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Exports to the US and Imports from China during the US-China Tariff War: Evidence from Regional Trade Data in Vietnam†

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This study empirically investigates how the exports of downstream products to the US change the imports of their upstream products from China during the US-China tariff war. To accomplish this, we use province-level trade data in Vietnam, known to be a country that increased its exports to the US market in place of China, i.e., known to enjoy a trade diversion in the US market. The use of regional trade data enables us to capture the input-output linkages more precisely. Specifically, focusing on the trade in general and electrical machinery industries from January of 2019 to December of 2023, we regress imports of upstream products from China on exports of their downstream products to the US, finding that the rise of exports of downstream products to the US significantly increases imports of their upstream products from China. On the other hand, the rise in these products does not significantly increase the imports of upstream products from Japan, Korea, and Taiwan. Furthermore, the input-output linkage between exports to the US and imports from China was found to be greater in provinces with better business environments in terms of entry costs, transparency in public services, and public support to businesses.

Key Word: US-China Trade War; Vietnam; Input-output Linkages
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I. Introduction

Vietnam is considered to be among the group of countries enjoying a trade diversion in the US market during the US-China tariff war. Since 2018, the US has imposed additional tariffs on imports from China.[1] In retaliation, China also imposed additional tariffs on various products (e.g., agricultural goods) imported from the US. These additional tariffs have led to decreased international trade between China and the US. On the other hand, we have also observed a trade diversion effect, i.e., increased imports from countries not directly involved in this war.[2] Specifically, Southeast Asian countries and Mexico have increased their exports to the US. In particular, Vietnam has attracted much attention from the public as an alternative export base for products bound for the US market.

Several studies have shown a significant increase in exports from Vietnam to the US. Alfaro and Chor (2023) demonstrated that Vietnam enjoys this trade diversion effect, especially in upstream products or less labor-intensive products. Using product-level trade data, Choi and Nguyen (2023) and Rotunno et al. (2023) examined exports from Vietnam to the US and found a significant increase. The latter study showed that the increase in Vietnamese exports was driven by both new export product varieties (i.e., extensive margin) and increased exports in existing categories (i.e., intensive margin). Furthermore, using micro data from Vietnamese firms, Ngoc and Wie (2023) found that tariff hikes on Chinese products augmented the likelihood of Vietnamese firms in the targeted industries becoming exporters. Overall, the literature shows that Vietnam has enjoyed trade diversion effects in the US market during this tariff war.

The increase in Vietnamese exports to the US has led to two issues. The first is trade circumvention to the US by Chinese firms. US sanctions cause Chinese firms to export products to third countries, particularly utilizing ASEAN nations as transshipment platforms, before re-exporting them to the US without a significant transformation. This practice allows them to bypass US tariffs on Chinese goods (Ha and Phuc, 2019).[3] The second issue is "hidden exposure to China." Although China decreases exports to the US, the countries that increase exports of downstream products to the US in place of China may increase imports of upstream products from China to produce those downstream products. Using an in put-output table on international goods, Baldwin et al. (2023) show that by 2018, value-added output from China had been largest in the US manufactur ing sectors. Jones et al. (2024) argue that Beijing is running trade surpluses with countries such as Vietnam, Singapore, and the Philippines, which in turn

[1]See Bown (2021) for details on the timing and scale of the products subject to the tariff changes during the US-China trade war.

[2]As in the literature on the US-China tariff war, we use the trade diversion effect as an indicator of increased imports in the US or China from countries not directly involved in the tariff war. See, for example, https://unctad.org/publication/trade-and-trade-diversion-effects-united-states-tariffs-china#tab-1.

[3]Some pieces of anecdotal evidence on such trans-shipment are available. See, for example, https://www.woodworkingnetwork.com/cabinets/us-customs-border-protection-finds-us-cabinet-depot-evading-cabinet-duties, https://www.woodworkingnetwork.com/news/woodworking-industry-news/customs-finds-cabinet-importers-evaded-chinese-duties-transshipping, and https://www.forest-trends.org/blog/us-customs-and-border-protection-cbp-finds-chinese-timber-products-fraudulently-sold-in-us-as-made-in-vietnam-in-order-to-evade-tariffs/.

are running widening surpluses with the US, suggesting that China's manufa cturers are continuing to benefit from US consumers' demand for their good s. In short, the increased exports from Vietnam to the US, i.e., the trade diversion effect for Vietnam in the US market, include the effects of export circumvention by Chinese firms and exports using inputs imported from China.

