f_{HAB} to ship directly from H to A), and again to book route HBA (i.e. f_{HBA} to ship directly from H to B). The scale economy mechanism here is that once one of the fixed costs (either

[9] We can easily expand this to include a larger variety.

f_{HBA} or f_{HAB}) is paid, shipping to one country indirectly through the other reduces the amount of fixed costs firms have to pay.

3.5 Export and Shipping decisions

Because of the fixed transport costs associated with shipping, the export decisions to A and B from Home are linked.

With lower fixed costs of export to a country (all else equal), a firm will be more likely to export to it. With low enough fixed transport costs on a route (all else equal) a firm will be more likely to take it, either to ship directly or indirectly. When all fixed cost draws are low (and the triangle inequality is imposed) firms export to both countries and do so directly to economize on iceberg transport costs.

We explore the firm decision by first examining the export decision for a given shipping decision, then examine the shipping decision. There are four possible shipping decisions:

Case I: No Contract In this case, the firm does not export. Export profits are zero: $\pi(\omega_l, n) = 0$ for $n = A, B$.

Case II: Booking on HAB Route In this case, the firm has paid the fixed transport cost of booking route HAB ($f_{HAB}(\omega_l)$). It will export to A directly if its fixed export draw to A is low enough. It will export to B using A as an entrepôt if its fixed costs to export to B are low enough. Exporting profits will be

$$\pi(\omega_l) = \underbrace{\max\{\frac{v\pi(\omega_l, A)}{\tau_{HA}} - f^e_A(\omega_l), 0\}}_{\text{Direct export to A}} + \underbrace{\max\{\frac{v\pi(\omega_l, B)}{\tau_{HA}\tau_{AB}} - f^e_B(\omega_l), 0\}}_{\text{Indirect export to B via A}} - \underbrace{f_{HAB}(\omega_l)}_{\text{Fixed cost to book route } HAB}.$$

Note that in this case, the firm ships to A only when the fixed export cost to A is low enough. If the fixed export costs to B is low enough to merit export to B, but the fixed export costs to A is too high, then the firm will use A as an entrepôt to B without exporting to A. If the reverse is true (fixed export cost to B is too high, fixed export costs to A are low), then the firm will simply export directly to A. If both the fixed export costs are too high to merit exporting, this option is dominated by Case I.

Case III: Booking of HBA Route In this case, the firm has paid $f_{HBA}(\omega_l)$ which is the fixed transport cost for route HBA. It will export to B directly if its fixed export draw to A is low enough. It will export to A using B as an entrepôt if its fixed costs to export to A are low enough. In this case, profits are

$$\pi(\omega_l) = \underbrace{\max\{\frac{v\pi(\omega_l, B)}{\tau_{HB}} - f_B^e(\omega_l), 0\}}_{\text{Direct export to B}} + \underbrace{\max\{\frac{v\pi(\omega_l, A)}{\tau_{HB}\tau_{AB}} - f_A^e(\omega_l), 0\}}_{\text{Indirect export to A via B}} - \underbrace{f_{HBA}(\omega_l).}_{\text{Fixed cost to book route } HBA}$$

The analysis is symmetric to that in Case II.

Case IV: Contract With Both In this case, the firm has paid both $f_{HAB}(\omega_l)$ $f_{HBA}(\omega_l)$. It will export to both A and B and do so directly. If the fixed export costs to either do not justify doing so, this option is dominated by the other cases. Profits in this case are

$$\pi(\omega_l) = \underbrace{\max\{\frac{v\pi(\omega_l, B)}{\tau_{HB}} - f_B^e(\omega_l), 0\}}_{\text{Direct export to B}} + \underbrace{\max\{\frac{v\pi(\omega_l, A)}{\tau_{HA}} - f_A^e(\omega_l), 0\}}_{\text{Direct export to A}} - \underbrace{f_{HAB}(\omega_l) - f_{HBA}(\omega_l)}_{\text{Fixed cost to book both routes}}.$$

Knowing their fixed export costs, firms can determine their profits in each of these cases. Working backwards, firms choose which fixed transport costs to pay based on their fixed export costs and the subsequent outcomes.

3.6 Equilibrium

The four idiosyncratic fixed costs in the model smooth the shipping and exporting decisions, resulting in the following proposition

Proposition 1. *In equilibrium, each of the following behaviors are exhibited by a positive mass of operating firms:*

1. *Domestic sales only.*
2. *Direct sales to A only.*
3. *Direct sales to B only.*
4. *Indirect sales to A through B, only.*
5. *Indirect sales to B through A, only.*
6. *Direct sales to A in conjunction with indirect sales to B through A.*
7. *Direct sales to B in conjunction with indirect sales to A through B.*

Proof Outline. The idiosyncratic draws combined with the fixed-variable cost trade-offs ensure each of these occur for some region of the 4-dimensional joint distribution of fixed cost draws.

Proposition 2. *A reduction in the distribution of fixed export costs f_B^e, or an increase in demand at B increases the likelihood that a firm exports to A.*

Proof Outline. The increase in firms exporting to B can come from one of 2 margins: (1) firms who are not exporters (2) firms already exporting to A. Of those in the 2nd margin, direct export to A was profitable already, and therefore export to B, whether it happens through using A as an entrepôt, or directly through paying a second fixed shipping cost, will not reduce the number of A exporters (see Case III). More interestingly, the first margin can be decomposed into two groups, those who elect to pay $f_{HBA}(\omega_l)$, who ship directly to B, and those who elect to pay $f_{HAB}(\omega_l)$, who use A as an entrepôt to B. For the latter, since they were not exporters previously, the combined fixed costs $f_{HAB}(\omega_l) + f_A^e(\omega_l)$ were previously prohibitive. However, the marginal fixed cost of exporting to A conditional on paying $f_{HAB}(\omega_l)$ is only $f_A^e(\omega_l)$. This effectively lowers the fixed cost of export to A by $f_{HAB}(\omega_l)$, inducing some of those firms to export.

A more subtle point is that of those electing to pay $f_{HAB}(\omega_l)$ to export to B, the profitability of additionally selling at A induced export to B; intuitively, the new larger market at B might not be enough to induce entry for some on its own, but the bonus of now also being able to sell to A makes the fixed shipping cost worth paying.

Finally, an increase in transshipment in a particular industry k reduces costs through the price index deferentially for industries using k's products more intensively. This, in turn, increases exports.

Proposition 3. *Given industries l, l' and k, an increase in demand at B for goods in industry k results in a differential increase X_{AH} in l where $\beta_{kl} > \beta_{kl'}$.*

Proof Outline. By Proposition 2, an increase in demand from B increases exports from H to A in industry k. That differentially reduces the price index in industries to which k contributes a larger share of the price index. That in turn differentially reduces costs and increases the margin of profitable exporters from A to H in industry l. So long as there are no general equilibrium reversals of these forces, the increased transshipment due to the increased demand at B has downstream supply chain effects on A's exports.

4 Impact of Transshipment on Trade

We show our main results results using two research designs. The first is a simple empirical specification that looks at short, medium, and long run variation under the various assumptions about shock timing and persistence, primarily the when the transshipment starts and the resulting trade occurs must be within a specified window - without any other dynamic effects. We use an instrumental variable to control for omitted variables, reverse causation and attenuation bias. We also run a placebo test indicating our results hold at the product level only, suggesting that transshipment does not increase the general market access of hubs but instead highlighting a product-specific trade channel. The second research design adopts the "local projections" approach of Jordà (2005) and allows initial transshipment activities to dynamically affect subsequent trade flows over time. This not only allows us to look at dynamic effects over time, but lets us to better control for potential reverse causation, while keeping our instrumental strategy consistent. In addition to these results, we show the correlation between transshipment and downstream exports to better understand downstream economic effects and to tie to potential work on larger general equilibrium effects.

4.1 Static Research Design

We start by outlining an optimal empirical strategy when an exogenous transshipment contemporaneously affects trade flows as a one-time shock. Due to incomplete data and instruments, we show how to modify the estimating equation to our context, as well as account for attenuation bias, omitted variable bias, and reverse causation. We then extend this to a limited dynamic setting, when a transshipment shock must affect trade flows within a specified period. In the next subsection, we move towards a fully dynamic setting.

A regression relating transshipment volumes to trade would be of the form:

$$\log X_{o\to d,k,t} = \alpha_1 \log \sum_{f\in\mathcal{F}} Transshipment_{o\to d\to f,k,t} + \delta_{o\to,k,t} + \delta_{\to d,k,t} + \delta_{o\to j,k} + \epsilon_{o\to d,k,t}, \quad (2)$$

where the outcome variable $X_{o\to d,k,t}$ are the exports in from origin o to destination d, in product category k (at the HS-6 level) in year t. In this specification, the parameter of interest is the coefficient α_1 on $\sum_{f\in\mathcal{F}} Transshipment_{o\to d\to f,k,t}$, the volume of k transshipped at location d from origin o to any final destination f in the set of any final destination $\mathcal{F}$.

