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

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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 South East 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. 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

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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 representative 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., 2020), 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, a 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 can be heterogeneous across regions and countries. Contrary to our perception, predicted global trade in the products targeted did not come to a halt but even increased after the war since many bystander countries substituted Chinese exports to the US market along with newly created export opportunities (Fajgelbaum et al., 2021). For example, the automotive industry is targeted by both the US and China, making it heavily affected 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 the growth of export to the US in automotive parts after the trade war started. Seemingly, ASEAN countries function as the new export platform, 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 even 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

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

outward China. Moreover, 30.8% of them prefer to move out more, ranging from 30% to 100%. A 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 to the production network toward the ASEAN by japan's MNEs, increasing export from affiliates located in the ASEAN to the North American market. At this point, our study documents direct evidence of production relocation/substitution within multinationals due to the negative shock induced by the trade conflict.

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 all affiliates in the ASEAN region operated by Japanese multinationals, 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. Furthermore, by distinguishing the type of Chinese sibling affiliates, we find that affiliates in the ASEAN with vertically integrated Chinese siblings in the same multinational value chains tend to increase their export to North America. More importantly, sampling multinationals and their affiliates in the ASEAN differ in many ex-ante features, such as degree of exposure to trade with America, 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 such a potential problem of selection bias, we combine our DID setting with the propensity score matching approach for the baseline empirical estimation. Compared with results obtained from unmatched DID analysis, DID on matched samples shows a more significant and economically sizable positive effect of the trade war

on exports to North America and total sales 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 section4, we show estimation results in section 5. Section 6 concludes this paper.

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. It 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. Benguira (2019) examines the impact of the trade war on revenue earned by many companies worldwide 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. Ito (2022) finds that 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.

Second, there is another growing body of literature on multinationals' reorganization of production under supply-chain shocks. 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. 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. In terms of the finding, even though a widely expanded supply network may delay the recovery from a natural disaster shock, 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 a natural disaster may gain immunity to other exogenous shocks in the future (i.e., the COVID pandemic as the case).

By testing factual affiliate-level data, 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 adjustment behavior by firms when adverse shocks hit them. The next section will discuss the empirical strategy for our analysis.

3 Empirical strategy

3.1 DID estimation with propensity score matching

Adopting a DID setting with matching in this context, we first defined the treatment and the control groups. For simplicity, we classify ASEAN-located affiliates with Chinese siblings as the treatment group and those without any as the control group. As mentioned before, post-war outcomes (e.g., exporting performance) 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. In this way, we attempt to find affiliates in the control group having similar pre-war characteristics as those in the treatment groups.

Accordingly, to compute the propensity score of affiliates falling into the treatment group, we estimate a logistic model to investigate determinants for the types of MNEs based on pre-war characteristics of parent firms at the first stage. 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 consider the model:

$$P(D_{a,s,Pre-war} = 1) = \Lambda(\mathbf{X}_{h,Pre-war} + \delta_s + v_c)$$

where indicator D implies whether the parent firm h set up affiliates within industry s in both China and the ASEAN countries before the trade war, taking one if the parent firm invests in both locations, 0 for the opposite. $\mathbf{X}$ denotes characteristics of parent firms (e.g., firm size, overseas experience, profit earning from affiliates, royalties, dividend share to total sales). We also consider the industry-specific effect, δ_s, and host country effect, v_c. Using the obtained

propensity score for every affiliate, we conduct the matching between observations in control and treatment groups. Caliper matching is the baseline method for matching procedure [2], and we also employ alternative methods, including local linear regression, Nearest 1 to 1 without replacement, and Nearest 2 to 1 matching.

Based on the matched pairs of observations, we run the DID specification above at the second stage 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:

$$PSM - DID = \frac{1}{n_i} \sum_{i \in I_1} [\Delta y_{1,i,t'} - \sum_{j \in I_0} w(ps_i, ps_j) \Delta y_{0,j,t'}]$$

In the equation, I_1 is the set for the treatment group ($I_1 = \{i : D = 1\}$), 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 $\Delta y_{1,i,t'} = y_{i,t'} - y_{i,t}$ 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.

3.2 Further decomposition of treatment groups

To make it a more precise identification of the heterogeneous impact, for the DID estimation, we further split the treatment group into two subgroups: treatment group (1) consists of all affiliates located in the ASEAN with purely vertical FDI-typed Chinese siblings; treatment group (2) is the group of those with horizontal and other FDI-typed Chinese siblings. We have two significant reasons to use this classification: 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 productions across borders within the production network; second, classifying the FDI types of sibling affiliates in China may enable us to more precisely identify the heterogeneous impact of

[2]The caliper is set as 0.05 for our matching process

trade shocks on MNEs' production networks. We expect affiliates in ASEAN may operate independently with HFDI type Chinese siblings, while those with other vertically integrated affiliates in different locations are more sensitive or vulnerable to the shock. To split sibling affiliates in China into two categories in terms of their FDI types, here we refer to the measure proposed by Alfaro and Charlton (2009) and firstly distinguish the FDI forms of those affiliates by their industry affiliation. Due to the data limitation, we adopt a simplified version of this measure. We classify a Chinese affiliate as Vertical-FDI (VFDI) affiliate if her owner parent operates in a different industry and as a Horizontal-FDI (HFDI) affiliate if the owner parent operates in the same industry. Since VFDI affiliates are inter-industry investments mainly intended to produce for foreign sales and mean to generate export, our main concern in the analysis is the response of treatment group (1)– ASEAN affiliate with VFDI Chinese siblings– to the trade war. Based on the classification by industry affiliation, there are more than 1000 Chinese affiliates categorized as vertical FDI, taking into account for 25% of the total[3].

