Discussion Paper Series A No.745

Adjustments of Multinational's Production Activities in Response to the US-Sino Trade War: Evidence from Japanese affiliate-level data

LIANG Licheng
(Graduate School of Economics, Keio University)
and
MATSUURA Toshiyuki
(Professor, Keio Economic Observatory, Keio Univeristy)

July 2023

Institute of Economic Research
Hitotsubashi University
Kunitachi, Tokyo, 186-8603 Japan

Adjustments of Multinational's Production Activities in Response to the US-Sino Trade War: Evidence from Japanese affiliate-level data*

LIANG Licheng† MATSUURA Toshiyuki‡

July 3, 2023

Abstract

Using factual affiliate-level data of Japan's multinational firms from 2017 through 2019, this study investigates the impact of a trade shock (the 2018 US-Sino trade war in this case) on multinational firms' overseas production activities. Focusing on Japanese affiliates in the Association of Southeast Asian Nations (ASEAN) countries, we find evidence of a potential production shift from China to the ASEAN member countries. According to our empirical results, in response to the trade war, those affiliates in the ASEAN with vertically integrated Chinese siblings belonging to the same multinational parent's value chains may increase their export to North America and see a growth in total sales. Fast substitution of export and production occurs through the production network within Japanese multinationals when a part of which is negatively affected by the trade shock. In addition, this group of affiliates are also likely to increase both the share and value of local procurement. The study highlights the positive role of setting up a diversified production network for multinationals.

Keywords: trade shock; multinational enterprise (MNE); affiliates

JEL Codes: F13; F14; F23

*This study is conducted as a part of the project "Restructuring of multinational production networks in response to economic and institutional changes" undertaken at the Joint Usage and Research Center Programs, Institute of Economic Research, Hitotsubashi university. The microdata access in this study is granted by the National Statistics Center and used in the onsite facilities (statistical research data center) set up by universities and research institutions collaborating with the National Statistics Center. The authors wish to thank the Joint Usage and Research Center Programs under Hitotsubashi University for their great support. The authors are also grateful for helpful comments and suggestions by Nobuaki Yamashita (Swinburne University of Technology), Chih-Hai Yang (National Central University), Bin Ni (Hosei University), Naoto Jinji (Kyoto University) and the seminar participants at Keio University and Kyoto University.

†Graduate School of Economics, Keio University

‡Professor, Keio Economic Observatory, Keio Univeristy

1 Introduction

How do multinational enterprises (MNEs) respond to an unexpected negative trade shock? Would they adjust the production network when a part of it is affected by such a shock? To explore the impact of trade shock on MNEs' overseas organization of production activities, a trade war between the US and China starting in 2018 can serve as a quasi-natural experiment, given that the landmark event of the beginning is relatively exogenous. In 2018 March, the Trump administration of the US announced tariffs on up to $60 billion of goods imported from China, and subsequent retaliatory custom duties were imposed by China later, leading to a war-type trade conflict. By 2021, with persisting escalated tariffs, the trade war has racked up nearly $100 billion in duties. Against this background of an escalating situation, the economic impact of the trade war attracts worldwide attention, and related issues are extensively explored both from macro and micro perspectives. A branch of previous studies has examined the economic impact of the trade war on US income and investment (Amiti et al., 2019; Amiti et al., 2021), the financial performance of American and Chinese listed companies (Huang et al., 2019), and overseas operations by multinational enterprises from the view of a third country (Sun et al., 2019). Relative to previous studies, instead of evaluating the direct impact on firm performance, we mainly utilize a detailed Japanese overseas affiliates' data set to investigate potential adjustments of production activities, to be more specific, the shift of production within multinationals as a response to the US-Sino trade war.

Although amounting tariffs lead to a decline in trade flows between US and China, the impact on third countries can be heterogeneous across regions and sectors. In fact, we see the increases in global trade of products targeted since many bystander countries substituted Chinese exports to the US market along with newly created export opportunities (Fajgelbaum et al., 2022). For example, the automotive industry is targeted by both the US and China, making it heavily hit by the trade war. Comparing trade values (measured by Free Alongside Ship price in US$) of automotive parts imports to the US by various countries

between 2015 and 2020 (see Figure 1 below), we can see that imports from China dropped dramatically since 2018. However, meanwhile, the ASEAN imports kept growing and saw a sudden rise, especially from two member countries– Thailand and Vietnam – witnessed steadily and significantly growth of export in automotive parts to the US market around and after 2018. Seemingly, ASEAN countries took the role as new export platforms, and their export to the American market benefited from the war.

Insert Figure 1 about here.

From the micro perspective, multinational firms dominate international trade. A part of multinational's value chains located in the "war zone" is unlikely to avoid the hit of trade shock, and consequently, those multinationals get motive to relocate part of chains to relatively safe destinations– some other export platform countries(Flaaen et al., 2020). Regarding the case of Japan, the trade war somehow accelerates such a relocation process. Prior to the trade war, due to soaring labor costs in China, low-wage neighboring countries were found to benefit from the competition to inviting inward foreign direct investment (FDI) (Donaubauer and Dreger, 2018). Compared to China, the ASEAN countries like Indonesia and Vietnam became more attractive for Japanese FDI due to their lower labor costs and lower exposure to tariffs. According to a report by the Japan External Trade Organization (JETRO) in 2020 [1], a bunch of Japanese multinational manufacturers investing in China tend to move a part of production lines from China to other countries, including Thailand, Vietnam, other ASEAN states, Mexico (due to geographical proximity to the US), and home country to avoid rising Chinese labor cost or higher trade war tariffs. As summarized by the intention survey, among 293 interviewed MNEs, at least 9.2% MNEs show a willingness to move or have already been working on it. Regarding the scale of production relocation, 42.3% of those MNEs planned to or have already moved 10% to 30% production outward China. Moreover, 30.8% of them prefer to move out more, ranging from 30% to 100%. A

[1] Related information and data can be found at https://www.jetro.go.jp/biz/areareports/special/2019/1201/b9bc9720fbf660d4.html

few of the big names appear on the wish list, such as Mitsubishi Electric, Ricoh, Sharp, etc., across multiple industries– including automotive, chemicals, electronic equipment, and manufacturing machinery.

Taking the experience of Japanese manufacturing MNEs into account, we use the 2018 US-China trade war as an exogenous shock and hypothesize that this shock would cause further adjustments of the production network toward the ASEAN, increasing export from affiliates located in the ASEAN to the North American market. Figure 2 illustrates the conceptual framework behind this hypothesis. At this point, our study documents direct evidence of production relocation/substitution within multinationals due to the negative shock induced by the trade conflict.

Insert Figure 2 about here.

Our study relies on detailed information about Japanese multinationals' parents and their foreign affiliates from the Basic Survey on Overseas Business Activities (BSOBA) compiled by the Ministry of Economy, Trade and Industry (METI). By adopting a simple difference-in-differences (DID) setting for a data set on the information of Japanese affiliates in the ASEAN region, we find that those with affiliates established in China belonging to the same Japanese parent multinational's production network (from now on referred to as "Chinese siblings") may see an increase on total sales after the burst of the trade war. By further distinguishing the type of Chinese sibling affiliates, we find it is that affiliates in the ASEAN with vertically integrated Chinese siblings in the same multinational value chains tend to increase their total sales and export to North America. While, sampling multinationals and their affiliates in the ASEAN differ in many ex-ante features, such as degree of exposure to trade with the United States, firm size, productivity, etc. These production-relevant features may bias the estimation of the impact of the trade war on production and export performance. In order to address the potential problem of selection bias, we combine our DID setting with the propensity score matching approach for the baseline empirical estimation. Compared with results from simple DID analysis, the DID result on matched samples shows a more significant

and economically sizable positive effect of the trade war on exports to North America, local procurement, total sales and employment for focused affiliates in the ASEAN. To sum it up, we find that ASEAN-located Japanese affiliates with Chinese siblings highly integrated into the multinational's production network would function as a new export platform for the North American market, implying that the trade war leads to further relocation of overseas production within the Japanese multinationals.

This paper is organized as the followings. Section 2 presents the literature review, while the empirical strategy is explained in section 3. Then, after briefly explaining our data in section 4, we show estimation results in section 5. Section 6 concludes this study.

2 Literature Review

Our paper is mainly related to three strands of literature. First, this paper contributes to the nascent literature on the trade war in general. Benguira (2022) examines the impact of the trade war on revenue earned by using the data on 5536 listed companies from 40 countries and points out that firms benefit from export exposure to the US but are hurt by export exposure to China. The mechanism behind this suggests that firms with higher exposure to the US can take the chance of substituting Chinese goods due to the trade war. Our study is grounded on the recent work by Sun et al. (2019) suggesting that Japanese multinationals' operations in China are negatively affected by the trade war, and the higher degree of reliance on trade with North America, the more severe the impact could be. Moreover, as shown by their finding, the affiliates located in China that are highly dependent on trade with the US are more likely to see a decline in total sales, driven by a drop in exports to third countries. Accordingly, Huang et al. (2019) examines the market response of US firms to the initial round of tariff hike and reveals that dependence on trade with China can explain a firm's worsening financial performance; moreover, their finding addresses that production linkages intervene in the effect of the 2018 trade war leads to heterogeneous responses by

US firms. Ito (2022a) finds similar patterns of trade diversion by analyzing the monthly tariff-line trade data of the US, pointing out that trade partner countries of the US replaced Chinese exports of the tariff-targeted goods. He also demonstrates that the trade war tariffs improved Japan's trade terms and led to an increase in exports from Japanese industries positioned upstream within the value chains to Chinese downstream industries (Ito, 2022b).

Second, there is another growing body of literature on multinationals' reorganization of overseas production under shocks. Using German manufacturing MNEs' data, Becker and Muendler(2010) documents that multinational firms would reallocate employment across existing affiliates in response to wage differentials among locations. Flaaen et al. (2020) provides indirect and partial evidence on multinational firms' production relocation behavior. By analyzing the product-level data for the US, they find that relocation of production by multinationals intervenes in the pass-through of tariffs to consumer prices. Because of potential production relocation, the price effect of tariffs becomes non-monotone. Regarding the related experience of Japan, Hayakawa et al. (2015) documents how Japanese affiliates change their procurement patterns after a natural disaster. They focus on the impact of the Thai Flood in 2011 on Japanese affiliates in ASEAN countries and find that supply-chain disruptions caused by natural disasters change Japanese affiliates' import and local procurement.