In principle, this specification reflects Proposition 2 in our stylized theory model. In a first departure from the model, exporter-product-time fixed effects $i \rightarrow, k, t$ and $i \rightarrow, k$ fixed effects to control for time varying bilateral trends, as well as bilateral, product trends. Furthermore, our model is static and the comparative static in Proposition 2 is silent on the timing required to move from one equilibrium to the next. Moreover, as any empirical specification, any estimate of α_1 may be subject to biases outlined below.

4.1.1 Empirical Implementation

While we observe the timing of transshipments, we do not observe the timing of trade. So we aggregate our transshipment data to the yearly level. Taking first differences between t and t_0, we next consider the following specification:

$$\begin{aligned}\Delta_{t-t_0} \log X_{o\rightarrow d,k,t} = \alpha_1 \Delta_{t-t_0} \log \sum_{f\in\mathcal{F}} Transshipment_{o\rightarrow d\rightarrow f,k,t} \\ + \delta_{o\rightarrow,k_{HS_2},t} + \delta_{\rightarrow d,k_{HS_2},t} + \delta_{o\rightarrow d,k_{HS_2}} + \epsilon_{o\rightarrow d,k_{HS_2},t},\end{aligned} \tag{3}$$

where the $\delta_{o\rightarrow d,k}$ fixed effect in Equation (2) is differences out, and origin-product-time and destination-product-time fixed effects now flexibly control for time variation in trends within sectors (2-digit HS codes) and at the bilateral-sector level as well. The first differences take out an origin-destination-HS 6-digit fixed effect for every time pair between t and t_0.

Omitted Variables and Timing Assumptions A standard concern is omitted variables which confound the observed relationship between transshipment and trade. For example, demand shocks in the transshipment country or supply shocks from the origin country could generate increased transshipment and trade at the same time. In general, we have no prediction for the direction of bias for unspecified omitted variables.

Reverse Causation and Autocorrelation A related endogeneity problem is reverse causation. In our model, this takes the form of a simplified traveling salesman problem: conditional on selling to B, the benefits of trade with A make transshipment more attractive relative to direct shipping to B. Exporters servicing the US who begin servicing a second destination may switch shippers to one transshipping through the second destination. An important feature of this mechanism is that it should take effect in the same time period as an observed change in trade, while the causal impact of transshipment may be delayed as exporters search for markets after a shipping price change.

Attenuation Bias Finally, a key issue in our data is our measurement of transshipment, which will result in attenuation bias. Our data on transshipment's is not universal, we only observe if a particular location is used as a transshipment point for voyages transporting US imports. On these voyages to the US, we only observe the final transshipment activity. Furthermore, because bill of lading data is not designed for customs use, there can be misclassification of HS codes generating potential measurement error.[10] In our results, we will find significant scope for bias resulting from these measurement difficulties.

With these three issues in mind, we run the following specification:

$$\begin{aligned}\Delta_{t-t_0} \log X_{o\to d,k,t} &= \alpha_1 \Delta_{t-t_0} \log Transshipment_{o\to d\to US,k,t} \\ &\quad + \delta_{o\to,k_{HS_2},t} + \delta_{\to d,k_{HS_2},t} + \delta_{o\to d,k_{HS_2}} + \epsilon_{o\to d,k_{HS_2},t},\end{aligned} \tag{4}$$

where $\Delta_{t-t_0} Transshipment_{o\to d\to US,k,t}$ is the change in observed transshipment volumes for the US between time periods t and t_0.

We run these regressions in non-overlapping time periods, to account for issues with staggered-difference research designs. Our short run estimation will use one year variation, our medium run will look at three year variation, and our long-run will look over our entire data set over 9 years. We run two addition specifications as robustness checks, with origin-destination-product-time fixed effects and HS 4-digit level fixed effects, respectively.

While all three threats to identification are partially addressed by first differences and robust fixed effects—the specific supply or demand shocks posited above as omitted variables are absorbed at the k_{HS_2} level—ultimately, these strategies are quite insufficient - even in a simple setting where transshipment is a one-time shock. For that reason, we turn to an instrument to predict transshipment that plausibly satisfies the conditions of an instrumental variable, one that affects transshipment directly, but after accounting for the fixed effects - has no direct effect on industry-level trade flows.

[10] Our transaction level data is a partial list of the various HS codes in each shipment. For a substantial portion of these shipments, multiple HS codes are listed. In these cases, we assign the first HS code to the entire shipment. This over-counts the volume of transshipment in the first HS code and under-counts the volumes in others.

4.2 Instrumental Variable Approach

Our instrumentation strategy draws on that in Ganapati, Wong and Ziv (2021), which exploits the geographic nature of global trade. Similarly, we leverages historic patterns to create a shift-share instrument. Specifically, our shift is the change in shipments to the US in a particular product category from all countries excluding the origin o, and our share is the share of shipments from origin o that are transshipped to the US through d in the base year, excluding transshipments from good k's sector.

The intuition behind our instrument is that increased exports from o due to demand shifts in the US will make transshipment more likely overall, but deferentially more so for countries historically used as a transshipment location for o's US exports.[11] Leaving out US imports from the origin omits the possibility of capturing supply shocks which would induce exports to both the US and the transshipment country.

Formally, we create an instrumental variable $z_{o,d,k,t}$ constructed by conducting a first difference shift:

$$z_{o,d,k,t} = \underbrace{\ln \sum_{o' \setminus o} \left(X_{o',k,t} - X_{o',k,t_0} \right)}_{\substack{\text{Shift: total change in US imports of good } k \\ \text{not from } o \text{ over time}}} \times \underbrace{\frac{\sum_{k' \in K} Transshipment_{o \to d \to US,k,t_0}}{\sum_{o' \in N} \sum_{k' \in K} Transshipment_{o' \to d \to US,k,t_0}}}_{\substack{\text{Historic Share: transshipment} \\ \text{of good } k \text{ from } o \text{ to US via } d \text{ at period } t_0}} \quad (5)$$

where $X_{o',k,t}$ are US imports of good k from origin o' in period t.

We then use the instrument to estimate the following first stage:

$$\Delta_{t-t_0} \log Transshipment_{o \to d \to US,k,t} = \alpha + \beta_z z_{o,d,k,t} + \gamma_{o,d,t} + \gamma_{d,k_{HS_2},t} + \gamma_{o,k_{HS_2},t} + \nu_{o,d,k,t}$$

where $\Delta_{t-t_0} \log Transshipment_{o \to d \to US,k,t}$ is the change in the natural log of transshipment volume (or an indicator for transshipment status) of good k from o to the US via d between t_0 and t, and bilateral time, origin-good-time and destination-good-time trends are absorbed.

We then estimate our second stage equation:

$$\Delta_{t-t_0} \log X_{o,d,k,t} = \alpha_1 \Delta_{t-t_0} \log Transshipment_{o \to d \to US,k,t} + \gamma_{o,d,t} + \gamma_{o,k_{HS_2},t} + \gamma_{o,k_{HS_2},t} + \epsilon_{o,d,k,t}$$

Table 3 presents our results using three year lags. Columns (1)-(3) present our OLS results. Column (3) presents our main specification, while columns (1) and (2) present robustness specifications, with four-way (origin, destination, sector and time) fixed effects,

[11] In addition, we explore robustness by omitting historic bilateral transshipment in the HS 6-digit product category.