Against this backdrop, this study empirically investigates the second issue in relation to Vietnam, i.e., the increased level of input imports from China to produce outputs exported to the US.[4] To do this, we use province-level trade data in Vietnam from January of 2019 to December of 2023. Then, we regress imports of upstream products from China in a province on exports of the corresponding downstream products to the US in that province. Following the method proposed in Hayakawa (2024), we focus on trade in general (Harmonized System (HS) 84) and electrical machinery (HS 85) industries, which are the top two HS chapters in terms of exports to the US and imports from China in Vietnam.[5] Then, we identify input-output (IO) linkages in the trade data by exploiting the HS coding structure. For example, for HS 8508, HS 850870 denotes machinery parts to produce HS 850811, HS 850819, and HS 850860 items. In this way, we identify 82 pairs of downstream and upstream products. Unlike an IO table, trade data enable us to conduct our analysis at a short frequency, e.g., monthly or quarterly. To take into account the time lag between input imports and output exports, we use trade data aggregated at the quarterly or half-yearly frequency.

Furthermore, our use of regional trade data enables us to capture IO linkages more precisely. When using national-level trade data, there is the risk of regarding the increases of two independent trade flows in different regions (e.g., increases in imports in a northern region and exports in a southern region) as those based on IO linkages. We reduce this risk by using regional trade data because with this type of data, the geographical area of the trading players is narrowed. Our study provinces total 63, consisting of 58 provinces and five municipalities.

Our findings can be summarized as follows. First, we found that the rise of exports of downstream products to the US significantly increases imports of the corresponding upstream products from China. Second, the rise of those exports does not significantly increase the imports of upstream products from Japan, Korea, or Taiwan. Third, imports of upstream products from China decrease when exports of their downstream products to other ASEAN countries increase. Furthermore, those imports from China do not change when exports to China increase. This result indicates that inputs from China are not significantly used in outputs exported to China on average. Fourth, the IO linkage between exports to the US and imports from China was found to be greater in provinces with better business environments in terms of entry costs, transparency in public services, and public support for business. Among the different regions assessed here, the greatest IO linkages were found in the Mekong River Delta region, i.e., a southern region. Last, this IO linkage was stronger in the earlier period than in the latter period. In other words, the linkage between outputs to the US and inputs from China was

[4]Regarding studies focusing on the first issue, i.e., trade circumvention, see, for example, Hayakawa (2022) and Hayakawa and Sudsawasd (2024).

[5]According to the Global Trade Atlas, in 2023, HS 84 and 85, respectively, account for 36% and 15% of total exports to the US and 37% and 11% of total imports from China.

observed during or just after the period when US tariffs against China were rising.

Our study contributes to the literature on the US-China tariff war.[6] Many studies have examined the direct effects of tariffs on the US economy (Amiti et al., 2019; Amiti et al., 2020; Fajgelbaum et al., 2020; Cavallo et al., 2021; Handley et al., 2024) or on China's economy (Ma et al., 2021; Chor and Li, 2024; Cui and Li, 2021). Some studies have investigated the trade effects on third economies (e.g., Hayakawa et al., 2024; Fajgelbaum et al., 2024). As mentioned above, those in Vietnam were examined in Choi and Nguyen (2023), Rotunno et al. (2023), and Ngoc and Wie (2023). Furthermore, Mayr-Dorn et al. (2023) and Rotunno et al. (2023) investigated the effect of the US-China tariff war on wages in Vietnam, finding that Vietnamese workers and districts more exposed to the trade war displayed higher employment, working hours, and wages.

There are three studies of the IO linkages between outputs to the US and inputs from China. Freund et al. (2023) found that countries with faster export growth to the US in certain sectors also had more intense intra-industry trade with China in those same sectors. It was also revealed that growth in imports of goods at both the HS two- and six-digit levels from China is positively correlated with growth in exports of goods at the related ten-digit levels to the US. Specifically, Freund et al. (2023) sought to capture each country's IO linkages with China using an intra-industry trade index with China or import growth in the same industry/product from China. However, these measures obviously include trade based not on IO linkages, such as trade based on horizontal differentiation or trade circumvention. For this reason, they cannot be used to identify IO linkages precisely.

The other two studies identify the IO linkages better. Covering all industries, Yang and Hayakawa (2023) examined these linkages in Taiwan using monthly trade data from January of 2018 to December of 2019. They used the IO table to identify IO linkages across sectors and found a significant effect on input imports from China. Hayakawa (2024) applied the same method of identifying IO linkages used here to country-level trade data from January of 2017 to December of 2021. He investigated these linkages in East Asian countries, Southeast Asian countries, and Mexico in the general and electrical machinery industries, finding that certain countries, such as Taiwan, Malaysia, and Thailand, enjoy trade diversion effects in the US market. Nevertheless, only Thailand increased imports of upstream products from China to produce those downstream products, especially those goods associated with an intensive margin. Although one country-level study shows insignificant linkages in Vietnam (Hayakawa, 2024), the present study again examines such linkages using regional trade data, which enhances our identification of the IO linkages.

