

INTERNATIONAL MONETARY FUND

How Widespread is FDI Fragmentation?

Joanne Tan

WP/24/179

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IMF Working Paper
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How Widespread is FDI Fragmentation?
Prepared by Joanne Tan

Authorized for distribution by Carlos Sánchez-Muñoz
March 2024

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ABSTRACT: This paper examines the extent to which FDI has fragmented across countries, the ways it has done so, using a modified gravity approach. The paper finds that FDI fragmentation is, for now, not a widespread phenomenon. Instead, fragmentation is circumscribed in two ways. First, the paper finds that geo-economic fragmentation has occurred only for certain industries that likely have strategic value, including computer manufacturing, information and communications, transport, as well as professional, scientific and technical services. Secondly, fragmentation appears to be more pronounced for outward FDI from the US, notably in a shift of US FDI from China to advanced Europe and the rest of Asia. This shift appears to be driven by both the intensive and extensive margin. Fragmentation is also more pronounced for immediate rather than ultimate FDI, with evidence of ultimate parent companies aligning the geopolitical mix of their intermediaries more closely to that of their final FDI host destinations. Overall, the results suggest that fragmentation, where found, may be a response to targeted policies that have placed curbs on certain types of FDI on national security grounds, rather than an indiscriminate breakup of investment links between non-ally countries.

JEL Classification Numbers:	F02,F12,F15,F21,F23,F52
Keywords:	Fragmentation; Foreign Direct Investment
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WORKING PAPERS

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How widespread is FDI fragmentation?

Joanne Tan*

March 27, 2024

Abstract

This paper examines the extent to which FDI has fragmented across countries, the ways it has done so, using a modified gravity approach. The paper finds that FDI fragmentation is, for now, not a widespread phenomenon. Instead, fragmentation is circumscribed in two ways. First, the paper finds that geo-economic fragmentation has occurred only for certain industries that likely have strategic value, including computer manufacturing, information and communications, transport, as well as professional, scientific and technical services. Secondly, fragmentation appears to be more pronounced for outward FDI from the US, notably in a shift of US FDI from China to advanced Europe and the rest of Asia. This shift appears to be driven by both the intensive and extensive margin. Fragmentation is also more pronounced for immediate rather than ultimate FDI, with evidence of ultimate parent companies aligning the geopolitical mix of their intermediaries more closely to that of their final FDI host destinations. Overall, the results suggest that fragmentation, where found, may be a response to targeted policies that have placed curbs on certain types of FDI on national security grounds, rather than an indiscriminate breakup of investment links between non-ally countries.

1 Introduction

Since the rise in US-China geopolitical tensions and Russia's invasion of Ukraine, economists have begun investigating the economic impacts of these events. Notably, recent papers have examined whether these tensions have had any impact on multilateralism and specifically, the fragmentation of economic links across countries. While there is no textbook definition of geo-economic fragmentation, the general consensus in the literature is

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that fragmentation refers to the reversal or slowdown of economic integration between countries along geopolitical lines. Various facets of economic relations between countries have been studied, including trade, currency choice in foreign reserves, financial markets and direct investments. This paper focuses on the geo-economic fragmentation of foreign direct investment (FDI). In particular, it addresses the question of the extent to which FDI has fragmented, the ways in which it has done so and whether any fragmentation observed is robust and significant. Understanding whether FDI has fragmented and the nature of such fragmentation is important, given that FDI is a potential driver of productivity growth.¹

Using a modified gravity approach, the paper finds no significant widespread fragmentation in FDI by geopolitical distance in any sub-period from 2009 to 2021, after controlling for country pair fixed effects, time dummies and a range of time-varying source and host country controls. Instead, the paper demonstrates that the fragmentation of FDI is targeted, localized, begins after 2013 and accelerates after 2018.²

FDI fragmentation is circumscribed in two ways. First, the paper finds that geo-economic fragmentation has occurred only for industries that likely have strategic value, including computer manufacturing, information and communications, transport, as well as professional, scientific and technical services. Secondly, fragmentation appears to be more pronounced for outward FDI from the US and is less significant for countries in advanced Europe. Notably, the paper shows that FDI from the US has decoupled from China, with US investment shifting towards advanced Europe and the rest of Asia. This decoupling is asymmetric, as China's FDI to the US and to the West in general does not appear to have declined either on relative or absolute terms.

For a comprehensive picture of FDI fragmentation, the paper constructs and employs several measures of FDI positions, distinguishing real FDI from FDI in special purpose entities (SPE), immediate FDI from ultimate FDI, as well as vertical FDI from horizontal FDI. The paper defines real FDI as FDI that is not placed in SPEs, where a SPE is a firm that receives direct investment but has no tangible impact on the host economy.³ Immediate FDI refers to FDI sent from immediate shareholders to their host destinations, without

¹See [Alfaro et al., 2009](#), [Malikov and Zhao, 2023](#), [Borensztein et al., 1998](#), [Foda et al., 2024](#), [Vaziri, 2021](#) on the economic impact of FDI.

²In this paper, a source country refers to the country *from* which FDI is sent, while a host country refers to the country where the FDI is received. I use the terms host, destination and recipient country interchangeably. I also use the terms source and investor country interchangeably.

³Following [Damgaard et al., 2019](#), I define a SPE as a FDI recipient firm that employs less than 5 employees and assets per employee exceeding 10 million USD.

any intermediary in a third country. In contrast, ultimate FDI refers all FDI sent from an ultimate parent company to their host destinations, whether or not there are intermediaries present in other countries. In turn, the ultimate parent shareholder is not owned by any other company. Lastly, vertical FDI refers to FDI that is sent from a parent company to a host company with the same 4-digit industry code, while horizontal FDI refers to FDI that is sent from parent to host companies in different industries.

The paper finds that fragmentation is more pronounced for immediate rather than ultimate FDI, and is slightly less likely significant for vertical FDI. These results imply that ultimate ownership decisions of parent companies are less influenced by geopolitical tensions, compared to immediate FDI. In addition, production decisions and their associated supply chains, reflected more in vertical than horizontal FDI (see [Ramondo et al., 2011](#) and [Spearot, 2013](#)), are somewhat less impacted by geo-fragmentation. Next, the paper attempts to examine if the observed fragmentation of US FDI is driven by the intensive or extensive margin of firm decisions.⁴ It finds that the intensive margin is insufficient to account for fragmentation and deduces that the extensive margin is likely to have also played a role.

Lastly, to explore whether ultimate parent companies have altered their ownership networks in response to geopolitical tensions, I estimate the extent to which ultimate parent firms' choice of intermediaries is impacted by their geopolitical proximity to the final host destinations. I find that, compared to the reference period, ultimate parent companies that are geopolitically distant from their final FDI hosts are more likely to choose intermediaries that are geopolitically close to these FDI host countries. This evidence suggests that parent companies may be seeking to circumvent future FDI barriers in host countries by channeling their FDI through intermediary countries that are geopolitical close to these hosts.

Taken together, the results suggest that fragmentation, where found, may be a response to recent targeted policies that have placed curbs on certain types of FDI on national security grounds, rather than an indiscriminate severance of investment relations between non-ally countries. This paper relates to two main strands of literature. The first strand consists of the nascent literature on the impact of recent geopolitical tensions on the macroeconomy. In this literature, the papers, including [Fajgelbaum and Khandelwal, 2022](#), [Felbermayr et al., 2023](#), [Smarzynska Javorcik et al., 2022](#), [Aiyar et al., 2023](#), [Góes and Bekkers, 2022](#), [Antràs, 2020](#) and [Ahn et al., 2023](#), explore the economic impact of the US-

⁴Specifically, the intensive margin refers to the size of investment by firms already investing in a given host country while the extensive margin refers to the decision by firms whether or not to invest in a country.

China trade war, the de-globalization of the supply chain, friend-shoring, near-shoring, as well as the consequences of such fragmentation. While most of these papers deal with trade fragmentation, this paper relates most closely to [Ahn et al., 2023](#), who provide descriptive evidence of the fragmentation of greenfield FDI, based on a sample of 300,000 greenfield FDI projects from 2003 to 2022. This paper adds to the literature by providing a view of FDI fragmentation that is comprehensive in terms of coverage, measures of FDI and measures of geopolitical distance. It also tests the robustness of fragmentation trends found with a number of gravity specifications and a rich set of controls. It finds that, just as for trade, there has been no widespread dismantling of FDI networks and that, instead, FDI fragmentation is a qualified phenomenon.

The second strand of literature is comprised of papers that study the determinants and distribution of FDI, either theoretically or empirically. This strand includes papers that look at models on the determinants of FDI, such as [Davis et al., 2021](#), [Blonigen and Piger, 2014](#), [Nocke and Yeaple, 2008](#) and [Jardet et al., 2023](#), as well as those that delve into firm-level investment decisions made by multinationals, such as [Yeaple, 2009](#), [Antràs and Yeaple, 2014](#) and [Antras et al., 2009](#). Amidst this broad literature, the paper is most closely related to those that seek to empirically model FDI using a gravity approach, including [Head and Ries, 2008](#), [De Sousa and Lochard, 2011](#) and [Blonigen et al., 2007](#) and [Keller and Yeaple, 2013](#). While the gravity model has conventionally been used to study trade ([Head and Mayer, 2014](#) and [Anderson, 2011](#)), these papers have derived testable empirical gravity specifications for FDI links between countries, starting from simple theoretical frameworks. This paper adapts the literature's gravity approach to incorporate measures of geopolitical distance and their interaction with time, to estimate whether the impact of geopolitical distance on FDI has changed significantly in recent years.

This paper is divided into five sections. The second section provides a background on recent FDI policies. The third section describes the data, the construction of different measures of FDI and presents some stylized facts. The fourth section discusses the empirical strategy, while the fifth delves into the estimation results. The last section concludes.

2 Policy background

This section explores the trends in FDI policies and notes if and when barriers to FDI have risen over time. In general, one can observe that there has been a decline in general FDI restrictions across countries. Using data from the OECD on selected countries, [Figure 1](#) displays an estimated index of openness to inward FDI, which ranges from 0 (fully open,

no restrictions) to 1 (fully closed to inward FDI), aggregated by regional groups.⁵ From the figure, apart from countries in the rest of the world (RoW), none of the other regional blocs have experienced a rise in FDI restrictiveness.⁶ For instance, while China has been the most FDI restrictive bloc since 2009, it has become less restrictive over time, starting from 2015.

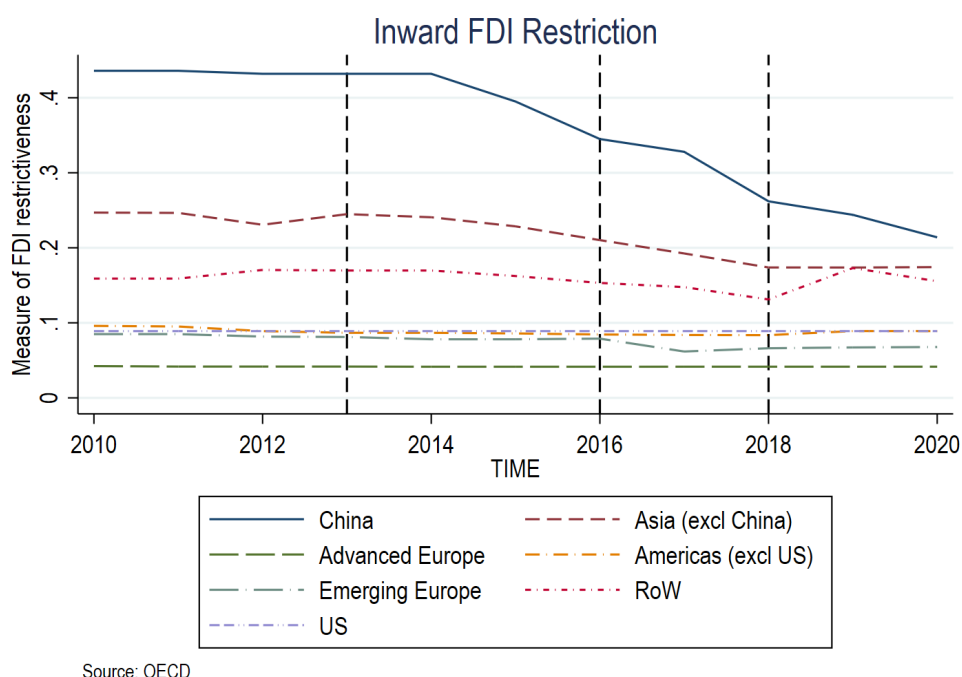


Figure 1: Index of restrictions to inward FDI

Instead of a general rise in FDI restrictions, there has instead been a series of specific and targeted policies adopted by some countries that has prompted recent worries about geo-economic fragmentation. Figure 2 presents the timeline of some recent events that may have shaped FDI trends among countries. While not exhaustive, one can note that since 2012, there has been a series of policies seeking to influence the patterns of both inward and outward FDI.

From its inception in 1975, the US government, via the Committee on Foreign Investment in the US (CFIUS), had only obstructed five FDI deals prior to the 2010s. Starting from

⁵The FDI restrictiveness index is not available for all countries. For the full list of reporting countries, the reader is invited to refer to <https://data.oecd.org/FDI/FDI-RESTRICTIVENESS.HTM>.

⁶Countries in advanced Europe include Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Portugal, San Marino, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom. All other countries on the European continent are in emerging Europe. China includes Hong Kong, Macau and mainland China.