Table 3: The Medium-Run Effects of Transshipment on Imports: 3 Years

	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
$\Delta_3 \log Transshipment_{o,d,k}$	0.00380	0.00321	0.00387	0.288	0.312	0.329
	(0.00179)	(0.00174)	(0.00168)	(0.119)	(0.112)	(0.124)
Observations	202,890	218,712	223,339	202,757	218,593	223,209
Adj. R-Square	0.10	0.05	0.09			
First Stage F				45.44	52.77	44.10
First Difference at o, d, k_{HS6}-level	X	X	X	X	X	X
Fixed Effects						
o, d, k_{HS2}, t	X			X		
o, k_{HS4} and d, k_{HS4}		X			X	
o, k_{HS2}, t and d, k_{HS2}, t			X			X
o, d, t		X	X		X	X

Notes: The dependent variable, $\Delta_3 \log X_{o,d,kt}$ is the 3-year change in the log of trade flow, in current USD, from exporter o to importer d in HS-6 product category k in year t. $\Delta_3 Transshipment_{o,d,k}$ is the 3-year change in the amount of goods transshipped from exporter o to the US via hub country d in k as defined in Equation (4). We look at stacked 3 year differences, to avoid overlapping differences. Panels (1)-(3) are run using ordinary least squares. Panels (4)-(6) use the geographic instrumentation strategy outlined in Equation (5). In addition to the first difference across o, d, and k (as the 6-digit harmonized system classification level), we run three different fixed effect specification. Columns (1) and (3) allow for time variation at the o and d pair within 2 digit-HS codes. Columns (2) and (5) allow for o, d, t time variation with trends in o-HS-4 and d-HS-4 digit levels. Column (3) and (6) replace the last fixed effects with those that absorb time-variation at the origin-HS-2 and destination HS-2 product levels. ■

and origin- product and destination product fixed effects at the four digit level, respectively. Across the first three columns, the OLS displays a modest, marginally significant relationship: doubling the volume of transshipment of a given product is associated with roughly between a 0.3-0.4% increase in product imports from the transshipment's origin country.

In columns (3)-(6), we employ our instrument. The Kleibergen and Paap F-statisticis 44 in our preferred specification (column (6)) and up to 52 in our robustness specifications. Coupled with the correct direction of the first stage (Appendix Table A.3 shows our first stage results), our instrument appears to be strong. The instrumental variable results display much larger relationships: just a 10% increase in transshipment results in a roughly 3% increase in trade. This large upward revision in the relationship's magnitude is consistent with the instrument rectifying the significant measurement error resulting from missed transshipment and misclassified shipments.

Table 4 displays result from our longest lags, 9 years difference. Despite the mechanical reduction in our sample size, Columns (1)-(3) demonstrate larger, now more significant correlations: doubling transshipment is related to roughly a 1% increase in trade. Our instrument (with overall larger K-P F-statistic, almost 97 for our main specification)

Table 4: The Long-Run Effects of Transshipment on Imports: 9 Years

	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
$\Delta_9 \log Transshipment_{o,d,k}$	0.0162	0.00985	0.0121	0.384	0.574	0.408
	(0.00392)	(0.00433)	(0.00365)	(0.0963)	(0.150)	(0.0971)
Observations	56,329	53,380	62,264	56,293	53,352	62,227
Adj. R-Square	0.20	0.27				
First Stage F				95.31	45.75	96.76
First Difference at o, d, k_{HS6}-level	X	X	X	X	X	X
Fixed Effects						
o, d, k_{HS2}, t	X			X		
o, k_{HS4} and d, k_{HS4}		X			X	
o, k_{HS2}, t and d, k_{HS2}, t			X			X
o, d, t		X	X		X	X

Notes: The dependent variable, $\Delta_9 \log X_{o,d,k,t}$ is the 9-year change in the log of trade flow, in current USD, from exporter o to importer d in HS-6 product category k in year t. $\Delta_9 Transshipment_{o,d,k}$ is the 9-year change in the amount of goods transshipped from exporter o to the US via hub country d in k as defined in Equation (4). We look at 9 year difference here over the entire time period. Panels (1)-(3) are run using ordinary least squares. Panels (4)-(6) use the geographic instrumentation strategy outlined in Equation (5). In addition to the first difference across o, d, and k (as the 6-digit harmonized system classification level), we run three different fixed effect specification. Columns (1) and (3) allow for time variation at the o and d pair within 2 digit-HS codes. Columns (2) and (5) allow for o, d, t time variation with trends in o-HS-4 and d-HS-4 digit levels. Column (3) and (6) replace the last fixed effects with those that absorb time-variation at the origin-HS-2 and destination HS-2 product levels. ■

also generates a larger magnitude: a 10% increase in transshipment results in a 4% increase in trade. These results indicate the effect of transshipment appear magnified over time, which is consistent with the notion—not captured by our static model—that transshipment effects take time to materialize. Speculatively, firms might revisit export decisions slowly after they learn about the lower transport cost, paying export costs including the time costs of establishing trading partners at the transshipment location.

Further exploring the possibility of delayed effects, Table 5 replicates our results for 1 year lags. Here we find OLS effects that are 30% of Table 3's size and 10% of Table 4's. Our instrument loses power, possibly due to the noise in 1-year demand changes in the US. In a Granger causality sense, this further confirms our positive results are likely not due to reverse causation.

Placebo Next, we consider a set of "placebo" correlations where we compare transshipment in one industry to imports in others. To the extent that our product-level regressions are picking up coefficients that are effects based on the mechanism outlined in our model, transshipment in one product category should not predict imports in any other.

Table 5: The Short-Run Effects of Transshipment on Imports: 1 Year

	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
$\Delta_1 \log Transshipment_{o,d,k}$	0.00118	0.00174	0.00140	0.0531	-0.152	0.127
	(0.000893)	(0.000831)	(0.000837)	(0.261)	(0.200)	(0.272)
Observations	785,625	874,706	868,276	93,651	99,548	103,053
Adj. R-Square	0.07	0.03	0.06			
First Stage F				8.14	14.12	7.63
First Difference at o, d, k_{HS6}-level	X	X	X	X	X	X
Fixed Effects						
o, d, k_{HS2}, t	X			X		
o, k_{HS4} and d, k_{HS4}		X			X	
o, k_{HS2}, t and d, k_{HS2}, t			X			X
o, d, t		X	X		X	X

Notes: The dependent variable, $\Delta_1 \log X_{o,d,k,t}$ is the 1-year change in the log of trade flow, in current USD, from exporter o to importer d in HS-6 product category k in year t. $\Delta_1 Transshipment_{o,d,k}$ is the 1-year change in the amount of goods transshipped from exporter o to the US via hub country d in k as defined in Equation (4). We look at 1 year differences here over the entire time period. Panels (1)-(3) are run using ordinary least squares. Panels (4)-(6) use the geographic instrumentation strategy outlined in Equation (5). In addition to the first difference across o, d, and k (as the 6-digit harmonized system classification level), we run three different fixed effect specification. Columns (1) and (3) allow for time variation at the o and d pair within 2 digit-HS codes. Columns (2) and (5) allow for o, d, t time variation with trends in o-HS-4 and d-HS-4 digit levels. Column (3) and (6) replace the last fixed effects with those that absorb time-variation at the origin-HS-2 and destination HS-2 product levels. ■

If our placebo tests do return positive results, and transshipment in one product category increases imports in another, a likely mechanism driving this result would be that transshipment increases market access more broadly: if, for example, increased transshipment brings larger or more frequent boats, this could lower trade costs for all imports from the transshipment's origin country. For this reason, our placebos will double as tests for broader market access effects of transshipment.

In particular, we will adjust our main specifications to examine the effect of transshipment of all products in k's 4-digit HS code (industry) except for the 6-digit product code itself:

$$\Delta_{t-t_0} \log X_{i,j,k',t} = \alpha_1 \Delta_{t-t_0} \log \left(\sum_{k' \in K_{HS_2} \setminus k} \widetilde{x}^{transshipment}_{i \to j \to US,k,t} \right) + \gamma_{i,j,t} + \gamma_{j,k_{HS_2},t} + \gamma_{i,k_{HS_2},t} + \epsilon_{i,j,k,t}.$$

We use this specification as our preferred for both OLS and our instrumental variable's second stage, in conjunction with our alternative robustness specifications with fixed effects as in Tables 3 through 5.

Table 6 reports our results for 3-year lags. In Column (3), our preferred specification, our coefficients drop by two thirds in magnitude – conforming to the zero effect we find

Table 6: Placebo for Within-Pair Market Access: Medium Run

	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
$\Delta_3 \log \widetilde{Transshipment}_{o,d,k}$	0.00140	-0.00172	0.00102	0.673	1.374	0.889
	(0.00281)	(0.00271)	(0.00263)	(0.451)	(1.086)	(0.567)
Observations	137,574	139,777	140,390	137,492	139,690	140,309
Adj. R-Square	0.11	0.06	0.09			
First Stage F				6.88	2.37	5.24
Fixed Effects						
o, d, k_{HS2}, t	X			X		
o, k_{HS4} and d, k_{HS4}		X			X	
o, k_{HS2}, t and d, k_{HS2}, t			X			X
o, d, t		X	X		X	X

Notes: The dependent variable, $\Delta_3 \log X_{odkt}$ is the 3-year change in the log of trade flow, in current USD, from exporter o to importer d in HS-6 product category k in year t. $\widetilde{Transshipment}_{o,d,k}$ is the amount of goods transshipped from o to the US via country d in a HS-4 digit sector, but excluding the six digit HS-6 code k. We look at stacked, non-overlapping 3 year differences here over the entire time period. Panels (1)-(3) are run using ordinary least squares. Panels (4)-(6) use the geographic instrumentation strategy outlined in Equation (5). In addition to the first difference across o, d, and k (as the 6-digit harmonized system classification level), we run three different fixed effect specification. Columns (1) and (3) allow for time variation at the o and d pair within 2 digit-HS codes. Columns (2) and (5) allow for o, d, t time variation with trends in o-HS-4 and d-HS-4 digit levels. Column (3) and (6) replace the last fixed effects with those that absorb time-variation at the origin-HS-2 and destination HS-2 product levels. ■

in 1-year lags, and our IV results in column (6) are similarly indistinguishable from zero. Results with alternative fixed effects in columns (1) and (2) and (4) and (5) are similar: OLS coefficients are near zero and sometimes negative, and instrumental results are indistinguishable from zero as well.