Moreover, this study is also related to the issue of shock propagation mechanics through the production chains. Todo et al. (2015) examines Japan's firm-level data, and their finding documents the advantages of a diversified supply chain network. According to their finding, even though a widely expanded supply network may delay the recovery from the Great East Japan Earthquake, firms can easily replace damaged firms with surviving ones in the same network to receive support. Thus, diversified or non-concentrated supply chain networks may improve resilience of firms to exogenous shocks. Similarly, Mendes (2021) also shows that firms that adjusted and diversified their supplier network in the years following the 2011 Great East Japan Earthquake may gain immunity to other exogenous shocks in the future

(i.e., the COVID pandemic as the case).

Building upon these previous researches, this study will contribute to the literature on trade friction between the US and China from a third-country perspective and provide new and more direct empirical evidence on production network adjustment behavior by MNEs against adverse shocks. The next section will discuss the empirical strategy for our analysis.

3 Empirical strategy

3.1 Treatment and control groups

Adopting a DID setting for estimation, first, we define the treatment and the control groups. Here we set up two treatment groups: treatment group (1) consists of all affiliates in the ASEAN with purely vertical FDI-typed Chinese siblings; treatment group (2) includes ASEAN affiliates associated with horizontal and other FDI-typed Chinese siblings. Those affiliates without any Chinese siblings fall into the control group. There are two major reasons to use this classification of treatment groups: first, as mentioned already, affiliates in ASEAN with Chinese siblings may react actively to the shock, especially those affiliated to an MNE prone to move production outward China, as they can relocate their production across borders through within-MNE networks; second, classifying the FDI types of sibling affiliates in China enables us to more precisely identify the heterogeneous impact of trade shocks on MNEs' production networks. Because affiliates in ASEAN may operate independently with their HFDI-type Chinese siblings, but those with vertically integrated siblings in other locations are more sensitive or vulnerable to the shock. We use the measure proposed by Alfaro and Charlton (2009) to classify the FDI forms of Chinese sibling affiliates regarding their industry affiliation. Similarly, we classify VFDI siblings as those who produce in industries that are intermediate inputs to the parent firm's final products and HFDI siblings if they produce in the same sector as their parent owner. Due to a lack of detailed intrafirm trade data, we infer the input-output relationship between industries where affiliates and parents

respectively operate according to the Input-Output tables (I-O tables) for Japan[2]. Following Alfaro and Charlton's method, we also need to calculate a vector of "total requirements" coefficients [3] or "direct requirements" coefficients[4] indicating the input relationship between industries from the I-O matrix with which we set a threshold to describe the strength of such a connection. Only the affiliate with a coefficient above the threshold can be selected as an input supplier for its parent owner, in other words, a VFDI affiliate. In our main analysis, we set 0.01 for the "total requirements" coefficient as the threshold, and alternative coefficients are used for the robustness check.

3.2 DID estimation with propensity score matching

The central aim of this paper is to identify the causal effect of the trade war on the production activities of ASEAN-located Japanese affiliates with different types of Chinese siblings. To evaluate the effect, we can estimate the following Average effect of Treatment on the Treated (ATT):

$$\begin{aligned} ATT =& E[y_{T,i,t'}|D_i = 1, X_{i,t}] - E[y_{0,i,t'}|D_i = 1, X_{i,t}] \\ T =& \{1, 2\} \end{aligned} \tag{1}$$

where $y_{T,i,t'}$ and $y_{0,i,t'}$ denote the outcomes in the post-trade war situation of treatment and counterfactual situation of the control. D_i represents a dummy variable indicating whether ASEAN-located affiliates hold VFDI/HFDI and other Chinese siblings, which takes one if an ASEAN-located affiliate i has VFDI/HFDI and other Chinese siblings (receiving treatment 1/ treatment 2), 0 if such affiliate has no Chinese siblings (being controlled), while, $X_{i,t}$ is a vector of pre-trade war pre-treatment affiliate-level characteristics. The impact of trade war on affiliate performance is given by $y_{T,i,t'} - y_{0,i,t'}$, meaning the average difference in

[2]We refer to the 2015 version of I-O tables which is compiled by Ministry of Internal Affairs, and Communications of Japan. The information in the I-O tables is assigned by 6-digit industrial sector codes, which are matched to 4-digit industry codes in the BSOBA datasets.

[3]Total requirements coefficients captures both the direct and indirect use of inputs to produce a dollar of commodity output.

[4]Direct requirements coefficients only shows both the direct use of inputs to produce a dollar of final output by industry.

outcomes between treated and controlled affiliates who are identical to each other. However, the second term on the right-hand side, $E[y_{0,i,t'}|D_i = 1, X_{i,t}]$, can not be estimated directly since it is a counterfactual.

Why we need to consider the counterfactual situation? As mentioned above, post-war outcomes (e.g., sales, exports) of the ASEAN-located affiliates may be influenced by their pre-war characteristics, so there is a potential concern that affiliates in the control group may be inherently under-performed on exporting even there was no trade war. In other words, the affected affiliates are unlikely from a random sample. In order to avoid such selection bias and find suitable pairs of affiliates in comparison, we conduct propensity score matching before the DID analysis. By doing so, we attempt to find affiliates in the control group having similar pre-war characteristics as those in the treatment groups. That's to say, each treated affiliate is matched with a controlled affiliate that has similar probability of holding a VFDI or HFDI and other typed Chinese siblings.

Accordingly, to compute the propensity score of affiliates falling into each treatment group, we estimate a logistic model to investigate the determinants of having a VFDI or HFDI and other Chinese siblings, respectively, using pre-war characteristics of the ASEAN-located target affiliate at the first stage. Since the choice of VFDI sibglings or HFDI siblings can be endogenously determined, logit estimation and matching are separately conducted for the two cases: affiliates with VFDI Chinese siblings vs. affiliates without Chinese siblings, and affiliates with HFDI and other Chinese siblings vs. affiliates without Chinese siblings. Considering the impact of the trade war on overseas activities, a problem of potential simultaneity selection of FDI location may arise, so we only use the pre-war characteristics of parent firms to estimate the choice. We run the following model:

$$P(D_{i,Pre-war} = 1) = \Lambda(X_{i,Pre-war} + v_c) \tag{2}$$

where indicator D implies whether the hypothetical affiliate i in ASEAN has VFDI/HFDI and other siblings in China before the trade war, taking 1 if it has VFDI/HFDI and other Chinese siblings, 0 for the opposite. X denotes pre-trade war characteristics of the ASEAN affiliate (e.g., firm size, firm age, labor productivity, labor cost, procurement from the parent owner). We also include the host country fixed effects, v_c. Using the obtained propensity score for each affiliate, we match between observations of affiliates in control and treatment groups for each industry to ensure the matching is restricted to affiliates within the same sector. Caliper matching is the baseline method for matching procedure [5], and we also employ kernel matching as an alternative method. For comparison, we run simple DID to check whether the results are robust even without matching.

Next, based on the matched pairs of observations, we run the DID specification to estimate the impact of the trade war on outcomes regarding affiliates' production activities. Overall, the estimator of DID with propensity score matching approach is given by:

$$\begin{aligned} PSM-DID =& \frac{1}{n_i}\sum_{i\in I_T}[\Delta y_{T,i,t'} - \sum_{j\in I_0} w(ps_i, ps_j)\Delta y_{0,j,t'}] \\ T =& \{1,2\} \end{aligned} \tag{3}$$

In the equation, I_T is the set for the treatment group 1 or 2 ($I_T = \{i : D = 1\}$), and I_0 is the set for the control group ($I_0 = \{i : D = 0\}$). Given t the pre-war period and t' the post-war period, we have $\Delta y_{T,i,t'} = y_{i,t'} - y_{i,t}$ and $\Delta y_{0,j,t'} = y_{j,t'} - y_{j,t}$, indicating that the difference in outcome y before and after the occurrence of the trade war for the treated affiliates and controlled ones, respectively. $w(.)$ denotes the weight for the matching between samples i and j; ps_i and ps_j are respective propensity scores for the treatment group and control group.

At the second step, the specification of our DID setting for the control and treatment

[5]The caliper is set as 0.05 for the matching process

groups is shown as the following:

$$\begin{aligned} y_{a,c,t} =& \beta_1 \cdot ChinaSib_a \cdot Post_t \cdot VFDI_{chnsib} + \beta_2 \cdot ChinaSib_a \cdot Post_t \cdot OtherFDI_{chnsib} \\ &+ u_a + \gamma_{s,t} + v_c + \epsilon_{a,s,c,t} \end{aligned} \tag{4}$$

where $y_{a,c,t}$ denotes outcomes (e.g., sales to North America, imports from North America, imports from Asia, local procurement, total sales, investment, and the number of employees) for the affiliate a in an ASEAN country c in year t. $ChinaSib_a$ equals one if the affiliate in ASEAN has a sibling affiliate in China in year t and 0 otherwise; $Post_t$ is a dummy variable indicating the period after the occurrence of a trade war (t=2018 and aftermath in this case); $VFDI_{chnsib}$ represents an indicator variable corresponding to 1 if Chinese siblings of target affiliate are classified as vertical FDI, 0 otherwise; $OtherFDI_{chnsib}$ takes 1 when Chinese siblings are in the category of horizontal FDI or others (note that there could be the case that both VFDI and HFDI Chinese siblings are in operation). u_a is included to control affiliate-level fixed effects; $\gamma_{s,t}$ represents the industry-year fixed effect controlled to filter out industry-specific trend that may intervenes the outcomes; v_c is set for country fixed effects and $\epsilon_{a,s,c,t}$ denotes the error term. After the matching procedures, we test this DID specification based on the matched samples. In the next section, we discuss data issues and a summary of statistics.