The DID setting for the control and treatment groups is shown as the following:

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

where $y_{a,c,t}$ denotes outcomes (e.g., sales to North America, import from North America, total sales, investment, and the number of employees) for the affiliate a in an ASEAN country c at year t. $ChinaSib_a$ equals one if the affiliate in ASEAN has a sibling affiliate in China at 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

[3]The distribution of VFDI affiliates in China is shown by Table A1 in Appendix A

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 source

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 primary 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 [4]. It is a reasonable choice because exports to the US have accounted for most of the ASEAN's

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

exports to North America during the sample period [5]. 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 [6].

Information on parent firms' characteristics 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 classification, paid-in capital) and take variables including total sales, regular employees, total export, export to affiliates, royalties and profit from affiliates. 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.

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, their sales, imports, exports, investment, and employment. Because both surveys for affiliates and their parent firms cover company profiles, the corresponding data contains parent firm ID, subsidiary ID, and secondary subsidiary ID. Referring to these three IDs, we can combine an affiliate with her parent company.

4.2 Description of statistics

Statistics of control and two treatment groups for the DID analysis are summarized in Table 1 between 2017 and 2019. Due to the fact that there are many HFDI affiliates in China, treatment group 2 (titled "Other Chinese siblings" on the table) has the greatest number of affiliates and observations. There are 2,146 Chinese siblings classified as HFDI or other types in our dataset. In contrast, the number of VFDI Chinese siblings is the lowest, and only 563

[5]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%.

[6]In this study, data analysis proceeded at research data center set up by universities and research institutions in collaboration with the National Statistics Center, where the annual affiliate-level data before 2017 is not available. So we limit our sample period to be from 2017 to 2019.

affiliates fall into this category. Regarding the share of export to North America (hereinafter 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 the three groups, which are around 1%. However, as for the log of export value to NA, ASEAN-located affiliates with HFDI Chinese siblings contribute the highest on average. Contrasting to the control group, both treatment groups have a higher average value on export to NA during the observation period, 0.509 and 0.651, respectively. Total sales and number of employees are also more remarkable for the affiliates with Chinese siblings than those without any. We can also find that affiliates with HFDI 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 relative closely production linkage with Japanese suppliers, so they are more likely to function as new exporting platforms when Chinese siblings are troubled by the trade war.

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 innegligible differences, matching is a proper tool to help us at least reduce the bias of sample selection for analysis later.

Insert Figure 2 about here.

Bearing in mind the difference in characteristics between groups, we investigate the second difference – the difference in these characteristics before the trade war and after. For this purpose, we plot the time trend for respective characteristics within each group during the sample period. Since export to NA is the variable of interest, we show the time series of export to NA separately for each treatment and control group in Figure 3. 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. In post-war period, export 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 4 shows the logged total sales time series for three groups, respectively. Two treatment groups share a similar upward tendency of logged total sales after the trade war, while the control group sees a slight decline in total sales. Figure 5 shows identical patterns of the trend for investment across all the affiliates in the ASEAN. After the trade war, investment was likely to increase for affiliates in the ASEAN to facilitate the relocation of production. Figure 6 shows employment changes for each group over the years. Compared to the control group, both treatment groups increased their labor input slightly after 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 adjusting labor input.

Insert Figure 3 - Figure 6 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. We then conduct the analysis, and the next section shows related results.

5 Results

5.1 Baseline

In our analysis, propensity score matching is conducted before DID. To check the effectiveness of matching, we use the balancing test. The test reveals that matched pairs of affiliates from control and treatment groups have very similar pre-war characteristics. Also, pseudo-R^2 is applied as another test. The vastly reduced explanatory power of pseudo-R^2 confirms a valid matching, so we also compared the pseudo-R^2 from the logistic estimation on samples before and after matching. In the case of caliper matching (the benchmark matching for our study), the pseudo-R^2 decreases from 0.313 for the logit estimation using the sample before matching to 0.02 that obtained from the exact estimation on matched samples[7].

Table 2 shows estimation results of DID with caliper matching and simple DID without matching. The upper panel provides the results obtained by DID with caliper matching as the baseline results for this study. According to the baseline estimation, we can first see that affiliates with VFDI Chinese siblings (the treatment group (1)) have a significant positive and sizable increase after the trade war. Hiking tariffs may lead to around a 28% increase in exports to NA for this group of affiliates in the ASEAN compared to ASEAN-located affiliates with no Chinese siblings (the control group). This result supports our hypothesis. As one consequence of increasing export to NA, the share of NA-oriented export in total sales witnessed a significant growth of 0.5%. Second, we also see a 10.7% increase in total sales at the 90% confidence level, possibly driven by export growth to NA. Third, an 8.3% increase in labor input is also found for the treatment group (2). More use of labor may also explain the expansion of sales. As suggested by the earlier finding, the trade war leads to a decline in labor within Japanese affiliates in China (Sun et al., 2019), and this result complementarily indicates silent substitution of labor through the production network of

[7]For the baseline model, after matching, our matched sample contains 440 affiliates without Chinese siblings as a match for the 319 affiliates with HFDI and other typed FDI Chinese siblings and 100 affiliates with VFDI Chinese siblings.

MNEs (Muendler and Becker, 2010). Compared to the treatment group (1), we do not find any significant trade war impact on the treatment group (2). However, it confirms the heterogeneous effect of trade shock on affiliates differently connected to their siblings in the same network. More specifically, affiliates with vertically embedded siblings are more affected than those operating independently.