In Table 7, we modify our fixed effects: removing industry controls. If market access effects exist but affect all import categories evenly, time-varying fixed effects at the HS2 level will absorb the effect. Removing these, we allow for broad market effects in the medium run. Here, the OLS and instrument for our main specifications are negative but indistinguishable from zero as well.

5 Event Study of Trade Response to Transshipment

Our initial research design finds statistically zero effects in the very short run (within the year), but large and growing effects at the medium and long-run. With this in mind, we now move to a fully dynamic estimating research design. Specifically, we consider the effect of transshipment at different horizons in a dynamic framework, in the spirit of Jordà (2005), allowing the process of transshipment to slowly affect trade over a variable

Table 7: Placebo for Broad Market Access: Medium Run

	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
$\Delta_3 \log \widetilde{Transshipment}_{o,d,k}$	0.00188	0.00142	-0.00346	0.122	2.352	-0.193
	(0.00257)	(0.00256)	(0.00328)	(0.0456)	(3.293)	(0.215)
Observations	140,166	140,773	136,108	140,079	140,692	136,015
Adj. R-Square	0.03	0.08	0.12			
First Stage F				402.37	0.59	24.90
Fixed Effects						
o, k_{HS4} and d, k_{HS4}	X			X		
o, k_{HS2}, t and d, k_{HS2}, t		X			X	
o, k_{HS4}, t and d, k_{HS4}, t			X			X

Notes: The dependent variable, $\Delta_3 \log X_{odkt}$ is the 3-year change in the log of trade flow, in current USD, from exporter o to importer d in HS-6 product category k in year t. $\widetilde{Transshipment}_{o,d,k}$ is the amount of goods transshipped from o to the US via country d in a HS-4 digit sector, but excluding the six digit HS-6 code k. We look at stacked, non-overlapping 3 year differences here over the entire time period. Panels (1)-(3) are run using ordinary least squares. Panels (4)-(6) use the geographic instrumentation strategy outlined in Equation (5). We use a weaker set of fixed effects than in Table 6and omit origin-destination fixed effects of any kind. ■

horizon. Our dynamic regression specification is similar to that used in the exchange rate and tariff pass through literature (Boehm, Levchenko and Pandalai-Nayar, 2023).

We follow the the literature's notation, using the time difference operator Δ_h to denote the difference between $t-1$ and $t+h$ for any given variable. As before, due to limited information on transshipment, we are unable to fully saturate fixed effects, as such we aggregate up to the 2-digit HS code for the local projection fixed effect. Furthermore to alleviate issues with both attenuation bias, endogeneity, and reverse causation, we use an instrument for the the low horizon transshipment. Our baseline specification takes the form:

$$\Delta_h \ln X_{i,j,p,t} = \beta^h \Delta_h \ln T_{i,j,US,p,t} + \delta^{1,X,h}_{i,p,t} + \delta^{2,X,h}_{j,p,t} + \delta^{3,X,h}_{i,j,p} + u^{X,h}_{i,j,p,t} \quad (6)$$

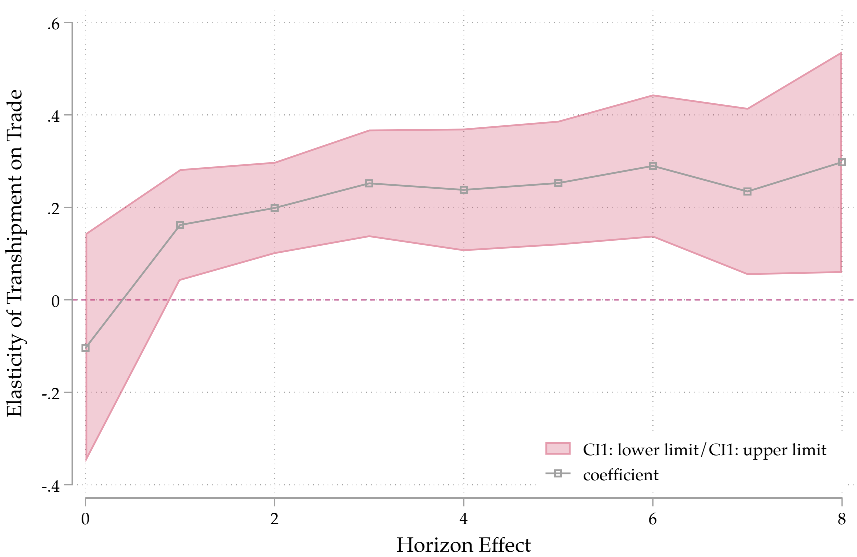
where the h-horizon effect of transshipment T from i to the US via j for product p at time t on trade flows X between i and j. The coefficient of interest is the partial effect of transshipment at a given horizon, β^h.

In this specification,the OLS specifications at the 1, 3, and 9 year horizons are identical to those in our previous results. Figure 6 plots the OLS results. The general pattern in our previous results holds more clearly here: the OLS effect is growing over time to an 8-period peak of 10-times the initial effect.

However, in addition to the identification threats isolated above, an increased secondary threat is auto-correlation: resulting changes at any horizon may be a product of transshipment changes at that horizon, or more or less recent changes to transshipment. To isolate the horizon-specific effects, our instruments now must be orthogonal to prior and future period shocks. We follow the literature by use base-period shocks for each time difference. Specifically, Figure 5 uses the period 1 transshipment changes as an instrument for h-horizon changes. As in Jordà (2005) and Boehm, Flaaen and Pandalai-Nayar (2019), the fixed effects of our main specification remove correlation between shock periods. Here, the general upward trend is more pronounced, increasing to a maximum 6-period effect of 2%.

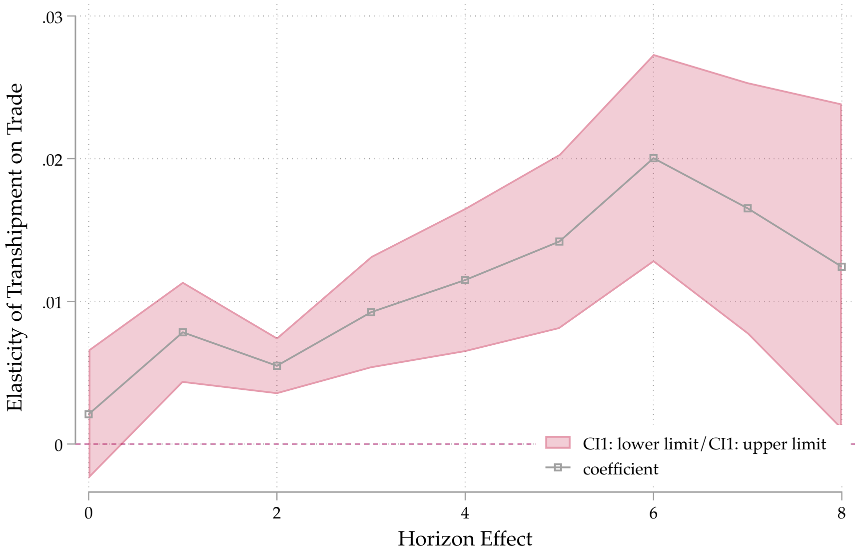
As Boehm, Flaaen and Pandalai-Nayar (2019) write, the initial period instrument should considered in the spirit of OLS, and will not address the main threats to identification listed above. As such, we employ a initial version of our shift-share instrument. Here, we use our shift share instrument from a 3-period change (recalling the weakness of the 1-period shift-share) to instrument for h-horizon changes. Figure 4 plots these dynamic effects. We confirm the zero short-run effect, and gradually increasing effect size levels off at around a 2030% effect, lower than our 9-period lag, which would be expected if the 9-period lag absorbs correlated shorter-horizon shocks.