2012, the Obama administration restricted two investments from China on national security grounds, the first being Huawei's attempted acquisition of a US server technology firm, 3Leaf systems, and the second being the forced divestment of Chinese investors in US wind farms.⁷ In 2013, China launched the Belt and Road Initiative (BRI), followed by the 'Made in China' strategy in 2015, that may strategically shape the patterns of FDI in and out of China.⁸ In the same year, the Chinese government published a draft law aimed at regulating FDI in industries relevant to national security. This draft law, along with a new national security law, was eventually enacted in 2020. The list of sectors with national security implications is long, ranging from the military, to agricultural products, manufacturing and information technology.⁹

Since 2016, the US and, to a lesser extent, the EU have adopted further FDI restrictions. In December 2016, the Obama administration ordered CFIUS to block the sale of a US-based semi-conductor firm to a company owned by China on national security grounds.¹⁰ CFIUS's powers to restrict FDI into the US for national security reasons were expanded in 2018, with the adoption of the Foreign Investment Risk Review Modernization Act (FIRRMA).¹¹ This was followed in 2021 with the passing of the Innovation and Competition Act that aimed to prevent the appropriation of US innovations.¹² Most recently, in August 2023, the Biden administration turned attention to outward FDI from the US, by adding restrictions on high-tech US investments to China.¹³ A succinct summary of the national security concerns relating to FDI in the US is provided by [Masters et al., 2023](#). Likewise, the EU commission, concerned with the security implications of FDI in the union, proposed a framework to review FDI in strategic sectors in 2017. This new regulation was adopted in 2019 by the EU parliament.¹⁴

To examine bilateral FDI restrictions between country host and source pairs, I use information on the number of FDI-related barriers announced, provided by the Global Trade Alert (GTA) database, which collates information on state interventions that impact trade,

⁷<https://www.reuters.com/article/us-huawei-3leaf-idUSTRE71I38920110219> and <https://www.reuters.com/article/us-usa-china-turbines-idUSBRE88R19220120929>.

⁸<https://www.cfr.org/backgrounder/made-china-2025-threat-global-trade>.

⁹See <https://www.cliffordchance.com/content/dam/cliffordchance/briefings/2015/02/china-proposes-new-foreign-investment-law.pdf>.

¹⁰<https://www.csis.org/analysis/president-obamas-second-order-cfius>.

¹¹<https://www.ft.com/content/a819ec8a-79f4-11e8-8e67-1e1a0846c475>.

¹²<https://www.csis.org/analysis/what-us-innovation-and-competition-act-gets-right-and-what-it-gets-wrong>.

¹³See <https://www.cfr.org/backgrounder/contentious-us-china-trade-relationship>.

¹⁴See https://eur-lex.europa.eu/procedure/EN/2017_224.

migration and foreign direct investment.¹⁵ Figure 3 plots the flow of FDI policies announced that obstruct FDI yearly from 2008 to 2023 between the US and China.¹⁶ From Figure 3, the US recorded one state intervention in 2012 targeting FDI from China and none in any other year before 2016. From 2016, however, the US government introduced at least one FDI barrier to Chinese investment per year, peaking at four policies a year between 2018 and 2020. In comparison, China enacted three FDI barriers targeting the US and three in 2018, with no other recorded policies outside these years. While the overlap between the events in Figure 2 and Figure 3 is not perfect, both figures suggest a rise in US policies restricting Chinese investment from 2016 and a one-off spike in Chinese barriers to US investment in the same period.

To give a global view of trends in FDI barriers, Figure 4 displays the number of FDI barriers across regional blocs, as announced by the US, China and countries in advanced Europe. From the figure, there is a clear spike in FDI barriers by the US targeted at China from 2016, even relative to other regions. Apart from the one FDI barrier announced by China targeting the US in 2018, there were no other FDI barriers raised by China. Lastly, from Figure 4c, there was a sharp hike in FDI barriers announced by advanced Europe against emerging Europe in 2021, but no discernible spike between 2015 and 2020.

Together, these descriptive results on FDI policy suggest that while barriers to FDI have been lowered in general over time, they have risen perceptively between the US and China, and between emerging and advanced Europe. The next section moves on to examine whether these changes in FDI policy correspond to realized changes in FDI, on top of describing the data sets used and the construction of key variables.

¹⁵The data can be found at: <https://www.globaltradealert.org/>

¹⁶These are the FDI policies classified as red or amber in the GTA. [Juhász et al., 2022](#) provides a detailed description of the how the GTA data can be used.

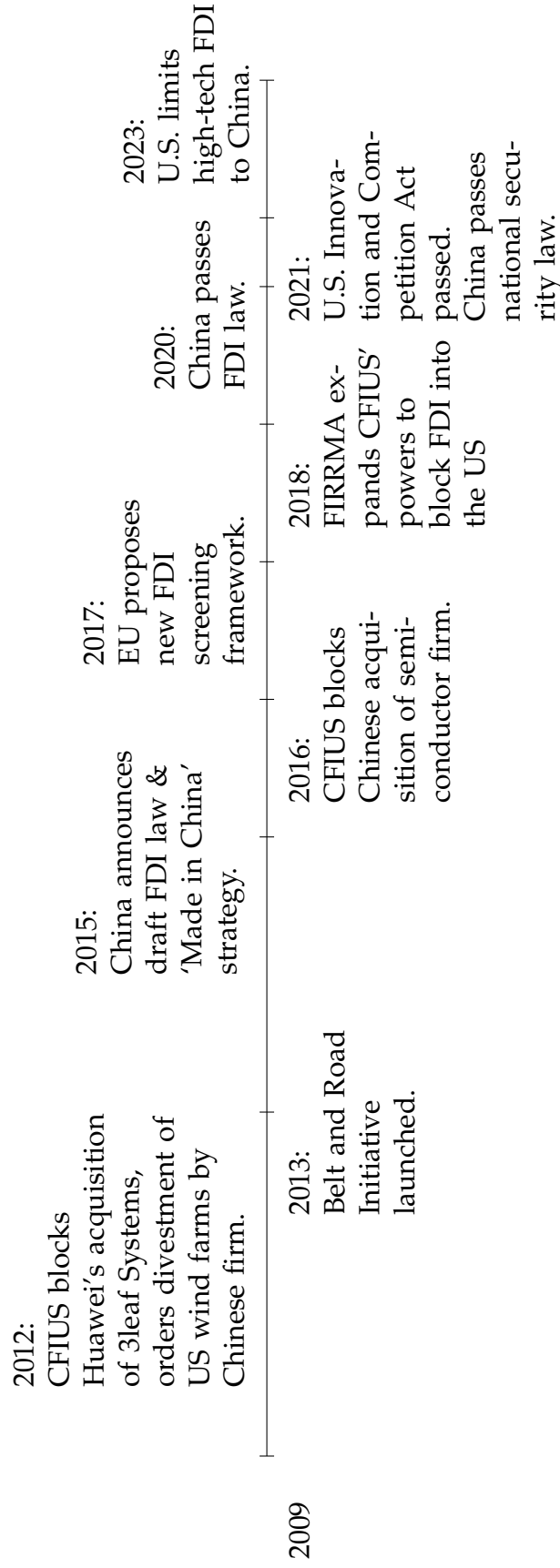


Figure 2: Timeline of key FDI policies

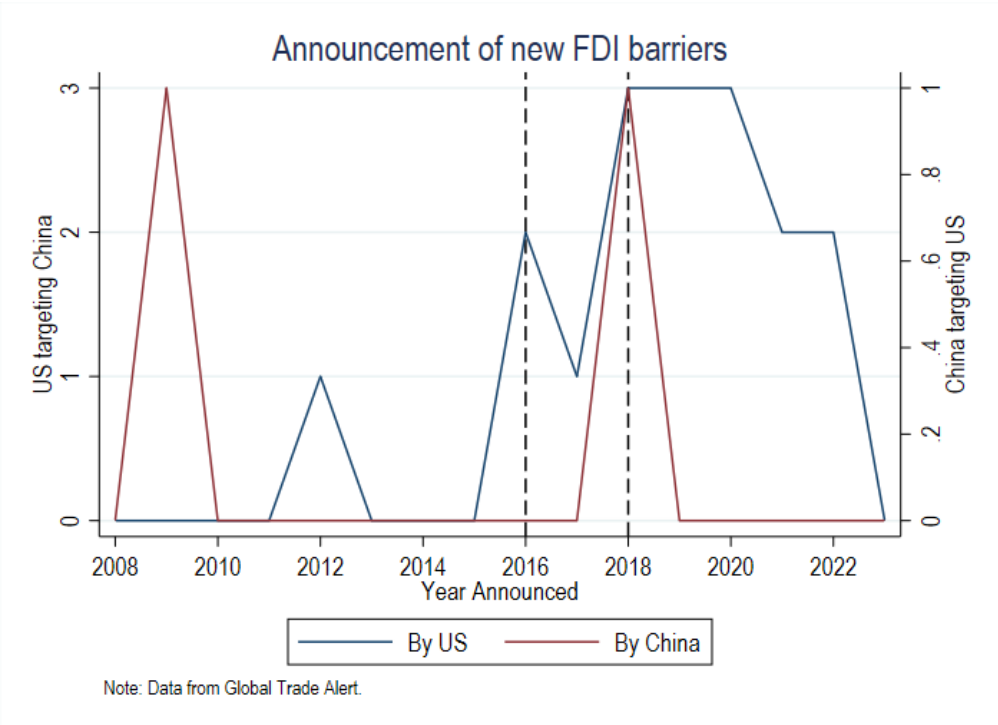
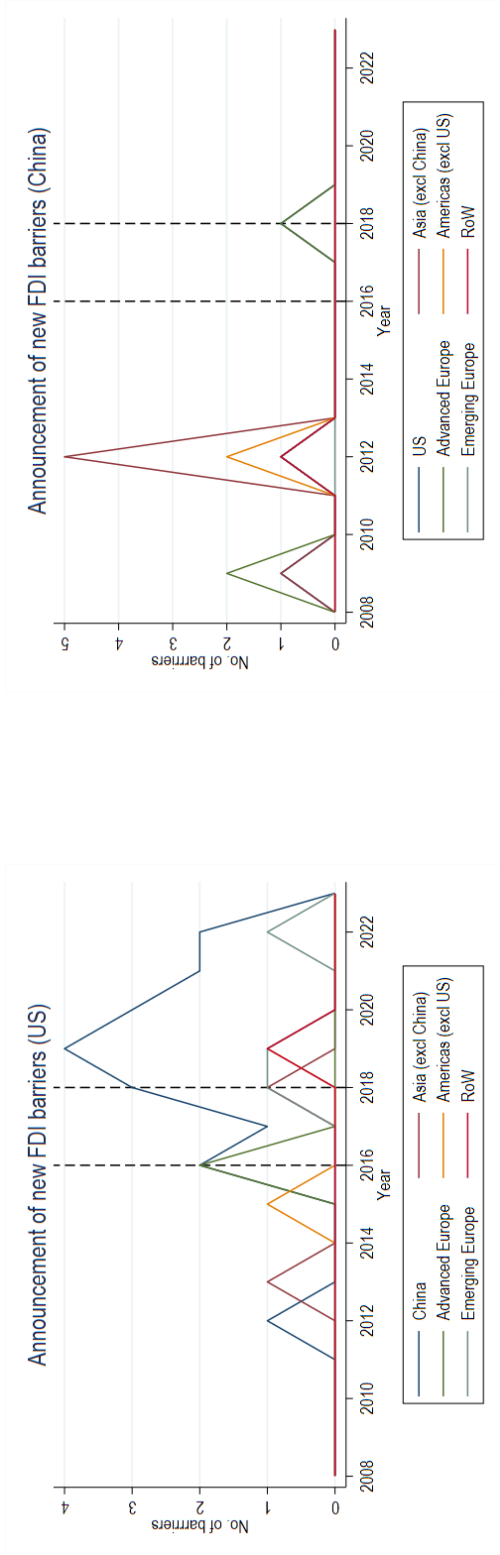
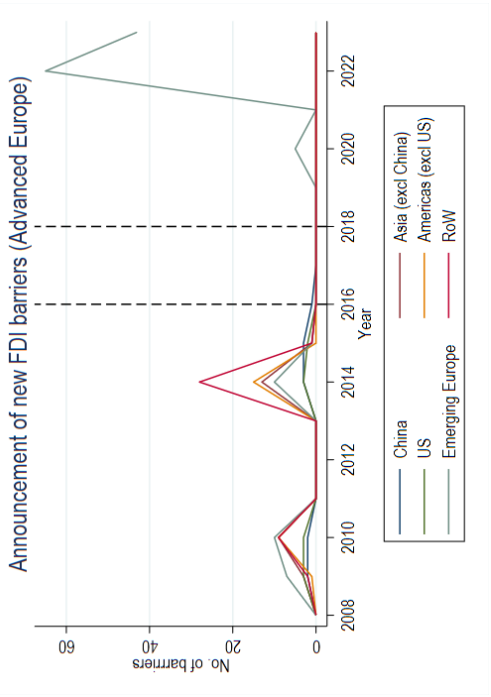


Figure 3: Announcements of new FDI barriers between the US and China



(a) Announced by the US

(b) Announced by China



(c) Announced by advanced Europe

Figure 4: Announcements of new FDI barriers between regional blocs

3 Data and Stylized Facts

The paper employs several data sets to examine FDI fragmentation in a comprehensive manner. In this section, I first describe the data and how the various measures of FDI positions are constructed. I then present a series of stylized facts on FDI fragmentation.

3.1 Data and measures of FDI

Due to limited information on bilateral FDI flows across countries, this paper focuses exclusively on FDI positions (stocks).¹⁷

CDIS The Coordinated Direct Investment Survey (CDIS) is a worldwide country-level database administered by the IMF, beginning from 2009. For each reporting country, the CDIS collects information on aggregate inward and outward FDI, as well as bilateral FDI between countries. The coverage of the CDIS is wide, with 110 reporting countries as of 2022. Moreover, for non-reporter countries, inward and outward bilateral FDI can still be estimated using mirror data from partner countries. It should be noted that the bilateral FDI values in the CDIS refer to total immediate FDI between source and host countries.¹⁸ Otherwise put, the CDIS neither distinguishes real FDI from FDI in SPEs between countries nor measures bilateral FDI by ultimate ownership.