Insert Table 2 about here.

However, we can not find any significant results for imports from NA. Regardless of import measured by value or share, there seems to be 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. So, the trade shock is not very likely to increase imports from NA for affiliates located in the ASEAN.

In addition to PSM-DID results, the lower panel of Table 2 describes results for the simple DID with unmatched samples. Including the observations from the whole sample, we can still find a barely significant increase in export to NA for the treatment group (1). Relative to affiliates without Chinese siblings, a 9.7 % increase in export to NA is still found for affiliates with VFDI Chinese siblings due to the trade war. Accordingly, total sales go up by 8% for them. Apart from the treatment group (1), it is worth noting that affiliates in the treatment group (2) also tend to have a 4% increase in total sales. This increase may be driven by less competition from Chinese firms in the ASEAN market, resulting from a reduction in Chinese exports due to the trade war (Sun et al., 2019). Given the unchanged export to NA for this group of affiliates, an increase in total sales naturally leads to a lower NA export share. Thus, we can find a decrease in NA-oriented export share for the treatment group (2). The baseline estimation and simple DID show us consistent results for NA-oriented export and total sales for a specific group of ASEAN affiliates, indicating that potential relocation of production is undertaken through the network within Japanese

MNEs.

5.2 Robustness

To check the robustness of the findings, we implement other matching methods before the DID analysis. Results from estimations with alternative matching methods are summarized in Table 3. The entire table is separated into three panels by two lines, and the upper panel shows the results obtained from DID with local linear matching, the panel in the middle provides the results for Nearest 1 to 1 matching (with no replacement), and the lower panel provides the results for Nearest 2 to 1 matching. All three methods show us consistent results that the trade shock has significantly increased NA-oriented exports by 25.4% to 26.8% for affiliates with VFDI Chinese siblings. The share of NA-oriented exports in total sales sees a significant increase for the case of Nearest 2 to 1 matching. However, for the other two matching methods, the coefficients on the share of exports to NA are still positive but not significant. No matter what matching method is applied, the trade war positively affects total sales for the same group of affiliates. After the trade war, the increase in total sales is ranged from 11.1% to 23.9% across three cases. Similar effects are found for employment as well. The results show that the trade war may lead to 7.7% to 8.85% more labor input for affiliates with Chinese VFDI siblings. There is no finding of any significant results for the other treatment group, those with HFDI Chinese siblings. Again, the results imply that relatively independent affiliates operating in the ASEAN would not be affected too much by the shock.

Insert Table 3 about here.

For three alternative matching techniques, regardless of whether local linear regression, Nearest 1 to 1, or Nearest 2 to 1 matching is applied, the trade war shows positive effects on exports to NA, total sales, and labor inputs 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.

The trade war effect on outcome variables may depend on the way how we split the treatment group. In order to check the robustness of our model, we redefined the measure of FDI types for Chinese siblings. Instead of classifying FDI as intra-industry or inter-industry investment, we use export intensity as the criterion and define VFDI as an export-intensive investment. Export intensity is computed as the ratio of export to total sales. Any affiliates with a higher export ratio relative to the industrial median will be classified as VFDI affiliates; the reverse cases will fall into the category of HFDI. We rerun the benchmark PSM-DID estimator based on differently classified Chinese siblings, and the applied matching method is caliper matching. Corresponding results are stored in Table 4. We can see the significant positive impact of the trade war on export to NA, total sales, investment, and employment for the first treatment group. The consistent results indicate that our results are robust even if we change the classification for treatment groups. To be Specific, we observe a 23.6% increase in export to NA for the first treatment group and a 14.5% increase in total sales, together with a 9.62% increase in employment. Contrary to our expectations, investment may also increase after the trade war.

Insert Table 4 about here.

5.3 Country-level heterogeneous effects

The trade war effects could be heterogeneous across affiliates located in different countries. Corresponding to this concern, we examine whether affiliates located in less industrialized ASEAN member countries – 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.

We add interactions between DID terms and a dummy variable that indicates affiliates were set up in the CLMV countries. Table 5 represents the corresponding results for the country-intervened effect of the trade war on treatment groups. Affiliates with VFDI Chinese

siblings are still the most affected ones. The interaction between DID term for this specific group of affiliates and the CLMV dummy carries a significant negative sign, indicating that CLMV-located affiliates who operate with VFDI Chinese siblings tend to increase export to NA in the aftermath of the trade war. While on average, the magnitude of growth in export to NA is smaller than that from the same type of affiliates in other ASEAN countries (34.2%-26.6%=7.6%). In contrast, labor increases substantially for the same group of affiliates (4.97%+13.2%=18.17%). That is to say, the impact of the trade war is even more positive on employment for CLMV-located affiliates with VFDI Chinese siblings.

Insert Table 5 about here.

Since CLMV countries are less industrialized countries in the ASEAN, the formation of industrial agglomeration is still in progress, so they still concentrate on producing labor-intensive products. Accordingly, when relocation of production happens in the aftermath of the trade war, those affiliates located in CLMV are more likely to increase labor input very soon in response to an expansion of production and sales.

5.4 Industry-level heterogeneous effects

Provided that some affiliates are producing in industries included by the tariff lists of 2018, but some others are not. In this section, we investigate the heterogeneous effects of industries. Firstly, we split the whole data set of matched affiliates into sub-samples in terms of industry affiliations, and then we run the DID on the respective sub-sample.