Figure 4: Dynamic Horizon Effect - Local Projections - Our IV



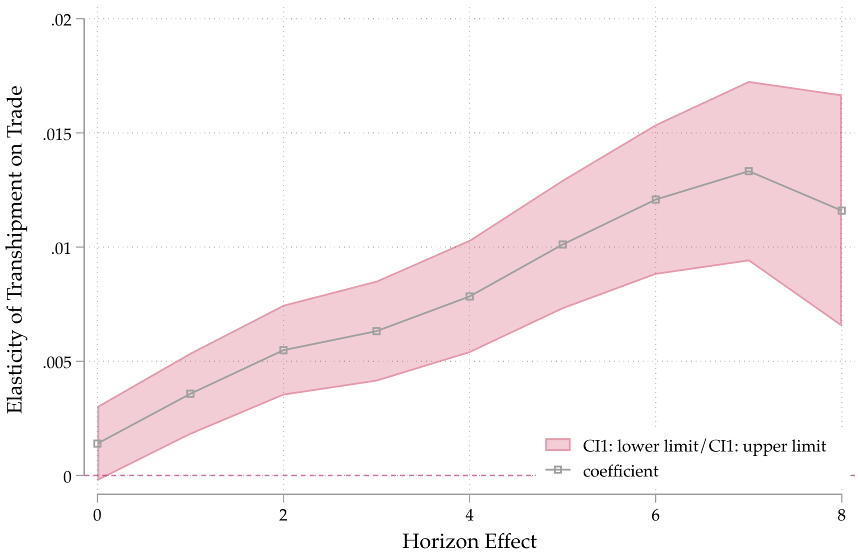
Notes: This figure plots the coefficients β^h that look at the effect transshipment over different horizons. The estimation is done in first differences at the HS 6-digit level (netting out origin-destination-product (HS-6)-pair effects) and includes origin-year-product(HS-2), destination-year-product (HS-2), and origin-destination-time fixed effect.

Figure 5: Dynamic Horizon Effect - Local Projections - Period 1 IV



Notes: This figure plots the coefficients β^h that look at the effect transshipment over different horizons. The estimation is done in first differences at the HS 6-digit level (netting out origin-destination-product (HS-6)-pair effects) and includes origin-year-product(HS-2), destination-year-product (HS-2), and origin-destination-time fixed effect.

Figure 6: Dynamic Horizon Effect - Local Projections - Pure OLS



Notes: This figure plots the coefficients β^h that look at the effect transshipment over different horizons. The estimation is done in first differences at the HS 6-digit level (netting out origin-destination-product (HS-6)-pair effects) and includes origin-year-product(HS-2), destination-year-product (HS-2), and origin-destination-time fixed effect.

6 Impact of Transshipment on Supply Chains

In the previous sections, we established a link between transshipment and imports at the product level: transshipping a product through a country increases the probability of export to it. Proposition 3 of our model highlights the fact that when imports are intermediates, this mechanism will generate comparative advantage effects, lowering the country's costs of production downstream and increasing downstream exports. The same mechanism has been highlighted by government agencies interested in transshipment activity (Government of Malta, 2019; Government of Jamaica, 2022).

In this section, we use our data to directly investigate these claims. We consider the effect of transshipment in one industry on *exports* in other industries, and how that relationship is mediated by the input-output relationship between the industries. In particular, we use the 2013 Release of the World Input-Ouput Tables (WIOT) to link industries according to their input expenditure share. Because the WIOT 2013 Release only consists of data for 35 sectors/industries classified according to the International Standard Industrial Classification revision 3 (ISIC Rev. 3), we must aggregate our HS-6 data to the 35 industries covered by WIOT. We then consider whether increased transshipment in one industry differentially affects exports in other industries that use that industry's products more in production.

We consider the following specification:

$$\begin{aligned}\Delta_{t-t_0} \log \sum_{o' \in I \setminus o} X_{d,o,k,t} =& \alpha + \beta_1 \Delta_{t-t_0} \log Transshipment_{o \to d \to US,k',t} \times Pct\_Input_{k,k'} \\ &+ \beta_2 \Delta_{t-t_0} \log Transshipment_{o \to d \to US,k',t} + \beta_3 Pct\_Input_{k,k'} \\ &+ \gamma_{d,t} + \gamma_{o,t} + \epsilon_{o,d,k,k',t}\end{aligned} \tag{7}$$

where $\sum_{o' \in I \setminus o} X_{d,o,k,t}$ is the sum of exports from d to o' leaving out transshipment origin country o and, as in our model. $Pct\_Input_{k,k'}$ is the percentage of industry k''s total input expenditures coming from industry k, across all countries in 2008, calculated using the World Input-Output Database 2013 Release. Note that because we have aggregated data to the 35-WIOT industry level in order to capture the input-output relationships between industries (and because the bilateral, bi-industry specification explodes the size of our dataset), our baseline specification drops our HS2 industry FEs. We include country-industry-time FEs as well, although they remove the bulk of our variation.

Table 8 presents our OLS results while Table 9 presents our IV results. We find positive but noisy short-run effects on supply chains (Column (1), Table 8). In Table 8 Columns (2) and (3), we see the export effects mimicking our baseline effects, expanding over the time horizon to 0.3% differential effect on downstream exports and then a full

1% differential effect at the 9-year horizon. We lack the data to test whether this is the full effect or whether the dynamic supply chain effects lag the overall import effects. As expected, our saturated country-industry-time fixed effects wash out nearly all variation including any effects on exports, up or downstream. Overall, we find evidence suggestive of the notion that the increased prevalence of intermediate inputs due to transshipment reduces costs, increases production, and increases exports in downstream industries.

Table 8: The Effects of Transshipping on Downstream Exports

	Short Run	Medium Run	Long Run
	(1)	(2)	(3)
	$\Delta_1 \log X_{d,k',t}$	$\Delta_3 \log X_{d,k',t}$	$\Delta_9 \log X_{d,k',t}$
$\Delta_1 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$	0.0017		
	(0.0011)		
$\Delta_1 \log Transshipment_{o,d,k,t}$	-4.79e-05		
	(0.0001)		
$\Delta_3 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$		0.0030**	
		(0.0015)	
$\Delta_3 \log Transshipment_{o,d,k,t}$		-0.0001	
		(0.0002)	
$\Delta_9 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$			0.0112***
			(0.0040)
$\Delta_9 \log Transshipment_{o,d,k,t}$			-0.0003
			(0.0005)
$Pct\_Input_{k,k'}$	0.0036***	0.0130***	0.0298***
	(0.0004)	(0.0008)	(0.0027)
Observations	22,343,407	16,800,526	2,184,408
First Difference at o, d, k, k'-level	X	X	X
Fixed Effects			
o, t	X	X	X
d, t	X	X	X

Notes: $X_{d,k',t}$ is the total export, in current USD, from country d to the rest of the world, leaving out transshipment origin country o, in industry k' in year t. $Transshipment_{o,d,k,t}$ is the volume of goods, in TEU, in industry k being transshipped from country o to the US via country d in year t. Δ_1, Δ_3, and Δ_9 denote one, three, and nine-period differences. $Pct\_Input_{k,k'}$ is the percentage of industry k''s total input expenditures coming from industry k, across all countries in 2008, calculated using the World Input-Output Database 2013 Release. Standard errors are clustered by origin-destination country pair. ■

7 Conclusion

In this paper, we study the returns from being a hub country—the impact of global transshipment activity by these hubs on their own international trade flows and supply chains over a 10-year period. We show that the very act of helping others trade can

Table 9: The Effects of Transshipping on Downstream Exports (IV)

	Short Run	Medium Run	Long Run
	(1)	(2)	(3)
	$\Delta_1 \log X_{d,k',t}$	$\Delta_3 \log X_{d,k',t}$	$\Delta_9 \log X_{d,k',t}$
$\Delta_1 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$	0.165***		
	(0.0589)		
$\Delta_1 \log Transshipment_{o,d,k,t}$	-0.0553***		
	(0.0157)		
$\Delta_3 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$		0.250***	
		(0.0818)	
$\Delta_3 \log Transshipment_{o,d,k,t}$		-0.0601*	
		(0.0362)	
$\Delta_9 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$			2.871
			(12.46)
$\Delta_9 \log Transshipment_{o,d,k,t}$			-0.755
			(2.824)
$Pct\_Input_{k,k'}$	0.00293***	0.00674***	-0.0963
	(0.000547)	(0.00209)	(0.576)
Observations	22,276,964	7,119,149	2,182,464
K-P F	31.16	9.37	0.04
First Difference at o, d, k, k'-level	X	X	X
Fixed Effects			
o, t	X	X	X
d, t	X	X	X

Notes: $X_{d,k',t}$ is the total export, in current USD, from country d to the rest of the world, leaving out transshipment origin country o, in industry k' in year t. $Transshipment_{o,d,k,t}$ is the volume of goods, in TEU, in industry k being transshipped from country o to the US via country d in year t. Δ_1, Δ_3, and Δ_9 denote one, three, and nine-period differences. $Pct\_Input_{k,k'}$ is the percentage of industry k''s total input expenditures coming from industry k, across all countries in 2008, calculated using the World Input-Output Database 2013 Release. Standard errors are clustered by origin-destination country pair.

have important spillovers in increasing your own trade and even downstream industries. However this effect does not work through increasing one's own general market access, but through particular product and possibly firm specific channels. These findings open up potential research using either firm-level or multi-county shipping data to look into how exactly the costs of finding and shipping to downstream users is paid. This could open up the black box into useful policy recommendations for developing and growing countries to enter into global value chains. In a world of interconnected trade flows and networks, transshipment is another way in which countries can harness global trade to their own advantage.