OECD Since the CDIS does not break down FDI into real FDI and investment in SPEs, I use annual bilateral FDI and SPE data for reporting OECD countries to impute the share of SPEs out of total FDI, so as to construct the level of real bilateral FDI for all countries, following [Damgaard et al., 2019](#).¹⁹ A description of how real FDI is imputed for the CDIS using the available breakdown in the OECD data is provided in the Data Appendix. The rest of this paper focuses primarily on real FDI.

Orbis Orbis provides firm-level balance sheet and shareholder data for over 448 million companies worldwide. It contains sufficient shareholder and subsidiary information to calculate the level of FDI of shareholder firms in their subsidiaries. It also contains information on both immediate and ultimate investors, which allows for a clearer view

¹⁷While some countries, including the US, publish data on bilateral FDI flows, such information is absent for most countries. Information on FDI flows is also not broadly available at the firm level.

¹⁸The data can be accessed at <https://data.imf.org/?sk=40313609-f037-48c1-84b1-e1f1ce54d6d5&sid=1482334777935>.

¹⁹The data can be accessed on the OECD Data page.

of ultimate ownership links that may be masked when looking solely at immediate investors. In addition, Orbis also contains industry information on both shareholder and subsidiaries, which allows for a bilateral industry breakdown of FDI, as well as information on employee numbers and total firm assets, allowing for the identification of likely SPEs. In this paper, I use 2009 to 2021 vintages of Orbis to impute ultimate bilateral FDI across countries, following the steps laid out in [Damgaard and Elkjaer, 2017](#), country-level bilateral vertical FDI, as well as country by industry bilateral FDI.²⁰ Using the industry information from Orbis, I also impute bilateral vertical FDI across countries, where, following the literature, vertical FDI is defined as FDI from a shareholder firm that does not share the same four-digit industry code as its subsidiary ([Alfaro and Charlton, 2009](#)), as opposed to horizontal FDI, where shareholder and subsidiary share the same industry code. The distinction between vertical and horizontal FDI may be important, since vertical FDI relates more to production and supply chain decisions while horizontal FDI is often a way for firms to gain market access, as a substitute to trade ([Atalay et al., 2014](#), [Anderson et al., 2019](#) and [Alfaro and Charlton, 2009](#)). In addition, the firm-level aspect of the Orbis data is exploited to run firm-level analysis of US outward FDI. Note that while the Orbis data is rich, there are several important limitations to Orbis, notably with regards to differing levels of firm coverage across countries. A detailed guide on using Orbis and its limitations can be found in [Kalemli-Ozcan et al., 2015](#) and [Bajgar et al., 2020](#).

BEA The Bureau of Economic Analysis (BEA) reports outward FDI data from the US by industry to host countries. This complements the Orbis data, especially where information on US firms is missing.²¹ I use this data to conduct more in-depth analysis of outward FDI from the US.

CEPII and BIS These datasets are used to construct control variables that will later be used in the gravity regressions. The Center for Prospective Studies and International Information (CEPII) provides bilateral country pair level data on standard gravity control variables for trade analysis. These include variables such as whether or not any pair of countries have signed a Free Trade Agreement (FTA), whether they had former colonial links or share a common language. It also provides various measures of bilat-

²⁰More information on Orbis can be found here: https://www.bvdinfo.com/en-gb/our-products/data/international/orbis?gad_source=1&gclid=EAIaIQobChMIn7e2id_NggMVdBZ7Bx2GngTtEAAAYASABEgL8CfD_BwE&gclidsrc=aw.ds.

²¹Data available at <https://www.bea.gov/INTERNATIONAL/DI1USDBAL>.

eral geographic distance between countries.²² Lastly, data on exchange rates is obtained from Bank of International Settlements (BIS). This data is used to adjust for valuation changes in FDI stocks due to exchange rate fluctuations and as controls in the gravity regressions.²³

In this paper, I focus on real FDI, which is defined as FDI that is not directed at companies with less than five employees or with assets per employee exceeding 10 million USD (Damgaard et al., 2019). Table 1 presents the summary statistics for the measures of FDI for all bilateral country pairs in the CDIS from 2009 to 2021 that are relevant to the analysis, namely immediate and ultimate real FDI, as well as immediate and ultimate real vertical FDI. For reference, the table includes the same statistics for immediate and ultimate total FDI in the last two rows.

	Summary Statistics				
	Mean	Std dev	Min	Max	N
Real immediate FDI	1.478	16.98	0	1969.13	199,279
Real ultimate FDI	1.478	16.56	0	1969.13	199,279
Real immediate vertical FDI	1.095	13.52	0	1969.13	199,279
Real ultimate vertical FDI	1.086	12.22	0	1559.21	199,279
Total immediate FDI	2.237	23.38	0	1969.13	234,652
Total ultimate FDI	2.392	23.74	0	1969.13	219,308

FDI measures are in billions of USD and are constructed as described in the Data Appendix. Summary statistics are for the period 2009 to 2021.

Table 1: Summary statistics of bilateral country-level FDI (in billions of USD)

The average bilateral real immediate and ultimate FDI position is around 1.478 billion USD.²⁴ Real immediate and real ultimate FDI make up around 60 percent of total immediate and ultimate FDI, while real vertical FDI makes up just under 80 percent of real FDI, for both the immediate and ultimate measures. Since some country pairs do not have enough information for the imputation of real FDI, there are more observations for total FDI compared to real FDI. In general, these measures of FDI are strongly positively correlated. For example, the correlation between real immediate and real ultimate FDI is 0.76 and that between real ultimate FDI and real ultimate vertical FDI is around 0.975.

²²The CEPII data can be accessed here: http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=8.

²³The BIS data can be found at <https://www.bis.org/statistics/xrusd.htm>.

²⁴The calculation of the mean includes bilateral country pairs with zero FDI. Just under 50 percent of country pairs have zero FDI between them.

Table [A1](#) in the Appendix displays the full correlation matrix for these six measures of FDI. Given the high correlation between the vertical and overall (vertical and horizontal) real FDI measures, the subsequent analysis focuses on the latter, leaving the results for vertical FDI to the Appendix, except when the results differ substantially.

3.2 Stylized facts

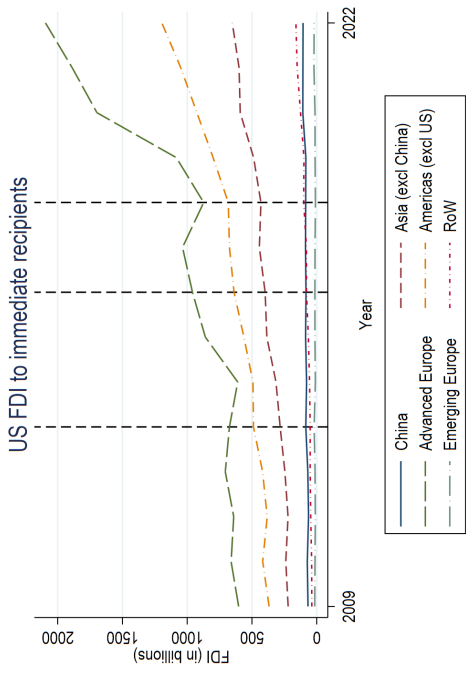
Having described the construction of the FDI measures, this section presents some key stylized facts on FDI fragmentation from 2009 to 2021.²⁵ Figures [5](#) to [7](#) plot the levels and distribution of outward immediate and ultimate real FDI from the US, China and countries in advanced Europe across regional blocs respectively. For ease of comparison, the same regional groupings as [Ahn et al., 2023](#) are used - the US, China, advanced Europe, emerging Europe, the Americas (excluding the US), Asia (excluding China) and the rest of the world (RoW).²⁶

From Figure [5a](#), US FDI in levels to immediate recipients has risen in advanced Europe, the Americas and the rest of Asia from 2009. The rate of increase to these regions accelerates after 2018. In contrast, FDI to Emerging Europe, China and the rest of the world seems to plateau from 2009. The trends in US FDI to ultimate recipients are similar, shown in Figure [5c](#), albeit less pronounced, with US FDI to advanced Europe dipping slightly in 2021 and recovering partially in 2022. From Figures [5b](#) and [5d](#), the distribution of immediate and ultimate FDI remains roughly stable over time, with the share of US FDI to advanced Europe rising slightly over time and that to China declining slowly from 2013. While the share of US immediate FDI rises in advanced Europe only, the share of US ultimate FDI also rises for the Americas and Asia (excluding China). As shown in Figure [A1](#) in the Appendix, the trends are similar when one only considers vertical FDI from the US.

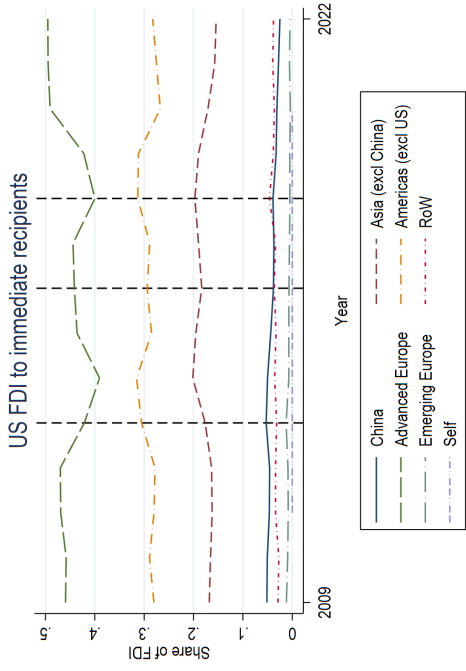
From Figure [6a](#), China's FDI to all regions has risen from 2009. While immediate Chinese FDI to the rest of Asia and advanced Europe rises more sharply just after 2016, Chinese FDI to the US plateaus from 2017. These trends largely hold for ultimate Chinese FDI as well, as shown in Figure [6c](#), though Chinese ultimate FDI to advanced Europe rises much more sharply from 2020, only dipping slightly in 2022. Concerning the distribution of Chinese immediate FDI, Figure [6b](#) shows that the share of Chinese FDI to its non-

²⁵The 2009 start year coincides with the start of the CDIS. At the time of writing, only data up to end 2021 was available. As a result, the fragmentation impact of the Russian invasion of Ukraine in 2022 is not reflected in the results. I leave this for future work.

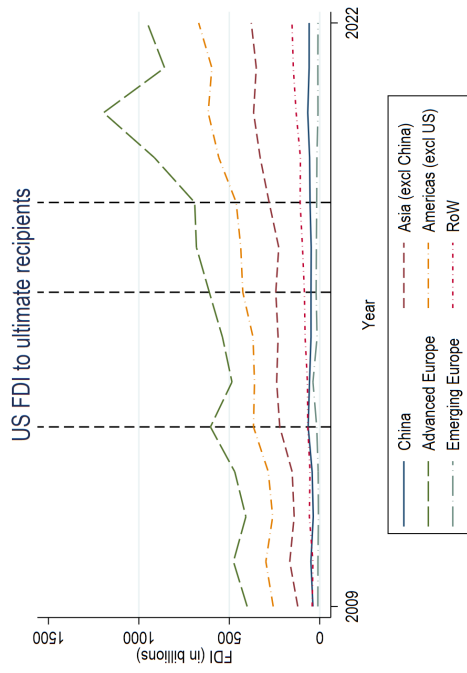
²⁶For the sake of brevity, the plots for outward FDI from the other regional blocs are not displayed.



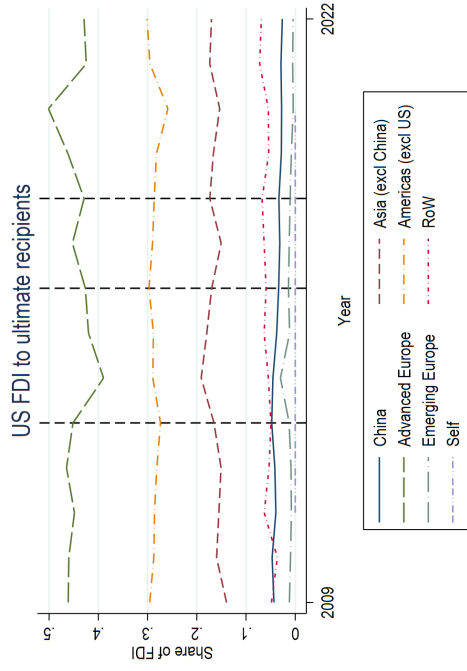
(a) Immediate FDI



(b) Distribution of immediate FDI

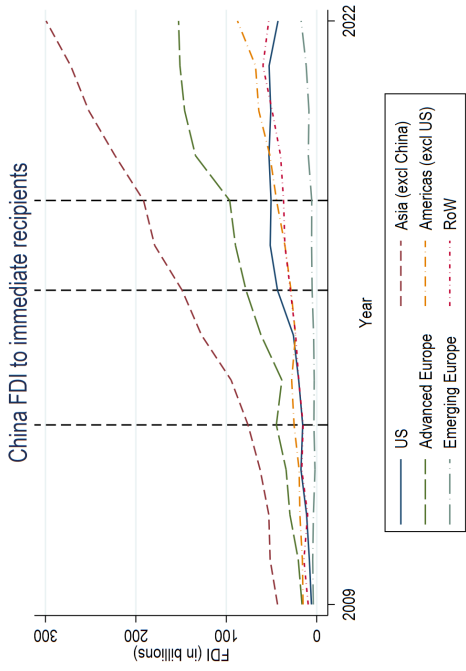


(c) Ultimate FDI

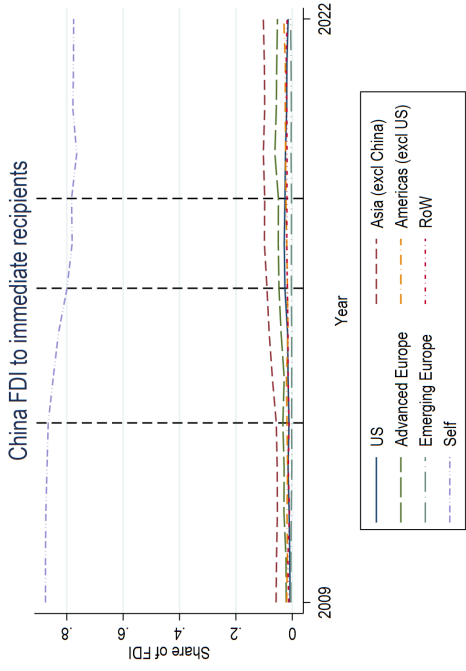


(d) Distribution of ultimate FDI

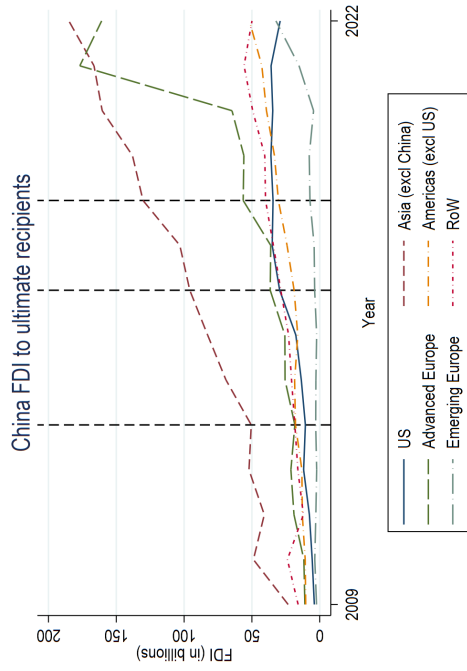
Figure 5: Immediate and ultimate outward real FDI from the US