The rest of this study is organized as follows. The next section explains our empirical framework. Section 3 reports our estimation results. Section 4 concludes this study.

[6]See, for example, Fajgelbaum and Khandelwal (2022) for a review of this literature.

II. Empirical Framework

This section explains our empirical framework for investigating the linkage between the exports of downstream products to the US and the imports of upstream products from China. We investigate this issue at the province level in Vietnam. The use of regional data enables us to examine IO linkages more precisely. Suppose that one firm in the northern region imports upstream products from China while another firm in the southern region exports downstream products to the US. These two firms do not have any IO relationship. Using country-level data, we can detect a positive correlation between these two independent trade values and interpret it as indicating an IO linkage. The best data to use to avoid this misinterpretation are firm-level trade data, which are unavailable for our study. Nevertheless, the use of province-level data will lower this risk by narrowing the geographical areas of trading players; here, the regional trade data are obtained from the Global Trade Atlas (IHS Markit), which provides monthly trade values by provinces, trading partners, and products. Due to data limitations, however, we focus on the period from January of 2019 to December of 2023, though US tariffs against China started to increase in 2018.

There are two empirical challenges. One is to identify IO linkages in the trade data. To this end, we follow the methodology developed in Hayakawa (2024); focusing on the general machinery (HS 84) and electrical machinery (HS 85) industries, we exploit the HS structure in these industries. In each four-digit code in these industries, the latter six-digit codes include parts of the former six-digit codes. For HS 8508, for example, HS 850870 is machinery parts of HS 850811, HS 850819, and HS 850860. Another coding type is that an HS four-digit code can form parts of other HS four-digit codes. For example, HS 8529 is parts of HS 8525, HS 8526, HS 8527, and HS 8528. The HS structure enables us to identify a pair between downstream products and the corresponding upstream products. In this way, we identified 82 linkages, i.e., 82 pairs of downstream and upstream products in total. In each pair, we aggregate the trade values of downstream products and those of upstream products separately.[7]

The other concern in this examination of the IO linkage is the time lag in production, which thus far has not attracted much attention in studies using IO tables. The data on the imports of upstream products and exports of downstream products are obtained from the importer and exporter sides, respectively. Therefore, the time point in our data indicates the departure of downstream products at customs in Vietnam and the arrival of upstream products there. After the latter arrival, firms must conduct production activities at their factories. The use of trade data defined at a monthly frequency means that these processes (i.e., the movement of upstream products from customs to firms' factories, the production of downstream products in those factories, and the movement of those products from

[7]According to Hayakawa (2024), these linkages cover 91% of six-digit codes and 92% of the global trade values in 2021. It should be noted that this method is not intended to identify all pairs with IO linkages. For example, although integrated circuits (HS 8542) are included in many modern products, we identify IO linkages within integrated circuits (downstream products are HS 854231, 854232, 854233, and 854239, while their parts are HS 854290). In short, this method identifies the nearest IO relationship in terms of HS codes rather than identifying all possible IO combinations across products.

the factories to customs) are conducted within one month, which seems to be too short. Therefore, we choose a quarterly time frame for the analytical frequency here in the baseline analysis. We also use the data defined at a half-yearly frequency as a robustness check.

Our estimation equation for IO linkage l in province r at time t is specified as follows.

$$\frac{Imports\ \ from\ China_{lrt}}{Imports\ \ from\ World_{lrt}} = \beta \cdot \text{arcsinh}(Exports\ to\ US_{lrt}) + u_{lr} + u_{rt} + u_{lt} + \varepsilon_{lrt} \tag{1}$$

The dependent variable is the imports of upstream products in linkage l in province r from China at time t ($Imports\ from\ China_{lrt}$) normalized by the corresponding global imports ($Imports\ \ from\ World_{lrt}$). Normalization as used here plays a key role in controlling for production expansions regardless of the sales destination. $Exports\ to\ US_{lrt}$ refers to the exports of downstream products in linkage l from province r to the US at time t. We take its inverse hyperbolic sine (or arcsinh) transformation.[8] Because $\text{arcsinh}(0) = 0$, zero-valued variables can be included in our analysis. As demonstrated in Bellemare and Wichman (2020), the elasticity can be computed as $\widehat{\beta}$ divided by the dependent variable if the variables take large values (e.g., >10). Exports to the US meet this requirement.