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Appendix

Appendix A Additional Tables and Figures

Table A.1: Top 30 Countries by Percent of Transshipment Activity, 2017 compared to 2008

(1)	(2)	(3)	(4)	(5)
Country	2017 Hub Rank	2017 Transship. (%)	2008 Hub Rank	2008 Transship. (%)
China	1	22.49	1	26.71
South Korea	2	10.06	3	7.35
Panama	3	6.24	8	3.97
Singapore	4	6.05	5	6.13
Belgium	5	5.81	7	4.09
Hong Kong	6	5.50	2	8.76
Germany	7	5.50	6	4.47
Taiwan	8	3.45	4	6.41
Netherlands	9	3.29	10	3.45
Spain	10	3.06	12	2.79
Guatemala	11	2.74	14	1.54
Mexico	12	2.46	13	1.65
Bahamas	13	1.94	9	3.84
Colombia	14	1.94	22	0.65
Portugal	15	1.78	34	0.24
Jamaica	16	1.52	11	3.05
Italy	17	1.41	16	1.28
Oman	18	1.25	20	0.84
Vietnam	19	1.25	51	0.04
Canada	20	1.18	25	0.59
Sri Lanka	21	1.07	19	1.10
Honduras	22	1.04	17	1.18
Malaysia	23	0.81	24	0.59
Dominican Republic	24	0.80	26	0.56
France	25	0.79	28	0.45
United Kingdom	26	0.62	23	0.65
Costa Rica	27	0.61	15	1.47
Netherlands Antilles	28	0.49	33	0.26
Chile	29	0.49	32	0.27
New Zealand	30	0.47	27	0.46

***Notes*:** This table lists the top 30 countries by percent of transshipment activity in year 2017 and compares the same list of countries to their rank ten years ago in 2008. The percent of transshipment activity is defined as the total of transshipped containers at these countries divided by the worldwide total of transshipped containers that year and multiplied by 100. Column (1) lists the country names while Column (2) lists the rank of these countries in 2017. Column (3) reports the percent of transshipment activity in 2017. Columns (4) and (5) report the rank of the same countries as well as their transshipment activity in 2008 respectively.

Table A.2: International Trade and Transshipment Activity at Hubs over the shorter run, from 2008 to 2017

	(1) log(Tot. Trade)	(2) log(Imports)	(3) log(Exports)	(4) log(GDP)	(5) log(Tot. Trade)	(6) log(Imports)	(7) log(Exports)
log(Transship Volume)	0.030	0.018	0.049	0.009	0.012	-0.001	0.034
	(0.012)	(0.012)	(0.015)	(0.005)	(0.009)	(0.009)	(0.012)
log(GDP)					1.519	1.485	1.666
					(0.136)	(0.128)	(0.272)
log(Transship Countries)	0.034	0.024	0.043	0.0001	0.026	0.013	0.044
	(0.016)	(0.018)	(0.019)	(0.008)	(0.012)	(0.012)	(0.017)
log(GDP)					1.537	1.484	1.717
					(0.138)	(0.128)	(0.286)
Observations	1,278	1,278	1,278	1,224	1,224	1,224	1,224
Country FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the regression coefficients based on Equation (1) and includes all years from 2008 to 2017. Standard errors are clustered at the country level. All variables are in logs. log(Transship Volume) is the natural log of total transshipment volumes through country h, measured in TEUs in year t. log(Transship Countries) is the natural log of the total number of countries that transship through country h. Columns (1) to (4) exclude the GDP control while Columns (5) to (7) include it. Source: Panjiva bills of lading, CEPII BACI, and authors' calculations. ■

Table A.3: First Stage: Instrumental Variable Regressions

	(1) $\Delta_3 \log Transshipped_{o,d,k}$	(2) $\Delta_3 \log Transshipped_{o,d,k}$	(3) $\Delta_3 \log Transshipped_{o,d,k}$
$IV_{o,d,k}$	0.146	0.166	0.143
	(0.0216)	(0.0231)	(0.0216)
Observations	202,757	195,186	202,757
Adj. R-Square	0.09	0.03	0.07
F-Stat	45.44	51.48	43.58
Fixed Effects			
o, d, k_{HS2}, t	X		
o, k_{HS4} and d, k_{HS4}		X	
o, k_{HS2}, t and d, k_{HS2}, t			X
o, d, t		X	X

Notes:

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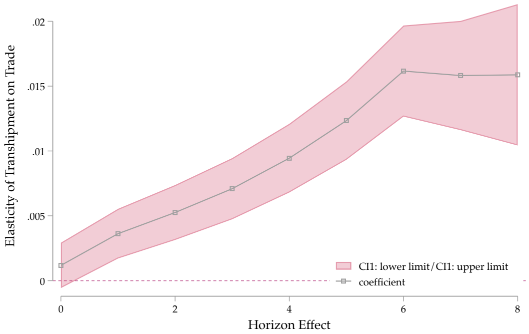
Table A.4: The Effects of Transshipping on Downstream Imports; O-Origin Industry-Year and D-Destination Industry-Year and Origin-Destination FEs

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	$x_{jk't}$	$x_{jk't}$	$x_{jk't}$	$x_{jk't}$	$x_{jk't}$	$x_{jk't}$
$\mathbb{I}_{trans,ijkt}$	-0.000576	8.82e-05				
	(0.00114)	(0.000122)				
log(Pct Input)	-4.73e-05		-6.47e-05		-3.94e-05	
	(8.27e-05)		(6.51e-05)		(8.75e-05)	
$\mathbb{I}_{trans,ijkt}$#log(Pct Input)	-0.000135					
	(0.000253)					
Pct Input		-0.000574		-0.000646		-0.000365
		(0.000657)		(0.000576)		(0.000748)
$\mathbb{I}_{trans,ijkt}$#Pct Input		-0.00139				
		(0.00207)				
$\sum_{hs6} \mathbb{I}_{trans,ijkt}$			1.39e-05	1.11e-05		
			(8.39e-05)	(1.14e-05)		
$\sum_{hs6} \mathbb{I}_{trans,ijkt}$#log(Pct Input)			1.81e-06			
			(2.14e-05)			
$\sum_{hs6} \mathbb{I}_{trans,ijkt}$#Pct Input				-8.02e-05		
				(0.000202)		
$\log \sum_{hs6} \mathbb{I}_{trans,ijkt}$					-0.000458	0.000214*
					(0.000888)	(0.000112)
$\log \sum_{hs6} \mathbb{I}_{trans,ijkt}$#log(Pct Input)					-0.000134	
					(0.000202)	
$\log \sum_{hs6} \mathbb{I}_{trans,ijkt}$#Pct Input						-0.00219
						(0.00195)
O-Org.Ind.-Yr FEs	Yes	Yes	Yes	Yes	Yes	Yes
D-Dest.Ind.-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
O-D FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	33,785,661	33,785,661	33,785,661	33,785,661	33,785,661	33,785,661

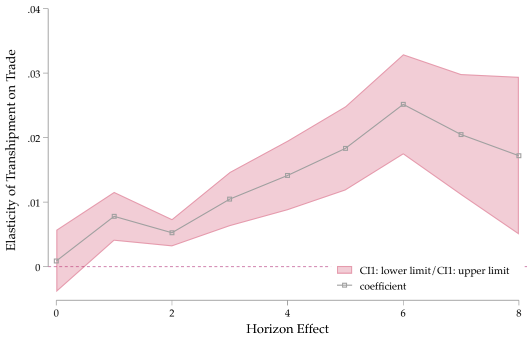
Notes: $x_{jk't}$ is the log of imports of products in industry k' by country j in year t. Standard errors are clustered two-way by origin country and transshipping country. Pct Input is the proportion of inputs used by industry k' coming from k. ■

