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Tariff cost and cross-border M&A affiliate sales: Evidence from China

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ABSTRACT

Cross-border mergers and acquisitions (M&A) is a major form of foreign direct investment (FDI). In contrast to many developed countries, the majority of China's cross-border M&As are vertical rather than horizontal. I study the difference in the reaction to tariff of horizontal and vertical M&A subsidiary sales. The baseline OLS regressions show that as export tariff cost increases, cross-border M&A affiliate sales relative to export rises, and the effect mainly comes from vertical affiliates, especially in downstream subsidiaries. The main results are robust to the Poisson pseudo maximum likelihood (PPML) regressions and an instrumental variable (IV) approach. A simple model is developed to reconcile the empirical findings when horizontal and vertical M&As co-exist in the same market and further tested at both the extensive and intensive margins. The results offer new insights to understanding the performance of M&As from developing economies.

1. Introduction

In recent years, the world economy has witnessed a new wave of deglobalization, represented by the US-China trade war since 2018 and Brexit in Europe. The Covid-19 pandemic accelerated the process even more. One of the direct effects of this wave is the increase of trade costs, especially tariff cost, which will most likely reduce exports between nations, yet the influence on foreign direct investment (FDI) is less clear. In this paper, I take China, the largest developing country as an example, and try to identify the performance of Chinese affiliates under increased tariff cost. In particular, I look at investment in the form of cross-border mergers and acquisitions (M&A), because it is the type of investment that accounts for 80% of total FDI globally, according to the statistics from the United Nations Conference on Trade and Development (UNCTAD) in 2018.

To have a better idea of the momentum of China's outward cross-border M&A investment, Fig. 1 presents the trend of China's cross-border M&A deals in numbers since the beginning of the 21st century. Before 2000, the number of deals was less than a dozen per year. Since China joined the WTO in 2001, along with the influx of foreign investment attracted to China, the M&A investment from China also began to grow. The number of deals dropped after 2008 when the financial crisis hit the global economy and recovered since 2013 when the Chinese government launched the "Belt and Road Initiative".[1] The deal values are summarized in Appendix Fig. A.1. They show similar patterns as deal numbers but more volatile.[2] For either deal numbers or values, horizontal

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[1] The "Belt and Road Initiative" is a global development strategy adopted by the Chinese government involving infrastructure development and investments in countries and international organizations in Asia, Europe, Africa, the Middle East, and the Americas. — the World Bank

[2] Regulations issued by the government may be at work to slow down the trend. The Ministry of Finance issued *The Measures for the Financial Management of the Overseas Investments by State-owned Enterprises* in August 2017. The National Development and Reform Commission, the Ministry of Commerce, and the People's Bank of China issued *The Code of Conduct for the Operation of Overseas Investments by Private Enterprises* in December 2017. The two documents aim to regulate state-owned and private enterprises respectively.

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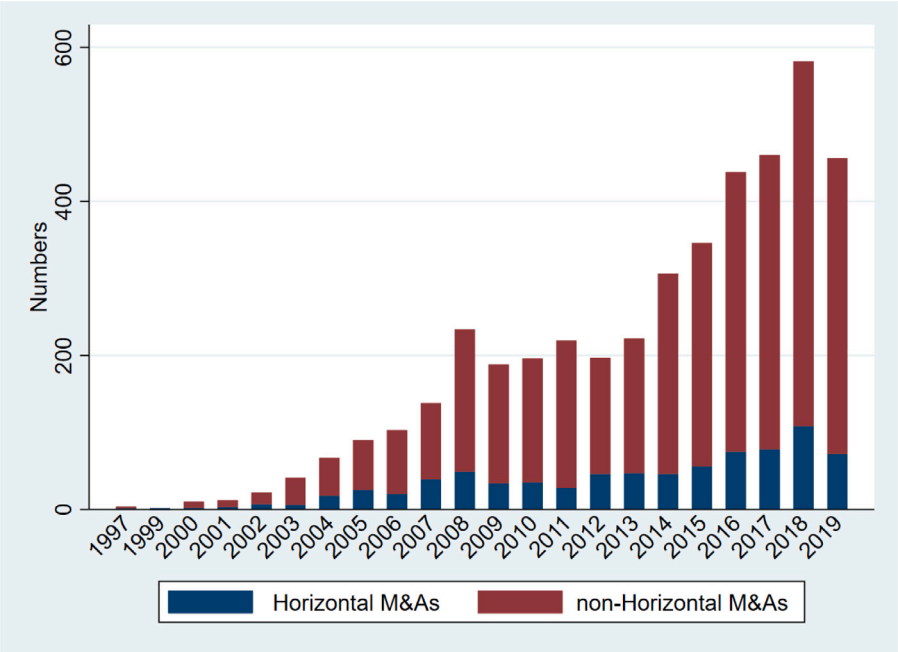


Note: Data are sourced from BvD Zephyr, calculated by the author.

Fig. 1. China's cross-border M&A numbers.

M&As account for a small share of all cross-border investment from China while the majority are non-horizontal M&As.[3] The formal definitions of horizontal and non-horizontal M&As are detailed in the data section.

According to classic FDI theories, horizontal cross-border investment is considered as investment on target firms within the same industry as the parent firm and is likely to be a replication of home production process in host countries with similar development levels, motivated by proximity to the destination market. This type of investment is usually observed between developed countries. In contrast, vertical foreign investment is often investment in different industries from the parent firm (upstream or downstream) to make use of the comparative advantages of different countries through global value chain and the main incentive is production cost minimization. Therefore, this type of investment should be more prevalent between dissimilar countries. While horizontal investment plays a dominant role in the US cross-border M&As (Davies & Markusen, 2020), the majority of China's cross-border M&As are vertical at the 6-digit NAICS 2017 level.[4] Since most of cross-border M&As flow into developed destinations, it is consistent with the theory that the US invest in developed countries with similar economic status in the form of horizontal M&As while China invests in more developed destinations in the form of vertical integration.

In this paper, I look into the cross-border M&A data by Chinese acquirers and disentangle horizontal and vertical investment, as they may react to tariff costs differently from the typical US pattern. I further divide vertical investment into upstream and downstream categories and see how the industry linkages affect the investment performance. I find that affiliate sales of China's outward cross-border M&As relative to export in the same 6-digit industry increase with a higher tariff levied by the destination country on Chinese goods. The evidence is consistent with the "tariff-jumping" effect of tariff on FDI which is also found in other countries.[5] However, different from what has been found with investment from developed economies, I find that the positive impact of tariff cost on China's cross-border M&A affiliate sales mainly derives from vertical investment instead of horizontal investment, and particularly in downstream industries.

To verify the baseline results, I use the Poisson pseudo maximum likelihood (PPML) regressions to deal with the problem of zero values in the dependent variable in the trade literature after Silva and Tenreyro (2006). The results are in line with the OLS regressions. To address the endogeneity problem, I also employ an instrumental variable (IV) approach following Autor, Dorn, and

[3] A representative case of horizontal cross-border M&A by Chinese firms is the merger of Geely Automobile from China and Volvo Cars, a Swedish brand and formerly part of the Ford Group. The transaction was completed in 2010 and was reckoned as a first step of Chinese car producers to engage in the global market. Another example in the pharmaceutical industry is Fosun, the Chinese drug firm which acquired 74% of Gland Pharma in India in 2017. Examples of vertical deals include the investment in the oil company Repsol YPF Brazil in 2017 by China Petrochemical Corporation for a 40% stake. In another case, China's home appliance maker Media Group bought the German factory robot manufacturer Kuka AG in 2016.

[4] NAICS 2017 is short for North American Industry Classification System 2017 version.

[5] "Tariff-jumping" refers to the phenomenon when facing higher tariff barriers, firms are discouraged from exporting and instead turn to alternative entry mode to foreign markets such as FDI.

Hanson (2013) where I use average tariff on other countries weighted by their respective share of export as the IV for bilateral tariff of the destination on China to clean the potential supply-side shocks.

Based on the empirical findings, I develop a simple theoretical model on the basis of Helpman, Melitz, and Yeaple (2004) framework. When both vertical and horizontal affiliates operate in the global value chain where there is intermediate exchange, vertical M&As are less influenced by tariff cost on the final product. The data show that vertical and horizontal affiliates co-exist in the same market at 6-digit NAICS level. The model implies that when the tariff cost increases, both horizontal and vertical cross-border M&As increase profits relative to exporters at the intensive margin. However, at the extensive margin, only vertical cross-border M&As in downstream industries show a relative rise to exporters in number. The relative number of horizontal cross-border M&As decreases, making the net effect smaller in magnitude and statistically less significant than that of vertical investment. Finally, I test the model implications at both the extensive and intensive margins with the data.

The rest of the paper is organized as follows. The next section reviews the main literature related to this topic. Section 3 introduces the data and sample characteristics. Section 4 shows the baseline regression results with OLS and PPML regressions. An instrumental variable approach is employed later in the section. Section 5 proposes the theoretical model to reconcile the empirical evidence and is further tested at both extensive and intensive margins in Section 6. The last section concludes the paper.

2. Related literature

The classic theory on multinational firms' cross-border M&As derives from the seminal Melitz (2003) framework (see Antràs & Helpman, 2004; Helpman et al., 2004; Kukharskyy, 2020 among others). The majority of literature takes all kinds of FDI as homogeneous. However, different forms of FDI can be quite diversified in terms of incentives and reactions to market features. Nocke and Yeaple (2007) explore the difference of greenfield and M&A investment and find that the choice of entry mode is based on the comparative advantage of the parent firm. In industries with higher mobile capabilities (e.g. technological know-how), M&As lead to higher expected return. In industries abundant with immobile factors (e.g. marketing), greenfield investment is instead more attractive. Jiang and Jiang (2017) test the theoretical predictions with data on Chinese industrial enterprises between 2003 and 2009 with a Probit model and find that firms with more mobile advantages are more likely to choose cross-border M&As rather than greenfield investment. More recently, Davies, Desbordes, and Ray (2018) examine patterns of greenfield investment and M&As and find that M&As are more affected by institutional factors and sensitive to temporary shocks while greenfield investment is more driven by comparative advantage and destination taxes.