We control for three types of fixed effects (FE), specifically linkage-province FE (u_{lr}), province-time FE (u_{rt}), and linkage-time FE (u_{lt}). Linkage-province FE control for region-specific product characteristics that are less likely to change dramatically in the short run, such as during our study period, including the existence of downstream and upstream industries and their technology levels in each province. Province-time FE control for time-variant factor prices, such as wages, in each province. This type of FE will also capture the average effect of the COVID-19 pandemic at the province level. Linkage-time FE control for time-variant product characteristics, such as changes in the supply capacity in China, demand sizes in the US, tariffs in the US and Vietnam, or other nationwide policy measures in Vietnam. The US additional tariffs on China are also included in this type of FE. Last, ε_{lt} is an error term. We estimate this model with the ordinary least square (OLS) method.[9]

Last, it is important to discuss endogeneity issues. Due to the inclusion of the three types of FE, our estimates by the OLS method are less likely to be affected detrimentally by omitted variable bias. On the other hand, our analysis of the IO linkage naturally leads to some concern over supply-demand simultaneity bias. For example, a shock to the demand for chips produced by Intel Corporation in Ho Chi Minh City changes exports of chips from Ho Chi Minh City to the US. If Intel

[8]In general, $\text{arcsinh}(x)=\ln(x+\sqrt{x^2+1})$.

[9]The basic statistics for our variables are available in the Appendix.

factories in Vietnam procure machinery parts from China, this shock will change their imports from China in Ho Chi Minh City. As a result, because the error term is positively correlated with exports to the US, the estimate of β by the OLS method incurs upward bias. Furthermore, due to the aforementioned time lag, our independent variable may contain some degree of measurement error, which biases the estimates toward zero. However, it is almost impossible to find instruments defined at a linkage-province-time level. Thus, we assume that unobservable shocks defined at such a detailed level are rare during our study period and that if any exist, our three types of FE control for them for the most part. Specifically, due to our control of US demand and the normalization of the dependent variable, our empirical identification relies on changes in provincial exports to the US in Vietnam driven by the supply side, such as those driven by firms' changes in business strategies based on the US-China tariff war.

Before moving to the estimation results, we provide an overview of exports of downstream products to the US and the imports of upstream products from China. Table 1 shows the growth rates of annually aggregated exports/imports from 2019 to 2023 by province. The findings on export growth to the US are as follows. Many provinces, especially those in the northwest and northeast, did not export to the US in 2019, whereas most of them had positive exports in 2023. Several provinces show extremely high export growth rates, e.g., more than ten times, given their small values in 2019. In other words, even regions that had not exported much to the US increased their exports dramatically during this period. Other regions also experienced remarkable increases close to or exceeding 100%. In 2023, the highest export amounts can be found in Bắc Giang in the northeast region, followed by Bắc Ninh in the Red River Delta region. On the other hand, nearly all provinces had positive imports of upstream products from China in both 2019 and 2023. Nevertheless, compared with exports to the US, many provinces had negative growth in imports from China. Two provinces show import growth of more than ten times due to their small values in 2019. The highest amounts of imports can be found in Bắc Ninh, followed by Hải Phòng, both of which are in the northeast of the country.

TABLE 1—EXPORTS OF DOWNSTREAM PRODUCTS TO THE US AND IMPORTS OF UPSTREAM PRODUCTS FROM CHINA IN 2019 AND 2023

(Unit: Million USD, %)

		Exports to the US			Imports from China		
		2019	2023	Growth	2019	2023	Growth
Northwest							
	Hòa Bình	0.28	141	49,458	6	12	105
	Lai Châu	0	0.00		1	3	252
	Lào Cai	0	0.07		5	2	-60
	Sơn La	0	0.00		7	1	-88
	Yên Bái	0	0.01		6	2	-74
	Điện Biên	0	0.01		3	2	-30
Northeast							
	Bắc Giang	1,971	10,766	446	355	1,423	300
	Bắc Kạn	0	0		0	0	
	Cao Bằng	0	0		1	0.06	-88
	Hà Giang	0	0.01		6	0.16	-97
	Lạng Sơn	0	19		17	18	5
	Phú Thọ	23	422	1,711	35	77	124
	Quảng Ninh	0	411		19	108	463
	Thái Nguyên	5,115	6,020	18	3,893	807	-79
	Tuyên Quang	0	4		1	6	882
Red River Delta							
	Bắc Ninh	5,348	6,691	25	3,418	2,440	-29
	Hà Nam	100	2,333	2,228	67	319	374
	Hà Nội	209	466	123	554	506	-9
	Hưng Yên	75	200	166	30	53	79
	Hải Dương	381	775	103	262	196	-25
	Hải Phòng	2,138	2,931	37	1,057	2,296	117
	Nam Định	0.21	10	4,506	3	5	78
	Ninh Bình	8	2	-74	14	24	74
	Thái Bình	251	12	-95	29	11	-63
	Vĩnh Phúc	290	2,263	681	221	301	37
North Central							
	Hà Tĩnh	0.24	0	-100	100	8	-92
	Nghệ An	0	151		9	46	390
	Quảng Bình	2	0.00	-100	2	2	-2
	Quảng Trị	0	0		0.03	0.29	845
	Thanh Hóa	0.04	2	3,852	1	2	88
	Thừa Thiên–Huế	4	15	315	3	5	108