4 Data

4.1 Data sources

Affiliate-level data of Japanese multinational firms are from Japan's governmental surveys. Our data source is the Basic Survey on Overseas Business Activities (BSOBA), compiled by the ministry of economy, trade and industry (METI). The raw data set on this survey contains more than 25,000 observations each year for Japanese affiliates worldwide in all

industries except finance and insurance. We construct our primary data set by using the information provided by this survey. Company profiles in this data source enable us to identify company name, location, industrial classification, and affiliation for all existing overseas subsidiaries operated under Japanese MNEs during the sample period. Besides, one merit of using this data source is that it contains detailed information on affiliate-level sales and procurement, which are decomposed into shipment destinations and procurement origins (e.g., local market, North America, Asia, Europe, and rest of the world). The decomposed export is critical for our analysis since the change of exports to North America, especially the US, is our main concern. Note that exports to the US would be a more appropriate candidate variable for the analysis, but the data on affiliate-level sales does not include any country-level categories, so we use the exports to North America instead to proxy it [6]. It is a reasonable choice because exports to the US have accounted for most of the ASEAN's exports to North America during the sample period [7]. Additionally, we can obtain various affiliate-level characteristics from the source, such as the number of regular employees, paid-in-capital, etc. Our data are panel data covering the three years from 2017 to 2019 [8].

Information on parent firms' profile and features comes from the same data source, BSOBA, but a different subsection of the surveys titled the survey form for parent companies. From the data on the survey designed for parent companies, we can refer to the profile of parent firms (i.e., company name, identification code, industrial affiliation) and extract the ownership data. Corresponding to the affiliate-level data set, we also have a three-year data set for all the parent companies, spanning from 2017 to 2019.

To identify the input relationship for affiliates and split treatment groups in terms of the FDI forms, we utilize the information provided by the 2015 Input-Output tables (I-O

[6]In BSOBA, the category of North America includes only the US and Canada.

[7]According to UN Comtrade Database, in 2017, before the trade war, ASEAN exports to the US were more than $143 billion, while the exports to Canada were about $ 7.8 billion. The US export share in total export to the US and Canada is around 95%.

[8]As of 2021, METI does not provide data prior to 2017 for data users who work at research data center set up by universities and research institutions in collaboration with the National Statistics Center, so we limit our sample period to be from 2017 to 2019.

tables) for Japan. Firstly, the data is matched to BSOBA datasets according to the correspondence table for industrial classifications between BSOBA and I-O tables. Then, we construct the total requirements coefficients matrix and direct requirement matrix at the four-digit BSOBA industry level, and the matrices provide a vector of coefficients that enable us to identify the input-output relationship for parent firms and their affiliates.

Our final data set covers all Japanese manufacturing affiliates located in the ASEAN countries (i.e., Singapore, Malaysia, Thailand, Indonesia, the Philippines, Cambodia, Brunei, Lao PDR, Vietnam, Myanmar) between 2017 and 2019, including their sales, imports, exports, investment, and employment.

4.2 Description of statistics

Statistics of control and two treatment groups for the DID analysis are summarized in Table 1. Treatment group 2 ("Other Chinese siblings" on the table) has the most significant number of affiliates and observations. Our dataset has 1,838 Chinese siblings classified as HFDI or other types. In contrast, the number of VFDI Chinese siblings is the lowest; only 155 affiliates fall into this category. Regarding the share of export to North America (from now on referred to as "NA") in total sales, computed by the ratio between export to NA and total sales, the average values are almost identical for all three groups, which are above 1% for all groups. However, as for the log of export value to NA, ASEAN-located affiliates with VFDI Chinese siblings contribute the highest on average. Contrasting to the control group, both treatment groups have a much higher average value on exports to NA during the observation period, 0.917 and 0.809, respectively. It is the same with the log of imports from NA. Total sales and the number of employees are also more remarkable for the affiliates with Chinese siblings than those without any. We can also find that affiliates with VFDI Chinese siblings take the highest value of the investment, and the lowest is for those with no Chinese siblings. Notably, affiliates with VFDI Chinese siblings see the highest imports from NA, and they also have the highest share of NA imports measured by the ratio between imports from NA

and total purchases. This group of affiliates accounts for the largest share of home-country imports measured by the cost of goods sold. Seemingly, affiliates with VFDI Chinese siblings maintained close production linkage with Japanese suppliers. Hence, they are more likely to function as new exporting platforms when Chinese siblings are troubled by the trade war. Regarding procurement, affiliates with no Chinese siblings see the highest value in either log of local procurement and the share of local procurement in total purchases.

Insert Table 1 about here.

Significant heterogeneity between the treated and controlled affiliates can also be observed from distributions of some affiliates' characteristics. Visualization of distributions for total sales, employment, and investment is illustrated in Figure 2. Taking the distribution of total sales as an example, we find that both treatment groups are located at the right of the control group and show a more considerable mean value, which is in line with the finding from summary statistics. Similarly, for the case of investment, both treatment groups are characterized by higher average investment than the control, but there seems to be no apparent difference between the two treatment groups. Given the existence of observable differences, matching is a proper tool to help us at least reduce the bias of sample selection for further analysis.

Insert Figure 3 about here.

Bearing in mind the difference in characteristics between groups, we investigate the second difference – the difference in affiliates' production performance before the trade war and after. We plot the time trend for respective characteristics within each group during the sample period. Since exports to NA is the main variable of interest, we show the time series of export to NA separately for each treatment and control group in Figure 4. The green dashed line represents the control group, the solid yellow line represents the treatment group (1), and the solid blue line refers to the treatment group (2). A vertical red dotted line indicating the timing of the trade war separates the whole time into the pre-war and post-

war periods. Around and after the year of 2018, exports to NA increased for the group of affiliates with VFDI Chinese siblings, enlarging the gap with the affiliates having no Chinese siblings. In contrast, the group of affiliates with other types of FDI roughly remained at the same export level to NA even after the trade war. Figure 5 shows the logged total sales time series for three groups, respectively. the treatment group (1) shows a upward tendency of logged total sales after the trade war, while the control group sees a slight decline in total sales. Figure 6 shows identical patterns of the trend for investment across all the affiliates in the ASEAN. With the beginning of trade war, investment was likely to increase for affiliates in the ASEAN to facilitate the relocation of production. Figure 7 shows employment changes for each group over the years. Compared to the control group, both treatment groups increased their labor input slightly around the trade war. Finally, there could be many explanations for the decreasing labor for affiliates in the control group. One explanation is that those affiliates face more competition from other affiliates or local firms, thus adjusted labor input.

Insert Figure 4 - Figure 7 about here.

From the graphical representation of the difference in affiliates-level characteristics before and after the trade war, we find that the trade war may lead to MNEs' adjustment of production activities for those affiliates with Chinese siblings. The next section shows the corresponding results for the empirical estimations.

5 Results

5.1 Baseline

Following the matching approach described in Section 3.2., we first estimate the logistic model shown by equation (2) to calculate the propensity scores for all affiliates in our data set. Using the pre-trade war data (the data for the year 2017 in this case), we estimate the

model to examine whether an affiliate has VFDI or HFDI and other typed Chinese siblings based on a series of its features (e.g., age, size, R&D ratio, sourcing from parent owner). The dependent variables are the VFDI Chinese sibling dummy and the "HFDI and Other" Chinese sibling dummy. Regarding the explanatory variables, we include log of firm age, log of total labor cost[9], firm size[10], sourcing from parent ("Parent sourcing" variable), R&D ratio, and labor productivity[11]. The model also includes a set of industry and host country dummies.

The results from logit estimation are summarized in Table 2. As for the case of VFDI Chinese siblings, we can see only the firm size associates with a significant coefficient, indicating that larger ASEAN-based affiliates are likely to have a vertically operated Chinese sibling. In contrast, many features are significant determinants for an affiliate to keep a horizontal integrated or other typed Chinese sibling, including firm age, labor cost, size, and labor productivity. This result shows that younger and larger affiliates with higher labor productivity tend to have other typed siblings in China.

Insert Table 2 about here.

Using the results from logit estimation, we assign the propensity scores to all affiliates and then select the affiliate in the control group to its most similar one in the treatment group in terms of their propensity scores with the matching technique. Through caliper matching, a matched affiliate in the control group is supposed to be "identical" to affiliates in either treatment group 1 or treatment group 2 in terms of its propensity score. To check the effectiveness of matching, we employ the balancing test. The balancing test examines whether the mean of each variable differs between each treatment and the control group. So, for every variable in the propensity score estimation between the treatment and control group, we conduct the t-test to check the equality of their means before and after matching.

[9]Here, we use total salaries to proxy labor cost.

[10]We use the log of total sales to proxy firm size.

[11]Labor productivity is defined as the sales per employee, and this variable is centered by using the industry-level mean.

The test results are shown in Table 3, which reveals that almost all the variables in each case satisfy the balancing condition, indicating that the matched pairs of affiliates from the control and treatment groups share very similar pre-war characteristics.

Insert Table 3 about here.

Table 4 shows the estimation results of the DID regression with caliper matching. The left panel of the table presents the case for the treatment group (1), and the right panel for the treatment group (2). According to these baseline estimates, first, we can see that ASEAN affiliates with VFDI Chinese siblings (the treatment group (1)) tend to experience a significant positive and sizable increase in exports to NA after the trade war. Hiking tariffs may lead to around a 31.5% increase in NA exports for this group of affiliates compared to those with no Chinese siblings (the control group). This result supports our hypothesis that affiliates in ASEAN with vertically integrated Chinese siblings may perform actively after the shock. As one consequence of increasing export to NA, the share of NA-oriented export in total sales also shows a negligible positive but insignificant coefficient. However, we do not find any significant results for imports from NA. Regardless of import measured by value or share, there is no statistical difference in either one of the treatment groups before the trade war and after compared to the control group. In fact, due to deepening industrial agglomeration within the ASEAN, agglomerated suppliers of parts and components facilitated intra-region trade, and affiliates do not highly rely on imports from NA. The trade shock is not likely to increase imports from NA for affiliates in the ASEAN. Thus, the affiliates with vertically integrated Chinese siblings within the same MNE may not increase their imports from NA. Second, we also find an approximately 9% increase in total sales at the 95% confidence level, possibly driven by export growth to NA. The same group saw an 8.12% increase in labor input, and more use of labor may contribute to the growth in their sales. As suggested by earlier findings, the trade war has led to a decline in labor use by Japanese affiliates in China (Sun et al., 2019), and our result complementarily indicates a silent substitution of labor at affiliates across regions within the production networks of

Japanese MNEs (Muendler and Becker, 2010). Local procurement from ASEAN increases significantly in value and share in total purchases. Due to the shock, local backward linkages are likely to contribute more to expanding production activities in the ASEAN. Compared to the treatment group (1), we do not find any statistically significant impacts on the treatment group (2). These results confirm the heterogeneous effects of the trade war shock on affiliates differently connected to their siblings in the same MNE network. Specifically, affiliates with vertically embedded siblings are more affected than those operating independently.