Another way to distinguish FDI is horizontal and vertical investments. Antràs and Yeaple (2014) review the literature in detail under the workhorse monopolistic competition model with constant elasticity of substitution (CES) preferences. Empirically, most papers focus on a specific mode of foreign market entry. The contribution to identification methods started with Lael Brainard (1997) which looks into horizontal FDI by introducing the ratio of affiliate sales over export to measure the propensity of US firms to serve foreign markets. In terms of vertical FDI, Yeaple (2003) argues that the right specification should include the factor intensity of the industry times the factor abundance of the destination country to capture the comparative advantage of parent and target companies. Both of them find that FDI is positively affected by trade costs. When pooling horizontal and vertical FDI together, Antràs and Yeaple (2014) conclude that "There have been few empirical studies motivated by models of complex strategies perhaps in part because of the conceptual complications that the models entail".

The results from the IO perspective is less conclusive and many of them show that reduction in trade costs may lead to cross-border M&A investment, but not necessarily (Bertrand & Zitouna, 2006; Chalkley & Stewart, 2011; Collie, 2011). Some studies even provide evidence that contradicts the predictions of classic theories (Hijzen & Holger, 2008; Tekin-Koru, 2012). For instance, Tekin-Koru (2012) uses data on Swedish manufacturing multinational enterprises and multivariate Probit models to show that greenfield FDI declines as trade costs fall, while cross-border M&As and export are encouraged. Hijzen and Holger (2008) use data on OECD countries between 1990 and 2001 and find that aggregate trade costs affect cross-border M&A numbers and values negatively yet the impact is less negative or even positive for horizontal mergers. They claim this as evidence of "tariff-jumping".

Some other studies explore the topic with alternative models and the findings are mixed. Among them, Ornelas and Turner (2012) show with a property rights model that a rise in tariff of intermediate inputs may encourage cross-border investments. Liu, Lu, and Yang (2020) introduce spatial weights to modify the gravity model and find that China's outward FDI in countries along the "Belt and Road Initiative" tend to be export-platform driven, especially in southeastern and southern Asia where the trade integration is at a higher level. Yan (2018) further shows that M&As also promote trade, especially from cross-border M&As. In addition, some papers investigate market size effects (Eicher & Kang, 2005; Breinlich, 2008; Edwards, Ferrett, & Gravino, 2020) and third-country effects (Baltagi, Egger, & Pfaffermayr, 2007; Bergstrand & Egger, 2007; Blonigen, Davies, Waddell, & Naughton, 2007; Garretsen & Peeters, 2009), etc.

To the best of my knowledge, previous studies mainly focus on cross-border M&A transactions and trade costs. However, not much attention has been paid to the affiliates after acquisitions when facing trade cost fluctuations except Helpman et al. (2004). Yet it is important for firms to generate further profits after making the cross-border M&A deals. In this paper, I revisit the reaction of multinational firms to tariff cost, and test whether the classic or alternative multinational firm theories better explain the reality. Specifically, I examine horizontal and vertical cross-border M&A affiliate sales relative to export in the destinations countries and explore heterogeneous effects between upstream and downstream investments. On one hand, China has witnessed rapid increase in outward FDI in recent years, especially in the form of cross-border M&As, which makes the question relevant. On the other hand, in contrast to previous studies which mainly focus on developed countries, especially the US, in this paper I focus on China, which may provide some further evidence on the behavior of multinational firms originated from emerging markets.

Table 1
China's cross-border M&As' top 30 destination countries.

Country	No. of deals	Country	No. of deals
Germany	98	Russia	15
Singapore	71	Malaysia	14
United States	56	Netherlands	12
Australia	52	Austria	10
Italy	52	Finland	10
Canada	43	Vietnam	10
France	38	Portugal	9
Japan	37	Brazil	8
Spain	37	Denmark	8
Korea	32	Hungary	8
India	24	Norway	8
United Kingdom	24	Egypt	7
Taiwan	23	Luxembourg	7
Sweden	20	Israel	6
Czechia	17	Thailand	5

Note: The number of China's cross-border M&A deals are between 2010 and 2018.

3. Data and descriptive statistics

I use several sources of data in the empirical specification of this paper. The cross-border M&A deal information is drawn from the Bureau van Dijk (BvD) Zephyr database, which includes M&A transactions globally. I can identify the acquirer and target firms of each M&A deal using the BvD ID numbers. I then merge the M&A data with the BvD Orbis dataset to obtain information on affiliate sales, which covers the period from 2010 to 2018.

3.1. Summary statistics

As a preliminary step, I look at the major destination countries of China's cross-border M&A investment in the sample with positive affiliate sales at the 6-digit NAICS 2017 industry-level in Table 1. Investment to tax havens are excluded due to potential tax evasion purpose of investment.[6] Only deals that are completed are counted for in the analysis.[7] China's cross-border M&A investment flows mostly to major developed economies and also to neighboring countries in Asia.

In terms of industry distribution, for better comparability with export, only tradable sectors are preserved. The tradable sectors here refer to those with a counterpart in export. I later focus on the relative profitability of cross-border affiliate sales to export. The corresponding NAICS 2017 industries are mainly manufacturing industries that begin with codes 31 to 33. Some fall into the category of Agriculture, Forestry, Fishing and hunting that begin with code 11 and others belong to Mining, Quarrying, and Oil and gas extraction that begin with code 21.

Since I merge the Zephyr M&A data with the Orbis data to obtain the affiliate sales information, it is useful to look at the coverage of datasets. Table 2 shows that the Orbis data cover on average 65.20% of deals in the Zephyr cross-border M&A sample. At the 3-digit NAICS 2017 industry level, the coverage ranges from 45.45% to 100%, which is a representative sample of total transactions.

Horizontal M&As are defined as investment in targets within the same 6-digit NAICS 2017 code as the acquirers, which is the finest possible record with the current M&A data on Chinese firms.[8] When there are multiple primary industry codes for the acquirer or target firms (around 30% of the sample), I denote the deal as horizontal as long as there are overlapping industries between the acquirer and the target. To identify vertical M&As, I follow Ahern and Harford (2014) and define a deal as vertical if the acquirer and target industries exceed a threshold of 1% across any of the following relations: (1) acquirer industry purchases from target, (2) target industry purchases from acquirer, (3) acquirer industry sells to target, (4) target industry sells to acquirer.[9] The industry linkages are obtained from the World Input-Output Tables (WIOT). In a few cases the NAICS 2017 6-digit industry code maps into multiple 4-digit ISIC industry codes in the WIOT, I assign the firm to only one matching industry at random following the practice of Ahern and Harford (2014). Within vertical deals, if downstream linkage (i.e. the acquirer industry sells to target or target industry purchases from acquirer) is greater than the upstream linkage (i.e. the acquirer industry purchases from target or target industry sells to acquirer), I label the deal as a downstream vertical transaction, otherwise, the deal is defined as upstream.[10] The rest of the deals are considered neither horizontal nor vertical but conglomerate.

[6] Tax havens include Bahamas, Belize, Bermuda, British Virgin Islands, Cayman Islands, Cook Islands, Hong Kong, Liechtenstein, Macao, Mauritius, Panama, and Vanuatu.

[7] According to the Zephyr database, cross-border M&As deal status includes "announced", "completed", "pending", "postponed", "rumour", "unconditional", and "withdrawn".

[8] With the Zephyr database, one can define horizontal/vertical M&As at the 2-digit, 4-digit or 6-digit level, as is often done in the literature (see Chari, 2020). The finer the industry classification, the more deals are categorized as non-horizontal M&As. Alternative levels of industry classification do not change the qualitative features of the results but may neutralize the distinction between horizontal and non-horizontal M&As.

[9] Alternatively, I can use the 5% threshold as a robustness check and the findings are very similar to the 1% threshold in the regression analysis.

[10] Alternative downstream and upstream classification following Antràs and Chor (2018) provides qualitatively similar results in the regression analysis. However, the indices do not take into account the input–output linkages between acquirer and target firms and do not identify conglomerate deals.

Table 2
Sample coverage.

NAICS 2017		Zephyr		Orbis		
3-digit code	Industry name	No.	Percent	No.	Percent	Coverage
111	Crop Production	11	1.38%	5	0.96%	45.45%
113	Forestry and Logging	3	0.38%	2	0.39%	66.67%
212	Mining (except Oil and Gas)	47	5.90%	39	7.51%	82.98%
311	Food Manufacturing	20	2.51%	17	3.28%	85.00%
312	Beverage and Tobacco Product Manufacturing	8	1.01%	5	0.96%	62.50%
313	Textile Mills	6	0.75%	4	0.77%	66.67%
314	Textile Product Mills	9	1.13%	6	1.16%	66.67%
315	Apparel Manufacturing	6	0.75%	4	0.77%	66.67%
321	Wood Product Manufacturing	4	0.50%	2	0.39%	50.00%
322	Paper Manufacturing	2	0.25%	2	0.39%	100.00%
323	Printing and Related Support Activities	1	0.13%	1	0.19%	100.00%
324	Petroleum and Coal Products Manufacturing	6	0.75%	4	0.77%	66.67%
325	Chemical Manufacturing	92	11.56%	54	10.40%	58.70%
326	Plastics and Rubber Products Manufacturing	15	1.88%	9	1.73%	60.00%
327	Nonmetallic Mineral Product Manufacturing	11	1.38%	6	1.16%	54.55%
331	Primary Metal Manufacturing	20	2.51%	12	2.31%	60.00%
332	Fabricated Metal Product Manufacturing	25	3.14%	14	2.70%	56.00%
333	Machinery Manufacturing	142	17.84%	91	17.53%	64.08%
334	Computer and Electronic Product Manufacturing	158	19.85%	104	20.04%	65.82%
335	Electrical Equipment, Appliance, and Component Manufacturing	67	8.42%	35	6.74%	52.24%
336	Transportation Equipment Manufacturing	103	12.94%	72	13.87%	69.90%
337	Furniture and Related Product Manufacturing	3	0.38%	2	0.39%	66.67%
339	Miscellaneous Manufacturing	37	4.65%	29	5.59%	78.38%
	Total	796	100.00%	519	100.00%	65.20%

Notes: The table includes China's cross-border M&A deals between 2010 and 2018. Columns 4 and 6 list the percentage share of each industry from Zephyr and Orbis. The last column shows the coverage of Orbis on Zephyr by industry.

Table 3
Horizontal, vertical and conglomerate cross-border M&As.

	Horizontal	Vertical	Downstream	Upstream	Conglomerate	Total
Zephyr	221	474	220	254	101	796
Percent	27.76%	59.55%	27.64%	31.91%	12.69%	100.00%
Orbis	116	326	164	162	77	519
Percent	22.35%	62.81%	31.60%	31.21%	14.84%	100.00%

Note: Number and percentage share of each type of cross-border M&As in Zephyr and Orbis.