TABLE 1—EXPORTS OF DOWNSTREAM PRODUCTS TO THE US AND IMPORTS OF UPSTREAM PRODUCTS FROM CHINA IN 2019 AND 2023 (CONT'D)

(Unit: Million USD, %)

	Exports to the US			Imports from China		
	2019	2023	Growth	2019	2023	Growth
South Central Coast						
Bình Thuận	0	0.00		1	2	69
Bình Định	0.01	0.05	816	1	1	128
Khánh Hòa	0.00	1	30,347	1	3	102
Ninh Thuận	0	0.00		0.04	0.07	80
Phú Yên	1	10	690	1	3	395
Quảng Nam	9	105	1,083	7	17	135
Quảng Ngãi	1	28	4,806	31	21	-33
Đà Nẵng	20	82	319	11	13	20
Central Highlands						
Gia Lai	11	0.00	-100	0.01	0.03	173
Kon Tum	0	0		0.22	0.06	-72
Lâm Đồng	0	0.27		0.07	0.07	-2
Đắk Lắk	0	0.00		0.10	0.13	32
Đắk Nông	0	0.00		0.26	12	4,463
Southeast						
Bà Rịa–Vũng Tàu	18	80	352	7	41	516
Bình Dương	362	2,833	683	183	820	349
Bình Phước	8	141	1,603	17	18	2
Hồ Chí Minh	1,643	2,650	61	904	588	-35
Tây Ninh	42	145	246	80	36	-55
Đồng Nai	292	1,046	258	144	305	112
Mekong River Delta						
An Giang	0.26	4	1,276	0.16	1	643
Bạc Liêu	0	6		0.03	0.00	-96
Bến Tre	0.01	0.23	4,046	1	1	-23
Cà Mau	0	0		1	0.08	-90
Cần Thơ	0	4		0.35	0.15	-56
Hậu Giang	0	0		1	0.19	-84
Kiên Giang	0	0.00		0.05	0.16	228
Long An	82	167	103	34	47	39
Sóc Trăng	0	0.00		1	0.15	-72
Tiền Giang	1	7	1,245	8	10	36
Trà Vinh	3	1	-67	3	1	-66
Vĩnh Long	0.26	9	3,415	0.22	4	1,776
Đồng Tháp	0.03	0.00	-86	1	0.23	-55

Source: Author's compilation.

III. Empirical Results

This section reports our estimation results by the OLS method. In all estimations, we cluster standard errors at the province-linkage level. Table 2 reports our baseline results. In the upper panel, we use quarterly trade data. In the "China" column, we regress the import share from China. The coefficient for exports to the US is significantly positive, indicating that the rise of exports of downstream products to the US increases imports of the corresponding upstream products from China. Explicitly, we found the value-added content of Chinese goods in the US imports, i.e., hidden exposure to China in US trade. As mentioned in Section 3, the elasticity can be computed using this coefficient divided by the dependent variable. The sample average of the dependent variable is 0.468, as shown in Table A1 in the Appendix, so that the elasticity becomes 0.005 (=0.002/0.468) on average. The findings show that a 1% increase in exports to the US raises the import share from China by 0.5 percentage points, which may be economically small. Thus, this IO linkage may exist in only some exports to the US. The lower panel shows the results using half-yearly trade data. Exports to the US again have a significantly positive coefficient.

In Table 2, we also show the OLS results using the import share from Japan, Korea, and Taiwan as the dependent variable. While the estimated coefficients are insignificant in Korea and Taiwan, Japan has significantly negative coefficients. The latter result indicates that the increase in exports to the US decreases imports from Japan. Although it is challenging to interpret a negative coefficient, one possible explanation is that the production of downstream products to the US market does not require expensive inputs from Japan, instead taking less costly inputs from

TABLE 2—BASELINE RESULTS BY THE OLS

	China	Japan	Korea	Taiwan
Quarterly				
Exports to US	0.002**	-0.001**	0.000	-0.001
	[0.001]	[0.000]	[0.001]	[0.000]
Number of obs.	37,901	37,901	37,901	37,901
Adj. R-sq.	0.503	0.446	0.532	0.404
Half-yearly				
Exports to US	0.002**	-0.001***	0.000	-0.001
	[0.001]	[0.000]	[0.001]	[0.000]
Number of obs.	21,957	21,957	21,957	21,957
Adj. R-sq.	0.513	0.455	0.544	0.446

Notes: This table reports the estimation results using the OLS method. The dependent variable is the share of imports from the country in the first column out of global imports. We take the inverse hyperbolic sine (or arcsinh) transformation for the independent variables. The study time is defined quarterly in "Quarterly" and half-yearly in "Half-yearly." ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the province-linkage level. In all specifications, we control for province-linkage fixed effects, province-time fixed effects, and linkage-time fixed effects.

