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Impact of U.S. Tariffs on Chinese Firms' Outward Connection

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This paper delves into the repercussions of the 2018 China-US trade friction on China's supply chain and outward greenfield investment. By conducting an aggregated prefecture-level analysis, we unveil a substantial surge in disconnection from Chinese firms to U.S. entities. Moreover, there is a noteworthy decline in Chinese firms' greenfield investment towards the U.S.

Key Words: China-US Trade Friction; Supply Chain; Greenfield Investment.
JEL Classification Numbers: F13, F14.

1. INTRODUCTION

The 2018 China-US trade friction marked a significant turning point in the process of deglobalization. As the first two largest economies in the world, both the U.S. and China imposed high additional tariffs on almost the entire range of commodities traded between the two countries, resulting in significant uncertainties and disruptions in the global economy. The friction's impact on the surface is visible through imported products and prices. However, at a deeper level, it affects the interconnections between economies, including supply chain relationships and foreign investments. These profound impacts possess a greater capacity to shape long-term fundamental economic changes.

We formally investigate the impact of U.S. tariffs by constructing a prefecture-level measure of tariff exposure. Utilizing this measure and harnessing data from the FactSet Revere Supply Chain and fDi Markets dataset, we have gained valuable insights into shifts within Chinese firms' supply chain and greenfield investment dynamics. Notably, following the

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emergence of the China-US trade friction, a distinct upswing in supply chain disruptions from China to U.S. firms has become evident. In contrast, supply chain relationships from foreign upstream suppliers to Chinese firms have not shown a significant decline. Furthermore, we also identify declines in China's outward greenfield investment to other nations, particularly directed at the U.S.

This paper belongs to the extensive literature assessing the impact of the China-US trade friction. Within this body of research, some research primarily focus on aggregated welfare shifts. Amiti et al. (2019) document that US consumers and importers borne the brunt of the tariffs, implying a huge reduction in aggregate U.S. real income. Fajgelbaum et al. (2021) calculate the resulting losses incurred by U.S. consumers and firms purchasing imports, which amounted to $51 billion, equivalent to 0.27% of U.S. GDP. Ding et al. (2022), utilizing a general equilibrium framework, quantify a 0.24% decline in China's welfare. Tariff pass-through is another focal point of research. Amiti et al. (2020), Fajgelbaum et al. (2021), and Cavallo et al. (2021) observe complete tariff pass-through using distinct data sources and across various timeframes. One plausible explanation for the complete pass-through lies in elastic supply. Jiao et al. (2020) employ firm-level estimates of Chinese firms and propose that despite a decline in sales to the U.S., there is no significant decline in firm-level sales to the world. Fan et al. (2023) similarly discover a sharp decline in both China's exports and imports following the commencement of the trade friction. To further examine the impact of U.S. tariff on export reallocation, we go beyond previously available reviews in focusing on more fundamental supply-chain changes. We also estimate the shift of greenfield investment of Chinese firms using an approach distinct from that employed by Fan et al. (2023).

The rest of the paper is organized as follows. In section 2, we present the background of the China-US trade friction and several stylized facts. Section 3 describes the data and empirical framework. Section 4 interprets our empirical results. Section 5 concludes.

2. FACTS

Since the inauguration of the Trump administration on January 20, 2017, the United States' trade policy has gradually shifted towards "America First" trade protectionism. The Trump administration executed a sequence of trade protectionist measures, which included exiting the Trans-Pacific Partnership Agreement, initiating a "301 investigation" against China, and commencing a "232 investigation" on Chinese steel and aluminum products. Within this context, the China-US trade friction emerged, characterized by its prolonged duration, substantial scale, and significant tariff rates spanning from 5% to 25%.

As illustrated in Table 1, the trade conflict encompassed an expanding array of goods and an extensive spectrum of products. Notably, the cumulative value of the impacted goods reached an unprecedented magnitude, and the duration of the friction extended beyond that of previous trade disputes. The ramifications of this trade friction have reverberated broadly, impacting the economies of both China and the United States, as well as the global economy. These characteristics elevates the China-US trade friction to a rare and momentous event in the annals of trade history.