Table 3 summarizes the share of each cross-border M&A type. According to the definition above, horizontal M&As account for nearly 28% of total cross-border deals in the Zephyr database, while vertical M&As take up nearly 60%. Downstream and upstream integrations are evenly distributed among vertical M&As. Finally, conglomerate deals which are neither purely horizontal nor vertical make up 13% of the total transactions. Merging with sales data from Orbis changes the shares very little so the Orbis data is also representative of the whole cross-border M&A sample in the aspect of deal types.

Focusing on the most popular industries of China's cross-border M&As with positive affiliate sales, Appendix Tables B.1 and B.2 show that both horizontal and vertical cross-border M&A investment are scattered across various industries. There are more vertical deals than horizontal ones according to our classification, and vertical investment is more dispersed across industries.

One can further investigate the relative upstreamness/downstreamness of acquirers and targets by looking at their respective positions in the global value chain (GVC). Following Antràs and Chor (2018), I employ the upstreamness index and the downstreamness index to measure the degree of integration into the international production process. The upstreamness index reflects the distance of a sector to the final output, which is first developed by Antràs, Chor, Fally, and Hillberry (2012). A higher upstreamness index means the sector in the given country makes more contribution to the GVC. The downstreamness index instead captures the distance from the primary input, and is originally proposed by Fally (2012). A higher downstreamness indicates more reliance on the GVC.[11]

I plot the relative upstreamness/downstreamness of acquirers and targets in horizontal and vertical M&As respectively in Appendix Figs. A.2 and A.3. The size of the circles and squares reflects the sales in each NAICS 2017 6-digit industry, which suggests that horizontal acquirers and targets overlap in the same sectors. For vertical acquirers and targets, there are more targets distributed to the upper-right side with both higher upstreamness and downstreamness on average than acquirers, suggesting the targets are both more reliant on GVC primary inputs and contribute more to GVC final outputs. In other words, the targets of vertical M&As are more integrated into the GVC than the parent firms.

[11] The upstreamness and downstreamness indices are constructed separately from final demand and primary factors respectively and are not negatively related. In fact, Antràs and Chor (2018) find that these two measures are positively correlated and intensified over the years, though the correlation of China is not very strong among all countries.

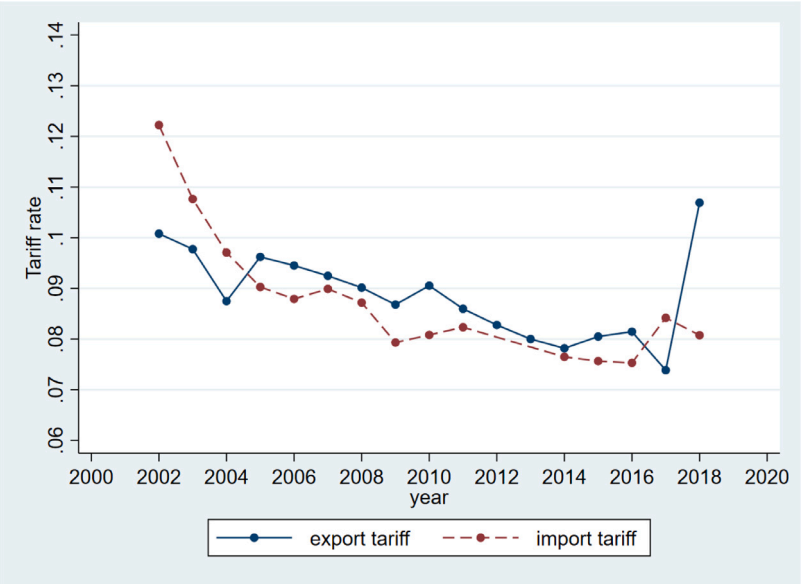


Fig. 2. China's average export and import tariffs.

3.2. Variable definitions

In the next sections, I use regression analysis to study how tariff cost affects the sales of Chinese affiliates relative to export in the same sector. In particular, I focus on the following dependent variables. First, $Export$ is measured by $\log(X_{ijt}+1)$, where X_{ijt} is export value in thousand US dollars from China to host country j aggregated at 6-digit NAICS 2017 industry i and year t level. The export tariffs are sourced from the World Integrated Trade Solution (WITS) database and aggregated from the Harmonized System (HS) 6-digit coding to match the cross-border M&A data using the concordance tables provided by the Census Bureau of the US.[12] I add 1 before computing the logarithm to preserve the number of observations with zero value. $Sales$ is calculated in a similar way as $\log(S_{ijt}+1)$, where S_{ijt} is affiliate sales in thousand US dollars of China's cross-border M&As at corresponding industry i, host country j and year t level. Observations of $Sales$ that are zero across industries and countries over all periods are dropped. $Ratio$ is the ratio of affiliate sales to export, which equals $\log\left(S_{ijt}/X_{ijt}+1\right)$. $RatioH$ denotes the ratio of horizontal affiliate sales to export. $RatioV$ refers to the same ratio when the deals are vertical. Among vertical affiliate sales, I further differentiate downstream and upstream affiliate sales compared to the parent industry, denoted by $RatioVD$ and $RatioVU$ respectively.

The main explanatory variable of interest is $tariff_{ijt}$, which is the bilateral tariff on Chinese goods exported to the host country j in the affiliate industry i in year t. $tariff\_im_{ijt}$ is the corresponding import tariff at the country-industry-year level, which is included in the main specifications to control for import competition. I further winsorize the tariffs at 1% tails to remove outliers. Although tariff costs have decreased a lot since China joined the WTO in 2001, it is not the case that the majority of tariff rates are effectively close to zero in the sample, but there are still variations across years, host countries and industries. Zero tariff rate accounts for 20.8% of all export tariffs and 12.7% of all import tariffs in the sample. Fig. 2 shows the trend of average export and import tariff rates of China. The average export tariff declined mildly until 2018 when the US-China trade war started and tariff increased sharply. The average import tariff declined along with the export tariff. Table 4 reports the descriptive statistics of the main variables together with the sources of the data.

To further show the variation of the tariffs across country, industry and year, I count the observations within each country-industry bin, and summarize how many observations have a year-over-year increase, decrease or stay the same. The statistics are reported at the end of Table 4. Around 60% of export tariffs change over periods and near 80% of import tariffs change over periods. I also draw additional figures on the tariffs with major trade partners of China to show the distribution of tariffs across industries over the years in the sample. The results are summarized in Fig. 3.

4. Empirical analysis

Compared to export, cross-border M&As allow multinational firms to replicate or outsource part of the production process to foreign countries so that they can better serve the final market and save on trade costs. However, multinationals face the risk of operating in different socio-economic environment from the home country and may not be able to fully exploit increasing returns

[12] The concordance tables can be found at https://www.census.gov/foreign-trade/reference/codes/index.html.

Table 4
Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
Export	25,136	11.43	3.02	0.02	17.82	WITS
Sales	25,136	0.35	2.02	0	19.74	BvD Orbis
Ratio	25,136	0.06	0.65	0	22.99	constructed by the author from BvD Zephyr, Orbis and WITS
RatioH	25,136	0.01	0.22	0	13.49	same as above
RatioV	25,136	0.03	0.48	0	22.99	same as above
RatioVD	25,136	0.01	0.30	0	22.99	same as above
RatioVU	25,136	0.01	0.15	0	5.70	same as above
tariff	24,991	0.05	0.16	0	12.06	WITS
tariff_im	15,562	0.08	0.11	0	7.6	WITS
tariff count	3944	6.02	2.34	1	9	constructed by country-industry
cross-year change		3.61	2.27	1	9	same as above
tariff_im count	3448	4.54	1.94	1	7	same as above
cross-year change		3.52	2.07	1	7	same as above

Table 5
OLS regressions.

	(1) *Export*	(2) *Sales*	(3) *Ratio*	(4) *RatioH*	(5) *RatioV*	(6) *RatioVD*	(7) *RatioVU*
tariff	−1.939***	1.932***	0.713***	−0.135***	0.419***	0.212***	0.013
	(0.185)	(0.466)	(0.136)	(0.048)	(0.100)	(0.056)	(0.036)
tariff_im	2.817***	1.338*	0.125	−0.106	0.443***	0.281***	0.155***
	(0.303)	(0.762)	(0.222)	(0.078)	(0.164)	(0.091)	(0.059)
Observations	14,546	14,546	14,546	14,546	14,546	14,546	14,546
R-squared	0.884	0.098	0.171	0.201	0.177	0.133	0.076
Country-year FEs	✓	✓	✓	✓	✓	✓	✓
Industry-year FEs	✓	✓	✓	✓	✓	✓	✓

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

to scale relative to exporters. The balance between export and FDI is referred to in the literature as the proximity-concentration trade-off. In order to identify the response of China's cross-border M&As to tariff costs, the econometric specification is the following:

$$\text{Dependent variable}_{ijt} = \beta_0 + \beta_1 tariff_{ijt-1} + \beta_2 tariff\_im_{ijt-1} + \mu_{it} + \mu_{jt} + \epsilon_{ijt} \quad (1)$$

where $tariff_{ijt-1}$ and $tariff\_im_{ijt-1}$ are export and import tariffs in the affiliate industry i in host country j. Here I use one-year lagged tariffs to take into account that it may take some time for the tariffs to affect export and sales. μ_{it} and μ_{jt} are industry-year and country-year fixed effects and ϵ_{ijt} is the error term.

4.1. The baseline OLS regressions

Table 5 presents the baseline OLS regression results. In all columns I control for industry-year and country-year fixed effects to exclude any industry-specific fluctuations across years and country-specific shocks across years. Column (1) shows that as tariff increases, export from China to the host countries decrease, which is consistent with the economic intuition. The second column shows that contrary to export alone, the correlation between affiliate sales to export tariff is positive, which is a first evidence that overall affiliate sales and export are substitutes. Column (3) confirms this by further looking at the ratio of affiliate sales to export. However, if I separate horizontal and vertical M&A affiliate sales, the coefficient of horizontal M&As in column (4) turns negative while the coefficient of vertical M&As in column (5) remains positive. Moreover, the positive correlation of vertical M&As mainly derives from downstream investment as is shown in column (6). There seem to be no apparent impact on upstream investment since the estimated coefficient in column (7) is not statistically significant.