China. In addition, the insignificant result for imports from Korea is surprising due to the outstanding presence of Korean multinational firms in Vietnam. One possible reason for this outcome may be that they started exporting to the US before the US-China tariff war and have not competed with goods exported from China in the US market. Specifically, the increase in exports from Vietnam to the US during the tariff war may not be significantly associated with exports by Korean multinational firms. Overall, the increase in Vietnamese exports to the US increased the import inputs from China but not those from other East Asian economies. In other words, hidden exposure to China is significant in the US market compared to that to other East Asian economies.

We conduct three additional analyses. First, we extend export destinations to other regions. Specifically, in Table 3, we introduce exports to other ASEAN countries, China, and the rest of the world (ROW), in addition to those to the US. We take the inverse hyperbolic sine transformation of all of these exports. The dependent variable is the import share from China. The results in exports to the US are unchanged and show significantly positive coefficients. The coefficient for exports to ASEAN member states is insignificant in the quarterly data but significantly negative in the half-yearly data. The negative coefficient indicates that outputs exported to ASEAN are produced using inputs from countries other than China. Interestingly, exports to China have insignificant coefficients, which indicate that inputs from China are not significantly used in outputs exported to China on average. Similar to exports to the US, those to the ROW have significantly positive coefficients.[10]

TABLE 3—OLS RESULTS: EXPORT DESTINATIONS

	Quarterly	Half-yearly
Exports to US	0.002**	0.002**
	[0.001]	[0.001]
Exports to ASEAN	-0.001	-0.002**
	[0.001]	[0.001]
Exports to China	0.001	-0.001
	[0.001]	[0.001]
Exports to ROW	0.002**	0.002**
	[0.001]	[0.001]
Number of observations	37,901	21,957
Adjusted R-squared	0.504	0.513

Notes: This table reports the estimation results using the OLS method. The dependent variable is the share of imports from China out of global imports. We take the inverse hyperbolic sine (or arcsinh) transformation for the independent variables. The study time is defined quarterly in "Quarterly" and half-yearly in "Half-yearly." ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the province-linkage level. In all specifications, we control for province-linkage fixed effects, province-time fixed effects, and linkage-time fixed effects.

[10]We also use the share of exports to the US out of those to the world as an explanatory variable. In the quarterly data, we again obtain a significantly positive coefficient for this share. In the half-yearly data, the coefficient is positive but insignificant.

Next, we investigate instances of province-level heterogeneity in the linkages. In developing countries such as Vietnam, the quantity and quality of government services differ greatly depending on the administrative unit. Therefore, the business environment for the linkage between outputs to the US and inputs from China may also differ by province. To see this heterogeneity, we introduce the interaction terms of exports to the US with three indices defined at the province-year level. These indices are obtained from the Provincial Competitiveness Index (PCI), which is provided by the Vietnam Chamber of Commerce and Industry and the United States Agency for International Development.[11] The indices are calculated using business survey data and published data sources and are standardized on a ten-point scale. For example, the PCI survey for 2022 is based on the responses from 11,872 firms (consisting of 10,590 domestic firms and 1,282 foreign-invested enterprises), with a response rate of 20%. Higher values of the indices indicate a better business environment.

Specifically, the three indices are as follows. The first index is *Entry*, which assesses the differences in entry costs for new firms across provinces.[12] The second is *Transparency*, measuring whether firms have access to the proper planning and legal documents necessary to run their businesses, whether those documents are equitably available, whether new policies and laws are communicated to firms and predictably implemented, and the business utility of the provincial webpage.[13] The third is *Support*, which is a measure of provincial services for private sector trade promotion, the provision of regulatory information to firms, business partner matchmaking, the provision of industrial zones or industrial clusters, and technological services for firms.[14]

We introduce the interaction terms of exports to the US with these three indices into equation (1). Our equation is thus extended as follows.

$$
\begin{aligned}
(2) \qquad & \frac{Imports\ \ from\ China_{lrt}}{Imports\ \ from\ World_{lrt}} \\
& = \beta \cdot \text{arcsinh}(Exports\ to\ US_{lrt}) + \gamma_1 \\
& \cdot \text{arcsinh}(Exports\ to\ US_{lrt}) \cdot \text{arcsinh}(Entry_{r,y-1}) + \gamma_2 \\
& \cdot \text{arcsinh}(Exports\ to\ US_{lrt}) \cdot \text{arcsinh}(Transparency_{r,y-1}) \\
& + \gamma_3 \cdot \text{arcsinh}(Exports\ to\ US_{lrt}) \cdot \text{arcsinh}(Support_{r,y-1}) \\
& + u_{lr} + u_{rt} + u_{lt} + \varepsilon_{lrt}
\end{aligned}
$$

[11]For more details, the reader can see https://pcivietnam.vn/en/about-us.html.