Insert Table 4 about here.

Insert Table 5 about here.

For comparison, Table 5 describes the results for the simple DID regression with unmatched samples. Including the observations from the whole sample, we can still see a barely significant increase in export to NA for the treatment group (1). Relative to affiliates without Chinese siblings, there is a 17.2 % increase in exports to NA for affiliates with VFDI Chinese siblings. Accordingly, total sales go up by 18.9%. Apart from treatment group (1), treatment group (2) shows no significant increase in total sales and NA exports. Whether or not matching is performed before DID, the analysis provides consistent results on NA-oriented exports and total sales for the treatment group (1), demonstrating a potential relocation of production within the Japanese MNEs' network. In response to the trade war, Japanese MNEs adjusted their overseas network and shifted production from China to ASEAN.

5.2 Robustness

We conducted two robustness checks. First, we further implement kernel matching combined with DID. Corresponding results for the alternative matching method are summarized by Table 6. The entire table is separated into two panels by the middle vertical line, with the left panel showing the results for the treatment group (1) and the right panel providing

the results for the treatment group (2). The left panel shows that the trade shock has significantly caused an increase in NA-oriented exports by 28.8% for affiliates with VFDI Chinese siblings. Likewise, they witnessed growth in total sales and employment, 7.81% and 7.15%, respectively. Local sourcing sees a 6.51% increase at a 95% confidential level. As a result, local sourcing also accounts for a larger proportion of total procurement. In contrast to the VFDI case, we still do not find any statistically significant change for the affiliates with other Chinese siblings. Again, the results demonstrate that relatively independent affiliates operating in the ASEAN are not likely to be affected less by the shock.

Insert Table 6 about here.

Regardless of whether caliper or kernel matching is applied, the trade war shows positive effects on exports to NA, total sales, labor inputs, and local procurement for affiliates with VFDI Chinese siblings that are statistically significant at 10% or higher level. Such results further strongly convince us that Japanese MNEs adjusted their production network by relocation.

Second, we utilize the alternative definition of VFDI. Given that the trade war effect on performance outcomes may depend on how we split the treatment group, to check whether our analysis is sensitive to the way we classify the treatment groups, we redefined the measure of VFDI types for Chinese siblings. Instead of using the "total requirements" coefficients, we switch to "direct requirements" coefficients as an alternative measure to distinguishing vertically operated Japanese subsidiaries in China (the treatment group (1)). In line with the definition of VFDI in the baseline model, here we also take 0.01[12] as the threshold for the coefficients assigned to each affiliate. Again, only those with a coefficient beyond 0.01 enter the category of VFDI affiliates.

Then, we rerun the benchmark PSM-DID estimator based on differently classified Chinese siblings with caliper matching. The corresponding results are stored in Table 7. There

[12]We also use other values for the threshold, such as 0.001, and no matter which value we use, the PSM-DID results are similar.

is a significant positive impact of the trade war on exports to NA, local sourcing and employment for the first treatment group. These consistent results indicate that our estimations are robust even if we change the classification for treatment groups. In this case, we observe a 36.4% increase in export to NA, 6.18% increase in local sourcing and a 7.56% growth in labor. We see a positive effect on total sales, but which is not statistically significant. Since the definition of HFDI and other Chinese affiliates does not change, the results for this specific group are unchanged as well.

Insert Table 7 about here.

Table 8 reports the simple DID results. Similarly, according to the first column, the treatment group (1) of affiliates tends to see higher exports to NA and total sales after the trade war. Table 9 provides the results obtained from the DID analysis on the matched groups using the kernel technique. This finding, similar to the finding on the PSM-DID with caliper matching, shows the positive impact of the trade war on NA exports, local sourcing, and employment. In summary, the reclassification of the treatment group (1) does not change our main finding that the trade war increased exports to NA for the ASEAN-located affiliates with Chinese VFDI siblings. The consistent results indicate the robustness of our setting even if we change the way of classification for treatment groups.

Insert Table 8 about here.

Insert Table 9 about here.

5.3 Country-level heterogeneous effects

The trade war effects could be heterogeneous across affiliates in different host countries. Corresponding to this concern, we examine whether affiliates established in less industrialized ASEAN member countries, for example, Cambodia, Laos, Myanmar, and Vietnam, known as the CLMV countries, performed differently from other affiliates in the relatively more developed ASEAN countries around and after the trade war. So, we split the entire

data set of affiliates into sub-samples regarding their location and estimate the benchmark PSM-DID for each case. Specifically, we split the whole data into three groups by their location: 1)Singapore and Thailand (the most developed and industry-agglomerated areas); 2) Indonesia, Malaysia, and the Philippines; 3) CLMV countries (the less developed areas).

Table 10 summarizes the country-intervened effects of the trade war on affiliates in Singapore and Thailand. Affiliates with VFDI Chinese siblings are still the most impacted ones. According to the first column, their exports to NA from these two countries grew dramatically after the trade war. Meanwhile, their total sales witnessed an 10.3% increase.

Insert Table 10 about here.

The following case is for Indonesia, Malaysia, and the Philippines. Referring to the results in Table 11, we only observe insignificant positive coefficient on NA-oriented exports for both treatment groups. Different from Singapore and Thailand, primary Japanese FDI recipients and overseas production base, affiliates based in Indonesia, Malaysia and the Philippines are less likely to undertake production relocation. While comparing with local affiliates without Chinese siblings, affiliates with VFDI Chinese siblings tend to increase their local sourcing and employment. This finding is intriguing because it may indicate a potential production shift toward the countries concerned. As suggested by a previous study ((Zeng et al., 2023)), firm's tendency of relocation in response to the trade war is strongly influenced by local sourcing embeddedness. For instance, firms with higher local resource dependence in China are more inclined to be reluctant to choose the relocation strategy. However, we find that Japanese MNEs tend to enhance their backward linkages in Indonesia, Malaysia and the Philippines after the trade war, implying the future tendency of further relocation toward these three destinations[13].

[13]We find significant decreasing imports from Asia (mainly from China) for affiliates in these three countries, which is coincident with the rising local resourcing. Also, by running the following DID specification for China-based affiliates: $y_{a,c,t} = \beta_1 \cdot China_a \cdot Post_t + u_a + \gamma_{s,t} + \epsilon_{a,s,t}$ where y follows the previous definition but include exports to Asia, *Post* indicates the period after the trade war, and we also control affiliate, industry-year fixed effects. *China* is a dummy taking 1 if affiliates locate in China The control group are affiliates elsewhere. The estimated results are reported by Table A1 in the appendix, which shows us that China-located affiliates reduced exports to surrounding Asia areas after the trade war.

Insert Table 11 about here.

Table 12 presents similar results for the case of CLMV countries. Specifically, affiliates based in CLMV owning Chinese VFDI siblings rose their local sourcing after the trade war[14]. In contrast, no significant increase in NA exports is found for the same group of affiliates. There is an interpretation of the reason behind it. In fact, many bystander countries have increased exports to the US at the expense of China, and Vietnam is one of them (Ito, 2022a). Some local affiliates in our control group also captured the opportunity to expand their sales to the US, resulting in a closer difference in NA exports between them and the treated affiliates. Since CLMV countries are less developed and industrialized than other ASEAN members, they mainly concentrate on producing labor-intensive products. The trade war creates exporting chances for their products to replace a part of targeted goods from China.

Insert Table 12 about here.

In summary, our findings prove that the impacts of the trade war are heterogeneous across host countries. By substituting China's exports for NA, Japanese affiliates in bystander countries may benefit from the trade war. In our case, production relocation took place among affiliates based in Singapore and Thailand. However, there is no evident finding for other countries on the change of NA exports in the aftermath of the trade war.

5.4 Industry-level heterogeneous effects

Provided that the 2018 tariff lists targeted several industries, we are concerned about whether the trade war is heterogeneous across industries. We suppose that affiliates operating in targeted industries by the US tariffs may benefit from the trade shock and increase their sales to NA. In this section, we examine the industry-level heterogeneous effects for affiliates.

We conduct the DID analysis based on the further breakdown of industries. Table 13 stores the results for the case of the electrical machinery, ICT device, and transportation

[14]A decline in imports from Asia is coincident with the rising local resourcing for this case.

equipment industries. As estimated, exports to NA markedly increased for the affiliates with VFDI Chinese siblings (42.1%). The expansion in exporting sales has stimulated employment, leading to a 9.99% increase. At the same time, we do not find any significant results on imports from NA for affiliates with Chinese VFDI siblings. The trade war has no significant effects on affiliates with HFDI siblings. Prioritized in the ASEAN, manufacturing of electrical and electronics contributed the most considerable proportion of total exports[15]. With the current industrial foundation, production relocation brings new opportunities for ASEAN-based affiliates. In addition, a few ASEAN countries have actively integrated into the global value chains of the transportation equipment industry. For a country like Thailand, the hub of automobile manufacturing in southeast Asia, has successfully realized the industrial agglomeration. Relocation of automobile production is relatively easy to undertake by affiliates based in Thailand[16].

Insert Table 13 about here.

Regarding the results for industrial chemicals, iron, steel, and non-ferrous metals (shown by Table 14), we can not find any significant results for treated affiliates. The explanation could be straightforward: For all these capital-intensive industries, production relocation is quite impossible to be implemented within a short period. So, even though the trade war occurred, prompt relocation is unlikely to be carried on.

Insert Table 14 about here.