Table 6 shows the results for affiliates within all machinery manufacturing industries. Again, export to NA markedly increases for the affiliates with VFDI Chinese siblings (40.4%). The increase in export value drives an increase in export share to NA. After the trade war, the export share to NA increased by around 1%. The coefficient on total sales is positive but not significant for the same group of affiliates. Also, The trade war leads to a 12.3% increase in employment at a very significant level. While we still can not find

any significant results on imports from NA for affiliates with Chinese VFDI. No significant effects of the trade war are found for affiliates with HFDI siblings either. The results for all machinery manufacturers are consistent with the results we obtained from earlier estimations. In this case, machinery manufacturers are likely to recruit more employees and expand the production of exporting commodities in the ASEAN. So, ASEAN-located affiliates producing within machinery industries may benefit from such rearrangement of production.

Insert Table 6 about here.

Next, we conduct the DID analysis based on the further breakdown of industries. We select industries including electrical machinery and ICT equipment, transportation equipment, business machinery, chemicals, iron, steel, and non-ferrous metals. For comparison, we also examine the impact of the trade war on industries less likely to be affected by 2018 tariffs. We run the analysis on the sample for textile and textile mill products industries. The upper part of Table 6 shows results for affiliates producing within electrical machinery and ICT equipment industries. As estimated, the exports to NA increased by 26.2% for those with VFDI Chinese siblings. For the same group, employment and investment experienced a sizable increase. Being prioritized industries in the ASEAN, manufacturing of electrical and electronics contributed the biggest proportion of total exports [8], With the current industrial foundation, production relocation brings new opportunities for this group of affiliates. The middle part of the table shows results for manufacturing transportation equipment and business machinery. Similarly, for the group of affiliates with VFDI Chinese siblings, both value and share of export to NA witnessed a substantial increase. While in this case, only positive but insignificant results can be seen for total sales and employment. A few ASEAN countries have actively integrated into the value chain of transportation equipment, especially the automobile industry. Well-established automobile industries already exist in countries like Thailand and Indonesia. Substitution of production is relatively easy to undertake by

[8] 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

affiliates set up in these countries. Regarding the results for industrial chemicals, iron, steel, and non-ferrous metals, 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 7 about here.

The 2018 tariff list did not cover the industries of textile mill products. We examine the impact of the trade war on the industries of textile mill products but find no significant results for either treatment group. Again, we do not see any significant increase in export to NA. Since textile is not a highly fragmented industry in the ASEAN, the trade shock is less likely to propagate through MNEs' value chains.

To sum it up, our analysis documents evidence of the heterogeneous effect of the trade war on affiliates across multiple industries. Affiliates operating in targeted industries may benefit from the trade war and increased exports to North America. In contrast, those affiliates operating in industries with heavy capital spending or industries excluded by the first round of hiking tariffs 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-located affiliates for Japanese MNEs. We find that those affiliates with Chinese siblings may see an increase in total sales around and after the trade war, particularly compared to independently operated affiliates, those affiliates with vertically integrated Chinese siblings within the same value chains of a Japanese MNE tend to increase their export to the North American market. Also, their expanding sales to North America may lead to more labor input. This finding document the evidence of potential prompt relocation of production undertaken by Japanese MNEs in response to a

trade shock. Furthermore, the impact of the trade war is heterogeneous across affiliates in different locations and industries. Affiliates in CLMV countries tend to see a slight increase in exports to North America but a substantial increase in labor relative to more developed ASEAN countries (ASEAN-6). As for industry heterogeneity, we find that affiliates with Chinese VFDI siblings operating in some affected industries would see export expansion to North America around and after the trade war.

Our study documents empirical evidence for MNEs' adjustments to overseas production activities. It may derive implications for MNEs to set up a diversified overseas production network.

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Tables

Table 1: Summary statistics

	ASEAN affiliates of Japan MNEs, 2017-2019								
	No Chinese siblings (# of affiliates: 1573)			VFDI Chinese siblings (# of affiliates: 563)			Other Chinese siblings (# of affiliates: 2146)		
VARIABLES	N	Mean	SD	N	Mean	SD	N	Mean	SD
export to NA/total sales	3,696	0.012	0.07	1,413	0.008	0.04	5,685	0.011	0.06
log (export to NA)	3,696	0.389	1.40	1,413	0.509	1.63	5,685	0.651	1.88
import from NA/total purchase	3,696	0.004	0.04	1,413	0.007	0.05	5,685	0.003	0.03
log (import from NA)	3,696	0.108	0.69	1,413	0.263	1.14	5,685	0.238	1.08
log (total sales)	2,961	6.602	1.65	1,144	7.609	1.80	4,838	7.949	1.89
log (investment)	2,225	3.249	2.12	923	4.045	2.16	3,859	4.222	2.31
log (employees)	3,021	4.682	1.43	1,167	5.169	1.56	4,876	5.381	1.68

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 HFDI Chinese siblings and affiliates with VFDI Chinese siblings.