[12]This index is based on items such as the length of business registration in days, the length of business re-registration in days, the percentage of firms that need additional licenses/permits, the number of licenses and permits necessary to start operations after 2010, and/or the number of days to wait for the Land Use Rights Certificate.

[13]This index is based on items such as access to planning documents, access to legal documents, the predictability of the implementation of central laws at the provincial level, and/or the openness and quality of the provincial webpage.

[14]This index is based on items such as the number of trade fairs held by province in the previous year and registered for the present year, the ratio of the total number of service providers to the total number of firms, and/or the ratio of the number of nonstate and foreign direct investment service providers to the total number of service providers.

The subscript y indicates the year of time t. The three indices are lagged by one year. These indices may be endogenous. For example, the existence of active trading firms will encourage local governments to improve the business environment. Due to the absence of appropriate instruments, we cannot eliminate endogeneity bias in any case. Nevertheless, our province-time FE (u_{rt}) will address endogeneity issues based at least on the omitted-variable bias at this level. The estimation results are reported in Table 4 and show natural results. Except for the interaction term with transparency in the quarterly data, all interaction terms have significantly positive coefficients. Thus, the IO linkage between exports to the US and imports from China is greater in provinces with better business environments in terms of entry costs, transparency in public services, and public support to businesses.[15]

To determine which region is more actively engaged in these IO transactions on average, we introduce the interaction terms of exports to the US with region dummy variables rather than the indices on the business environment. We set the northwest region as a base region. The results are reported in Table 5. The most notable result is that the dummy for the Mekong River Delta has the largest, positive coefficient, at a significant level, in both the quarterly and half-yearly trade data. In Table 1, we find that this region increased exports to the US by 130% and imports from China by 33%. These increases are linked to the IO relationship. Thus, firms in the Mekong River Delta may be the main exporters in this IO linkage.

TABLE 4—OLS RESULTS: HETEROGENEOUS EFFECTS

	Quarterly	Half-yearly
Exports to US	-0.071***	-0.080***
	[0.024]	[0.026]
Exports to US * Entry	0.012**	0.012**
	[0.005]	[0.005]
Exports to US * Transparency	0.007	0.011*
	[0.005]	[0.006]
Exports to US * Support	0.009**	0.008*
	[0.004]	[0.004]
Number of observations	37,901	21,957
Adjusted R-squared	0.504	0.513

Notes: This table reports the estimation results using the OLS method. The dependent variable is the share of imports from China out of global imports. We take the inverse hyperbolic sine (or arcsinh) transformation for the independent variables. The study time is defined quarterly in "Quarterly" and half-yearly in "Half-yearly." ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the province-linkage level. In all specifications, we control for province-linkage fixed effects, province-time fixed effects, and linkage-time fixed effects.

[15]The coefficient for exports to the US becomes negative in 9% of all observations. Such observations arise in provinces with worse business environments. In those provinces, an increase in exports to the US does not increase imports from China.

TABLE 5—OLS RESULTS: BY REGION

	Quarterly	Half-yearly
Exports to US	-0.013*	-0.008
(Base: Northwest)	[0.007]	[0.007]
* Northeast	0.013*	0.008
	[0.008]	[0.007]
* Red River Delta	0.015**	0.008
	[0.007]	[0.007]
* North Central	0.018**	0.012
	[0.009]	[0.008]
* South Central Coast	0.017**	0.011
	[0.008]	[0.007]
* Central Highlands	0.008	0.013
	[0.017]	[0.017]
* Southeast	0.016**	0.01
	[0.007]	[0.007]
* Mekong River Delta	0.018**	0.013*
	[0.008]	[0.008]
Number of observations	37,901	21,957
Adjusted R-squared	0.503	0.513

Notes: This table reports the estimation results using the OLS method. The dependent variable is the share of imports from China out of global imports. We take the inverse hyperbolic sine (or arcsinh) transformation for the independent variables. The study time is defined quarterly in "Quarterly" and half-yearly in "Half-yearly." ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the province-linkage level. In all specifications, we control for province-linkage fixed effects, province-time fixed effects, and linkage-time fixed effects.

In the quarterly trade data, the north central region also has a significantly large coefficient.[16]

Last, we examine IO linkage changes over time. To do this, we introduce the interaction terms of exports to the US with year dummy variables, setting 2019 as the base year. These results are reported in Table 6. The coefficient for exports to the US is significantly positive. The coefficients for the interaction terms with dummy variables for 2020 and 2021 are insignificant, while those for 2022 and 2023 have significantly negative coefficients in quarterly and half-yearly data, respectively. These results imply that the IO linkage was stronger in the earlier period than in the latter period. In other words, the linkage between outputs to the US and inputs from China was observed during or just after the period when US tariffs against China were rising.