To make sense of the magnitude of the estimates, one percentage point increase in tariff increases the log of sales to export ratio by 0.007. Note that the mean of the log of sales to export ratio in the sample is 0.06, which indicates an approximately 11.7% increase on average. The size of the estimate varies according to the specification but the magnitudes are similar.

4.2. PPML regressions

To further check the baseline OLS regression results, I use the Poisson pseudo maximum likelihood (PPML) regressions following Silva and Tenreyro (2006) to deal with the problem of zero values in the dependent variable. The definition of dependent and independent variables are the same as in the OLS regressions. Reassuringly, the results in Table 6 are consistent with the OLS regressions, except that the impact of export tariff on the ratio of horizontal cross-border M&A affiliate sales to export is not statistically significant, but still negative. The other columns are in line with Table 5.

Note: The import tariffs are not available in 2012 and 2013.

Fig. 3. Tariffs of China with major trade partners.

Table 6
PPML regressions.

	(1) *Export*	(2) *Sales*	(3) *Ratio*	(4) *RatioH*	(5) *RatioV*	(6) *RatioVD*	(7) *RatioVU*
tariff	−0.171***	1.752***	2.106***	−3.789	9.452***	12.934**	6.885
	(0.057)	(0.398)	(0.557)	(5.286)	(2.966)	(5.513)	(4.392)
tariff_im	0.013	5.224**	1.757	2.978	2.252	−3.391	6.612
	(0.010)	(2.105)	(2.689)	(8.795)	(3.488)	(4.125)	(6.408)
Observations	14,492	7742	7742	782	4603	3119	1492
R-squared	0.881	0.110	0.481	0.845	0.669	0.778	0.686
Country-year FEs	✓	✓	✓	✓	✓	✓	✓
Industry-year FEs	✓	✓	✓	✓	✓	✓	✓

Notes: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7
IV regressions.

	(1) *Export*	(2) *Sales*	(3) *Ratio*	(4) *RatioH*	(5) *RatioV*	(6) *RatioVD*	(7) *RatioVU*
tariff	−3.423***	2.051**	0.712*	−0.264***	0.455***	0.260***	−0.020
	(0.452)	(0.797)	(0.373)	(0.092)	(0.123)	(0.073)	(0.050)
tariff_im	2.035***	1.093*	−0.014	−0.089*	0.286*	0.205**	0.154***
	(0.477)	(0.650)	(0.215)	(0.047)	(0.170)	(0.096)	(0.059)
Observations	13,564	13,564	13,564	13,564	13,564	13,564	13,564
Country-year FEs	✓	✓	✓	✓	✓	✓	✓
Industry-year FEs	✓	✓	✓	✓	✓	✓	✓
First-stage				*tariff*			
tariff_iv				0.712***			
				(0.026)			
KP F-stat.				745.4			

Notes: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.3. IV approach

The potential problem with bilateral tariffs levied by host countries on Chinese export is that changes in affiliate sales can be due to shocks from the Chinese market instead of bilateral tariffs. To deal with the potential endogeneity problem, an alternative identification strategy is to introduce an instrumental variable in the spirit of Autor et al. (2013). The instrument is constructed as the average tariff imposed on exports from the top nine countries doing outward FDI (excluding China) weighted by their value of export. The nine countries are selected among the top FDI investors worldwide according to the World Investment Report 2018 issued by the UNCTAD. Namely, they are the US, Japan, the UK, Germany, Canada, France, Russia, South Korea and Singapore.[13] The construction of the IV is the following:

$$tariff\_iv_{ijt} = \sum_{k \neq CN}^{n} tariff_{ijt}^{k} \frac{export_{ijt}^{k}}{export_{ijt}^{all}} \tag{2}$$

where i, j and t represent industry, host country and year respectively. k is one of the other nine top investing countries and all stands for the sum of all nine countries. I use this instrumental variable to conduct a two-stage least square (2SLS) estimation. The relevance of the instrument requires that the average tariff of the other nine top investors can well predict the tariff levied on China in the same industry. Therefore, I could clean out fluctuations from China that may affect the affiliate sales relative to export. The exclusion restriction is fulfilled if conditional on the set of control variables, the residual change in affiliate sales of Chinese acquirers is uncorrelated with tariffs on the other top investors. Since the set of countries chosen in the IV consist of both Asian countries close to China (Japan, South Korea, Singapore), major North American,countries (the US and Canada) and European countries (the UK, Germany, France and Russia), the diverse locations and country characteristics reduce the possibility that Chinese affiliate sales in the destination market will be affected by the weighted average tariff of other countries. In addition, shocks from the destination countries are largely absorbed by the destination country-year and industry-year fixed effects. The positive and negative shocks with various destinations may also to some extent cancel out each other, which makes the destination side shocks smaller than the origin side. Table 7 shows the results from the IV specifications.

The first-stage results are reported in the bottom panel of Table 7. The coefficients are positive and robust, suggesting that the instrument is quite strong in predicting bilateral tariff between China and the host countries. The Kleibergen-Paap (KP) F-statistics of weak identification test is far above the critical value of 10. Compared to the baseline OLS regression results, the

[13] The top nine exporters are very similar to the top nine countries doing FDI and changing into the alternative instrumental variable does not affect the results significantly.

estimated coefficients of the IV approach verify the main finding that horizontal and vertical cross-border M&As react to tariff changes differently. The slightly larger coefficients of IV estimations may partly be due to measurement error in bilateral tariffs on Chinese goods which causes downward attenuation bias in OLS estimations.

So far I find that when tariff cost increases, Chinese firms' cross-border M&A affiliate sales increase relative to export at the 6-digit NAICS 2017 industry level, and the increase mainly derives from vertical M&As, especially in downstream affiliates, rather than horizontal M&As. The findings are in contrast to what have been documented with FDI from developed economies, where horizontal M&As are substitutes of export and vertical M&As are compliments, and the increase in sales mainly comes from horizontal affiliates. Current models do not include horizontal and vertical cross-border M&As in the same market. I show in the following section that when both horizontal and vertical multinational firms and exporters compete in the same market, we can derive conclusions that are consistent with the baseline findings.

5. The model

In this section, I propose an extension of the model of horizontal multinationals in Helpman et al. (2004). In particular, I assume that both horizontal and vertical cross-border M&A affiliates operate along the GVC and compete in the same broadly-defined industry with exporters. Tariff costs affect horizontal multinational firms more than vertical ones, which generates implications that rationalize the findings in the previous sections.

The intuition of the model is the following. Exporters produce domestically and pay tariff costs as well as fixed costs to sell to the foreign market. Usually, exporters focus on certain parts along the value chain, but do not have control over the whole production process from raw materials to the final good. In contrast, vertical cross-border M&As expand the scope of control for the parent firms in upstream or downstream industries. Vertical multinationals pay higher fixed costs in the destination market, but they do not pay the same tariff costs as exporters. By comparison, horizontal cross-border M&As mainly replicate the production process of the home country at the destination country, so that firms save on the tariff costs but may suffer from even higher fixed costs and cannot enjoy the economies of scale compared to exporters whose production is concentrated in the home country.

In this model, I focus on the industry of the parent firm. In other words, I compare the profitability of horizontal and vertical cross-border M&As relative to exporters within the industry of the parent firms. Firms that choose different entry modes are affected differently by tariff changes. Exporters are affected the most, while multinationals are less affected by tariffs.

5.1. Setup

I consider a sector where the preference over a continuum of goods ω has constant elasticity of substitution (CES). The resulting demand for each variety is:

$$q(\omega) = Dp(\omega)^{-\sigma} \tag{3}$$

where σ is the elasticity of substitution, $D = E/P^{1-\sigma}$ is the demand shifter and $P = \left[\int_{\omega\in\Omega} p(\omega)^{1-\sigma} d\omega\right]^{1/(1-\sigma)}$ is the price index.

On the supply side, assume the production process requires two stages, where only labor is needed during production.[14] The two stages can take place in the same country or at different locations. The production function follows a Cobb–Douglas form:

$$q = \varphi \left(\frac{L_1}{\eta}\right)^{\eta} \left(\frac{L_2}{1-\eta}\right)^{1-\eta} \tag{4}$$

where φ denotes the productivity of the firm drawn from distribution $G(\varphi)$, L_1 and L_2 represent the labor used during the two stages of production respectively, η and $1-\eta$ are the intensity of each input in the production process, $\eta \in (0, 1)$.

Under monopolistic competition, the revenue is:

$$R = q^{\alpha} D^{1-\alpha} \tag{5}$$

The producer maximizes the profit:

$$\max_{L_1, L_2} \pi = R - w_1 L_1 - w_2 L_2 - f \tag{6}$$

where w_1 and w_2 are the prices of labor at the two stages respectively, and f represents fixed cost.

5.2. Profit maximization

Using Eqs. (4) to (6) to solve the maximization problem yields the optimal amounts of inputs:

$$L_1 = \eta \frac{\alpha R}{w_1}, L_2 = (1-\eta)\frac{\alpha R}{w_2} \tag{7}$$

[14] One could introduce capital and skill as well, which would not affect the main implications of the current model.

The optimal revenue is:

$$R = \left(\frac{\varphi}{w_1^{\eta} w_2^{1-\eta}} \right)^{\frac{\alpha}{1-\alpha}} D \tag{8}$$

which gives the maximum profit:

$$\pi = (1-\alpha)R - f \tag{9}$$

5.3. Entry mode

To keep in line with the empirical scenario, assume there are three ways to serve the foreign market: exporting, becoming a horizontal multinational or a vertical multinational through cross-border M&As. For exporters, both production stages are performed in the home country. For horizontal multinationals, production is done mainly at the destination market. However, the affiliates may still receive a small proportion η_H ($0< \eta_H <1$) of intermediates from the parents within the same industry. For vertical multinationals, the affiliates also receive a proportion η_V ($0< \eta_V <1$) of intermediates from the parents but the share is larger than horizontal multinationals ($\eta_V > \eta_H$). This is because horizontal multinationals replicate most of the production in the destination market and vertical multinationals rely more on the coordination between home and host countries in production.

Suppose the wages at home and the destination country are given by w and w^* respectively. Since exporters carry out the entire production process in the home country, the wage is w. Therefore, the profit of exporters in the foreign market is:

$$\pi_X^* = (1-\alpha)\left(\frac{\varphi}{\tau w} \right)^{\frac{\alpha}{1-\alpha}} D^* - f_X, \tau > 1 \tag{10}$$

where τ is the iceberg trade cost. The superscript * indicates profits from foreign markets.