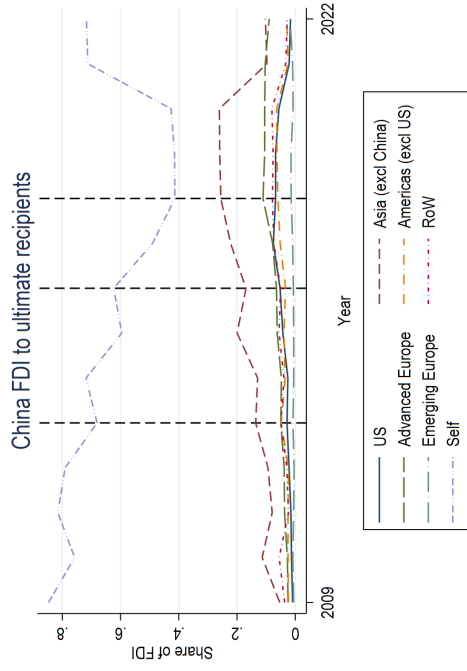
(a) Immediate FDI



(b) Distribution of immediate FDI



(c) Ultimate FDI



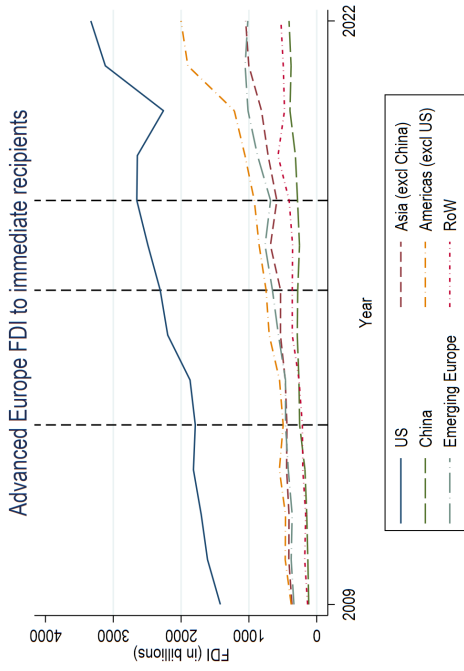
(d) Distribution of ultimate FDI

Figure 6: Immediate and ultimate outward real FDI from China

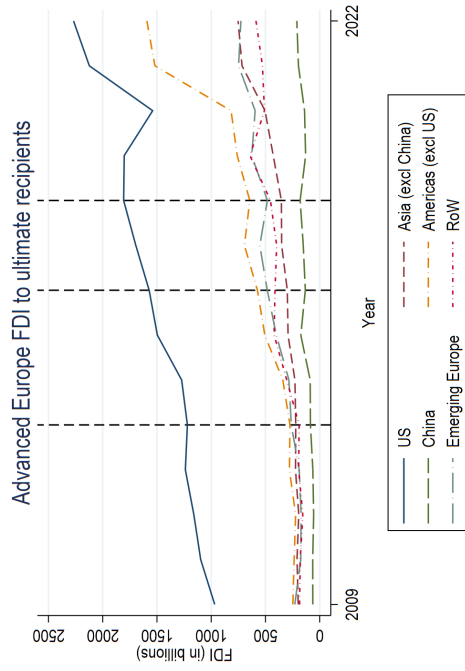
mainland territories, Hong Kong and Macau, has declined from 2009 to 2022, while that to other regions, such as the rest of Asia and advanced Europe has risen. Figure 6b, however, belies the role of round-tripping, since one observes from Figure 6d, that the secular trends in Chinese ultimate FDI to itself and to the rest of Asia are reversed from 2020, suggesting that some FDI in China is ultimately controlled by Chinese firms. The trends for outward vertical Chinese FDI are similar, as shown in Figure A2.

From Figures 7a and 7c, outward immediate and ultimate FDI from advanced Europe to all other regions has risen, more so for the US, the Americas (excluding the US), emerging Europe and Asia (excluding China). FDI from advanced Europe to China has also risen steadily from 2009, albeit by a smaller extent. Regarding the distribution of FDI from advanced Europe, Figures 7b and 7d, firms in advanced Europe invest primarily within the bloc, although this share has been declining slowly from 2009. The share of FDI to the US is a mirror image of the share of FDI to advanced Europe. The share of advanced Europe's FDI to the Americas, emerging Europe and the rest of the world has risen somewhat, while that to China remains low and flat. From Figure A3 in the Appendix, the trends in vertical real FDI are similar.

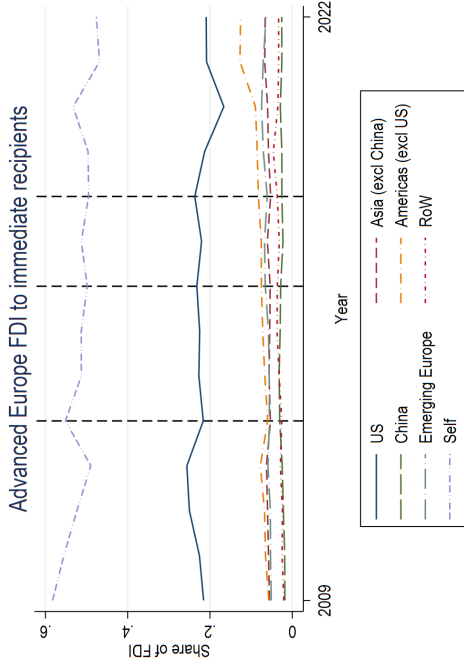
Since some of the above geographic regions consist of countries that may have heterogeneous geopolitical alignment, it is unclear whether the above trends between regional blocs reflect fragmentation. FDI has risen between the US and advanced Europe. Yet, there has been no evidence of China moving away from investments in the West. As such, examining trends by prescribed geopolitical blocs may be more informative. Using an index of geopolitical distance developed by [Catalán and Tsuruga, 2023](#), based on [Häge, 2011](#), countries are ranked by their geopolitical proximity to the US and then grouped into terciles - those *closest* to the US (including the US), those *less close* and those *farthest* from the US. Figure 8 presents the distributions of immediate and ultimate FDI by these geopolitical blocs. From Figures 8a, 8c and 8e, countries closest and furthest from the US tend to invest most within their bloc, even as the within-bloc shares of immediate investment decline slowly over time. Countries that are less close to the US invest most in the bloc furthest from the US, even though this share is declining over time. The trends for the distribution of ultimate FDI differ slightly from those for immediate FDI, notably after 2018, where the intra-bloc share of ultimate FDI rises for countries closest and furthest from the US. For countries less close to the US, their share of ultimate FDI to countries close to the US rises steeply after 2018. Trends for vertical FDI are similar, as shown in Figure A4 in the Appendix.



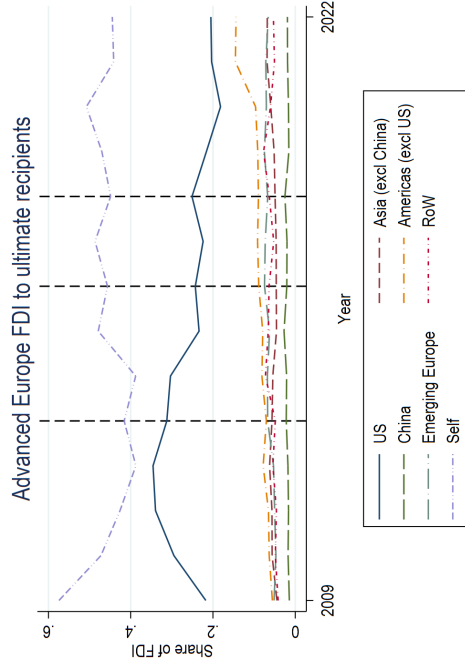
(a) Immediate FDI



(c) Ultimate FDI

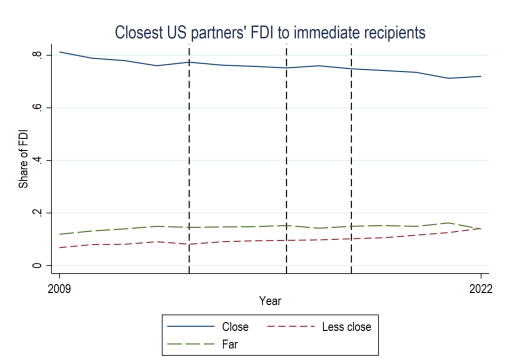


(b) Distribution of immediate FDI

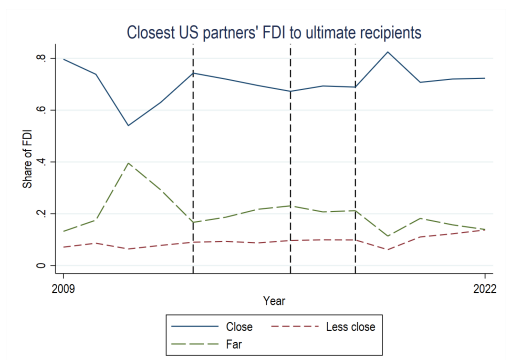


(d) Distribution of ultimate FDI

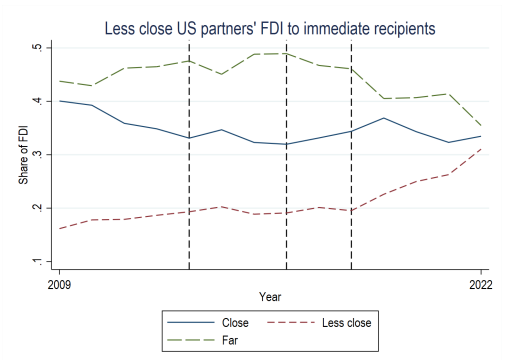
Figure 7: Immediate and ultimate outward real FDI from advanced Europe



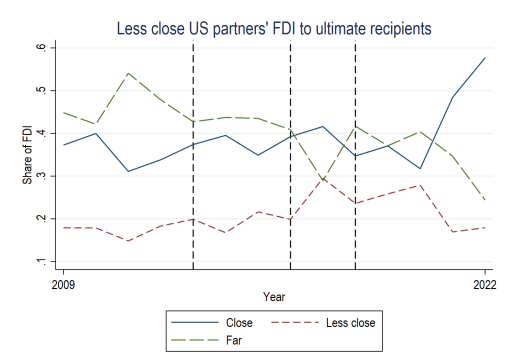
(a) Immediate FDI (Closest)



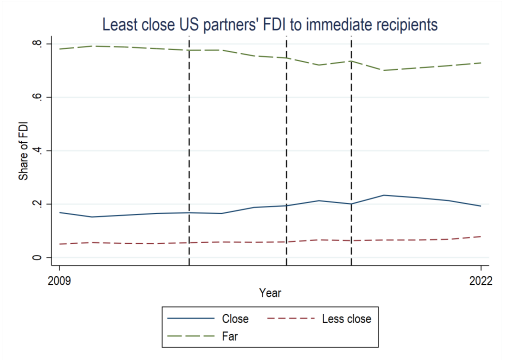
(b) Ultimate FDI (Closest)



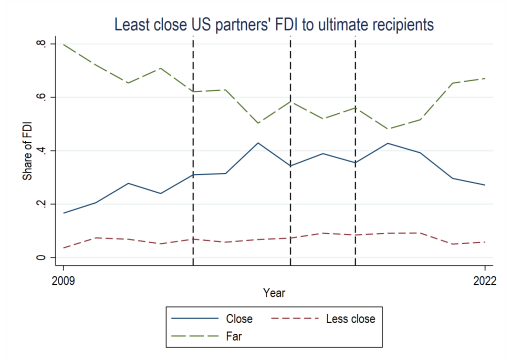
(c) Immediate FDI (Less close)



(d) Ultimate FDI (Less close)