Figure A.1: Dynamics - Alternative Fixed Effects

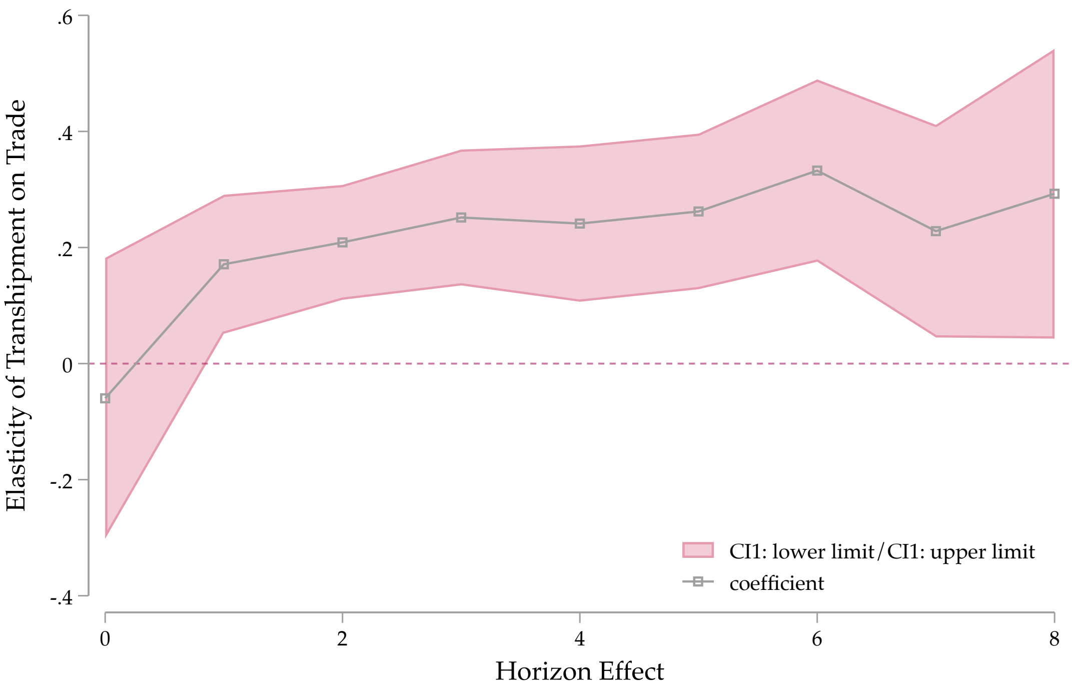
(a) Local Projection: OLS



(b) Local Projection: First Period IV



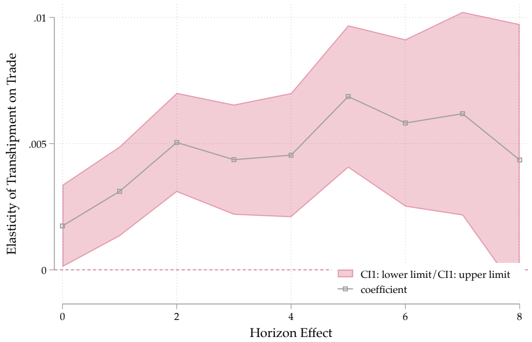
(c) Local Projection: First Period Geographic IV



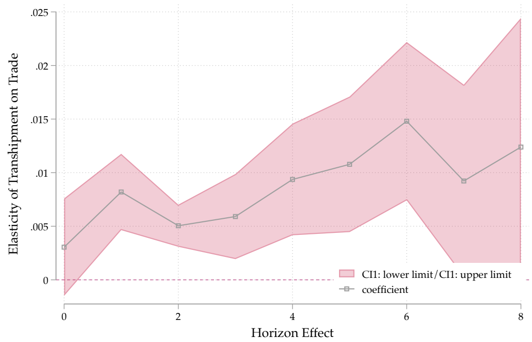
Notes: This replicates the figures in the text, but with origin-destination-HS 2-digit-year fixed effects. Panel (a) includes OLS results, panel (b) uses the initial period as an IV for all periods, panel (c) uses our initial IV for all periods.

Figure A.2: Dynamics - Alternative Fixed Effects

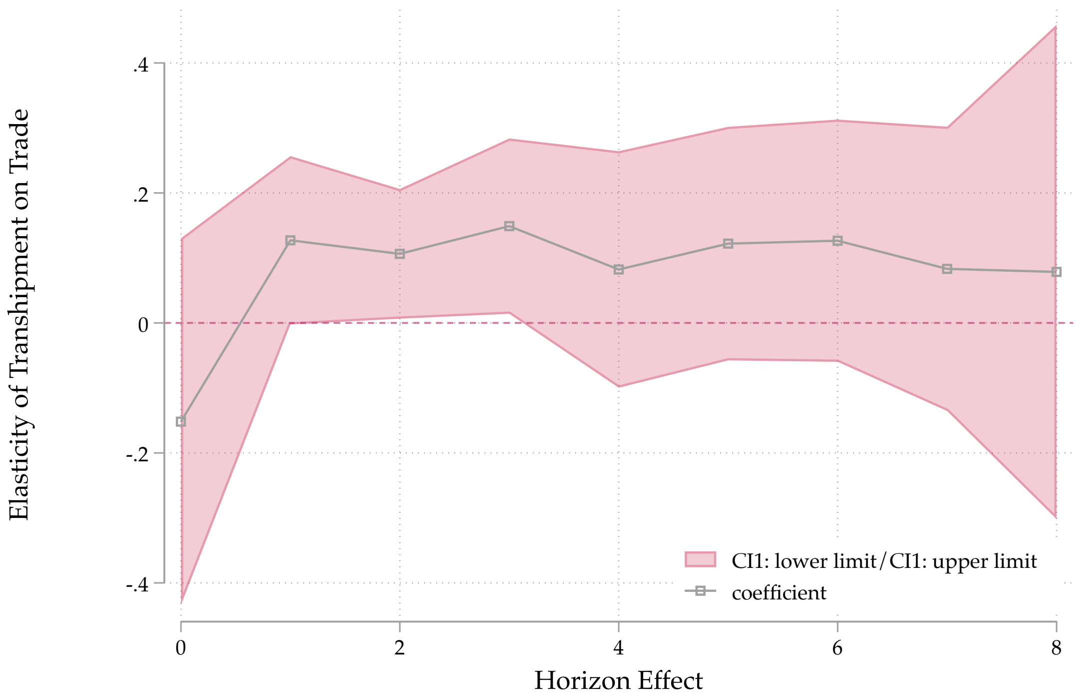
(a) Local Projection: OLS



(b) Local Projection: First Period IV



(c) Local Projection: First Period Geographic IV



Notes: This replicates the figures in the text, but with origin-HS 4-digit, destination-HS 4-digit, and origin-destination-year fixed effects. Panel (a) includes OLS results, panel (b) uses the initial period as an IV for all periods, panel (c) uses our initial IV for all periods.

Table A.5: Placebo on Outcomes: Medium Run

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta_3 X_{o,d,\widetilde{k}}$	$\Delta_3 X_{o,d,\widetilde{k}}$	$\Delta_3 X_{o,d,\widetilde{k}}$	$\Delta_3 X_{o,d,\widetilde{k}}$	$\Delta_3 X_{o,d,\widetilde{k}}$	$\Delta_3 X_{o,d,\widetilde{k}}$
$\Delta_3 \log transhipment_{o,d,k}$	0.00808	0.0108	0.0110	0.144	0.197	0.152
	(0.00199)	(0.00204)	(0.00202)	(0.103)	(0.111)	(0.111)
Observations	134,030	135,160	135,611	133,947	135,069	135,527
Adj. R-Square	0.22	0.15	0.17			
First Stage F				45.09	42.87	42.71
Fixed Effects						
o, d, k_{HS2}, t	X			X		
o, k_{HS4} and d, k_{HS4}		X			X	
o, k_{HS2}, t and d, k_{HS2}, t			X			X
o, d, t		X	X		X	X

Notes:

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Table A.6: Placebo on Outcomes: Medium Run, Loose Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta_3 X_{o,d,\widetilde{k}}$	$\Delta_3 X_{o,d,\widetilde{k}}$	$\Delta_3 X_{o,d,\widetilde{k}}$	$\Delta_3 X_{o,d,\widetilde{k}}$	$\Delta_3 X_{o,d,\widetilde{k}}$	$\Delta_3 X_{o,d,\widetilde{k}}$
$\Delta_3 \log transhipment_{o,d,k}$	0.0243	0.0160	0.0122	0.199	0.0129	-0.135
	(0.00204)	(0.00202)	(0.00192)	(0.0368)	(0.128)	(0.145)
Observations	135,365	135,805	133,057	135,275	135,722	132,963
Adj. R-Square	0.09	0.13	0.36			
First Stage F				393.93	31.64	18.78
Fixed Effects						
o, k_{HS4} and d, k_{HS4}	X			X		
o, k_{HS2}, t and d, k_{HS2}, t		X			X	
o, k_{HS4}, t and d, k_{HS4}, t			X			X

Notes:

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A.1 Extensive Margin

We re-run out main specification on the extensive margin of transshipment on trade flows, replication of Table 3 but using an indicator variable for transhipping a good from o to the US via d over a three year horizon. We find large effects. But we note that identification in the IV case is highly limited due to the limited number of switchers and caution extrapolation from these results. See table A.7 for the baseline 3-period results and A.8 for the supply chain results.