Horizontal multinationals perform the first stage in the home country where the wage is w and the second stage at the destination country where the wage is w^*. In addition, the parent firms need to pay for the trade cost τ due to the transfer of intermediates within the industry. Therefore, the profit is:

$$\pi_H^* = (1-\alpha)\left[\frac{\varphi}{(\tau w)^{\eta_H} (w^*)^{1-\eta_H}} \right]^{\frac{\alpha}{1-\alpha}} D^* - f_H \tag{11}$$

Similarly, for vertical integrations, the two stages are done at home and the destination respectively but the second stage is performed in a different sector with trade cost τ'. Therefore, the profit of vertical integration is:

$$\pi_V^* = (1-\alpha)\left[\frac{\varphi}{(\tau' w)^{\eta_V} (w^*)^{1-\eta_V}} \right]^{\frac{\alpha}{1-\alpha}} D^* - f_V, \tau' > 1 \tag{12}$$

Assume the fixed costs are ranked as:

$$f_X < f_V < f_H \tag{13}$$

This is reasonable since firms need to make investment to enter foreign markets as exporters. It is even more costly to acquire foreign affiliates. Horizontal acquisitions cost more than vertical ones because in a horizontal investment, the affiliate has to replicate a bigger share of the production than a vertical investment. In other words, horizontal multinationals are more likely to establish larger plants in the foreign country than vertical multinationals.[15]

To compensate differences in fixed costs, the slopes of profit lines should satisfy the following relationship so that each entry mode could exist:

$$\text{slope}_X < \text{slope}_V < \text{slope}_H \tag{14}$$

This implies the variable costs are ranked as:

$$\tau w > (\tau' w)^{\eta_V} (w^*)^{1-\eta_V} > (\tau w)^{\eta_H} (w^*)^{1-\eta_H} \tag{15}$$

Since outward cross-border M&As by China flow mainly to developed destinations, it is likely that the foreign wage is higher than domestic wage (i.e. $w^* > w$) so that the relationship in Eq. (15) can hold given $\eta_V > \eta_H$. However, in recent years, wage rate in China has increased and it is no longer regarded as the cheapest destination for labor supply. In that case, the relationship between wages home and abroad may be reversed (i.e. $w \geq w^*$). As a result, the variable costs of vertical and horizontal cross-border M&As may be reversed. I show the results under this condition in Appendix E where horizontal investment is always dominated, and the change in relative affiliate sales comes mainly from vertical investment which do not contradict the previous findings.

Under the assumptions above, there is an ordering such that firms choose how to operate depending on cutoff productivities:

$$\varphi_X^* < \varphi_V^* < \varphi_H^* \tag{16}$$

[15] If the deal values of cross-border M&As by Chinese acquirers are taken as a measure of fixed costs, the transaction data show that the distribution of horizontal deal values is to the right of their vertical counterpart, with the average value higher than vertical deals, which supports the assumption.

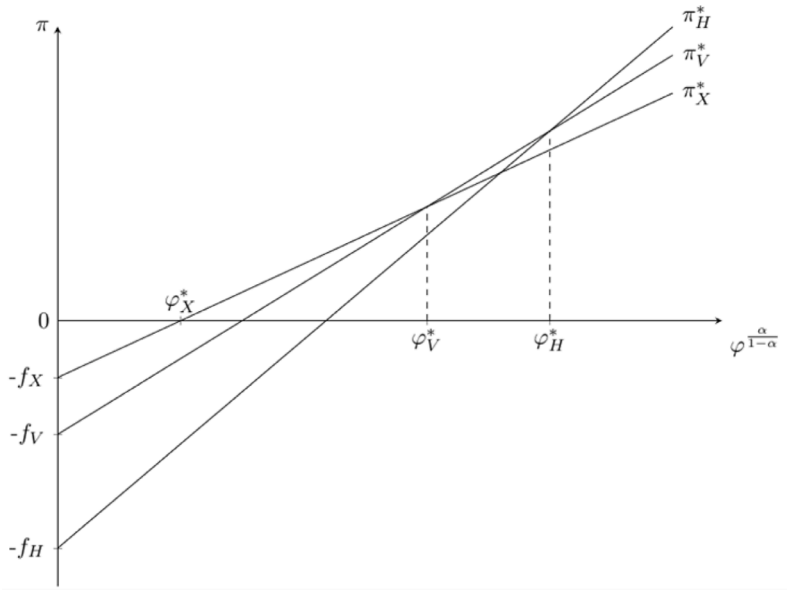


Fig. 4. Relationship between profits of different entry modes.

Table 8
Extensive and intensive margins of tariff increase on affiliate sales.

	Extensive margin (relative mass of firms)	Intensive margin (relative profitability)	Overall effect
Horizontal M&As	decrease	increase	ambiguous
Vertical M&As	increase	increase	increase

Fig. 4 better illustrates the profits for the three modes of foreign market entry under the previous assumptions. The cutoff productivity levels of exporters, vertical and horizontal multinationals are φ_X^*, φ_V^* and φ_H^*, corresponding to $\pi_X^* = 0$, $\pi_X^* = \pi_V^*$ and $\pi_H^* = \pi_V^*$, respectively.[16] Firms with productivity below φ_X^* do not enter the foreign market, firms with productivity above φ_X^* but below φ_V^* export, firms with productivity above φ_V^* but below φ_H^* are vertical multinationals, and firms with productivity above φ_H^* are horizontal multinationals.

5.4. Comparative statics

Suppose the tariff of the exporter good, which is a major source of trade cost τ rises, while the tariff of a different sector τ' is not affected. Exporter profits will drop as variable cost increases. The profits of horizontal integration will also decrease. The profits of vertical integration stay the same. What happens is illustrated in Fig. 5.

The figure shows when tariff of the final product rises, the cutoff productivity of exporters increases slightly, the cutoff productivity of vertical multinationals falls and the cutoff productivity level of horizontal multinationals rises. The change leads to the productivity range of vertical multinationals to expand and the productivity range of horizontal multinationals as well as exporters to shrink at the extensive margin, i.e. the mass of firms. At the intensive margin, which is measured by profits, it is straightforward that vertical integration becomes more profitable than export. The profitability of horizontal integration is a bit more complicated because the profit lines of both exporters and horizontal multinationals drop. I prove in Appendix C that the relative profitability of horizontal integration to export rises as tariff on the affiliate industry increases, implying an increase at the intensive margin for horizontal multinationals.

To sum up, the effects of extensive margin and intensive margin on horizontal and vertical cross-border M&As are shown in Table 8. Given that the extensive and intensive margins of horizontal multinationals work in opposite directions, the net effect (which is the mass of firms times the profit) on horizontal affiliate sales to export ratio thus depends on the parameter values and is up to empirical tests.

According to the empirical evidence above, the negative extensive margin effect prevails for horizontal multinationals so that the overall affiliate sales to export ratio drops, and the general magnitude is smaller than that of vertical multinationals. Whereas for

[16] $(\varphi_X^*)^{\frac{1-\alpha}{\alpha}} = \frac{f_X}{(1-\alpha)D^*} \cdot \frac{1}{(\tau w)^{-\frac{\alpha}{1-\alpha}}}$, $(\varphi_V^*)^{\frac{1-\alpha}{\alpha}} = \frac{f_V - f_X}{(1-\alpha)D^*} \cdot \frac{1}{[(\tau' w)^{\eta_V}(w^*)^{1-\eta_V}]^{-\frac{\alpha}{1-\alpha}} - (\tau w)^{-\frac{\alpha}{1-\alpha}}}$, $(\varphi_H^*)^{\frac{1-\alpha}{\alpha}} = \frac{f_H - f_V}{(1-\alpha)D^*} \cdot \frac{1}{[(\tau w)^{\eta_H}(w^*)^{1-\eta_H}]^{-\frac{\alpha}{1-\alpha}} - [(\tau' w)^{\eta_V}(w^*)^{1-\eta_V}]^{-\frac{\alpha}{1-\alpha}}}$.

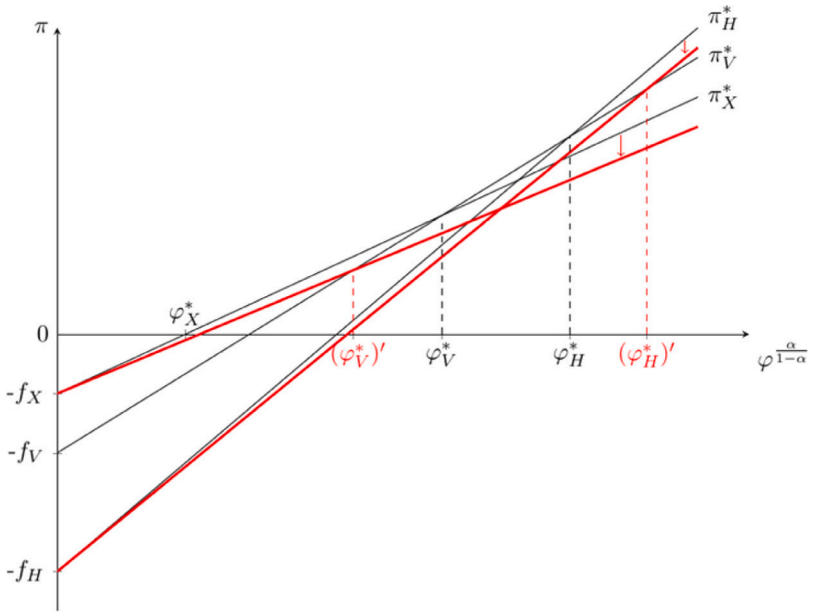


Fig. 5. Change in trade costs.

Table 9
Relative profitability (intensive margin).

	(1) *Export*	(2) *Sales*	(3) *Ratio*	(4) *RatioH*	(5) *RatioV*	(6) *RatioV D*	(7) *RatioV U*
tariff	−1.196***	3.842	8.787***	0.535	2.188	1.100	12.570
	(0.201)	(3.196)	(1.816)	(2.332)	(2.640)	(3.234)	(9.525)
tariff_im	1.210***	−3.625	−5.092	6.911	5.272	1.914	−7.365
	(0.285)	(6.318)	(3.589)	(4.776)	(3.951)	(5.158)	(9.133)
Observations	14,281	585	585	101	345	188	86
R-squared	0.851	0.742	0.919	0.985	0.957	0.947	0.923
Country FEs	✓	✓	✓	✓	✓	✓	✓
Industry FEs	✓	✓	✓	✓	✓	✓	✓
Year FEs	✓	✓	✓	✓	✓	✓	✓

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

vertical multinationals, both extensive and intensive margins push up the relative profitability to exporters, which echoes with the main empirical finding that the affiliate sales to export ratio of vertical investment responds positively to tariff increases. Analytically, the aggregate net effect of extensive and intensive margins hold under Pareto productivity distribution following Helpman et al. (2004) which I prove in Appendix D.