TABLE 1.

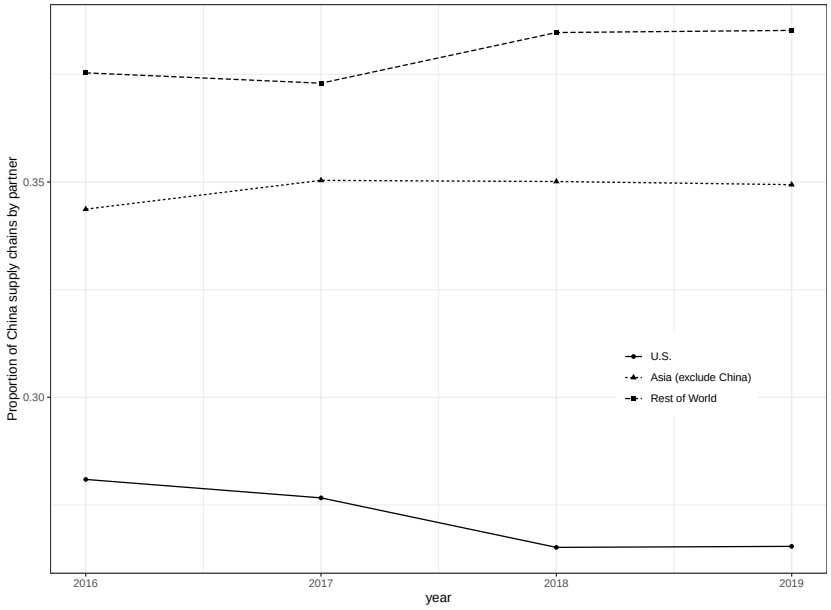
Chronology of China-US Trade War Tariffs

Stage	Effective Date	Content of Tariff List
First Round (Batch 1)	July 6, 2018	US to China: 818 items / $34 billion / 25% import tariff
		China to US: 545 items / $34 billion / 25% import tariff
First Round (Batch 2)	August 23, 2018	US to China: 279 items / $16 billion / 25% import tariff
		China to US: 333 items / $16 billion / 25% import tariff
Second Round (Batch 1)	September 24, 2018	US to China: 5,745 items / $200 billion / 10% import tariff
		China to US: 1,636 items / $60 billion / 5% or 10% import tariff
Second Round (Batch 2)	US to China: May 10, 2019; China to US: June 1, 2019	US to China: Tariffs on $200 billion goods increased from 10% to 25%
		China to US: Tariffs on $60 billion goods increased to 10%-25%, unchanged from the initial 5%
Third Round	September 1, 2019; December 15, 2019	US to China: $300 billion / 10% import tariff
		China to US: 5,078 items / $75 billion / varying tariffs of 10% and 5%; tariffs on automobiles and auto parts reverted to 25% and 5% respectively.

In order to comprehensively assess the overall changes in China's foreign supply chains across different countries, we categorized China's outward supply chains into three distinct groupings: those linked with the United States, Europe, and other nations. For a comprehensive perspective, we aggregated the supply chain data on an annual basis, focusing exclusively on relationships within the respective year. The outcomes, depicted in Figure 2, unveil a decrease in China's supply chains connected to the United States, contracting from 27.6% in 2017 to 26.5% in 2019.

In order to delve further into the specific transformations within China-US supply chains, we compute the ratio of China-US supply chains in comparison to the total supply chains originating from China. Subsequently, we plot the monthly variations in these proportions, as depicted in the left panel of Figure 2. Simultaneously, we calculate the monthly average U.S. import tariff rates on Chinese commodities, exhibited in the right panel of Figure 2. It becomes evident that as the average tariff rates rise, a notice-