Table 2: Impact of trade war on production activities of ASEAN affiliates

Dependent variables	(1) Export share (NA)	(2) log of export (NA)	(3) Import share (NA)	(4) log of import (NA)	(5) log (Total sales)	(6) log (Investment)	(7) log (Employees)
				Caliper matching (baseline)			
1.Post#1.ChinaSib#1.VFDI	0.00573*	0.279***	-0.000241	0.0543	0.107*	-0.0866	0.0828***
	(0.00302)	(0.0926)	(0.00145)	(0.0485)	(0.0578)	(0.226)	(0.0267)
1.Post#1.ChinaSib#1.OtherFDI	0.000963	0.0739	-0.00112	-0.00968	0.0493	0.167	0.0316
	(0.00293)	(0.0618)	(0.00190)	(0.0412)	(0.0343)	(0.127)	(0.0288)
N	2,419	2,419	2,419	2,419	2,226	1,776	2,239
R-squared	0.849	0.892	0.901	0.842	0.973	0.840	0.981
				Simple DID			
1.Post#1.ChinaSib#1.VFDI	0.000134	0.0970*	-0.000137	0.0200	0.0803**	-0.0381	-0.00465
	(0.00204)	(0.0519)	(0.00111)	(0.0280)	(0.0352)	(0.104)	(0.0188)
1.Post#1.ChinaSib#1.OtherFDI	-0.00290*	-0.0141	-9.42e-05	-0.00313	0.0396*	0.0493	0.00695
	(0.00175)	(0.0382)	(0.00111)	(0.0234)	(0.0213)	(0.0740)	(0.0167)
N	10,053	10,053	10,053	10,053	8,226	6,258	8,316
R-squared	0.858	0.895	0.808	0.870	0.978	0.867	0.983

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 3: Impact of trade war on production activities of ASEAN affiliates: alternative matching methods

Dependent variables	(1) Export share (NA)	(2) log of Export (NA)	(3) Import share (NA)	(4) log of Import (NA)	(5) log (Total sales)	(6) log (Investment)	(7) log (Employees)
				local linear matching			
1.d#1.ChinaSib#1.VFDI	0.00557	0.257**	0.000910	0.0668	0.143*	0.0160	0.0770**
	(0.00426)	(0.116)	(0.00186)	(0.0681)	(0.0780)	(0.321)	(0.0354)
1.d#1.ChinaSib#1.OtherFDI	0.00178	0.0826	0.000761	0.0133	0.0324	0.204	0.0322
	(0.00330)	(0.0710)	(0.00191)	(0.0470)	(0.0441)	(0.150)	(0.0368)
N	1,782	1,782	1,782	1,782	1,642	1,304	1,652
R-squared	0.822	0.880	0.860	0.833	0.971	0.848	0.982
				Nearest 1 to 1 without replacement			
1.Post#1.ChinaSib#1.VFDI	0.00233	0.254*	-0.00134	0.0300	0.239***	-0.103	0.0885**
	(0.00533)	(0.144)	(0.00173)	(0.0746)	(0.0910)	(0.336)	(0.0386)
1.Post#1.ChinaSib#1.OtherFDI	0.000774	0.113	-0.00262	-0.0163	0.0358	-0.0525	0.0396
	(0.00427)	(0.0914)	(0.00254)	(0.0508)	(0.0566)	(0.164)	(0.0309)
N	1,495	1,495	1,495	1,495	1,382	1,061	1,385
R-squared	0.843	0.886	0.757	0.767	0.961	0.848	0.987
				Nearest 2 to 1 matching			
1.Post#1.ChinaSib#1.VFDI	0.00548*	0.268***	-0.000242	0.0462	0.111*	-0.105	0.0881***
	(0.00307)	(0.0941)	(0.00147)	(0.0486)	(0.0592)	(0.232)	(0.0268)
1.Post#1.ChinaSib#1.OtherFDI	0.000960	0.0723	-0.00112	-0.00725	0.0514	0.167	0.0334
	(0.00294)	(0.0616)	(0.00190)	(0.0412)	(0.0343)	(0.128)	(0.0288)
N	2,410	2,410	2,410	2,410	2,217	1,768	2,230
R-squared	0.846	0.889	0.901	0.840	0.973	0.840	0.981

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 4: Impact of trade war on production activities of ASEAN affiliates: redefined FDI types

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Export share (NA)	log of Export (NA)	Import share (NA)	log of Import (NA)	log (Total sales)	log (Investment)	log (Employees)
1.Post#1.ChinaSib#1.VFDI	0.00539	0.236**	0.00138	0.0802	0.145**	0.397**	0.0962*
	(0.00358)	(0.111)	(0.00179)	(0.0698)	(0.0689)	(0.193)	(0.0512)
1.Post#1.ChinaSib#1.OtherFDI	0.00138	0.0972	-0.00136	-0.00988	0.0470	0.0549	0.0332
	(0.00278)	(0.0594)	(0.00183)	(0.0381)	(0.0337)	(0.130)	(0.0270)
N	2,419	2,419	2,419	2,419	2,226	1,776	2,239
R-squared	0.849	0.892	0.901	0.842	0.973	0.841	0.981

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 trade war on affiliates in CLMV

Dependent variables	(1) Export share (NA)	(2) log of Export (NA)	(3) Import share (NA)	(4) log of Import (NA)	(5) log (Total sales)	(6) log (Investment)	(7) log (Employees)
1.Post#1.ChinaSib#1.VFDI	0.00669**	0.342***	-0.000200	0.0358	0.0333	0.0273	0.0497*
	(0.00337)	(0.113)	(0.00143)	(0.0474)	(0.0493)	(0.259)	(0.0270)
1.Post#1.ChinaSib#1.OtherFDI	0.00155	0.0862	-0.00138	-0.0123	0.0299	0.218	0.0275
	(0.00323)	(0.0696)	(0.00205)	(0.0448)	(0.0344)	(0.135)	(0.0335)
1.Post#1.ChinaSib#1.VFDI#1.CLMV	-0.00398	-0.266**	-0.000194	0.0779	0.287*	-0.450	0.132**
	(0.00339)	(0.118)	(0.00131)	(0.175)	(0.156)	(0.462)	(0.0575)
1.Post#1.ChinaSib#1.OtherFDI#1.CLMV	-0.00344	-0.0721	0.00152	0.0156	0.109	-0.297	0.0229
	(0.00334)	(0.0670)	(0.00163)	(0.0429)	(0.0766)	(0.279)	(0.0521)
N	2,419	2,419	2,419	2,419	2,226	1,776	2,239
R-squared	0.849	0.892	0.901	0.842	0.973	0.841	0.981