Table A.7: The Medium-Run Effects of Transshipment on Imports: Extensive Margin

	(1) $\Delta_3 \log X_{o,d,k}$	(2) $\Delta_3 \log X_{o,d,k}$	(3) $\Delta_3 \log X_{o,d,k}$	(4) $\Delta_3 \log X_{o,d,k}$	(5) $\Delta_3 \log X_{o,d,k}$	(6) $\Delta_3 \log X_{o,d,k}$
$\Delta_3 \mathbb{I}^{Transshipped}_{o,d,k}$	0.0184***	0.0151***	0.0184***	4.141***	3.522***	4.038***
	(0.00370)	(0.00363)	(0.00362)	(0.974)	(1.044)	(0.916)
Observations	10,501,194	10,712,372	10,734,814	10,501,194	10,712,372	10,734,814
Adj. R-Square	0.06	0.04	0.03			
First Stage F				160.05	136.85	185.34
Fixed Effects						
o, d, k_{HS2}, t	X			X		
o, k_{HS4} and d, k_{HS4}		X			X	
o, k_{HS2}, t and d, k_{HS2}, t			X			X
o, d, t		X	X		X	X

Notes:

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Table A.8: The Effects of Transshipping on Downstream Exports: Extensive Margins

VARIABLES	(1) $x_{jk't}$	(2) $x_{jk't}$	(3) $x_{jk't}$	(4) $x_{jk't}$	(5) $x_{jk't}$	(6) $x_{jk't}$
$\mathbb{I}_{trans,ijkt}$	0.00420***	-0.000437				
	(0.00149)	(0.000450)				
$\mathbb{I}_{trans,ijkt}$#log(Pct Input)	0.000919***					
	(0.000322)					
$\mathbb{I}_{trans,ijkt}$#Pct Input		0.0116**				
		(0.00560)				
$\sum_{hs6} \mathbb{I}_{trans,ijkt}$			0.000655**	-3.57e-05		
			(0.000277)	(8.36e-05)		
$\sum_{hs6} \mathbb{I}_{trans,ijkt}$#log(Pct Input)			0.000151**			
			(6.47e-05)			
$\sum_{hs6} \mathbb{I}_{trans,ijkt}$#Pct Input				0.00120*		
				(0.000663)		
$\log \sum_{hs6} \mathbb{I}_{trans,ijkt}$					0.00562***	-0.000723
					(0.00207)	(0.000578)
$\log \sum_{hs6} \mathbb{I}_{trans,ijkt}$#log(Pct Input)					0.00127***	
					(0.000468)	
$\log \sum_{hs6} \mathbb{I}_{trans,ijkt}$#Pct Input						0.0152**
						(0.00612)
O-D-Org. Ind.-Dest. Ind. FEs	Yes	Yes	Yes	Yes	Yes	Yes
O-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
D-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29,024,914	29,024,914	29,024,914	29,024,914	29,024,914	29,024,914

Notes: $x_{jk't}$ is the log of exports of products in industry k' by country j in year t. Standard errors are clustered two-way by origin country and transshipping country. Pct Input is the proportion of inputs used by industry k' coming from k, omitted due to perfect collinearity after partialling out the FEs. ■

A.2 Manufacturing Subsample

Table A.9: The Effects of Transshipping on Downstream Exports

	Short Run		Medium Run		Long Run	
	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta_1 \log X_{d,k',t}$	$\Delta_1 \log X_{d,k',t}$	$\Delta_3 \log X_{d,k',t}$	$\Delta_3 \log X_{d,k',t}$	$\Delta_9 \log X_{d,k',t}$	$\Delta_9 \log X_{d,k',t}$
$\Delta_1 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$	0.00218**	-0.000143				
	(0.00109)	(0.000155)				
$\Delta_1 \log Transshipment_{o,d,k,t}$	-2.83e-05	6.43e-06				
	(0.000104)	(7.00e-06)				
$\Delta_3 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$			0.00511***	-5.96e-05		
			(0.00135)	(0.000180)		
$\Delta_3 \log Transshipment_{o,d,k,t}$			-0.000327**	2.68e-06		
			(0.000137)	(8.10e-06)		
$\Delta_9 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$					0.00845**	-0.000100
					(0.00359)	(0.000668)
$\Delta_9 \log Transshipment_{o,d,k,t}$					4.02e-05	4.50e-06
					(0.000419)	(3.00e-05)
$Pct\_Input_{k,k'}$	0.00234***	-0.000105**	0.0142***	-8.51e-05	0.0216***	-0.000372
	(0.000489)	(4.88e-05)	(0.00107)	(7.21e-05)	(0.00330)	(0.000228)
Observations	15,993,950	15,989,351	12,049,372	12,046,118	1,569,490	1,569,075
Fixed Effects						
o, t	X		X		X	
d, t	X		X		X	
o, d, t		X		X		X
o, k, t		X		X		X
d, k', t		X		X		X

Notes: $X_{d,k',t}$ is the total export, in current USD, from country d to the rest of the world, leaving out transshipment origin country o, in industry k' in year t. $Transshipment_{o,d,k,t}$ is the volume of goods, in TEU, in industry k being transshipped from country o to the US via country d in year t. Δ_1, Δ_3, and Δ_9 denote one, three, and nine-period differences. $Pct\_Input_{k,k'}$ is the percentage of industry k''s total input expenditures coming from industry k, across all countries in 2008, calculated using the World Input-Output Database 2013 Release. Standard errors are clustered by origin-destination country pair. ■

Table A.10: The Effects of Transshipping on Downstream Exports (IV)

	Short Run		Medium Run		Long Run	
	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta_1 \log X_{d,k',t}$	$\Delta_1 \log X_{d,k',t}$	$\Delta_3 \log X_{d,k',t}$	$\Delta_3 \log X_{d,k',t}$	$\Delta_9 \log X_{d,k',t}$	$\Delta_9 \log X_{d,k',t}$
$\Delta_1 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$	0.176***	0.00728				
	(0.0271)	(0.00532)				
$\Delta_1 \log Transshipment_{o,d,k,t}$	-0.0509***	-0.000195				
	(0.0148)	(0.000151)				
$\Delta_3 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$			0.0784*	-0.00587		
			(0.0413)	(0.00923)		
$\Delta_3 \log Transshipment_{o,d,k,t}$			-0.0104	-8.78e-05		
			(0.0207)	(0.000170)		
$\Delta_9 \log Transshipment_{o,d,k,t} * Pct\_Input_{k,k'}$					143.2	0.154
					(7,834)	(0.404)
$\Delta_9 \log Transshipment_{o,d,k,t}$					-1.459	0.000312
					(77.84)	(0.00407)
$Pct\_Input_{k,k'}$	0.00166***	-0.000150***	0.00681***	-0.000122	-8.323	-0.00877
	(0.000522)	(5.80e-05)	(0.00145)	(0.000183)	(456.6)	(0.0219)
Observations	15,942,010	15,937,653	5,104,493	5,103,213	1,567,902	1,567,512
K-P F	38.20	7.95	15.38	4.03	0.00	0.08
Fixed Effects						
o, t	X		X		X	
d, t	X		X		X	
o, d, t		X		X		X
o, k, t		X		X		X
d, k', t		X		X		X

Notes: $X_{d,k',t}$ is the total export, in current USD, from country d to the rest of the world, leaving out transshipment origin country o, in industry k' in year t. $Transshipment_{o,d,k,t}$ is the volume of goods, in TEU, in industry k being transshipped from country o to the US via country d in year t. Δ_1, Δ_3, and Δ_9 denote one, three, and nine-period differences. $Pct\_Input_{k,k'}$ is the percentage of industry k''s total input expenditures coming from industry k, across all countries in 2008, calculated using the World Input-Output Database 2013 Release. Standard errors are clustered by origin-destination country pair. ∎