FIG. 1. Comprehensive Overview of China's Foreign Supply Chain



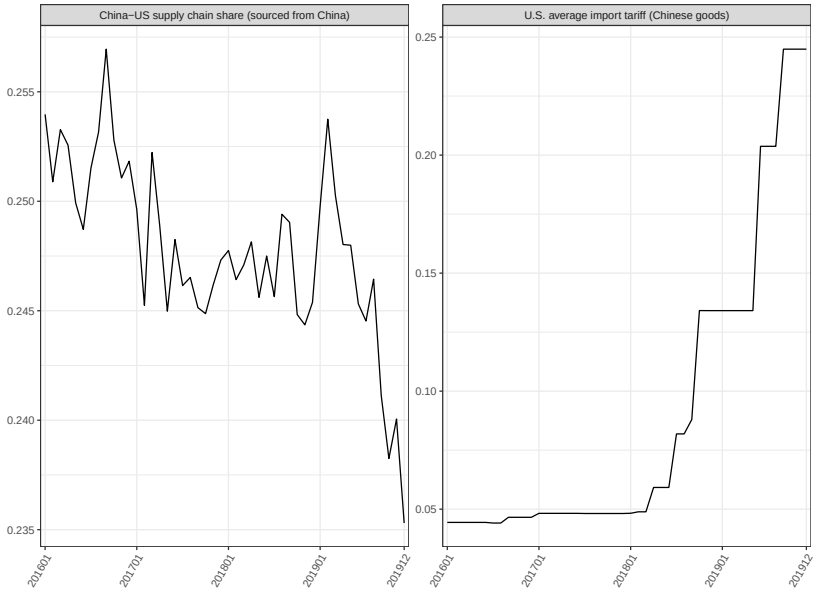
Notes: In this figure, Chinese firms' foreign supply chains has been aggregated at the annual level and by different location of partners. The aggregated results indicate that the proportion of supply chains to U.S. firms declined from 27.7% in 2016 to 26.5% in 2019.

able downward trajectory is observed in the proportion of the supply chain linking China to the U.S.

These escalations in U.S. tariff levels have augmented the trade costs associated with China's exports to the U.S., potentially prompting Chinese suppliers to curtail their ties with U.S. entities. For categorization purposes, we define the period preceding July 2018 (spanning from January 2016 to June 2018) as the pre-shock phase, while the period succeeding July 2018 (from July 2018 to December 2019) is designated as the post-shock phase. Subsequently, we partition outward supply chain relationships stemming from China into two distinct groups according to their destination: the China-to-US group and the China-to-others group. For each group and phase, we quantify both disruptions and connections and subsequently compute the disruption rate (disruptions/connections) for each group.

As illustrated in Table 2, during the pre-shock phase, the supply chain disruption rate for the China-to-US group stands at 0.019, whereas the disruption rate for the China-to-others group is marginally higher at 0.021. Following the shock, the disruption rate for the China-to-US group ex-

FIG. 2. Dynamics of Supply Chain and Tariff Rates



Notes: In this figure, the left panel displays the monthly proportion of Chinese supplier to the U.S. market, among all supply chains sourced from China. The right panel exhibits the monthly U.S. average tariff rates on Chinese exports.

TABLE 2.

Comparison of Disruption of Supply Chains

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pre-Shock (2016.1-2018.6)			Post-Shock (2018.7-2019.12)			Change in Disruption Ratio
	Disruptions	Connections	Disruption Ratio	Disruptions	Connections	Disruption Ratio	
China-to-US	578	30774	0.019	715	25840	0.028	47.3%
China-to-others	1955	92920	0.021	2086	79480	0.026	24.7%

Notes: Columns (1) to (3) belong to the pre-shock phase, columns (4) to (6) belong to the post-shock phase, and column (7) shows the relative percentage change in the disruption ratio between the two phases. The disruption ratio is defined as disruptions divided by connections.