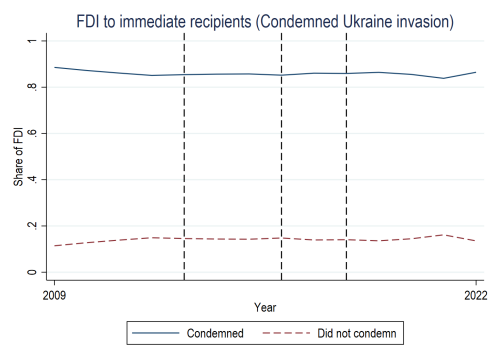


(e) Immediate FDI (Farthest)

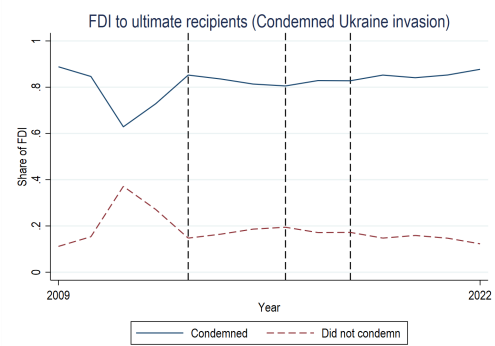


(f) Ultimate FDI (Farthest)

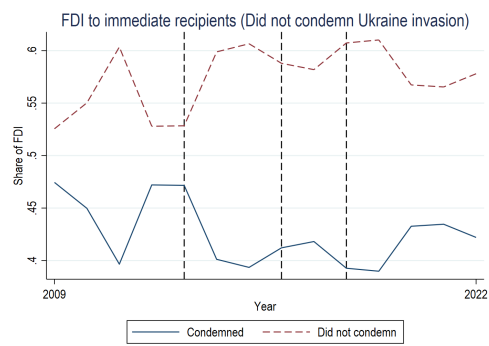
Figure 8: Distribution of immediate and ultimate outward real FDI by geopolitical proximity to the US



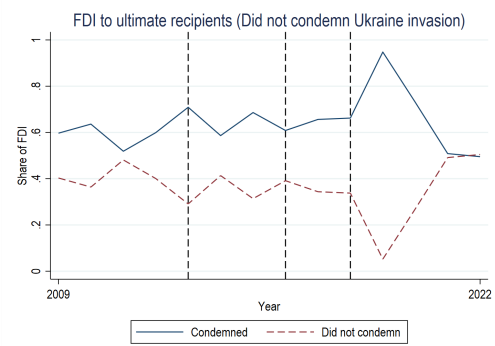
(a) Immediate FDI (Voted 'Yes')



(b) Ultimate FDI (Voted 'Yes')



(c) Immediate FDI (Did not vote 'Yes')



(d) Ultimate FDI (Did not vote 'Yes')

Figure 9: Distribution of immediate and ultimate outward real FDI by UN voting bloc

Some papers in the literature, including [Ahn et al., 2023](#), have also used countries' voting patterns in the UN to define geopolitical blocs, focusing especially on whether countries voted to condemn Russia's invasion of Ukraine in the UN General Assembly in 2022. Figure 9 shows the trends in FDI distribution between countries that voted to condemn the Russian invasion of Ukraine and those that did not. For countries that did, in Figures 9a and 9b, immediate and ultimate FDI within their bloc remained quite stable over time. On the contrary, countries that did not condemn the invasion, seen in Figures 9c and 9d, experience more volatile changes in the distribution of FDI, with immediate FDI within bloc declining after 2018 for immediate FDI and with ultimate FDI within the bloc rising after 2018. Trends for vertical FDI are similar, as shown in Figure A5 in the Appendix. Whether for ultimate or immediate FDI, there does not appear to be a clear relative rise in intra-bloc FDI.

Apart from classifying countries into pre-defined groups, which may be too prescriptive, I also consider more organic ways to group countries. Figures 10, 11, 12 and 13 show the bilateral immediate FDI positions between countries on a world map. The size of each country node is proportional to the level of aggregate inward FDI, while the width of each arrow is proportional to the level of bilateral inward FDI between countries. Countries are grouped into communities, represented by different colors. These communities are created using a heuristic algorithm that maximises the modularity of each community ([Blondel et al., 2008](#)). Modularity refers to the weighted density within a community versus between communities. Maximising the modularity of a network implies partitioning a network into densely connected FDI communities, where countries in different communities are less connected. Insofar as there is greater FDI fragmentation, one may expect either an increase in the number of communities, or a reshuffling of countries into communities that are more geopolitically aligned. Comparing the four figures, neither expectation has materialized. From 2010 to 2022, there are 4 large communities, North America (in pink) that at times contains countries in Western Europe, the rest of Western Europe (in light blue), China (in green), Russia and eastern Europe (in orange) that is at times subsumed into the Western Europe bloc.

Similarly, Figures 15 to 17 present global patterns for ultimate FDI. From 2010 to 2022, the number of communities hovers been 4 and 5. There is some reshuffling of countries over time as well, with the bloc of countries containing China (in green) becoming less interconnected over time. Interestingly, the network containing Russia does not appear to be diminishing, even in 2022.

Overall, the trends discussed above provide small but inconclusive evidence of fragmentation. While FDI between the US and advanced Europe has risen in both absolute and relative terms, the level of FDI from the West to China has been quite stable over time. Moreover, there has been no observable decoupling of Chinese FDI from the West, with China's FDI to advanced Europe in particular rising in both absolute and relative terms. Results are also mixed when countries are grouped by pre-defined geopolitical blocs. While there is some evidence of a rise in ultimate FDI within blocs of countries grouped by geopolitical distance from the US beginning in 2018, there is neither a clear pattern of fragmentation when countries are grouped by UN voting blocs nor when countries are organically grouped into communities of FDI networks based on modularity.

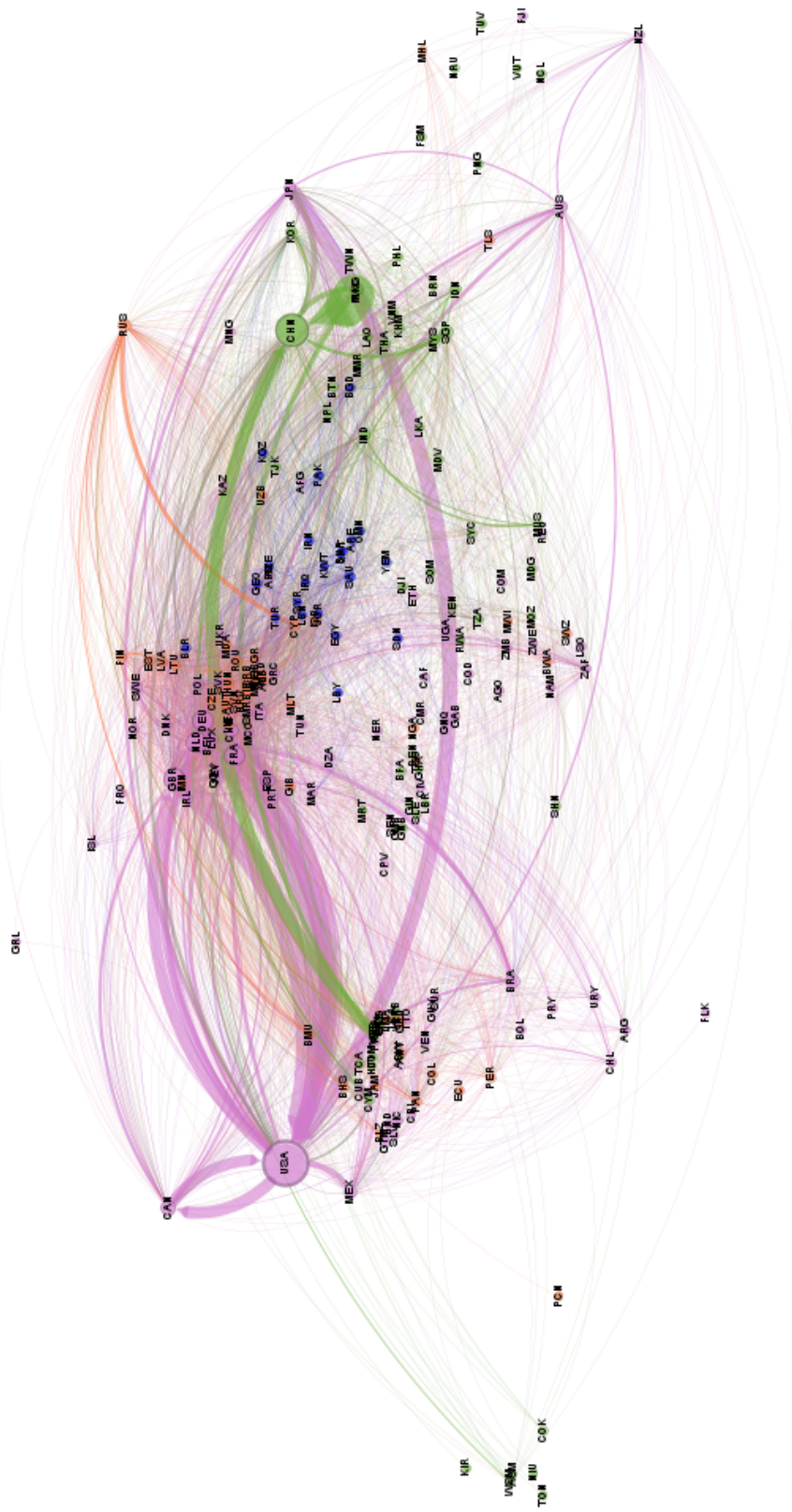


Figure 10: Real immediate FDI in 2010 (World)

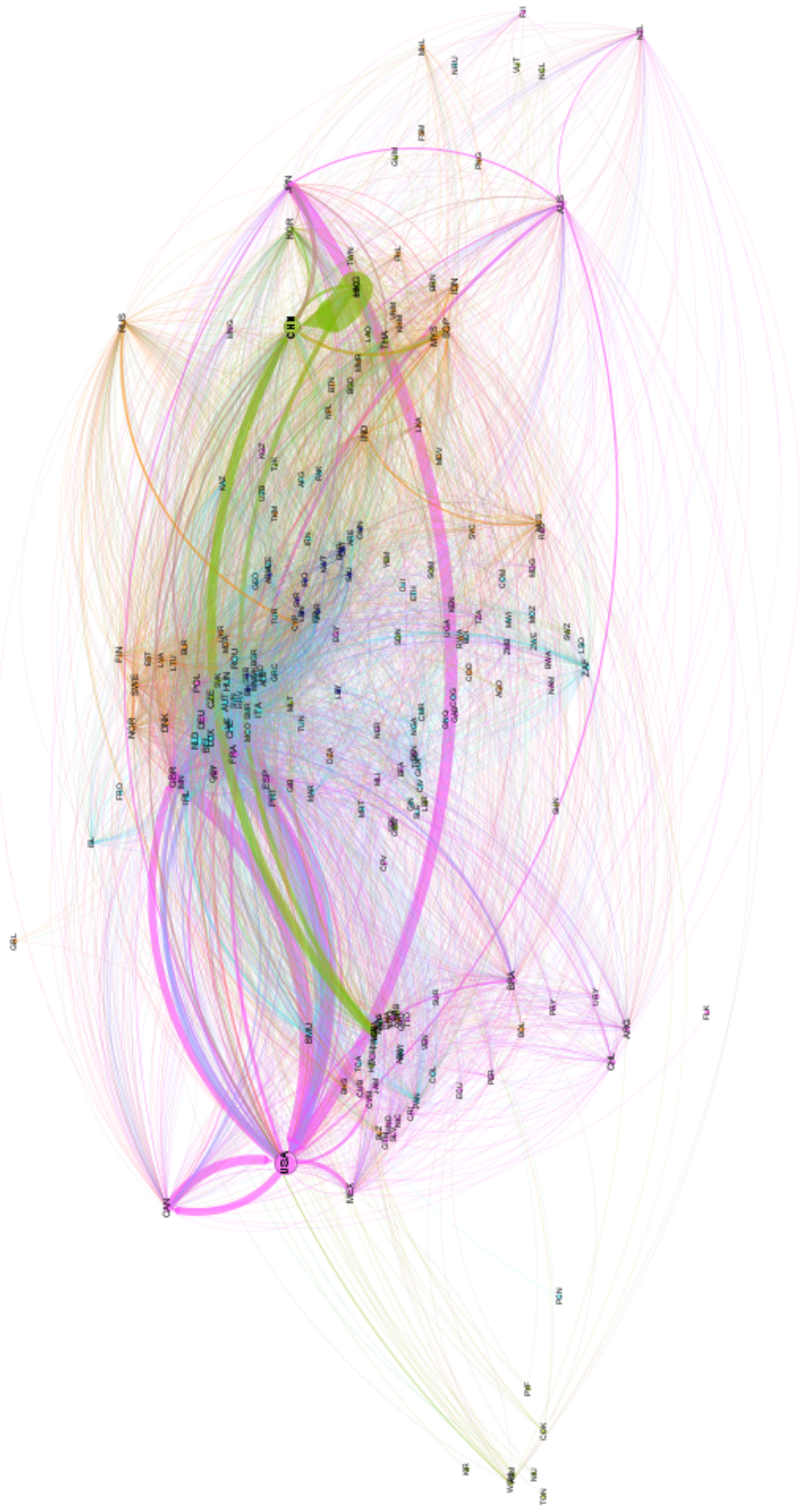


Figure 11: Real immediate FDI in 2015 (World)