We examine the impact of the trade war on the industries of miscellaneous manufacturing[17] but find no significant results for either treatment group (see Table 15). Since miscellaneous manufacturing industries are not highly fragmented in the ASEAN, the trade shock is less likely to propagate through MNEs' value chains.

[15]According to the report Global Value Chains in ASEAN published by the ASEAN-Japan Centre, the percentage is 27% in 2021. Related infomation can be found through https://www.asean.or.jp/ja/wp-content/uploads/sites/2/GVCs_Electronics_Paper-13_full_web.pdf

[16]Thailand unveiled new incentives in 2019 to support foreign companies with relocation. See https://www.reuters.com/article/thailand-economy-foreign-investors-idUSL4N25I1S1

[17]include manufacture of furniture and fixtures, printing and allied industries, plastic products, rubber products, leather tanning, leather products and fur skins, and other miscellaneous manufacturing.

Insert Table 15 about here.

To sum it up, our analysis documents evidence of the heterogeneous effects of the trade war on affiliates across multiple industries. Affiliates operating in heavily-targeted industries, electrical machinery and transportation equipment, may benefit from the trade war and increased exports to North America. In contrast, those affiliates operating in industries with heavy capital spending seem less affected.

6 Conclusion

In this study, utilizing a PSM-DID approach, we examined the impact of the 2018 US-Sino trade war on production acclivities of ASEAN-based affiliates for Japanese MNEs. Affiliates with vertically integrated Chinese siblings within the same value chains of the same Japanese MNE owner may see an increase in total sales around and after the trade war. Compared to ASEAN-based affiliates without any Chinese siblings, these affiliates tend to increase their exports to the North American market. The expanding sales to North America may also lead to more labor input and deepen local backward linkages. So, our finding provides the evidence of potential prompt relocation of production undertaken by Japanese MNEs in response to the unprecedented trade shock[18]. Moreover, the impact of the trade war is heterogeneous across affiliates in different locations and industries. Affiliates in Thailand and Singapore tend to see a substantial increase in their exports to North America but the relocation of production are not observed for late developing countries in the ASEAN (CLMV in this case). As for industry heterogeneity, we find that affiliates with Chinese VFDI siblings operating in most targeted industries, such as electrical machinery and automobile, are more likely to see increasing exports to North America.

Our study documents empirical evidence for within-MNE adjustments using the 2018 US-China trade war as a quasi-natural experiment. Our findings highlight the advantages

[18]While, due to the data limitation, we can not detect the long lasting effects of the trade war so far.

of geographical diversification of production networks and derive policy implications for ASEAN countries to take over foreign investors' relocation in the near future.

References

Alfaro, L. and Charlton, A. (2009). Intra-industry foreign direct investment. *American Economic Review*, 99(5):2096–2119.

Amiti, M., Kong, S. H., and Weinstein, D. (2021). Trade protection, stock prices, and welfare. NBER Working Paper, No. 28758.

Amiti, M., Redding, S. J., and Weinstein, D. E. (2019). The impact of the 2018 tariffs on prices and welfare. *Journal of Economic Perspectives*, 33(4):187–210.

Benguria, F. (2022). The global impact of the US–China trade war: firm-level evidence. *Review of World Economics*. https://doi.org/10.1007/s10290-022-00490-1.

Donaubauer, J. and Dreger, C. (2018). The end of cheap labor: Are foreign investors leaving China? *Asian Economic Papers*, 17(2):94–107.

Fajgelbaum, P., Goldberg, P. K., Kennedy, P. J., Khandelwal, A., and Taglioni, D. (2022). The US-China trade war and global reallocations. Policy Research Working Paper Series 9894, The World Bank.

Flaaen, A., Hortaçsu, A., and Tintelnot, F. (2020). The production relocation and price effects of US trade policy: the case of washing machines. *American Economic Review*, 110(7):2103–27.

Hayakawa, K., Matsuura, T., and Okubo, F. (2015). Firm-level impacts of natural disasters on production networks: Evidence from a flood in Thailand. *Journal of the Japanese and International Economies*, 38:244–259.

Huang, Y., Lin, C., Liu, S., and Tang, H. (2019). *Trade War: The Clash of Economic Systems Endangering Global Prosperity*, chapter :Supply chain linkages and financial markets: evaluating the costs of the US-China trade war. CEPR EBook.

Ito, T. (2022a). Third country effects of Trump tariffs: Which countries benefited from Trump's trade war? RIETI Discussion paper 22-E-007.

Ito, T. (2022b). The effects of Trump's trade war with China on Japan's trade. RIETI Discussion paper 22-E-019.

Mendes, B. M. D. M. (2021). Do firms create immunity to production network shocks? evidence from the Covid-19 global pandemic. https://run.unl.pt/handle/10362/121946.

Muendler, M.-A. and Becker, S. O. (2010). Margins of multinational labor substitution. *American Economic Review*, 100(5):1999–2030.

Sun, C., Tao, Z., Yuan, H., and Zhang, H. (2019). The impact of the US-China trade war on Japanese multinational corporations. RIETI Discussion paper 19-E-050.

Todo, Y., Nakajima, K., and Matous, P. (2015). How do supply chain networks affect the resilience of firms to natural disasters? Evidence from the Great East Japan Earthquake. *Journal of Regional Science*, 55(2):209–229.

Zeng, K., Xu, Y., and Xie, Z. (2023). Local sourcing embeddedness, manufacturing relocation, and firm attitudes toward the US-China trade war: A survey analysis of China-based MNC subsidiaries. *Business and Politics*, 25(2):1–26.

Tables

Table 1: Summary statistics

	No Chinese Siblings (# of affiliates: 1554)			VFDI Chinsese Siblings (# of affiliates: 155)			Other Chinsese Siblings (# of affiliates: 1838)		
VARIABLES	Obs	Mean	Sd	Obs	Mean	Sd	Obs	Mean	Sd
Export Share (NA): Export to NA/Total Sales	3672	0.014	0.077	371	0.019	0.075	4891	0.018	0.089
log (Export to NA)	3672	0.424	1.465	371	0.917	2.189	4891	0.809	2.098
Import Share (NA): Import from NA/Total Purchases	3672	0.005	0.052	371	0.024	0.113	4891	0.004	0.041
log (Import NA)	3672	0.424	1.465	371	0.917	2.189	4891	0.809	2.098
Local Share: Local Purchases/Total Purchases	3672	0.423	0.419	371	0.307	0.375	4891	0.309	0.384
log (Local Sourcing)	3672	0.309	0.295	371	0.230	0.269	4891	0.230	0.275
log (Employees)	2997	4.706	1.396	289	5.204	1.473	4240	5.441	1.647
log (Investment)	3672	2.005	2.297	371	3.072	2.599	4891	3.055	2.754
log (Total Sales)	2977	6.556	1.730	286	7.512	1.947	4269	7.862	2.125

Note: This table shows the summary of statistics of Japanese affiliates in the ASEAN countries by three groups: affilate without any Chinese siblings, affiliates with VFDI Chinese siblings and affiliates with HFDI and other Chinese siblings.

What Affiliates have VFDI/Other FDI Chinese Siblings?

Table 2: Logit estimation

VARIABLES	VFDI Chinsese Siblings	Other Chinsese Siblings
log(Age)	-0.221	-0.376***
	(0.219)	(0.0946)
log (Labor Cost)	-0.0308	0.160**
	(0.157)	(0.0628)
Size	0.451**	0.295***
	(0.175)	(0.0682)
Parent Sourcing	-0.421	-0.270
	(0.457)	(0.180)
R&D Ratio	-7.783	1.500
	(14.18)	(3.307)
Labor Productivity	0.0909	0.504***
	(0.163)	(0.0619)
Constant	-4.747***	0.642
	(0.796)	(0.942)
Observations	794	1,788
Pseudo R^2	0.156	0.108
Log Likelihood	-236.959	-1083.305

Balancing test

Table 3: Balancing test for matching

	VFDI Chinsese Siblings		Other Chinsese Siblings	
	Before matching	After caliper matching	Before matching	After caliper matching
log (Age)				
Mean treated	2.786	2.801	2.738	2.741
Mean control	2.596	2.779	2.738	2.670
t-test (p-value)	0.010	0.861	0.005	0.023
log (Labor cost)				
Mean treated	5.014	4.916	5.303	5.272
Mean control	4.467	4.923	4.484	5.167
t-test (p-value)	0.000	0.978	0.000	0.110
Size				
Mean treated	5.225	5.217	5.398	5.394
Mean control	4.750	5.266	4.802	5.290
t-test (p-value)	0.002	0.855	0.000	0.124
Parent sourcing ratio				
Mean treated	0.180	0.196	0.192	0.196
Mean control	0.220	0.192	0.225	0.199
t-test (p-value)	0.229	0.936	0.020	0.788
R&D ratio				
Mean treated	0.002	0.001	0.002	0.002
Mean control	0.001	0.001	0.001	0.001
t-test (p-value)	0.090	0.921	0.226	0.693
Labor productivity				
Mean treated	0.052	0.131	0.153	0.100
Mean control	-0.014	0.114	-0.275	0.052
t-test (p-value)	0.495	0.909	0.000	0.280

Baseline

Table 4: Impact of the trade war on production activities of ASEAN affiliates (caliper matching)

	1.Post#1.ChinaSib#1.VFDI				1.Post#1.ChinaSib#1.OtherFDI			
	coef.	sd	obs	R^2	coef.	sd	obs	R^2
Export Share (NA)	0.000156	(0.00989)	963	0.901	-0.00147	(0.00224)	4,804	0.901
log (Export to NA)	0.315**	(0.154)	963	0.926	0.00810	(0.0536)	4,804	0.897
Import Share (NA)	0.00720	(0.00782)	963	0.857	0.00127	(0.00137)	4,804	0.827
log (Import NA)	0.185	(0.195)	963	0.693	0.0266	(0.0359)	4,804	0.853
Local Share	0.0902**	(0.0428)	963	0.860	0.00236	(0.0122)	4,804	0.864
log (Local Sourcing)	0.0630**	(0.0306)	963	0.855	0.00312	(0.00861)	4,804	0.862
log (Labor)	0.0812**	(0.0370)	910	0.988	0.0162	(0.0148)	4,589	0.986
log (Investment)	-0.0528	(0.298)	963	0.788	0.101	(0.0914)	4,804	0.828
log (Total Sales)	0.0899**	(0.0430)	924	0.987	0.0269	(0.0218)	4,630	0.974