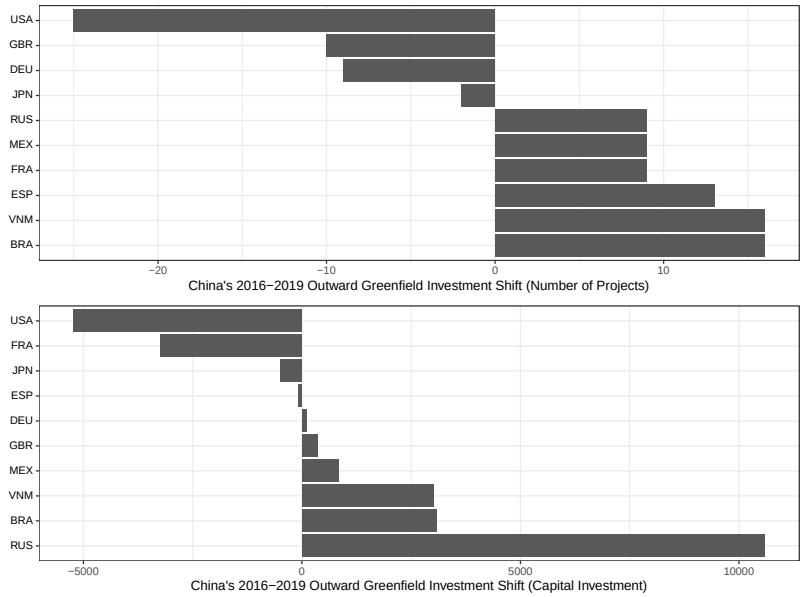
perienced a substantial surge of 47.3%, reaching 0.028. In contrast, the disruption rate for the China-to-others group witnessed a comparatively lower increase of 24.7%, ascending to 0.026. Importantly, this increase rate is nearly half that of the China-to-US group.

Furthermore, the China-US trade friction has the potential to expose Chinese businesses to a certain level of uncertainty and market risks (Ben-

guria et al., 2020). Studies such as Julio and Yook (2012), Gulen and Ion (2016), and Alfaro et al. (2018) have validated a negative correlation between uncertainty and investment. Consequently, in response to heightened uncertainty, Chinese firms may consider the cancellation of planned greenfield investments.

To provide a comparative context, we present a set of stylized facts concerning China's greenfield projects. Initially, we categorize the greenfield project data of Chinese firms from the fDi Market dataset based on destination and select 10 representative countries. Subsequently, we count the number of China's greenfield projects and aggregate the capital investment amount for each country in both 2016 and 2019. Illustrated in Figure 2, we show the disparities in project counts and capital investment amounts between the years 2016 and 2019. Evidently, the U.S. registered the most pronounced decline, both in terms of the number of greenfield investment projects and the amount of greenfield capital investment originating from China.

FIG. 3. China's Greenfield Investment Shift between 2016 and 2019



Notes: The chart above illustrates the changes in the number of Chinese greenfield projects to different countries from 2016 to 2019. The below chart represents the difference in the amount of Chinese greenfield capital investment to different countries from 2016 to 2019. The 10 countries are represented by their ISO 3 codes.

Likewise, we partitioned the period spanning 2016 to 2019 into pre-shock and post-shock phases, once again anchored to the onset of the China-US trade friction. Table 3 presents the alterations in Chinese greenfield investment during these two phases.

TABLE 3.

Changes in Chinese Greenfield Investment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pre-Shock (2016.1-2018.6)			Post-Shock (2018.7-2019.12)			Change in Capital Investment
	Number of Projects	Jobs Created	Capital Investment	Number of Projects	Jobs Created	Capital Investment	
China-to-US	225	28160	16483.86	99	12236	4560	−72%
China-to-others	1499	407063	175131.44	843	289060	76360.32	−56%

Notes: Columns (1) to (3) belong to the pre-shock phase, columns (4) to (6) belong to the post-shock phase, and column (7) shows the relative percentage change in the capital investment between the two phases. In columns (1) and (4), we report the number of greenfield projects; in columns (2) and (5), the number of job positions created; and in columns (3) and (6), the amount of greenfield capital investments. The two groups of China-to-US and China-to-others are defined as before.

3. DATA AND EMPIRICAL FRAMEWORK

3.1. Data

Our study is founded upon three primary datasets: FactSet Revere Supply Chain Relationships data for supply chain relationships, FactSet Revers Company fDi Markets data for greenfield investment information, and U.S. import tariff rates on Chinese exports, sourced from the U.S. Trade Representative (USTR) and the Federal Register. Furthermore, we leverage China's 2016 customs data to compute export shares at the prefecture-product level. Our sample encompasses Chinese firms that were either importers or exporters during the period spanning from January 2016 to December 2019. In the subsequent discourse, we will expound upon the data sources and elucidate the construction of key variables.