6. Further evidence

To assess whether the proposed intensive and extensive margins of the model are at work, I estimate two sets of additional regressions. I then carry out some robustness checks to verify the main findings in the empirical analysis.

6.1. Intensive and extensive margins

To check the intensive margin of the model predictions, I drop all zero observations of affiliate *Sales* in Table 9. This leaves not enough observations to include country-year and industry-year fixed effects but I control for country, industry and year fixed effects separately. Consistent with the baseline results, tariff cost negatively affects bilateral trade in column (1) but increases affiliate sales, though the coefficient is not significant in column (2). Then I take the ratio of affiliate sales relative to export, the effect in column (3) becomes significant. As predicted by the model, both horizontal and vertical cross-border M&A affiliate sales increase at the intensive margin as shown in columns (3) and (4), and vertical investment has a bigger coefficient, but they are not statistically significant with the small samples.

At the extensive margin, I look at the relative number of multinational corporations (MNCs) to exporters in Table 10. Overall, the number of cross-border M&A affiliates increase relative to exporters according to column (3). Vertical cross-border M&As show

Table 10
Relative number of firms (extensive margin).

	(1) *ExportN*	(2) *SalesN*	(3) *N Ratio*	(4) *N RatioH*	(5) *N RatioV*	(6) *N RatioV D*	(7) *N RatioV U*
tariff	8.115	−1.468	0.593***	−0.009	0.264**	0.490***	−0.094
	(716.684)	(1.863)	(0.216)	(0.026)	(0.109)	(0.110)	(0.165)
tariff_im	−724.842	−1.329	−0.328	0.031	−0.057	0.005	−0.332
	(917.565)	(2.385)	(0.282)	(0.034)	(0.142)	(0.131)	(0.285)
Observations	2587	2587	2471	2471	2471	1734	1262
R-squared	0.760	0.303	0.698	0.444	0.519	0.672	0.573
Country-year FEs	✓	✓	✓	✓	✓	✓	✓
Industry-year FEs	✓	✓	✓	✓	✓	✓	✓

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 11
5% threshold of vertical linkages.

	(1) *Export*	(2) *Sales*	(3) *Ratio*	(4) *RatioH*	(5) *RatioV*	(6) *RatioV D*	(7) *RatioV U*
	Panel A: OLS regressions						
tariff	−1.771***	1.794***	0.678***	−0.153***	0.430***	0.201***	0.013
	(0.184)	(0.467)	(0.133)	(0.046)	(0.099)	(0.055)	(0.036)
tariff_im	2.137***	1.234	0.109	−0.118	0.490***	0.301***	0.174***
	(0.317)	(0.805)	(0.229)	(0.079)	(0.170)	(0.095)	(0.062)
Observations	14,370	14,370	14,370	14,370	14,370	14,370	14,370
R-squared	0.887	0.101	0.181	0.156	0.186	0.162	0.078
Country-year FEs	✓	✓	✓	✓	✓	✓	✓
Industry-year FEs	✓	✓	✓	✓	✓	✓	✓
	Panel B: PPML regressions						
tariff	−0.151***	4.121***	4.667***	−7.806	13.272***	20.048***	−38.390
	(0.039)	(0.993)	(1.200)	(0.000)	(2.241)	(4.221)	(0.000)
tariff_im	0.181***	3.897*	1.016	−1.921	4.352	2.811	66.665
	(0.046)	(2.248)	(2.573)	(0.000)	(3.536)	(6.718)	(0.000)
Observations	14,384	7673	7673	783	4483	2119	621
R-squared	0.878	0.110	0.466	0.867	0.690	0.827	0.607
Country-year FEs	✓	✓	✓	✓	✓	✓	✓
Industry-year FEs	✓	✓	✓	✓	✓	✓	✓

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

significant positive response to tariff while the coefficient for horizontal cross-border M&As is negative though insignificant. Again, the vertical M&As sales increase derives primarily from downstream affiliates. These results show supportive evidence of the model's implication on differences between horizontal and vertical cross-border M&As at both the intensive and extensive margins.

6.2. Robustness checks

To check the robustness of the baseline results, I do some additional exercises in this section. First, I use alternative threshold of upstream and downstream industry linkages at 5% instead of 1% to define vertical cross-border M&As. Second, I re-do the analysis at the firm-level. Third, I use the sample at firm-level with majority final shares acquired by the parent firms to show that the results are qualitatively consistent with the baseline regressions.

6.2.1. Definition of horizontal and vertical M&As

I first use alternative threshold at 5% of upstream and downstream industry linkages in the definition of vertical cross-border M&As instead of the 1% threshold in the baseline results. The OLS and PPML regression results are shown in Table 11. The estimated coefficients are in line with those at the 1% threshold of industry linkages so the findings are not sensitive to the definition of vertical cross-border M&A deals.

6.2.2. Firm-level analysis

I then check the robustness of the main findings with firm-level observations. The dependent and independent variables are defined similarly as in the OLS regressions for each host country j and year t, except that they are not aggregated to the industry-level but at the firm-level. Again, observations of $Sales$ that are zero across industries and countries over all periods are dropped. One shortcoming of firm-level regressions is that I cannot link firm export with the sales data from Orbis. Therefore, I am unable to look at the ratio of sales relative to export but only sales alone for horizontal and vertical affiliates. Yet the implications are similar to those at the industry-level. The regression results are in Table 12. The estimated coefficients follow the same pattern as

Table 12
Firm-level regressions.

	(1) *Sales*	(2) *SalesH*	(3) *SalesV*	(4) *SalesVD*	(5) *SalesVU*
	Panel A: OLS regressions				
tariff	0.933**	−0.436**	1.250***	1.256***	0.690***
	(0.380)	(0.203)	(0.336)	(0.288)	(0.255)
tariff_im	0.876	0.081	1.407***	0.716*	1.054***
	(0.545)	(0.293)	(0.468)	(0.401)	(0.360)
Observations	21,776	18,426	19,761	18,830	18,443
R-squared	0.096	0.086	0.116	0.105	0.109
Country-year FEs	✓	✓	✓	✓	✓
Industry-year FEs	✓	✓	✓	✓	✓
	Panel B: PPML regressions				
tariff	2.831***	−4.934**	5.717***	7.854***	8.199***
	(0.965)	(2.246)	(1.567)	(1.698)	(2.969)
tariff_im	3.475*	−0.109	7.720***	4.673	12.030***
	(1.824)	(3.964)	(2.627)	(2.922)	(3.928)
Observations	10,165	1459	5607	3675	2048
R-squared	0.092	0.136	0.134	0.146	0.121
Country-year FEs	✓	✓	✓	✓	✓
Industry-year FEs	✓	✓	✓	✓	✓

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 13
Sample of majority final shares.

	(1) *Sales*	(2) *SalesH*	(3) *SalesV*	(4) *SalesVD*	(5) *SalesVU*
	Panel A: OLS regressions				
tariff	0.998**	−0.367*	1.425***	1.314***	0.705***
	(0.388)	(0.207)	(0.376)	(0.323)	(0.273)
tariff_im	1.229**	0.028	1.356***	0.823*	1.234***
	(0.554)	(0.299)	(0.522)	(0.448)	(0.387)
Observations	19,700	16,723	18,423	17,439	16,842
R-squared	0.093	0.091	0.098	0.093	0.104
Country-year FEs	✓	✓	✓	✓	✓
Industry-year FEs	✓	✓	✓	✓	✓
	Panel B: PPML regressions				
tariff	3.041***	−4.300*	4.445***	3.767***	9.471***
	(0.937)	(2.423)	(1.192)	(1.124)	(2.037)
tariff_im	5.301***	1.413	7.365***	6.608**	12.869***
	(2.015)	(4.553)	(2.385)	(2.668)	(4.010)
Observations	8535	1052	6331	3992	2166
R-squared	0.091	0.169	0.096	0.102	0.130
Country-year FEs	✓	✓	✓	✓	✓
Industry-year FEs	✓	✓	✓	✓	✓

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

the industry-level regressions. The sales of all cross-border M&A affiliates increase with tariff, while the effect is positive for vertical M&As both for downstream and upstream investment but negative for horizontal M&As.

6.2.3. *Majority final shares*

Another potential concern is related to the shares acquired by the parent firms. In the baseline regressions, I include cross-border M&As with any shares acquired of the target firms. One can limit the sample to cross-border M&As with majority ownership of the target firms. In Table 13 I include deals with final stake over 50%, following the common threshold in the literature.[17] The magnitudes of the coefficients are close to the whole sample, indicating that the findings are robust to ownership shares.

[17] Using acquired shares instead of final shares give similar results.

Table B.1
Horizontal M&As top 10 industries.

NAICS 2017 code	Industry name	No. of deals
336111	Automobile manufacturing	20
336390	Other motor vehicle parts manufacturing	15
325412	Pharmaceutical preparation manufacturing	13
333611	Turbine and turbine generator set units manufacturing	9
339910	Jewelry and silverware manufacturing	9
311411	Frozen fruit, juice, and vegetable manufacturing	8
334118	Computer terminal and other computer peripheral equipment manufacturing	8
333249	Other industrial machinery manufacturing	7
333517	Machine tool manufacturing	7
331491	Nonferrous metal (except copper and aluminum) rolling, drawing, and extruding	6

Note: The number of M&A deals are between 2010 and 2018.

7. Conclusion

In this paper, I investigate how changes in tariff cost may affect cross-border M&A affiliate sales of Chinese parent firms relative to export. I combine firm-level financial data with cross-border M&A transaction data to obtain sales information on target firms. I then merge them with data on tariffs and export values in order to get the affiliates sales to export ratio for each industry-destination-year triplet.