Note: CLMV countries are Cambodia, Lao PDR, Myanmar and Vietnam. 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 6: Impact of trade war on all machinery industries

Dependent variables	(1) Export share (NA)	(2) log of Export (NA)	(3) Import share (NA)	(4) log of Import (NA)	(5) log (Total sales)	(6) log (Investment)	(7) log (Employees)
1.Post#1.ChinaSib#1.VFDI	0.00981*	0.404**	0.000216	0.0624	0.0406	0.238	0.123***
	(0.00577)	(0.168)	(0.000859)	(0.0901)	(0.0558)	(0.352)	(0.0410)
1.Post#1.ChinaSib#1.OtherFDI	-0.000881	0.0863	0.000286	-0.0657	0.0483	0.0163	0.0137
	(0.00444)	(0.0995)	(0.00102)	(0.0592)	(0.0431)	(0.182)	(0.0495)
N	1,089	1,089	1,089	1,089	1,000	806	1,016
R-squared	0.921	0.904	0.973	0.817	0.977	0.844	0.975

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).

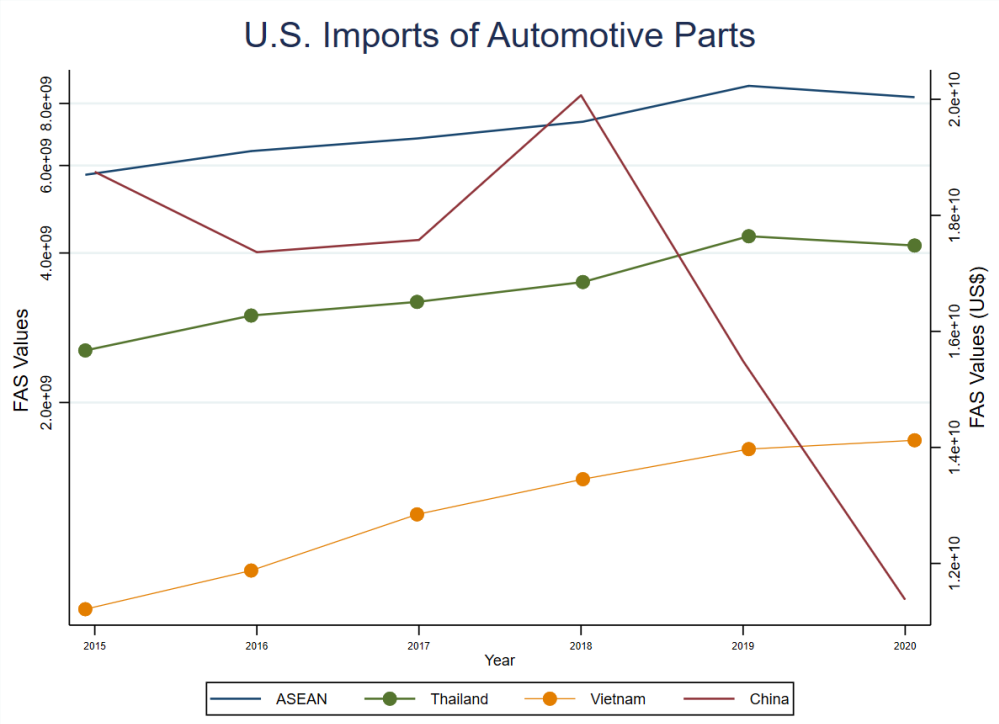
Table 7: Impact of trade war on selected industries

Dependent variables	(1) Export share (NA)	(2) log of Export (NA)	(3) Import share (NA)	(4) log of Import (NA)	(5) log (Total sales)	(6) log (Investment)	(7) log (Employees)
			Electrical machinery and ICT equipment				
1.Post#1.ChinaSib#1.VFDI	0.000944	0.262*	0.00147	0.361	0.0226	0.803**	0.226***
	(0.00509)	(0.136)	(0.00141)	(0.283)	(0.0831)	(0.331)	(0.0839)
1.Post#1.ChinaSib#1.OtherFDI	-0.0115	-0.0135	0.00223	0.0228	-0.0465	-0.193	-0.139
	(0.00886)	(0.131)	(0.00222)	(0.0989)	(0.107)	(0.329)	(0.137)
N	333	333	333	333	296	229	297
R-squared	0.687	0.926	0.750	0.798	0.972	0.909	0.957
			Transportation equipment and business machinery				
1.Post#1.ChinaSib#1.VFDI	0.0167*	0.531*	-0.000584	-0.0680	0.0390	0.0839	0.0826
	(0.00935)	(0.274)	(0.00126)	(0.0522)	(0.0820)	(0.498)	(0.0524)
1.Post#1.ChinaSib#1.OtherFDI	0.000398	0.0344	-0.000342	-0.0792	0.0693	0.0786	0.0848
	(0.00460)	(0.126)	(0.00132)	(0.0815)	(0.0470)	(0.236)	(0.0517)
N	621	621	621	621	582	495	596
R-squared	0.949	0.916	0.977	0.843	0.979	0.789	0.981
			Industrial-oriented chemicals, iron, steel and non-ferrous metals				
1.Post#1.ChinaSib#1.VFDI	-0.00265	0.0283	0.00301	0.146	-0.126	0.113	-0.0392
	(0.00353)	(0.0669)	(0.00197)	(0.116)	(0.0782)	(0.499)	(0.0530)
1.Post#1.ChinaSib#1.OtherFDI	-0.00484	0.0379	0.00422	0.0751	0.0222	0.249	-0.0271
	(0.00511)	(0.0879)	(0.00283)	(0.106)	(0.0714)	(0.298)	(0.0436)
N	485	485	485	485	446	367	448
R-squared	0.494	0.852	0.787	0.767	0.986	0.845	0.989
			textile mill products				
1.Post#1.ChinaSib#1.VFDI	0.000149	0.310	0.00524	-0.0620	0.481	-0.678	0.0800
	(0.00351)	(0.339)	(0.00889)	(0.0575)	(0.470)	(0.678)	(0.127)
1.Post#1.ChinaSib#1.OtherFDI	-0.00394	-0.230	0.00153	0.00135	0.0721	0.618	0.0278
	(0.00351)	(0.190)	(0.00216)	(0.0117)	(0.0898)	(0.663)	(0.0814)
N	94	94	94	94	87	68	86
R-squared	0.959	0.966	0.958	0.997	0.977	0.834	0.993