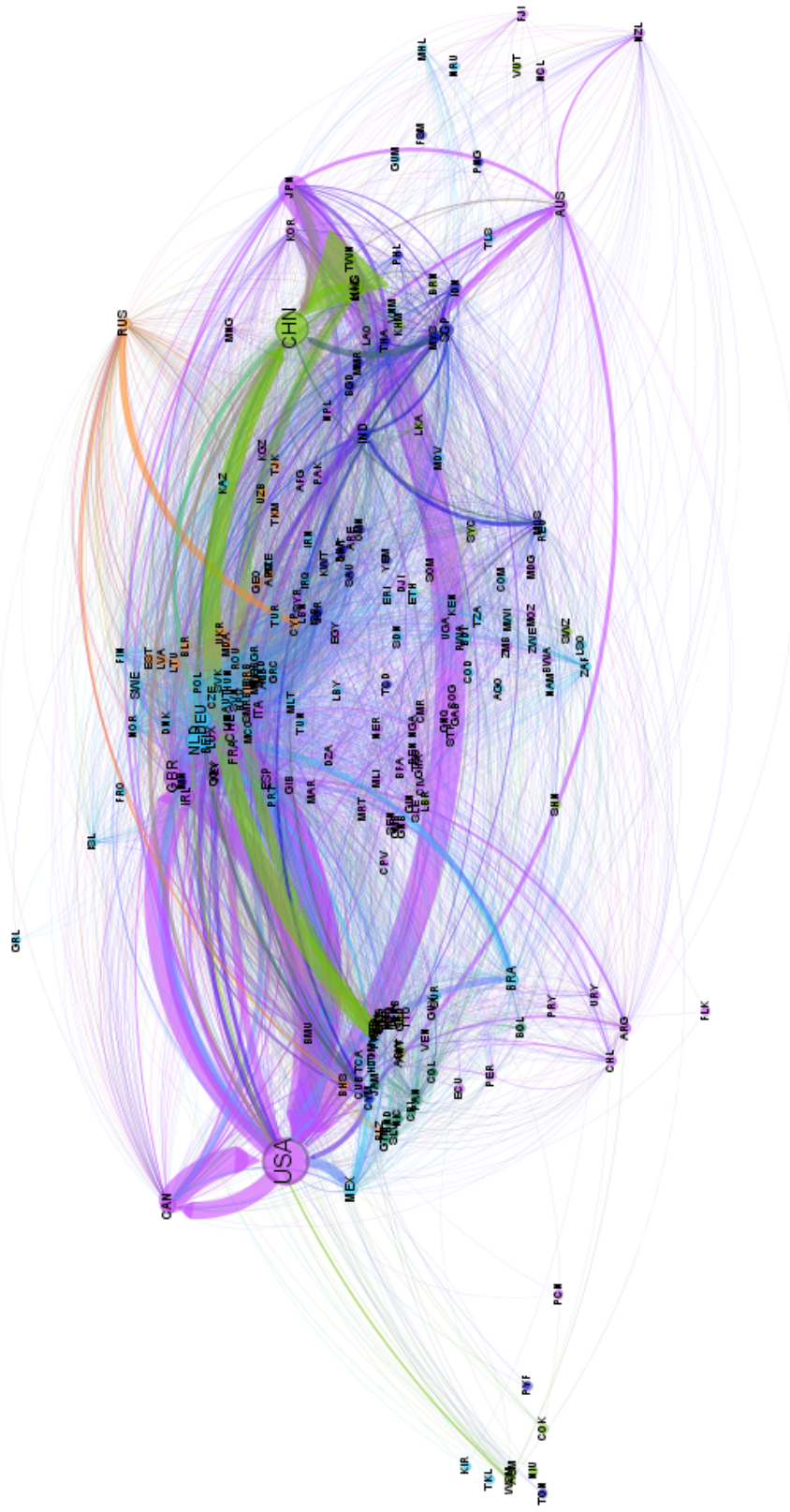


Figure 12: Real immediate FDI in 2018 (World)

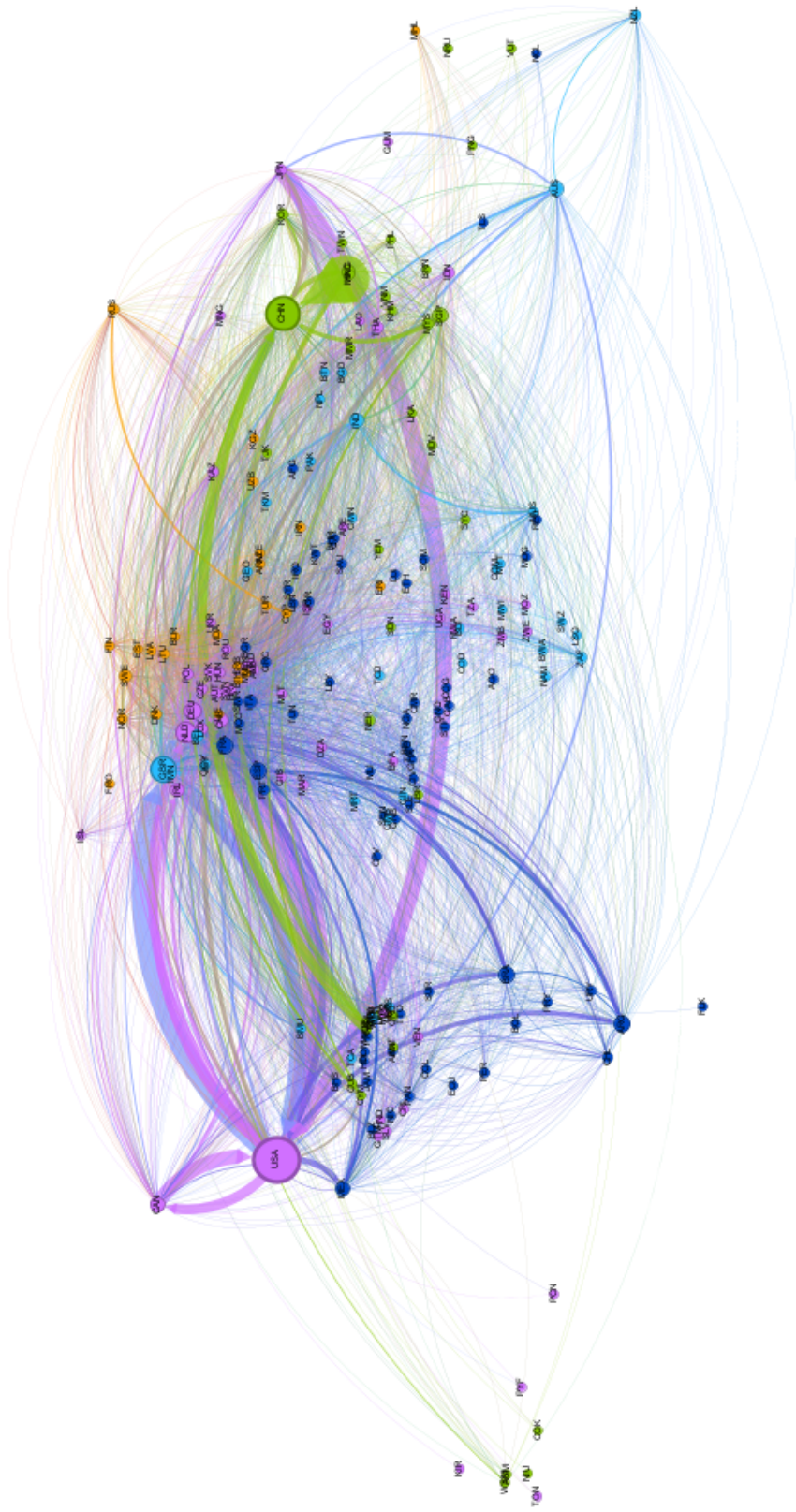


Figure 13: Real immediate FDI in 2022 (World)

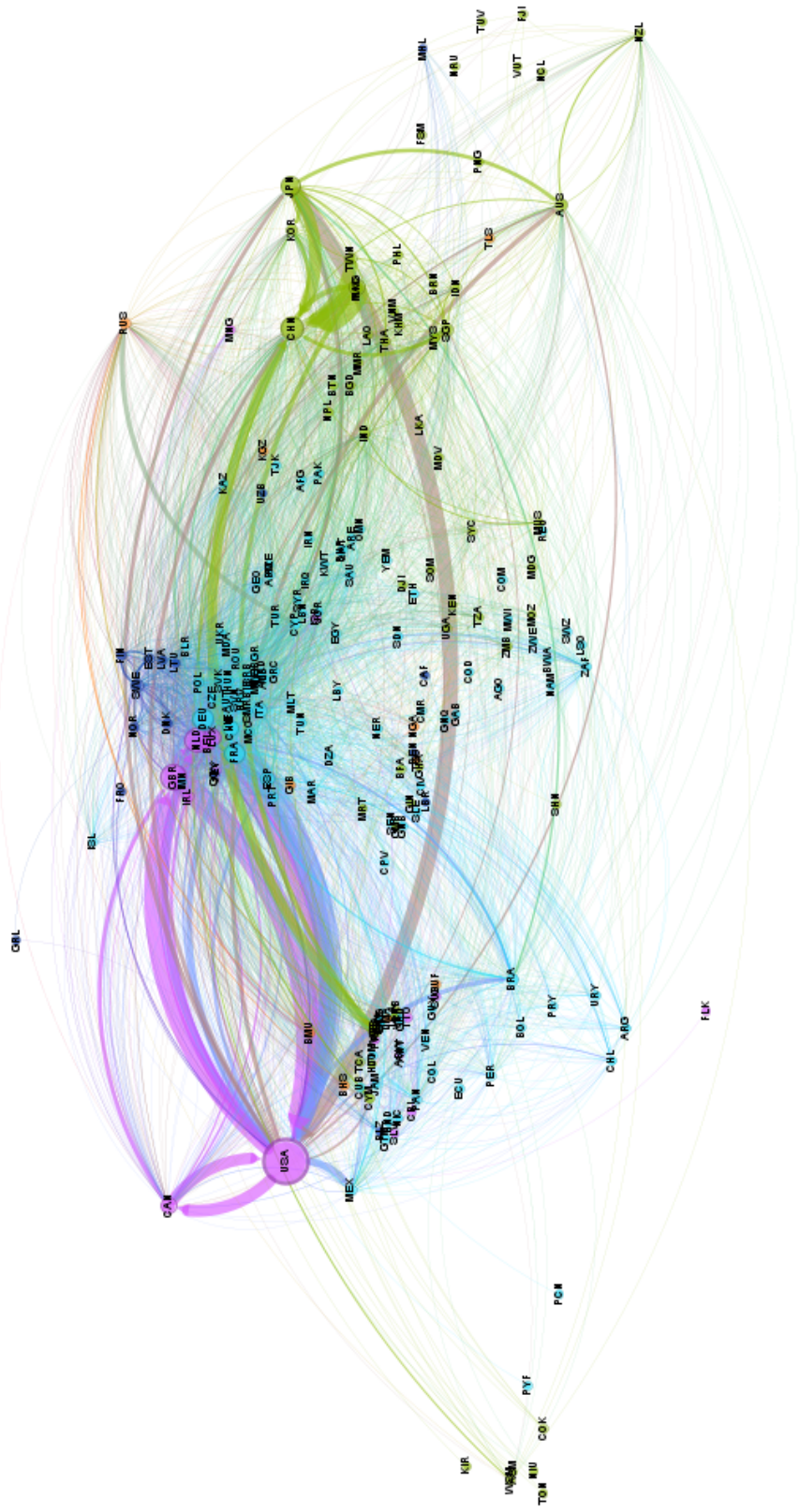


Figure 14: Real ultimate FDI in 2010 (World)

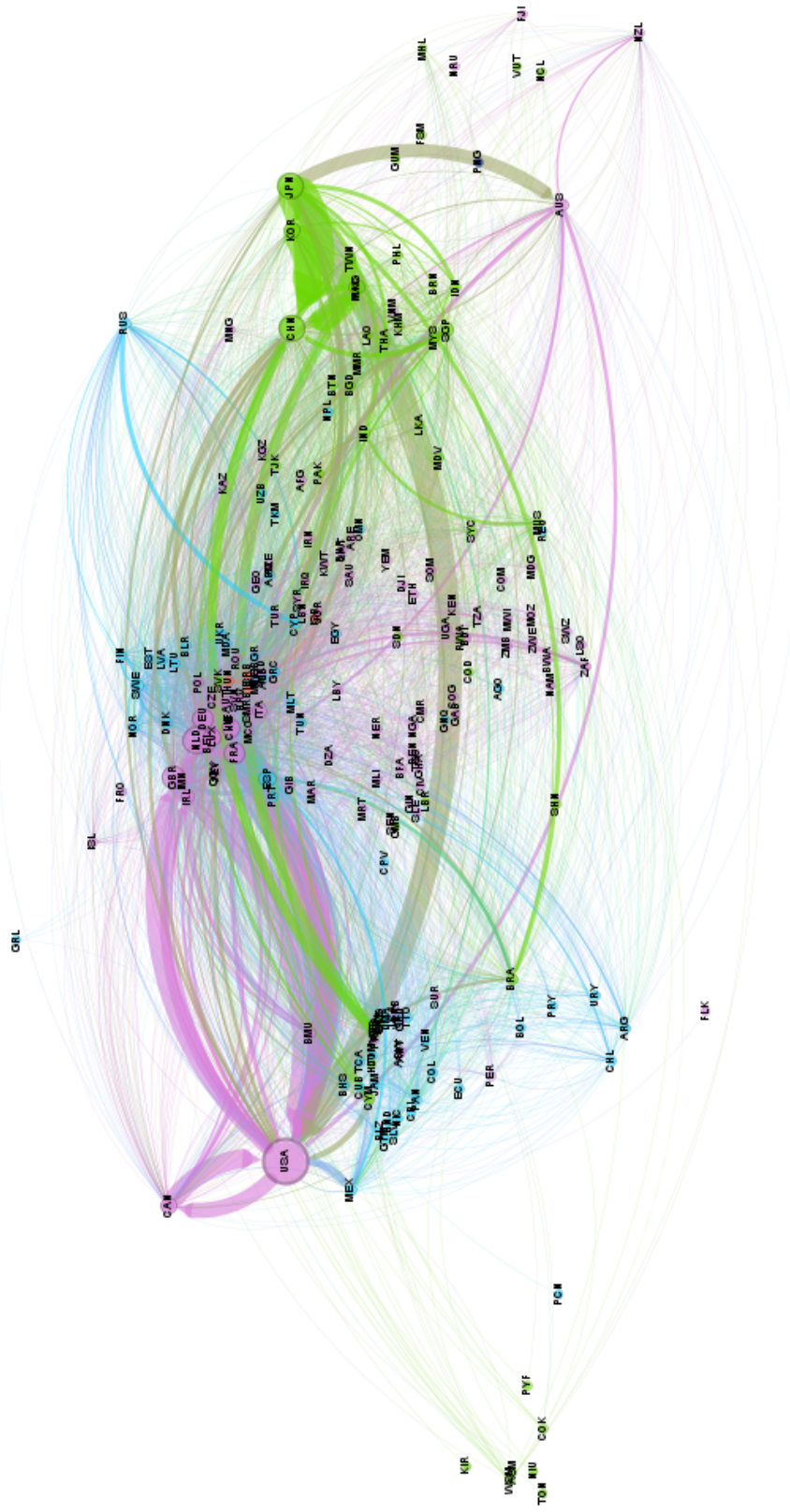


Figure 15: Real ultimate FDI in 2015 (World)