The findings are that China's cross-border M&A affiliate sales relative to export is higher when tariff cost rises, consistent with the overall "tariff-jumping" hypothesis. However, the positive affiliate sales ratio derives mainly from vertical M&A affiliates rather than horizontal ones, which is contrary to what has been found with the US parent firms where the majority of cross-border M&As are horizontal. The affiliate sales ratio of horizontal investment is even negative though small in magnitude. Further investigation shows that the increase in vertical affiliate sales ratio primarily comes from downstream affiliates. The results are consistent with both OLS regressions and PPML regressions. To deal with potential endogeneity, an IV approach is employed following Autor et al. (2013) where the average tariff of other nine top investing countries is constructed as an instrument of bilateral tariff on China to reduce supply-side shocks.

I then propose a model to rationalize the choice of entry modes when tariff cost changes. Within horizontal multinationals some intermediate transfer between parents and affiliates may suffer from similar tariff cost as exporters. In contrast, the vertical affiliate sales gain relatively to export because the tariff cost levied on intermediate goods is transferred through upstream/downstream linkages and are less likely to be directly affected. The evidence suggests that the profits of both horizontal and vertical MNCs increase at the intensive margin when tariff increases. However, the relative number of MNCs to exporters at the extensive margin rises only for vertical investment and declines for horizontal investment. These results help to explain the positive net effect of vertical cross-border M&A affiliate sales which is not found for horizontal ones.

Despite the finding that cross-border M&A affiliate sales ratio gains when tariff cost increases, it is important to bear in mind that the change is relative to export. In a world of trade war where tariffs upsurge, both trade and cross-border investment would suffer as a result of economic and political tensions. While this paper shows China's outward FDI performance presents an alternative pattern to the traditional FDI investors represented by the US, other research on emerging markets' FDI investment may provide more insights on the topic. As more firms originated from developing economies learn to become multinationals and engage actively into the global market, this may be a more relevant direction to explore.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

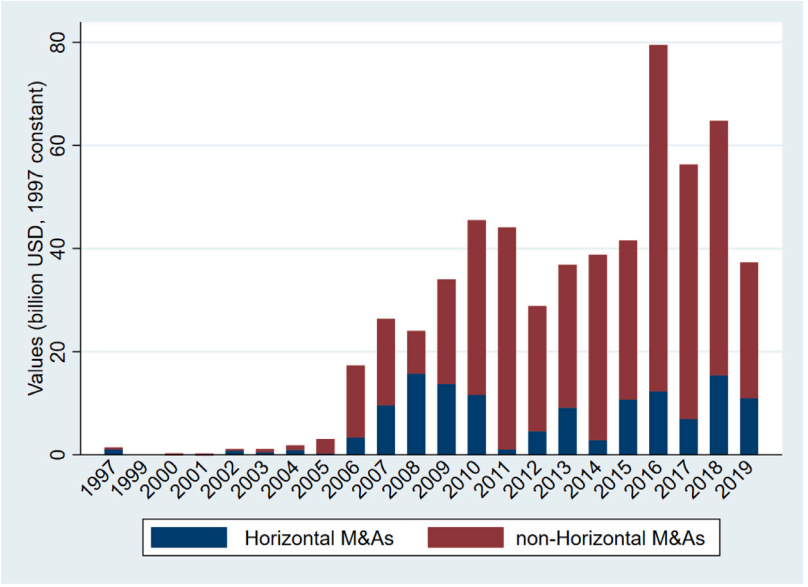
Data will be made available on request.

Appendix A. Additional graphs

See Figs. A.1–A.3.

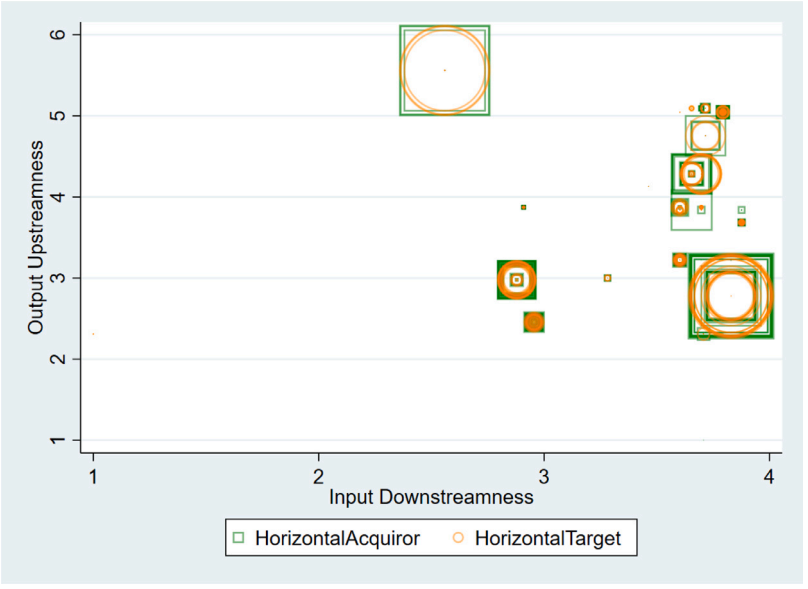
Appendix B. Additional tables

See Tables B.1 and B.2.



Note: Data are sourced from BvD Zephyr, calculated by the author.

Fig. A.1. China's cross-border M&A values.



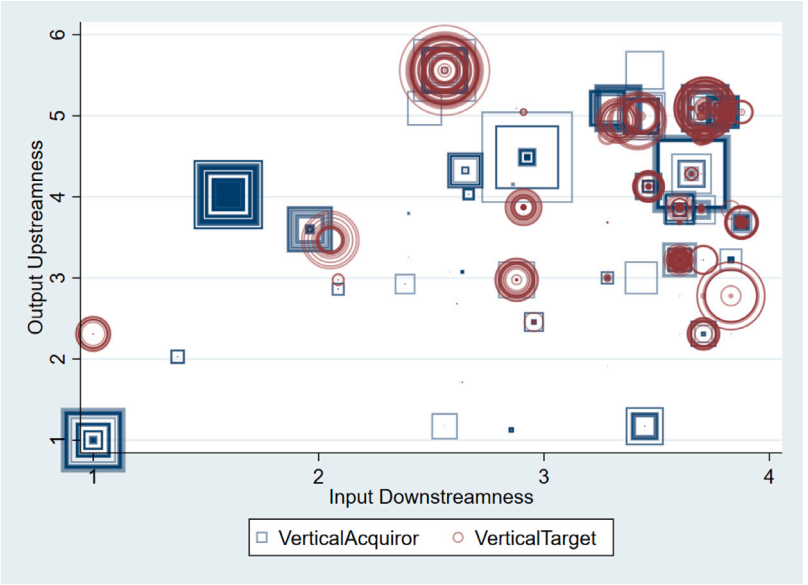
Note: The size of the circles and squares reflects the sales in each NAICS 2017 6-digit industry.

Fig. A.2. China's horizontal cross-border M&As in the GVC box.

Appendix C. Proof of horizontal relative profit over trade cost

One can take the partial derivative of the relative profit of horizontal integration to export over trade cost:

$$\frac{\partial(\pi_H^*/\pi_X^*)}{\partial\tau} = -\alpha D^* \cdot \frac{\pi_X^* \eta_H \left[\frac{\varphi}{(\tau w)^{\eta_H}(w^*)^{1-\eta_H}}\right]^{-\frac{\alpha}{1-\alpha}} - \pi_H^* \left(\frac{\varphi}{\tau w}\right)^{-\frac{\alpha}{1-\alpha}}}{(\pi_X^*)^2} \tag{17}$$



Note: The size of the circles and squares reflects the sales in each NAICS 2017 6-digit industry.

Fig. A.3. China's vertical cross-border M&As in the GVC box.

Table B.2
Vertical M&As top 10 industries.

NAICS 2017 code	Industry name	No. of deals
212210	Iron ore mining	24
333249	Other industrial machinery manufacturing	22
333517	Machine tool manufacturing	21
325412	Pharmaceutical preparation manufacturing	18
334413	Semiconductor and related device manufacturing	15
314999	All other miscellaneous textile product mills	14
335210	Small electrical appliance manufacturing	14
322211	Corrugated and solid fiber box manufacturing	13
324110	Petroleum refineries	13
332999	All other miscellaneous fabricated metal product manufacturing	13

Note: The number of M&A deals are between 2010 and 2018.

From which we have:

$$\begin{cases} \dfrac{\partial(\pi_H^*/\pi_X^*)}{\partial\tau} > 0, & \text{if} \quad \pi_X^* \eta_H \left[\dfrac{\varphi}{(\tau w)^{\eta_H}(w^*)^{1-\eta_H}}\right]^{-\frac{\alpha}{1-\alpha}} < \pi_H^* \left(\dfrac{\varphi}{\tau w}\right)^{-\frac{\alpha}{1-\alpha}}, \\ \dfrac{\partial(\pi_H^*/\pi_X^*)}{\partial\tau} \le 0, & \text{otherwise.} \end{cases} \tag{18}$$

Note that $\pi_X^* < \pi_H^*$ when $\varphi \ge \varphi_H^*$, and $\eta_H < 1$. Recall from Eq. (15) that $(\tau w)^{\eta_H}(w^*)^{1-\eta_H} < \tau w$, so that $\left[\dfrac{\varphi}{(\tau w)^{\eta_H}(w^*)^{1-\eta_H}}\right]^{-\frac{\alpha}{1-\alpha}} < \left(\dfrac{\varphi}{\tau w}\right)^{-\frac{\alpha}{1-\alpha}}$. Therefore, the first condition holds and we have $\frac{\partial(\pi_H^*/\pi_X^*)}{\partial\tau} > 0$ for sure.

Appendix D. Pareto productivity distribution

One can prove the change in relative sales of horizontal/vertical cross-border M&As to export based on Pareto distribution of productivity draw. Following Helpman et al. (2004), denote the market share of Chinese exporters, horizontal and vertical MNCs

as s_X, s_H and s_V respectively. The relative market share of horizontal and vertical MNCs to export are:

$$\begin{aligned}\frac{s_V}{s_X} &= \frac{V(\varphi_V^*) - V(\varphi_H^*)}{V(\varphi_X^*) - V(\varphi_V^*)} r_V^{1-\sigma} \\ \frac{s_H}{s_X} &= \frac{V(\varphi_H^*)}{V(\varphi_X^*) - V(\varphi_V^*)} r_H^{1-\sigma}\end{aligned} \tag{19}$$

where

$$V(\varphi) = \int_{\varphi}^{\infty} \varphi^{\sigma-1} dG(\varphi) \tag{20}$$

and $r_V = (\tau' w)^{\eta_V} (w^*)^{1-\eta_V} / \tau w$, $r_H = (\tau w)^{\eta_H} (w^*)^{1-\eta_H} / \tau w$ represent relative variable costs of vertical and horizontal cross-border M&As to export.