[16]In the quarterly data, the coefficient for exports to the US is significantly negative, consistent with the fact in Table 1 that a majority of northwest provinces experience negative growth in imports from China.

TABLE 6—OLS RESULTS: BY YEAR

	Quarterly	Half-yearly
Exports to US	0.003**	0.004**
(Base: 2019)	[0.001]	[0.002]
* 2020	-0.001	-0.002
	[0.001]	[0.001]
* 2021	0.000	-0.001
	[0.002]	[0.002]
* 2022	-0.002	-0.003*
	[0.002]	[0.002]
* 2023	-0.003*	-0.002
	[0.002]	[0.002]
Number of observations	37,901	21,957
Adjusted R-squared	0.503	0.513

Notes: This table reports the estimation results using the OLS method. The dependent variable is the share of imports from China out of global imports. We take the inverse hyperbolic sine (or arcsinh) transformation for the independent variables. The study time is defined quarterly in "Quarterly" and half-yearly in "Half-yearly." ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the province-linkage level. In all specifications, we control for province-linkage fixed effects, province-time fixed effects, and linkage-time fixed effects.

IV. Concluding Remarks

Several studies have shown that the US-China tariff war significantly decreased China's exports to the US but dramatically increased exports from Vietnam to the US. However, it has been also pointed out that such exports from Vietnam are supported by intermediate goods imported from China. Against this backdrop, this study empirically investigated how the exports of downstream products to the US changed the imports of the corresponding upstream products from China during the US-China tariff war. To capture the IO linkages precisely, we used province-level trade data in Vietnam. Specifically, focusing on the trade in general and electrical machinery industries from January of 2019 to December of 2023, we regressed imports of upstream products from China on exports of their downstream products to the US.

As a result, we found that exports of downstream products to the US significantly increased imports of their upstream products from China. On the other hand, these increases did not significantly increase the imports of upstream products from Japan, Korea, or Taiwan. Furthermore, the IO linkage between exports to the US and imports from China was found to be greater in provinces with better business environments in terms of entry costs, transparency in public services, and public support to business. In terms of regions, on average the greatest linkages were found in the Mekong River Delta region, i.e., a southern region, as opposed to regions sharing borders with China. Overall, our results imply that China may compensate for the loss of exports to the US by increasing exports to Vietnam. One caveat is that our results are valid only in intra-sectoral linkages, i.e., the IO linkages within general or electrical machinery products. There may exist inter-industry linkages between outputs to the US and inputs from China, calling for futher research in this area.

APPENDIX. OTHER TABLES

TABLE A1—BASIC STATISTICS: QUARTERLY

Variable	Obs	Mean	Std. Dev.	Min	Max
Import share from China	37,901	0.468	0.414	0	1
Import share from Japan	37,901	0.086	0.217	0	1
Import share from Korea	37,901	0.114	0.260	0	1
Import share from Taiwan	37,901	0.049	0.171	0	1
Exports to US	37,901	2.714	5.554	0	22.231
Exports to ASEAN	37,901	3.468	5.511	0	20.863
Exports to China	37,901	2.714	5.243	0	22.822
Exports to ROW	37,901	4.967	6.424	0	22.875
Exports to US * Entry	37,901	7.213	14.763	0	61.693
Exports to US * Transparency	37,901	6.822	13.971	0	58.833
Exports to US * Support	37,901	6.998	14.330	0	57.981

Note: Except for import share variables, we take the inverse hyperbolic sine transformation for all variables.

Source: Author's compilation.

TABLE A2—BASIC STATISTICS: HALF-YEARLY

Variable	Obs	Mean	Std. Dev.	Min	Max
Import share from China	21,957	0.472	0.408	0	1
Import share from Japan	21,957	0.082	0.209	0	1
Import share from Korea	21,957	0.109	0.250	0	1
Import share from Taiwan	21,957	0.049	0.170	0	1
Exports to US	21,957	2.816	5.684	0	22.895
Exports to ASEAN	21,957	3.910	5.741	0	21.306
Exports to China	21,957	2.991	5.473	0	23.497
Exports to ROW	21,957	5.375	6.548	0	23.481
Exports to US * Entry	21,957	7.487	15.112	0	63.583
Exports to US * Transparency	21,957	7.078	14.297	0	60.602
Exports to US * Support	21,957	7.257	14.661	0	59.644

Note: Except for import share variables, we take the inverse hyperbolic sine transformation for all variables.

Source: Author's compilation.

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