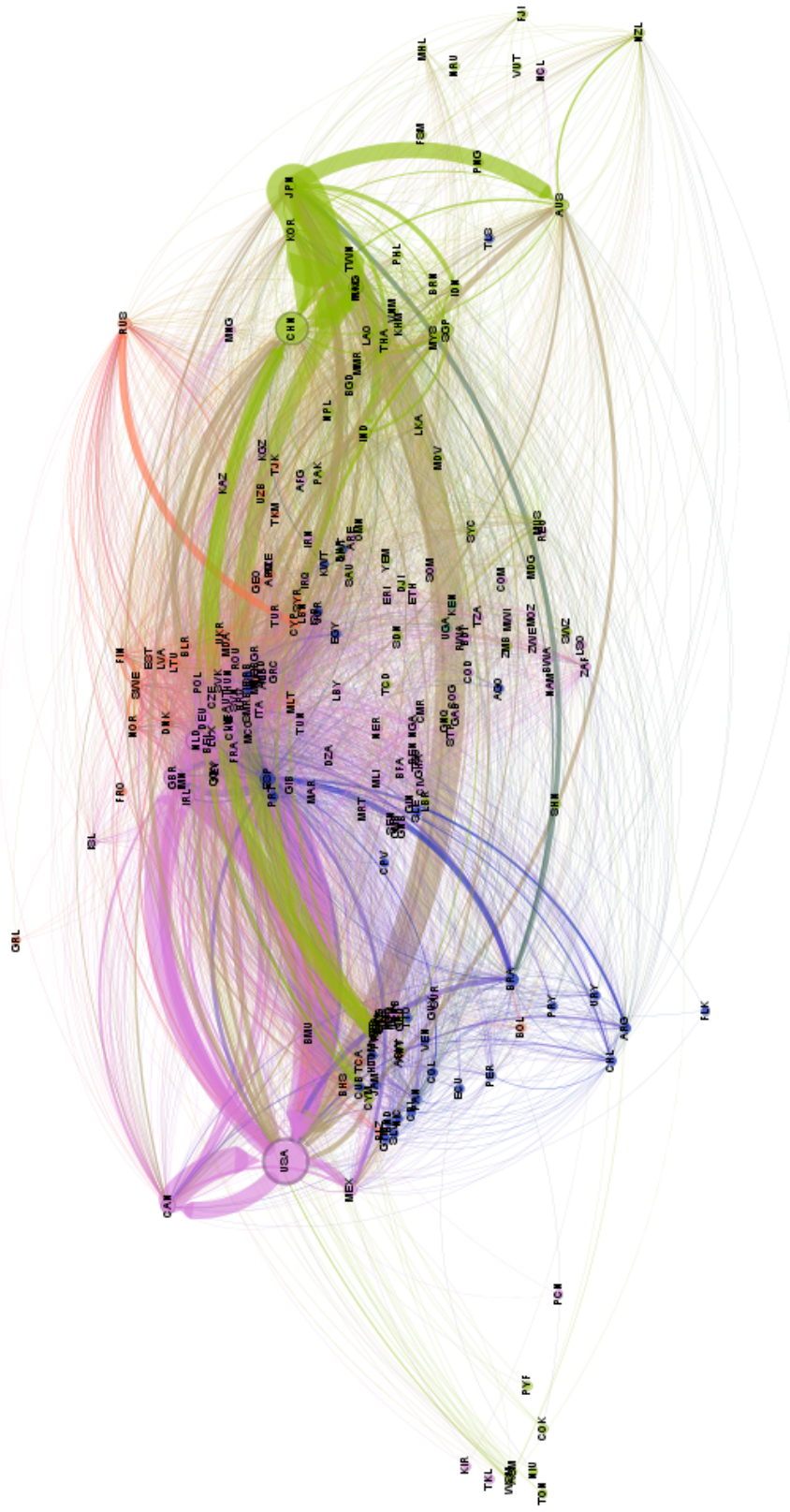


Figure 16: Real ultimate FDI in 2018 (World)

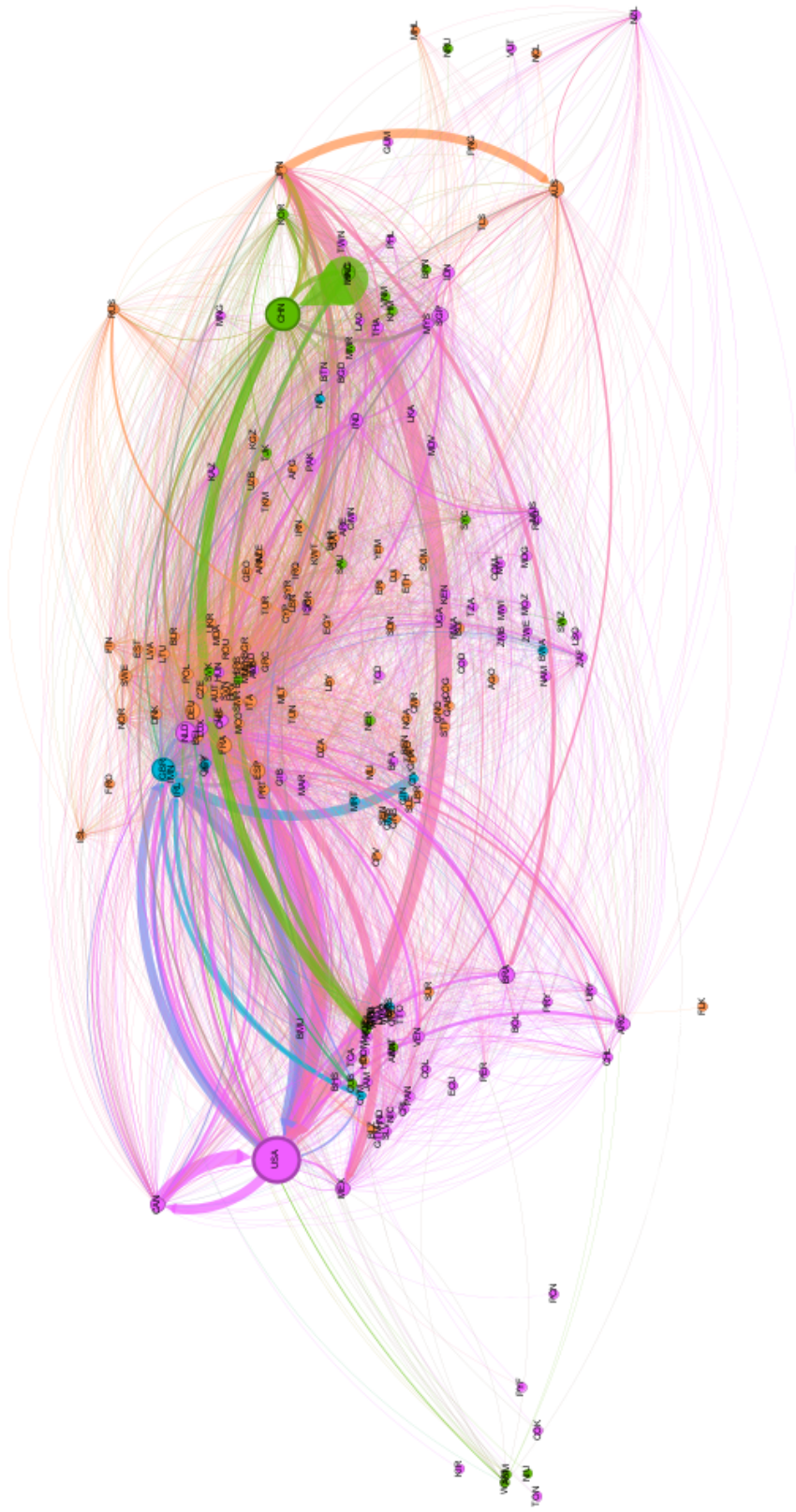


Figure 17: Real ultimate FDI in 2022 (World)

4 Empirical specification

As demonstrated in [De Sousa and Lochard, 2011](#) and [Head and Ries, 2008](#), the stock of FDI between countries can be modelled theoretically in such a way that, in equilibrium, the relationship between bilateral FDI and its determinants can be expressed by a gravity equation. Adapting the result from these papers, I run the following modified gravity equation for FDI.

$$F_{hst} = \exp(\theta_h + \rho_s + \psi_{hs} + X_{ht}\beta_h + Z_{st}\beta_s + Year_t + \epsilon_{hst}) \quad (1)$$

Where θ_h and ρ_s refer to host and source destination fixed effects respectively, ψ_{hs} refers to host and source country pair fixed effects, X_{ht} and Z_{st} correspond to time-varying host and source controls respectively, while $Year_t$ and ϵ_{hst} refer to year dummies and the error term respectively. Note that introducing pair fixed effects ψ_{hs} would control for factors such as time-invariant pair-wise variables such as historical colonial links and common language and would also account for host and source destination fixed effects. To assess whether geographic or geopolitical distance is a bigger deterrent to bilateral FDI over time, I include an interaction between the relevant measure of distance and time, so that the gravity equation becomes

$$F_{hst} = \exp(\theta_h + \rho_s + \psi_{hs} + X_{ht}\beta_h + Z_{st}\beta_s + \beta_d Dist_{hst} + \beta Dist_{hst} \times Year_t + Year_t + \epsilon_{hst}) \quad (2)$$

Where $Dist_{hst}$ is the selected measure of pairwise geographic or geopolitical distance between host h and source s and β refers to the importance of distance in a given period relative to the base year.

Four measures of pairwise distance $Dist_{hst}$ are adopted in the empirical exercise, namely

- *Distance* - Geographic distance between the most populated cities of the source and host country, measured in thousands of km.²⁷ Since the most populous cities may change over time, it is possible, though uncommon, for distance to be time-varying.
- *same_rank* - Geopolitical alignment with the US, using the index from [Ahn et al., 2023](#), based on [Häge, 2011](#). Countries are ranked by terciles based on geopolitical

²⁷The data on geographic distance comes from CEPII. See [Conte et al., 2022](#) and [Mayer and Zignago, 2011](#) for a description of the dataset.

distance to the US. *same_rank* is a dummy equaling 1 if both host and source country are in the same tercile and 0 otherwise. While geopolitical distance from the US may vary over time, it is rare for countries to switch terciles over the time period in consideration. Therefore, *same_rank* is *de facto* time invariant.

- *same_UN_vote* - This is a dummy equaling 1 if host and source country cast the same vote on UN General Assembly Resolution ES-11/1 condemning the Russian invasion of Ukraine, held in March 2022. Given that the vote was one-off, this is a time-invariant variable.
- *geopol_prox* $\in [-1, 1]$ is a continuous measure of bilateral geopolitical proximity between host and source countries, using the bilateral index in [Catalán and Tsuruga, 2023](#), based on [Häge, 2011](#). The larger the value of *geopol_prox*, the closer the host and source countries. This variable evolves with time, depending on changes in the geopolitical proximity between country pairs.

I consider two approaches to estimating the parameters of the gravity equation. The first, more common in the literature, involves taking logs and estimating the following via OLS.

$$\log(F_{hst}) = \theta_h + \rho_s + \psi_{hs} + X_{ht}\beta_h + Z_{st}\beta_s + \beta_d \text{Dist}_{hst} + \beta \text{Dist}_{hst} \times \text{Year}_t + \text{Year}_t + \epsilon_{hst}$$

However, given that many host and source countries have bilateral FDI positions worth 0, taking logs would exclude these country pairs from the estimation. Since this extensive margin may be important and be relevant for the estimated coefficients, the second approach involves running a Pseudo Poisson Maximum Likelihood Estimation (PPML), following [Head and Ries, 2008](#) and [Silva and Tenreyro, 2006](#), such that the following first order conditions are satisfied:

$$\sum_h \sum_s (F_{hst} - V_{hst}\Gamma) V_{hst}^k = 0, \quad \forall k \in \{1, 2, \dots, K\}$$

where V_{hst} is a vector of size K , consisting of all the independent variables in Equation 2 and likewise, Γ is a size K vector of coefficients. V_{hst}^k is the k th element in the vector. Since the estimation results from PPML are expected to be more robust, these results are discussed in Section 5, while the OLS results are placed in the Appendix.

Table 2 displays the summary statistics for the main independent variables used in the regressions below.²⁸ On average, the distance between the most populous cities of the source and host country is about 7410 km. Around 37 percent of source and host country pairs have the same geopolitical distance from the US and around 63 percent of them shared the same UN voting stance on the Russian invasion of Ukraine. The mean bilateral geopolitical distance between countries is modest, around 0.165 on a scale of 2.