The FactSet Revere Supply Chain Relationships data comprehensively covers more than 31,000 listed companies on a global scale, encompassing over 450,000 distinct supply chain connections. This dataset has been extensively utilized within the realm of existing operations and management literature (Wang et al., 2020; Osadchiy et al., 2021; Agca et al., 2021). In our study, we analyze the monthly supply chain information for all Chinese firms within the time frame spanning from January 2016 to December 2019.

Utilizing the FactSet Revere Company Basics data, we are able to access information pertaining to the geographical location of Chinese firms, specifically the names of their respective prefectures, along with the country details of all firms. We narrow our focus solely to Chinese firms that maintain foreign entities as partners. By harnessing the supply chain relationships data, we identify interactions between Chinese firms and foreign entities. This encompasses instances where Chinese firms function as upstream suppliers, as well as scenarios where they operate as downstream customers. Through the aggregation of firm-firm associations at the monthly prefecture-country level, and by filling unidentifiable relationships, we generate a balanced panel dataset at he prefecture-country-month level.

The data concerning outward greenfield investment is derived from the fDi Markets dataset, encompassing crucial details like firm names, project timelines, job creation figures, capital investments, destination countries, and source cities. Our principal emphasis rests on greenfield projects executed by Chinese firms. We aggregate project-level data at the prefecture-country level on a monthly basis and subsequently integrate this dataset with tariff data classified by prefecture and time, facilitating further analysis.

The U.S. import tariff data encompasses HS 10-digit product-level import tariff rates spanning from 2016 to 2019. Our primary objective involves constructing a metric denoting the level of tariff exposure at the prefecture level. To achieve this, we utilize China's 2016 export data, which encompasses all firms engaged in export activities within that particular year. This export data furnishes pertinent information such as firm IDs, product codes (HS 8-digit), export values, export types, and destination countries. Specifically, by utilizing the first four digits of the firm IDs in the export data, we can deduce the corresponding prefectures to which the firms belong.

Building upon this premise, we adopt a methodology akin to Topalova (2010) and Kovak (2013) to derive the measure of tariff exposure for prefecture i at time t as follows:

$$\text{tariff}_{it} = \sum_{k} \frac{X_{i,k,2016}}{X_{i,2016}} \times \text{tariff}_{kt}, \tag{1}$$

where $X_{i,k,2016}$ represents the export value of HS 6-digit product k in prefecture i at 2016, $X_{i,2016}$ represents the total export value in prefecture i at 2016, and tariff_{kt} is the average tariff rate over HS 6-digit product k in time t. A summary of the key variables during the sample period is presented in Table 4.

TABLE 4.

Descriptive Statistics

Variable	N	Mean	SD	Min	Max
tariff_{it}	9984	0.083	0.071	0	0.398
break($cn-$)	96960	0.055	0.405	0	34
break($-cn$)	67632	0.074	0.603	0	66
USdummy	121440	0.064	0.244	0	1
number	86004	0.031	0.214	0	6
jobscreated	86004	8.564	143.965	0	17000
capital	86004	3.169	92.673	0	20000

Notes: break denotes the number of supply chain disruptions, and ($cn-$) represents disruptions which China acts as a supplier, while ($-cn$) represents disruptions which China acts as a customer. USdummy is a dummy variable equals 1 if the source/destination country is the U.S., number is the number of greenfield projects, jobscreated is the number of jobs created by greenfield investment, and capital denotes the amount of capital investment.