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Table 5: Impact of the trade war on production activities of ASEAN affiliates (simple DID)

	1.Post#1.ChinaSib#1.VFDI		1.Post#1.ChinaSib#1.OtherFDI		Obs	R^2
	coef.	sd	coef.	sd		
Export Share (NA)	0.000745	(0.00654)	0.000165	(0.00218)	8,321	0.850
log (Export to NA)	0.172*	(0.0956)	0.0282	(0.0442)	8,321	0.889
Import Share (NA)	0.0111	(0.00865)	0.00102	(0.00162)	8,321	0.758
log (Import NA)	0.177	(0.119)	0.00324	(0.0279)	8,321	0.840
Local Share	0.0166	(0.0261)	-0.0149	(0.0110)	8,321	0.854
log (Local Sourcing)	0.0117	(0.0186)	-0.0106	(0.00778)	8,321	0.855
log (Labor)	-0.00693	(0.0314)	0.0108	(0.0164)	6,892	0.985
log (Investment)	-0.224	(0.165)	-0.0948	(0.0738)	8,321	0.849
log (Total Sales)	0.189*	(0.104)	0.0291	(0.0248)	6,910	0.970

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Robustness: Alternative matching

Table 6: Impact of the trade war on production activities of ASEAN affiliates (kernel matching)

	1.Post#1.ChinaSib#1.VFDI				1.Post#1.ChinaSib#1.OtherFDI			
	coef.	sd	obs	R^2	coef.	sd	obs	R^2
Export Share (NA)	-0.000465	(0.00967)	988	0.901	-0.00139	(0.00224)	4,815	0.906
log (Export to NA)	0.288*	(0.151)	988	0.929	0.00954	(0.0537)	4,815	0.899
Import Share (NA)	0.00774	(0.00769)	988	0.857	0.00129	(0.00137)	4,815	0.827
log (Import NA)	0.187	(0.192)	988	0.723	0.0274	(0.0361)	4,815	0.852
Local Share	0.0926**	(0.0421)	988	0.857	0.00265	(0.0122)	4,815	0.864
log (Local Sourcing)	0.0651**	(0.0300)	988	0.852	0.00332	(0.00860)	4,815	0.862
log (Labor)	0.0715**	(0.0339)	935	0.988	0.0157	(0.0147)	4,600	0.986
log (Investment)	-0.0388	(0.289)	988	0.794	0.102	(0.0913)	4,815	0.829
log (Total Sales)	0.0781*	(0.0416)	949	0.987	0.0268	(0.0217)	4,641	0.974

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Robustness: Redefined VFDI Chinese siblings

Table 7: Impact of the trade war on production activities of ASEAN affiliates: redefined VFDI (caliper matching)

	1.Post#1.ChinaSib#1.VFDI				1.Post#1.ChinaSib#1.OtherFDI			
	coef.	sd	obs	R^2	coef.	sd	obs	R^2
Export Share (NA)	0.00181	(0.0123)	823	0.895	-0.00147	(0.00224)	4,804	0.901
log (Export to NA)	0.364*	(0.191)	823	0.926	0.00810	(0.0536)	4,804	0.897
Import Share (NA)	0.00832	(0.00937)	823	0.610	0.00127	(0.00137)	4,804	0.827
log (Import NA)	0.205	(0.233)	823	0.663	0.0266	(0.0359)	4,804	0.853
Local Share	0.0892*	(0.0487)	823	0.854	0.00236	(0.0122)	4,804	0.864
log (Local Sourcing)	0.0618*	(0.0349)	823	0.851	0.00312	(0.00861)	4,804	0.862
log (Labor)	0.0756***	(0.0253)	787	0.993	0.0162	(0.0148)	4,589	0.986
log (Investment)	-0.212	(0.346)	823	0.786	0.101	(0.0914)	4,804	0.828
log (Total Sales)	0.0525	(0.0472)	794	0.987	0.0269	(0.0218)	4,630	0.974

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Table 8: Impact of the trade war on production activities of ASEAN affiliates: redefined VFDI (simple DID)

	1.Post#1.ChinaSib#1.VFDI		1.Post#1.ChinaSib#1.OtherFDI		Obs	R^2
	coef.	sd	coef.	sd		
Export Share (NA)	0.00139	(0.00800)	0.000160	(0.00219)	8,250	0.850
log (Export to NA)	0.199*	(0.112)	0.0285	(0.0442)	8,250	0.888
Import Share (NA)	0.0124	(0.0105)	0.00103	(0.00162)	8,250	0.746
log (Import NA)	0.181	(0.145)	0.00352	(0.0279)	8,250	0.832
Local Share	0.0228	(0.0309)	-0.0149	(0.0110)	8,250	0.853
log (Local Sourcing)	0.0157	(0.0220)	-0.0105	(0.00779)	8,250	0.854
log (Labor)	-0.00973	(0.0408)	0.0108	(0.0164)	6,835	0.985
log (Investment)	-0.297	(0.194)	-0.0947	(0.0739)	8,250	0.849
log (Total Sales)	0.237*	(0.128)	0.0293	(0.0248)	6,853	0.970

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Table 9: Impact of the trade war on production activities of ASEAN affiliates: redefined VFDI (kernel matching)

	1.Post#1.ChinaSib#1.VFDI				1.Post#1.ChinaSib#1.OtherFDI			
	coef.	sd	obs	R^2	coef.	sd	obs	R^2
Export Share (NA)	0.00163	(0.0121)	844	0.895	-0.00139	(0.00224)	4,815	0.906
log (Export to NA)	0.353*	(0.186)	844	0.926	0.00954	(0.0537)	4,815	0.899
Import Share (NA)	0.00814	(0.00932)	844	0.610	0.00129	(0.00137)	4,815	0.827
log (Import NA)	0.196	(0.231)	844	0.669	0.0274	(0.0361)	4,815	0.852
Local Share	0.0834*	(0.0478)	844	0.853	0.00265	(0.0122)	4,815	0.864
log (Local Sourcing)	0.0578*	(0.0342)	844	0.850	0.00332	(0.00860)	4,815	0.862
log (Labor)	0.0817***	(0.0251)	807	0.993	0.0157	(0.0147)	4,600	0.986
log (Investment)	-0.262	(0.341)	844	0.780	0.102	(0.0913)	4,815	0.829
log (Total Sales)	0.0603	(0.0462)	815	0.987	0.0268	(0.0217)	4,641	0.974

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Country-level heterogeneity

Table 10: Impact of the trade war on affiliates in Singapore and Thailand

	1.Post#1.ChinaSib#1.VFDI				1.Post#1.ChinaSib#1.OtherFDI			
	coef.	sd	obs	R^2	coef.	sd	obs	R^2
Export Share (NA)	0.0223	(0.0222)	387	0.925	0.00216	(0.00250)	2,115	0.931
log (Export to NA)	0.613*	(0.348)	387	0.906	0.0601	(0.0843)	2,115	0.895
Import Share (NA)	0.00146	(0.00375)	387	0.964	-0.000258	(0.00256)	2,115	0.935
log (Import NA)	0.220	(0.238)	387	0.695	0.0586	(0.0629)	2,115	0.852
Local Share	-0.0902	(0.0918)	387	0.837	-0.0176	(0.0202)	2,115	0.858
log (Local Sourcing)	-0.0605	(0.0649)	387	0.827	-0.0109	(0.0141)	2,115	0.856
log (Labor)	0.0416	(0.0515)	361	0.994	0.0130	(0.0166)	2,016	0.992
log (Investment)	-0.526	(0.610)	387	0.820	0.0519	(0.136)	2,115	0.839
log (Total Sales)	0.103*	(0.0577)	364	0.994	0.0328	(0.0305)	2,026	0.982

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Table 11: Impact of the trade war on affiliates in Indonesia Malaysia & the Phillipines

	1.Post#1.ChinaSib#1.VFDI				1.Post#1.ChinaSib#1.OtherFDI			
	coef.	sd	obs	R^2	coef.	sd	obs	R^2
Export Share (NA)	-0.0197	(0.0177)	368	0.776	-0.00602	(0.00443)	1,875	0.888
log (Export to NA)	0.225	(0.283)	368	0.932	-0.0316	(0.0910)	1,875	0.894
Import Share (NA)	0.0163	(0.0202)	368	0.635	0.00185	(0.00194)	1,875	0.681
log (Import NA)	0.318	(0.484)	368	0.745	0.0166	(0.0447)	1,875	0.853
Local Share	0.158**	(0.0623)	368	0.911	0.0219	(0.0182)	1,875	0.882
log (Local Sourcing)	0.111**	(0.0446)	368	0.910	0.0173	(0.0129)	1,875	0.881
log (Labor)	0.133*	(0.0725)	349	0.981	0.0281	(0.0331)	1,788	0.978
log (Investment)	0.471	(0.467)	368	0.764	0.0121	(0.157)	1,875	0.830
log (Total Sales)	0.135	(0.0912)	355	0.986	0.00906	(0.0397)	1,809	0.961

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Table 12: Impact of the trade war on affiliates in CLMV

	1.Post#1.ChinaSib#1.VFDI				1.Post#1.ChinaSib#1.OtherFDI			
	coef.	sd	obs	R^2	coef.	sd	obs	R^2
Export Share (NA)	-0.0156	(0.0203)	124	0.948	-0.00256	(0.00736)	726	0.884
log (Export to NA)	0.0591	(0.276)	124	0.961	-0.0304	(0.131)	726	0.929
Import Share (NA)	1.48e-05	(2.07e-05)	124	0.480	0.00284	(0.00227)	726	0.742
log (Import NA)	0.0414	(0.0582)	124	0.542	-0.0253	(0.0892)	726	0.890
Local Share	0.171**	(0.0764)	124	0.855	0.00759	(0.0312)	726	0.856
log (Local Sourcing)	0.113**	(0.0527)	124	0.855	0.00714	(0.0225)	726	0.853
log (Labor)	0.00530	(0.0890)	114	0.993	-0.000176	(0.0283)	694	0.990
log (Investment)	0.155	(0.540)	124	0.799	0.625**	(0.248)	726	0.836
log (Total Sales)	-0.0304	(0.156)	121	0.982	0.0685	(0.0453)	702	0.989