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

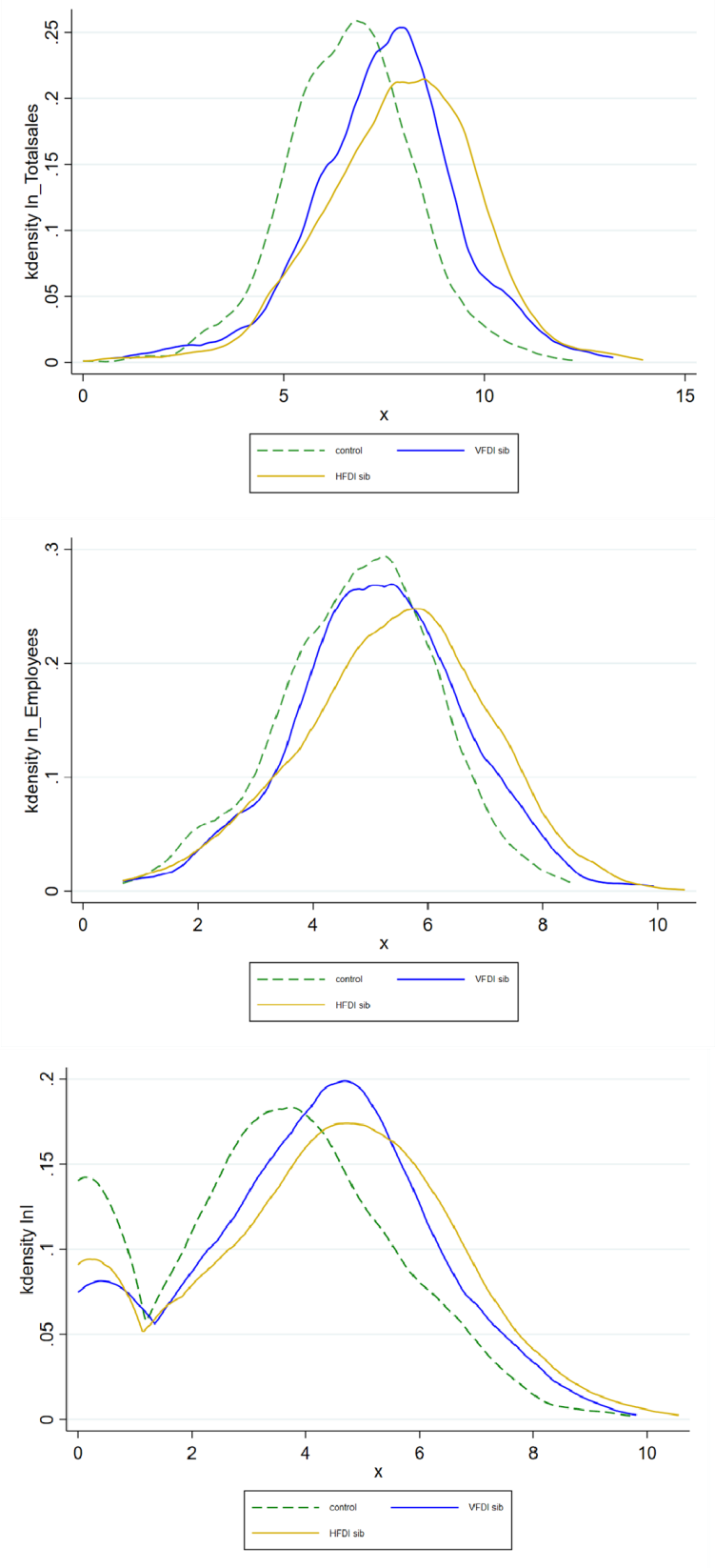


Figure 3: Before and after the trade war (export to NA)