3.2. Empirical Framework

To thoroughly scrutinize the aforementioned facts and findings, we employ the tariff exposure measure to analyze the repercussions of the China-US trade friction on Chinese firms. The fundamental regression equation is as follows:

$$Y_{ijt} = \alpha_1 \text{tarriff}_{it} + D_{ij} + D_t + u_{ijt}, \tag{2}$$

where the subscripts i, j and t denote prefecture, destination country and time, respectively. The dependent variable Y_{ijt} includes several key factors, such as supply chain disruptions form Chinese prefecture i to country j in time t, supply chain disruptions from country j to prefecture i in time t, the attributes of outward greenfield investments from Chinese prefecture i to country j in time t. The model also controls for prefecture-country fixed effects D_{ij} and year-month fixed effects D_t to account for factors specific at prefecture-country level or factors that vary over time. u_{ijt} represents the random error term.

Furthermore, in order to more comprehensively capture the distinct responses between the China-to-US group and the China-to-others group, we introduce a dummy variable termed USdummy which takes the value of 1 when the partner country is the U.S. The following empirical equation is employed to discern the specific impact on China-to-US outward connections:

$$Y_{ijt} = \alpha_1 \text{tarriff}_{it} + \alpha_2 \text{tarriff}_{it} \times \text{USdummy}_j + D_{ij} + D_t + u_{ijt}. \tag{3}$$

The coefficient α_2 is the primary focus of our attention.

4. RESULTS

4.1. Supply Chain

Table 5 presents the impact of China-US trade frictions on the disconnection of supply chains associated with Chinese firms. The dependent variables in columns (1) and (2) are the logarithm of disrupted connections originating from China to other countries.[1] In contrast, the dependent variables in columns (3) and (4) represent the logarithm of disrupted connections originating from other countries to China. In columns (2) and (4), we introduce the interaction term to capture the differentiation between China-US connections and China-others connections. Across all columns, we incorporate controls for prefecture-country and year-month fixed effects.

TABLE 5.

Impact of Tariff Shocks on Disconnection of Supply Chains

	(1)	(2)	(3)	(4)
	From CN to others		From others to CN	
	$\log(break+1)$	$\log(break+1)$	$\log(break+1)$	$\log(break+1)$
tariff_{it}	−0.008	−0.030	0.007	0.003
	(−0.228)	(−0.834)	(0.118)	(−0.051)
$\text{tariff}_{it} \times \text{USdummy}$		0.280***		0.065
		(4.493)		(1.572)
City-Country-FE	Y	Y	Y	Y
Yearmonth-FE	Y	Y	Y	Y
R-squared	0.233	0.234	0.331	0.331
N	96960	96960	67632	67632

Notes: The dependent variables in column (1) and (2) are the logarithm of disrupted connections sourced from China to other countries, dependent variables in column (3) and (4) are the logarithm of disrupted connections sourced from other countries to China. In column (2) and (4), we use the interaction term to capture the difference between China-US connections and China-others connections. Prefecture-country and year-month fixed effects are controlled in all columns. The significance levels are denoted as *** for $p < 0.01$, ** for $p < 0.05$, and * for $p < 0.1$. Robust standard errors are clustered at prefecture level, and the t-statistics are presented in parentheses.

The coefficients corresponding to tariff_{it} are insignificant across all columns, indicating that the surge in U.S. import tariffs has a limited impact on the foreign connections of Chinese firms. However, in column (2), the coefficient of $\text{tariff}_{it} \times \text{USdummy}$ exhibits a positive and statistically significant value. This result strongly supports our anticipation that connections from China to the U.S. are more vulnerable than other outward connects sourced

[1] We use $\log(1+y)$ where y is the dependent variable to handle the zeros in y.

from China. In contrast, column (4) reports an insignificant coefficient of $\text{tariff}_{it} \times \text{USdummy}$, which illustrates that the connections sourced from the U.S. to China are not that distinguished as inward connections from other countries to China.

The comprehensive findings presented in Table 5 offer substantial evidence that the U.S. import tariffs on Chinese exports can potentially elevate trade costs and uncertainty for Chinese firms that uphold outward supply chain associations with U.S. counterparts. Consequently, these elevated trade costs and heightened uncertainty contribute to supply chain disconnections. Notably, supply chain disruptions are more prone to manifest between Chinese suppliers and U.S. customers who are directly impacted by the U.S. import tariffs.

TABLE 6.