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Industry-level heterogeneity

Table 13: Impact of the trade war on industries of electricial machinery, ICT device & Transportation equipment

	1.Post#1.ChinaSib#1.VFDI				1.Post#1.ChinaSib#1.OtherFDI			
	coef.	sd	obs	R^2	coef.	sd	obs	R^2
Export Share (NA)	-0.00518	(0.0213)	476	0.849	-0.00567	(0.00421)	1,975	0.866
log (Export to NA)	0.421*	(0.252)	476	0.914	0.00481	(0.0941)	1,975	0.885
Import Share (NA)	0.0166	(0.0166)	476	0.664	0.00101	(0.000823)	1,975	0.960
log (Import NA)	0.443	(0.409)	476	0.561	0.0416	(0.0510)	1,975	0.876
Local Share	0.101	(0.0662)	476	0.848	0.0195	(0.0202)	1,975	0.879
log (Local Sourcing)	0.0735	(0.0483)	476	0.840	0.0148	(0.0143)	1,975	0.877
log (Labor)	0.0999**	(0.0398)	456	0.990	-0.00732	(0.0242)	1,911	0.982
log (Investment)	-0.172	(0.390)	476	0.749	0.164	(0.153)	1,975	0.832
log (Total Sales)	0.126	(0.0764)	458	0.984	-0.0322	(0.0353)	1,923	0.962

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Table 14: Impact of the trade war on industries of chenmicals, Iron, steel and non-ferrous metal

	1.Post#1.ChinaSib#1.VFDI				1.Post#1.ChinaSib#1.OtherFDI			
	coef.	sd	obs	R^2	coef.	sd	obs	R^2
Export Share (NA)	0.00299	(0.00188)	144	0.992	-0.00238	(0.00347)	676	0.966
log (Export to NA)	0.235	(0.208)	144	0.949	-0.00217	(0.137)	676	0.917
Import Share (NA)	0.00321	(0.00453)	144	0.633	0.00612	(0.00393)	676	0.881
log (Import NA)	0.0316	(0.182)	144	0.716	0.0409	(0.123)	676	0.829
Local Share	0.0297	(0.0714)	144	0.898	0.0177	(0.0269)	676	0.883
log (Local Sourcing)	0.0181	(0.0483)	144	0.903	0.0112	(0.0190)	676	0.880
log (Labor)	-0.0134	(0.0288)	137	0.997	-0.0326	(0.0248)	661	0.993
log (Investment)	-0.210	(0.570)	144	0.859	-0.172	(0.238)	676	0.804
log (Total Sales)	-0.0215	(0.0561)	139	0.989	-0.0193	(0.0316)	662	0.991

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

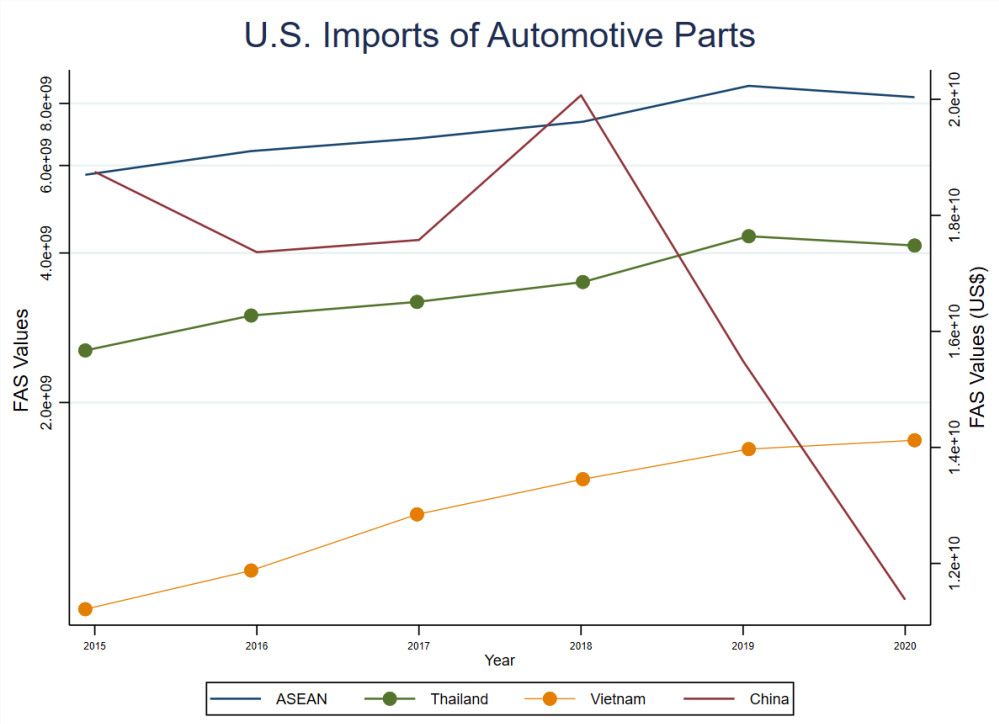
Table 15: Impact of the trade war on industries of miscellaneous manufacturing

	1.Post#1.ChinaSib#1.VFDI				1.Post#1.ChinaSib#1.OtherFDI			
	coef.	sd	obs	R^2	coef.	sd	obs	R^2
Export Share (NA)	0.0125	(0.0116)	200	0.761	-0.00511	(0.00490)	737	0.963
log (Export to NA)	0.499	(0.644)	200	0.869	-0.155	(0.127)	737	0.946
Import Share (NA)	-0.00699	(0.00787)	200	0.867	-0.000814	(0.00412)	737	0.883
log (Import NA)	-0.0228	(0.129)	200	0.708	0.111	(0.0839)	737	0.882
Local Share	0.0659	(0.0565)	200	0.902	-0.0120	(0.0292)	737	0.865
log (Local Sourcing)	0.0362	(0.0368)	200	0.898	-0.00889	(0.0207)	737	0.863
log (Labor)	0.00628	(0.0483)	181	0.984	0.0480	(0.0356)	670	0.980
log (Investment)	0.247	(1.058)	200	0.771	0.115	(0.223)	737	0.799
log (Total Sales)	0.0669	(0.0800)	191	0.990	0.123*	(0.0691)	684	0.965

Note: Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Figures

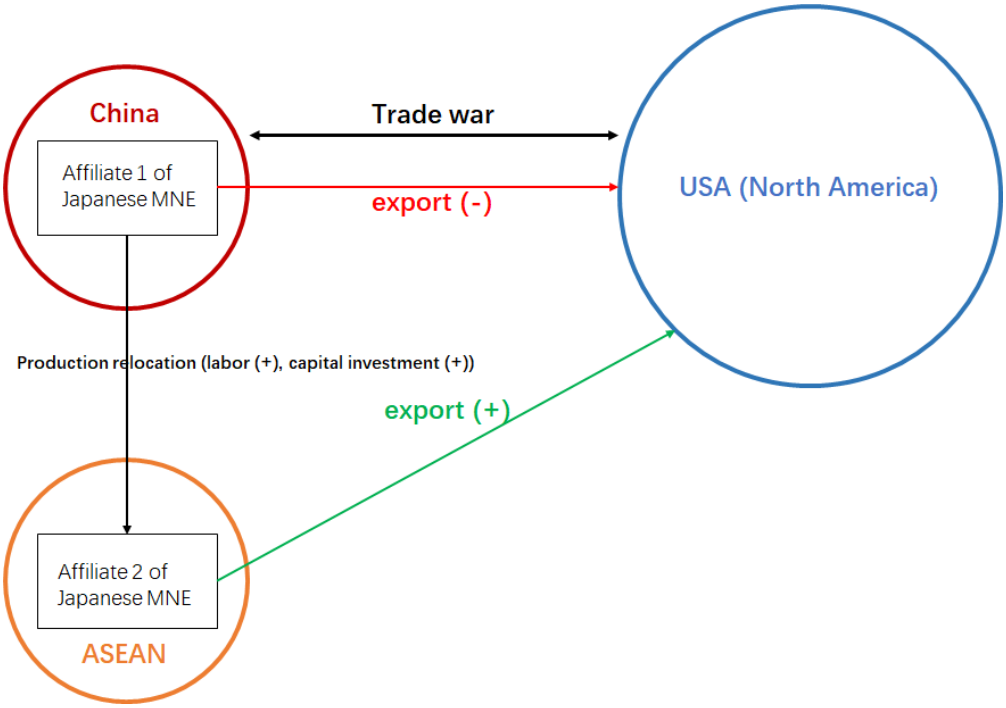
Figure 1: U.S. Imports of Automotive Parts



Data source: US' department of commerce, 2021

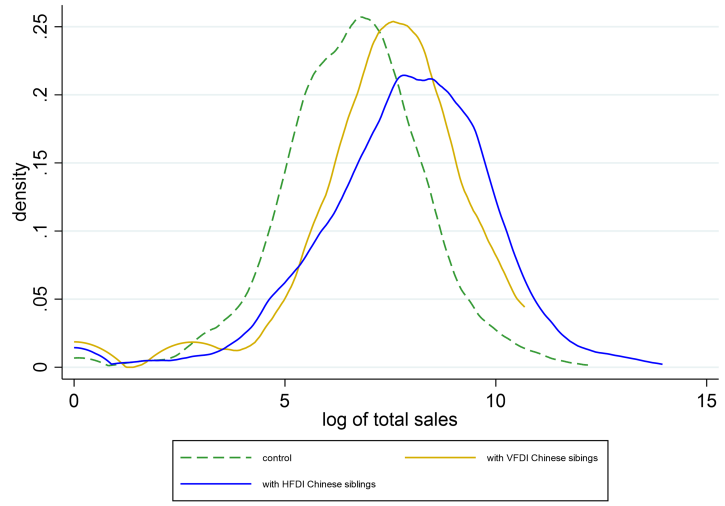
Note: The solid red line represents China, and solid blue line represents the case of ASEAN. The left vertical axis indicates the import value from ASEAN, Thailand, and Vietnam, and the right vertical axis indicates the import value from China.