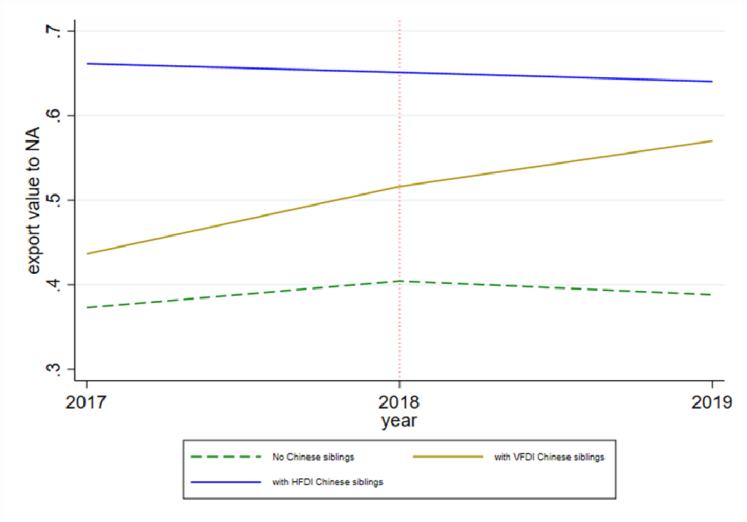


Figure 4: Before and after the trade war (log of total sales)

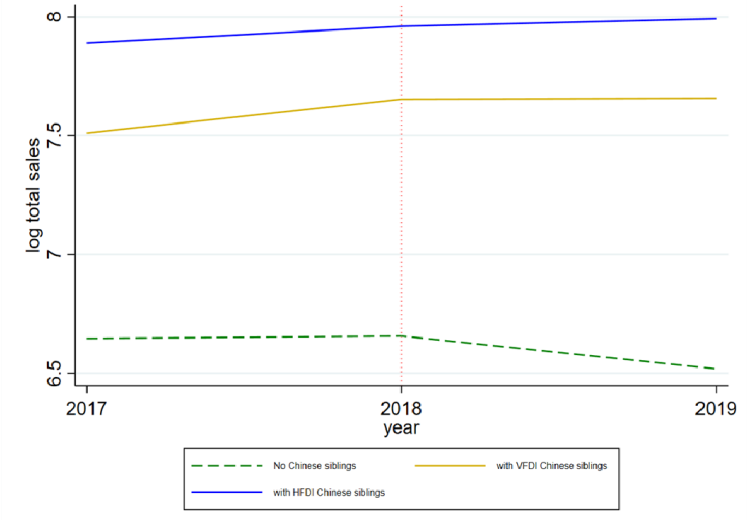


Figure 5: Before and after the trade war (log of investment)

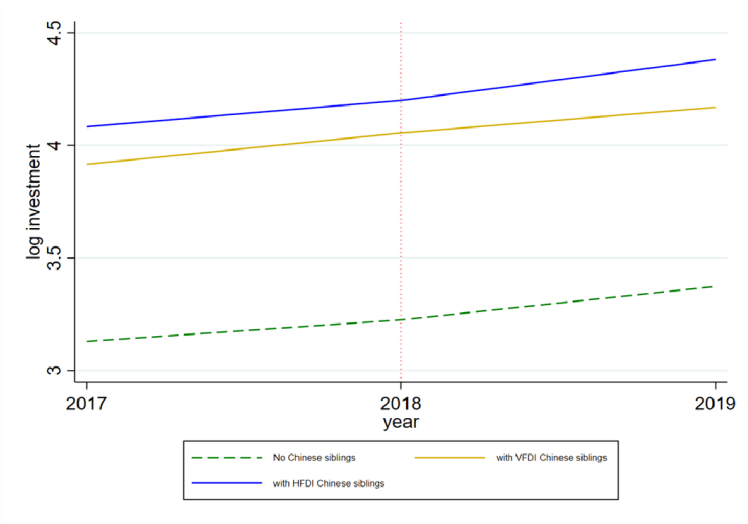
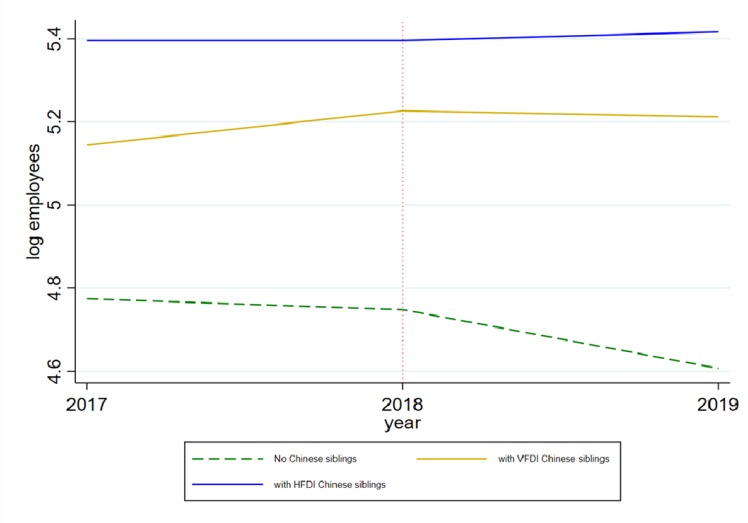


Figure 6: Before and after the trade war (log of employment)



Appendix A.

Table A1: Distribution of VFDI affiliates in China

	#affiliates in China		
Type of industry	VFDI	Total	Proportion
food, beverage and animal feed	13	133	10%
textile	40	254	16%
lumber and wood products, paper	19	68	28%
chemicals	105	341	31%
ceramic, stone and clay products	24	111	22%
iron and steel	16	70	23%
non-ferrous metals	43	143	30%
fabricated metal products	63	250	25%
general-purpose machinery	53	185	29%
production machinery	95	379	25%
business oriented machinery	38	115	33%
electrical machinery	120	350	34%
information and communication equipment	113	414	27%
transportation equipment	161	668	24%
Miscellaneous manufacturing	121	581	21%