The labor productivity $1/\varphi$ follows a Pareto distribution of shape parameter k:

$$G(\varphi) = 1 - \left(\frac{\varphi}{\bar{\varphi}}\right)^k, \text{ for } 0 < \varphi \leq \bar{\varphi} \tag{21}$$

The property of Pareto distribution gives that $1/V(\varphi)$ is also Pareto distributed with the shape parameter $k - (\sigma - 1)$. Thus, we can derive the following relationship:

$$\begin{aligned}\frac{s_V}{s_X} &= \frac{\frac{V(\varphi_V^*)}{V(\varphi_X^*)} - \frac{V(\varphi_H^*)}{V(\varphi_X^*)}}{1 - \frac{V(\varphi_V^*)}{V(\varphi_X^*)}} r_V^{1-\sigma} = \frac{\left(\frac{\varphi_X^*}{\varphi_V^*}\right)^{k-(\sigma-1)} - \left(\frac{\varphi_X^*}{\varphi_H^*}\right)^{k-(\sigma-1)}}{1 - \left(\frac{\varphi_X^*}{\varphi_V^*}\right)^{k-(\sigma-1)}} r_V^{1-\sigma} \\ \frac{s_H}{s_X} &= \frac{\frac{V(\varphi_H^*)}{V(\varphi_X^*)}}{1 - \frac{V(\varphi_V^*)}{V(\varphi_X^*)}} r_H^{1-\sigma} = \frac{\left(\frac{\varphi_X^*}{\varphi_H^*}\right)^{k-(\sigma-1)}}{1 - \left(\frac{\varphi_X^*}{\varphi_V^*}\right)^{k-(\sigma-1)}} r_H^{1-\sigma}\end{aligned} \tag{22}$$

The profits from Eqs. (10) to (12) together with the cutoff productivities imply:

$$\left(\frac{\varphi_X^*}{\varphi_V^*}\right)^{\sigma-1} = \frac{f_X}{f_V - f_X}(r_V^{1-\sigma} - 1), \quad \left(\frac{\varphi_X^*}{\varphi_H^*}\right)^{\sigma-1} = \frac{f_X}{f_H - f_V}(r_H^{1-\sigma} - r_V^{1-\sigma}) \tag{23}$$

The relative sales can then be written as:

$$\begin{aligned}\frac{s_V}{s_X} &= \frac{\left[\frac{f_X}{f_V - f_X}(r_V^{1-\sigma} - 1)\right]^{\frac{k-(\sigma-1)}{\sigma-1}} - \left[\frac{f_X}{f_H - f_V}(r_H^{1-\sigma} - r_V^{1-\sigma})\right]^{\frac{k-(\sigma-1)}{\sigma-1}}}{1 - \left[\frac{f_X}{f_V - f_X}(r_V^{1-\sigma} - 1)\right]^{\frac{k-(\sigma-1)}{\sigma-1}}} r_V^{1-\sigma} \\ \frac{s_H}{s_X} &= \frac{\left[\frac{f_X}{f_H - f_V}(r_H^{1-\sigma} - r_V^{1-\sigma})\right]^{\frac{k-(\sigma-1)}{\sigma-1}}}{1 - \left[\frac{f_X}{f_V - f_X}(r_V^{1-\sigma} - 1)\right]^{\frac{k-(\sigma-1)}{\sigma-1}}} r_H^{1-\sigma}\end{aligned} \tag{24}$$

It is easy to show that as τ increases, r_V decreases more than r_H. The numerator of $\frac{s_V}{s_X}$ increases while the denominator drops, leading to the vertical relative market share to rise, i.e. $\frac{\partial(s_V/s_X)}{\partial\tau} > 0$. As for the horizontal relative market share expression, the denominator is the same as the vertical counterpart, which declines at the presence of rising tariff cost. But the two components of the numerator changes in opposite directions, with the first part decreasing and the second part increasing, which offsets the impact of the denominator. The net effect on $\frac{\partial(s_H/s_X)}{\partial\tau}$ is thus ambiguous theoretically and up to empirical tests, analogous to the previous graphical analysis.

Appendix E. Alternative relations between variable costs

Here I discuss an alternative condition in addition to the analysis in Section 5.3 where domestic wage rate is higher than or equal to destination wage rate $w \geq w^*$ and the relationship between horizontal and vertical variable costs is reversed:

$$\tau w > (\tau w)^{\eta_H} (w^*)^{1-\eta_H} \geq (\tau' w)^{\eta_V} (w^*)^{1-\eta_V} \tag{25}$$

All other assumptions still hold. This leads to the profits of entry modes as in Fig. E.1.

As before, firms with productivity between φ_X^* and φ_V^* choose to export, while firms with productivity over φ_V^* will choose vertical investment. Note here that the profit of horizontal investment is always below the profit of vertical investment. Even though the relative profitability of horizontal investment to export gives the cutoff productivity φ_H^*, firms with productivity above the cutoff would not take horizontal investment as the best choice since it is dominated by vertical investment. What happens with increase in trade cost is shown as follows:

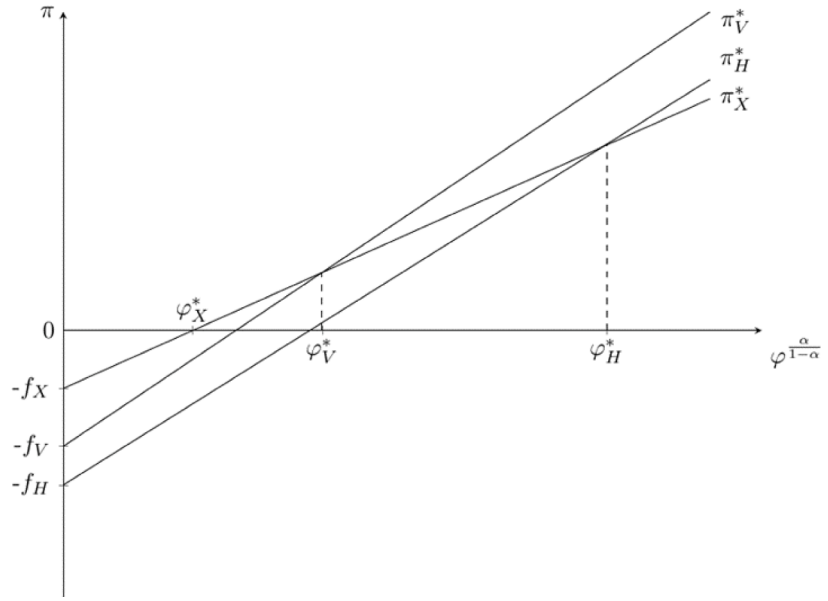


Fig. E.1. Alternative relationship between profits.

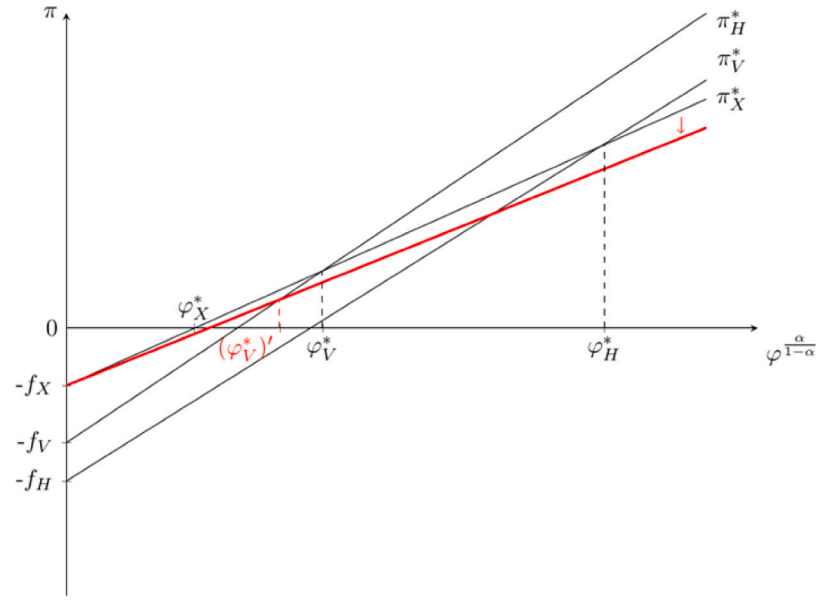


Fig. E.2. Change in trade costs.

As the profit line of exporters rotates downwards, the cutoff productivity φ_V^* shifts to the left. More firms are eligible for vertical investment and the relative profit of vertical MNCs to exporters also increases. The relative affiliate sales of vertical cross-border M&As to export will rise. Again, no firms would become horizontal MNCs under this condition. The effect of trade costs increase will be solely reflected by changes in vertical relative affiliate sales (see Figs. E.1 and E.2). Under Pareto distribution of productivity draw, we have:

$$\frac{s_V}{s_X} = \frac{\frac{V(\varphi_V^*)}{V(\varphi_X^*)}}{1-\frac{V(\varphi_V^*)}{V(\varphi_X^*)}} r_V^{1-\sigma} = \frac{\left(\frac{\varphi_X^*}{\varphi_V^*}\right)^{k-(\sigma-1)}}{1-\left(\frac{\varphi_X^*}{\varphi_V^*}\right)^{k-(\sigma-1)}} r_V^{1-\sigma} \tag{26}$$

The equation on relative cutoff productivity of vertical investment to export in Eq. (23) still holds: $\left(\frac{\varphi_X^*}{\varphi_V^*}\right)^{\sigma-1} = \frac{f_X}{f_V - f_X}(r_V^{1-\sigma} - 1)$. Therefore, the relative sales can then be written as:

$$\frac{s_V}{s_X} = \frac{\left[\frac{f_X}{f_V - f_X}(r_V^{1-\sigma} - 1)\right]^{\frac{k-(\sigma-1)}{\sigma-1}}}{1 - \left[\frac{f_X}{f_V - f_X}(r_V^{1-\sigma} - 1)\right]^{\frac{k-(\sigma-1)}{\sigma-1}}} r_V^{1-\sigma} \tag{27}$$

With $r_V^{1-\sigma}$ increasing in trade cost τ, the numerator rises while the denominator drops so that $\frac{\partial(s_V/s_X)}{\partial\tau} > 0$. This result implies that trade cost increase causes vertical relative affiliates sales to export to increase.

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