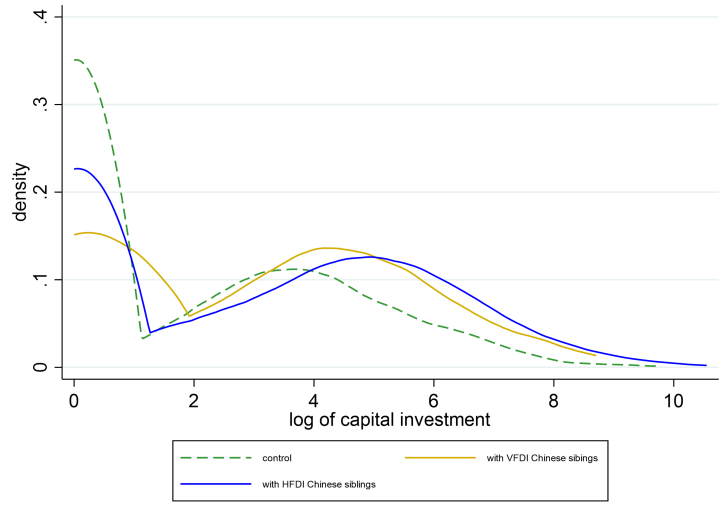
Figure 2: Illustration of conceptual framework



Note: This figure illustrates the conceptual framework of the empirical study. In China, Affiliate 1 of a Japanese MNE is directly exposed to the US-Sino trade war. Facing a higher cost of exporting to the US, We expect that the owner MNE is motivated to relocate the production from that affiliate ("Affiliate 1" in China) to her ASEAN-located affiliate ("Affiliate 2" in the figure). Consequently, trade diversion occurs between the US, ASEAN-located affiliates, and their siblings in China, meaning that US-oriented exports from ASEAN-located affiliates increase and substitute those from Chinese-located affiliates.

Figure 3: Distribution of variables (log of total sales / log of investment / log of employment)





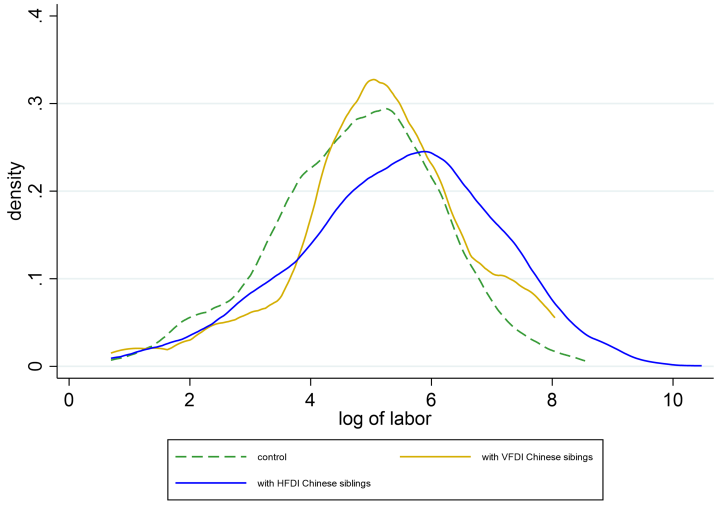


Figure 4: Before and after the trade war (log of exports to NA)

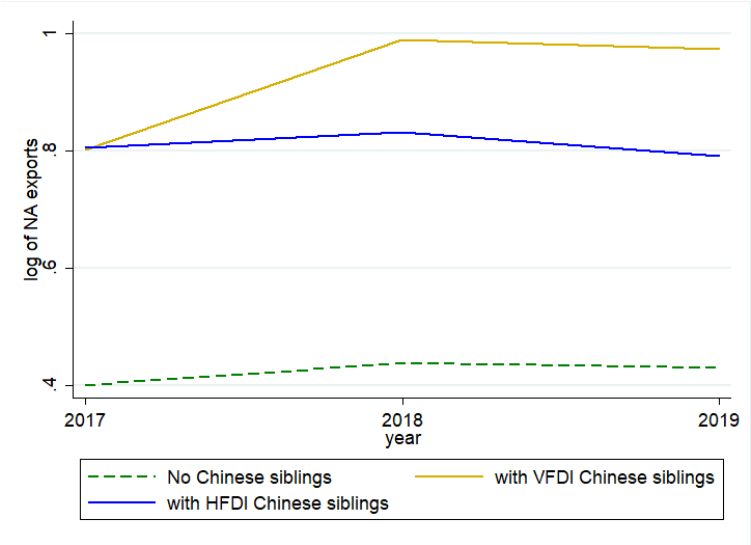


Figure 5: Before and after the trade war (log of total sales)

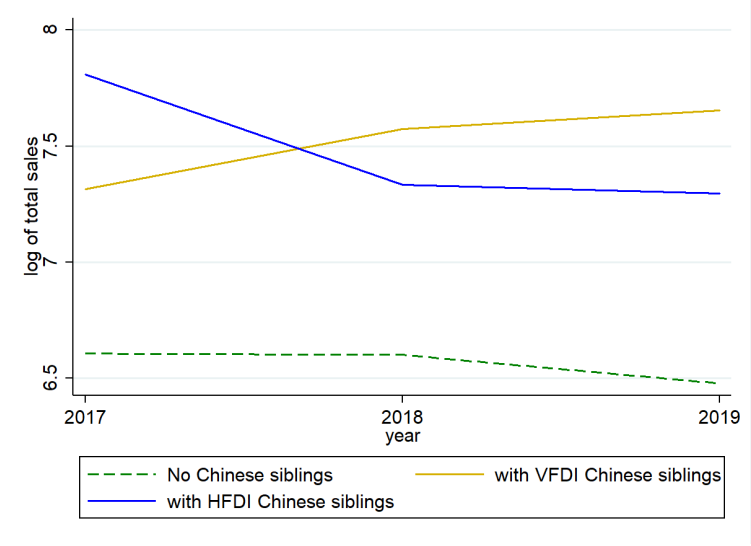


Figure 6: Before and after the trade war (log of investment)

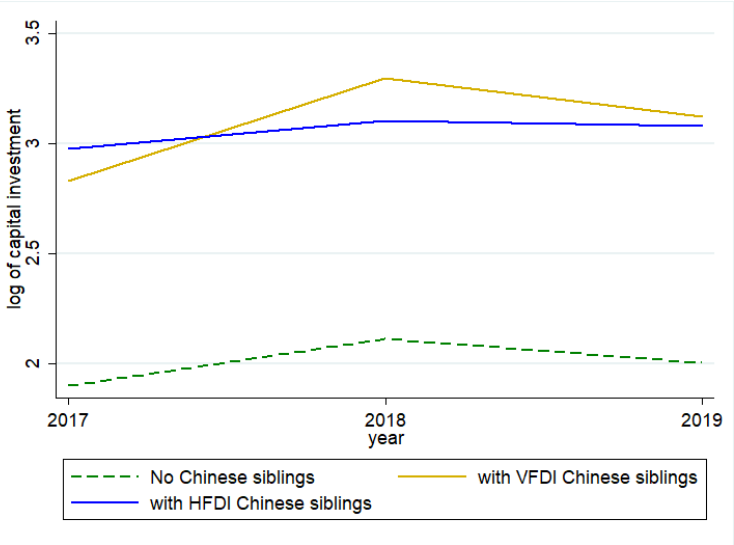
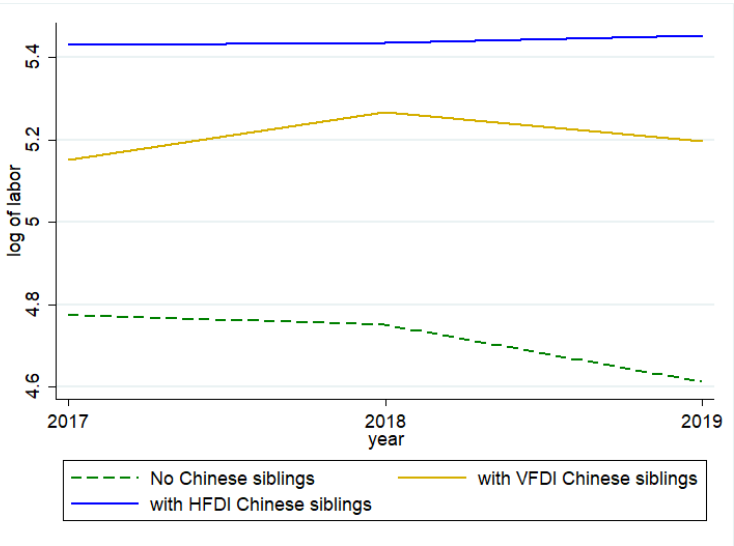


Figure 7: Before and after the trade war (log of employment)



Appendix

Impact of the trade war on China-based affiliates

Table A1: Impact of the trade war on affiliates located in China (simple DID)

	1.Post#1.China		Observations	R^2
	coef.	sd		
Export Share (NA)	-0.00190**	(0.000846)	32,643	0.889
log (Export to NA)	-0.0426**	(0.0207)	32,643	0.897
Import Share (NA)	-0.000625	(0.000683)	32,643	0.770
log (Import NA)	-0.0236**	(0.0120)	32,643	0.877
log (Export to Asia)	-0.0487*	(0.0285)	32,643	0.902
Local share	-0.00703	(0.00530)	32,643	0.860
log (Local sourcing)	-0.00514	(0.00373)	32,643	0.861
log (Labor)	-0.0628***	(0.00877)	26,046	0.983
log (Investment)	0.0582*	(0.0340)	32,643	0.857
log (Total sales)	-0.0155	(0.0154)	26,514	0.963

Note: The data set for this analysis contain all Japanese affiliates around the world. "China" is a dummy variable indicating 1 if the affiliate locate in China. The definition of "Post" is same as above, indicating timing of the trade war. Firm, country and industry-year level fixed effects are included in estimation for each case. Identification of industry is based on 4-digit industrial classification. Standard errors are clustered at affiliate level. Robust standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).