Impact of Tariff Shocks on China's Outward Foreign Direct Investment (OFDI)

	(1)	(2)	(3)	(4)	(5)	(6)
	$\log(number+1)$	$\log(number+1)$	$\log(jobscreated+1)$	$\log(jobscreated+1)$	$\log(capital+1)$	$\log(capital+1)$
tariff_{it}	−0.027	−0.020	−0.133	−0.101	−0.092	−0.067
	(−1.348)	(−1.005)	(−1.100)	(−0.834)	(−1.101)	(−0.791)
$\text{tariff}_{it} \times \text{USdummy}$		−0.064**		−0.304*		−0.243*
		(−2.251)		(−2.347)		(−2.375)
City-Country-FE	Y	Y	Y	Y	Y	Y
Yearmonth-FE	Y	Y	Y	Y	Y	Y
R-squared	0.170	0.170	0.021	0.026	0.022	0.026
N	86004	86004	86004	86004	86004	86004

Notes: In columns (1) and (2), the dependent variables are the logarithm of the number of greenfield projects. Columns (3) and (4) take the logarithm of the number of job opportunities created by greenfield projects as dependent variables. Columns (5) and (6) represent the result for the logarithm of the greenfield capital investment. In columns (2), (4) and (6), we also use the interaction term to capture the difference between China-to-US projects and China-to-others projects. Prefecture-country and year-month fixed effects are controlled in all columns. The significance levels are denoted as *** for $p < 0.01$, ** for $p < 0.05$, and * for $p < 0.1$. Robust standard errors are clustered at prefecture level, and the t-statistics are presented in parentheses.

4.2. Greenfield Investment

Table 5 primarily examines alterations within foreign supply chains associated with Chinese firms. Similarly, Table 6 delves into the fluctuations observed in the greenfield investment endeavors of Chinese firms amidst the backdrop of the China-US trade friction. Columns (1) and (2) focus on the logarithm of the count of greenfield projects as dependent variables. Columns (3) and (4) center on the logarithm of the number of job opportunities generated through greenfield projects. Finally, columns (5) and (6) analyze the logarithm of the greenfield capital investment. In columns (2), (4), and (6), the interaction term $\text{tariff}_{it} \times \text{USdummy}$ is also incorporated to discern differences between China-to-US projects and China-to-others

projects. The fixed effects controlled in Table 5 are maintained in this analysis as well.

The insignificant coefficients of the tariff-exposure term in all columns indicate that U.S. import tariffs, on average, have a relatively minor impact on outward greenfield investments at the prefecture level in China. However, when the destination of outward investment is taken into account, the number of projects, job positions created, and capital investment experience a decline for China-to-US greenfield investments compared to China-to-others greenfield investments, as evidenced by columns (2), (4), and (6). The results presented in Table 6 offer evidence that connections originating from China to the U.S. are directly and negatively affected by the China-US trade friction.

5. CONCLUSIONS

By utilizing aggregated monthly data on supply chains and greenfield investments at the prefecture level, we analyze the impact of China-U.S. trade frictions on supply chain relationships and the outward investment decisions of Chinese firms. Our analysis reveals significant trends in China's foreign supply chains and greenfield investments during the period of China-U.S. trade frictions. Specifically, the disconnection between Chinese suppliers and U.S. entities becomes more pronounced, and there is a noticeable decline in Chinese firms' greenfield investments towards the U.S. To delve deeper into these findings, we construct a prefecture-level tariff exposure measurement based on U.S. import tariffs levied on commodities from China. This measure is then used to estimate the impact of this exposure on supply chains and greenfield investments.

The empirical results underscore that China-U.S. trade frictions have heightened the likelihood of disconnections between Chinese suppliers and U.S. entities. Additionally, a reduced likelihood of greenfield investment by Chinese firms towards the U.S. is observed. However, no parallel changes are witnessed in the opposite direction of supply chains. In conjunction with the existing literature on the impact of U.S. import tariffs on exports and prices, our study extends the research scope to encompass impact of U.S. import tariffs on supply chains and greenfield investments, contributing to a more comprehensive understanding of the repercussions of China-U.S. trade frictions on Chinese firms.

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