	Summary Statistics				
	Mean	Std dev	Min	Max	N
<i>Distance</i> (in thousands of km)	7.408	4.541	.055	19.93	166947
<i>same_rank</i>	.369	.233	0	1	166947
<i>same_UN_vote</i>	.634	.481	0	1	166947
<i>geopol_prox</i>	.165	.410	-.923	1	166947
Trade agreement	.245	.430	0	1	166947
Common language	.124	.330	0	1	166947
Contiguous border	.025	.158	0	1	166947
Colonial link	.015	.121	0	1	166947

Distance, *same_rank*, *same_UN_vote* and *geopol_prox* are the selected measures of geographic and geopolitical distance. Trade agreement is a dummy equaling 1 if the source and host country have signed a joint trade agreement. Common language is a dummy equaling 1 if the source and host country share a common national or working language. Contiguous border and colonial link are dummies equaling 1 if the source and host country share a border or colonial links.

Table 2: Summary statistics of main variables in country-level regressions

In the next section, I run the the gravity regressions for all countries covered by the CDIS, before focusing on selected countries and industries for which fragmentation is deemed to be more prominent.

5 Results

In this section, I first present regression results on the determinants of FDI for all countries and then examine whether fragmentation of FDI has occurred on a global scale. Next, I move on to consider a select handful of countries and industries that may be more exposed to fragmentation.

²⁸The data for most of the gravity estimation controls comes from CEPII. See [Conte et al., 2022](#) and [Mayer and Zignago, 2011](#).

5.1 The determinants of FDI

Tables 3 and 4 present the gravity estimates for Equation 1 for immediate and ultimate FDI using QPMLE. The estimates from OLS are displayed in the Appendix. The base period is 2009 to 2013. The coefficients on the determinants of FDI are not unexpected. For immediate FDI, in Table 3, geographic distance has a significantly negative impact on real FDI stocks between Source and Host countries. For instance, before controlling for geopolitical distance, a one unit (i.e. 1000km) increase in geographic distance between a host and source country lowers immediate FDI by 10.6 percent ($(e^{-0.112} - 1) * 100 = 10.59$) and ultimate FDI by 12.62 percent ($(e^{-0.135} - 1) * 100 = -12.62$).

Closer geopolitical proximity between Source and Host countries, either measured by geopolitical alignment with the US (*same_rank*), UN voting pattern on the Russian invasion of Ukraine (*same_UN_vote*) or bilateral geopolitical proximity (*geopol_prox*), is correlated with larger real FDI from Source to Host countries. For instance, a 0.1 unit (5 percentage point increase in bilateral geopolitical proximity) between a source and host country raises immediate FDI by 51.9 percent ($(e^{0.418} - 1) * 100 = 51.89$), as shown in column 4 of Table 3. Also, from column 2 of the same table, a source and host country sharing similar geopolitical distance from the US have 106.7 percent ($(e^{0.726} - 1) * 100 = 106.67$) more immediate FDI than a source and host country that do not do so. In addition, from column 3 of the table, a source country has 103.8 percent ($(e^{0.712} - 1) * 100 = 103.80$) more FDI in a host country voted the same way on the Russian invasion of Ukraine than one that did not.

Other factors, such as sharing a common language, a contiguous border or colonial links, as well as having a regional trade agreement, have a significantly positive impact on bilateral real FDI. In addition, relative to the base period, real FDI has increased significantly, both in 2014-2017 and 2018-2021. The results for ultimate FDI, in Table 4, are similar, except that the coefficients on distance, common language and colonial links are larger in magnitude than for immediate FDI, while the coefficients on geopolitical proximity measures are smaller and less statistically significant. Having studied the gravity estimates for ultimate and immediate FDI, the next sub-section examines if there has been significant fragmentation of these FDI measures globally.

	(1)	(2)	(3)	(4)
	Real FDI (immediate)			
<i>Distance</i>	-0.112*** (0.0165)	-0.0971*** (0.0148)	-0.108*** (0.0159)	-0.0971*** (0.0157)
Trade agreement	0.511*** (0.104)	0.426*** (0.0869)	0.411*** (0.0890)	0.312*** (0.0828)
Common language	0.533*** (0.135)	0.521*** (0.122)	0.552*** (0.125)	0.514*** (0.116)
Contiguous border	0.645*** (0.146)	0.549*** (0.128)	0.465*** (0.140)	0.406*** (0.137)
Colonial link	0.253* (0.137)	0.249* (0.127)	0.241* (0.126)	0.318*** (0.0994)
2014-2017	0.267*** (0.0264)	0.270*** (0.0260)	0.271*** (0.0262)	0.297*** (0.0277)
2018-2021	0.523*** (0.0368)	0.530*** (0.0357)	0.532*** (0.0357)	0.594*** (0.0348)
<i>same_rank</i>		0.726*** (0.112)		
<i>same_UN_vote</i>			0.712*** (0.150)	
<i>geopol_prox</i>				0.418*** (0.0919)
Source Country FE	Yes	Yes	Yes	Yes
Host Country FE	Yes	Yes	Yes	Yes
Observations	167130	167130	167130	166297

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries.

Table 3: Determinants of real immediate FDI (QPMLE)

	(1)	(2)	(3)	(4)
	Real FDI (ultimate)			
<i>Distance</i>	-0.135*** (0.0130)	-0.130*** (0.0129)	-0.134*** (0.0130)	-0.133*** (0.0134)
Trade agreement	0.199 (0.168)	0.141 (0.171)	0.217 (0.152)	0.200 (0.130)
Common language	1.025*** (0.159)	1.012*** (0.156)	1.013*** (0.149)	1.046*** (0.160)
Contiguous border	0.274* (0.162)	0.211 (0.154)	0.313* (0.175)	0.157 (0.164)
Colonial link	0.809*** (0.245)	0.810*** (0.244)	0.806*** (0.236)	0.854*** (0.226)
2014-2017	0.306*** (0.101)	0.310*** (0.101)	0.303*** (0.102)	0.326*** (0.105)
2018-2021	0.782*** (0.124)	0.791*** (0.125)	0.777*** (0.118)	0.795*** (0.107)
<i>same_rank</i>		0.562*** (0.131)		
<i>same_un_vote</i>			-0.155 (0.257)	
<i>geopol_prox</i>				-0.135 (0.228)
Source Country FE	Yes	Yes	Yes	Yes
Host Country FE	Yes	Yes	Yes	Yes
Observations	159123	159123	159123	158710

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries.

Table 4: Determinants of real ultimate FDI (QPMLE)

5.2 Fragmentation on a global scale

Tables 5 and 6 present the gravity regression results for the four measures of geographic and geopolitical distance for immediate and ultimate FDI respectively. From the results in Table 5, there is no clear evidence of fragmentation of immediate FDI by geographic or geopolitical distance. Instead, from columns 2 and 4 of the table, there is some evidence that globally, geopolitical alignment matters *less* for immediate FDI between countries in 2014-2017 and in 2018-2021 compared to the base period of 2009-2013. For instance, relative to country pairs that do not share similar geopolitical distance to the US, country pairs that do experienced a 9.9 percent ($(e^{-0.104} - 1) * 100 = -9.87$) decline in FDI in 2014-2017 and a 19.7 percent ($(e^{-0.219} - 1) * 100 = -19.66$) drop in 2018-2021, compared to 2009-2013.

Concerning ultimate FDI, there is only mild evidence of fragmentation by bilateral geopolitical proximity in 2014-2017, though this is only significant at the 10 percent level, as shown in column 4 of Table 6, where a 0.1 unit (5 percentage points) increase in bilateral geopolitical proximity raises ultimate FDI by 52.7 percent ($((e^{0.423} - 1) * 100 = 52.65)$ in 2014-2017 compared to 2009-2013. As shown in the appendix, these findings are robust even when one considers only bilateral vertical FDI. The evidence suggests, therefore, that fragmentation in FDI has not occurred along geopolitical lines, at least on a global scale.

5.3 Fragmentation by regional blocs

While FDI may not have fragmented along defined geopolitical lines, some fragmentation may have taken place across certain regional blocs, particularly between the US, China and countries in advanced Europe. Indeed, as previously observed in Figures 5, 6 and 7, there is some evidence of shifts in FDI across regional blocs, particularly of US FDI away from China and toward advanced Europe. As before, I define five regional blocs - the US, China, advanced Europe, emerging Europe and the rest of the world. I then aggregate real FDI by host and source regional blocs and re-estimate Equation 2 for each Source bloc separately. Tables 7 and 8 present the results of the estimation for real FDI and for vertical real FDI respectively. For the sake of brevity, I focus only on outward FDI from the US, China and advanced Europe, since these blocs are the major sources of FDI. As before, the base period is 2009-2013, while the reference host regional bloc is advanced Europe.

Relative to 2009-2013, real FDI from the US and China to advanced Europe, as well as

real FDI within advanced Europe, increased significantly, as shown in the first two rows of Table 7. From the first two columns of the same table, outward real FDI from the US to China, as well as from the US to emerging Europe, fell in 2014-2017 and 2018-2021, relative to advanced Europe. For all other regional blocs, US real FDI rose relative to advanced Europe over time. Interestingly, the relative decline in ultimate FDI from the US to China is much smaller than the decline in immediate FDI. Specifically, while immediate FDI from the US to China, relative to that from the US to advanced Europe, fell in 2018-2021 by 42.9 percent ($(e^{-0.561} - 1) * 100 = -42.93$) compared to the base year, ultimate FDI only decreased by 5.0 percent ($(e^{-0.0516} - 1) * 100 = -5.02$). This suggests that while the decoupling of US investment to China is significant, it is less pronounced when one accounts for investment from non-US resident firms ultimately owned by US parent companies.

In contrast, there is less evidence of movement of Chinese investment away from the US, or the west in general. From the third and fourth columns of Table 7, immediate and ultimate FDI from China to advanced Europe (the reference group) rose significantly over time. While immediate FDI from China to the US declined by 11.7 percent ($(e^{-0.124} - 1) * 100 = -11.66$) relative to advanced Europe in 2018-2021, relative ultimate FDI from China to the US still rose during this period, by 2.3 percent ($(e^{0.0228} - 1) * 100 = 2.30$). In fact, the largest decline in Chinese FDI occurred within Chinese territories, followed by Asia (excluding China) and emerging Europe. Lastly, from the last two columns of Table 7, real FDI within advanced Europe has increased significantly over time. In addition, relative to FDI within the bloc, FDI from advanced Europe has increased significantly more over time in all other regional blocs, with the exception of the US in 2018-2021. Unlike the US, therefore, advanced Europe does not appear to have shifted its FDI out of China.

The results for vertical real FDI, presented in Table 8, are similar, apart from some key differences. In particular, the fall in US investment in China is less definitive, with only FDI from immediate US shareholders to China falling by 30.9 percent ($(e^{-0.370} - 1) * 100 = -30.92$) relative to advanced Europe in 2018-2021. Vertical FDI from ultimate US shareholders to China actually increased relative to advanced Europe in 2014-2017 and 2018-2021. These differences between real FDI and vertical real FDI suggest that US parent companies have not really shifted their supply chains out of China. Instead, the decline in real FDI from the US to China in Table 7 appears to be driven by horizontal FDI, which is typically linked to market access rather than supply chain production. Moreover, the decline in market access-related FDI may reflect either a shift of consumer base away from US firms, or may also reflect a lowering of trade barriers between the US and China,

which then lowers the need for horizontal FDI. The former would signify decoupling of the US from China, the latter would not. To delve further into these findings, the next sub-section narrows the focus to selected industries and firms, with emphasis on US investment in China.

	(1)	(2)	(3)	(4)
	Real FDI (immediate)			
<i>Distance</i>	0.0129 (0.131)			
2014-2017	0.268*** (0.0388)	0.369*** (0.0373)	0.331*** (0.0544)	0.342*** (0.0289)
2018-2021	0.535*** (0.0466)	0.734*** (0.0531)	0.623*** (0.0740)	0.681*** (0.0411)
<i>Distance</i> × 2014-2017	0.00546 (0.00496)			
<i>Distance</i> × 2018-2021	0.00959 (0.00612)			
<i>same_rank</i> × 2014-2017		-0.104** (0.0432)		
<i>same_rank</i> × 2018-2021		-0.219*** (0.0595)		
<i>same_UN_vote</i> × 2014-2017			-0.0417 (0.0543)	
<i>same_UN_vote</i> × 2018-2021			-0.0506 (0.0732)	
<i>geopol_prox</i>				0.0534 (0.0775)
<i>geopol_prox</i> × 2014-2017				-0.0826 (0.0581)
<i>geopol_prox</i> × 2018-2021				-0.193*** (0.0642)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	104597	104597	104597	104336

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 5: Real immediate FDI fragmentation along different measures of distance (QPMLE)

	Real ultimate FDI			
<i>Distance</i>	0.000421 (0.334)			
2014-2017	0.326 (0.206)	0.375 (0.236)	0.0349 (0.398)	0.269* (0.146)
2018-2021	0.674*** (0.179)	0.734*** (0.211)	0.839* (0.506)	0.921*** (0.243)
<i>Distance</i> × 2014-2017	0.00421 (0.0240)			
<i>Distance</i> × 2018-2021	0.0388* (0.0219)			
<i>same_rank</i> × 2014-2017	-0.0762 (0.240)			
<i>same_rank</i> × 2018-2021	0.152 (0.209)			
<i>same_UN_vote</i> × 2014-2017				0.404 (0.408)
<i>same_UN_vote</i> × 2018-2021				0.0315 (0.412)
<i>geopol_prox</i>				0.103 (0.186)
<i>geopol_prox</i> × 2014-2017				0.423* (0.240)
<i>geopol_prox</i> × 2018-2021				0.0554 (0.254)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	104699	104702	104702	104346

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 6: Real ultimate FDI fragmentation along different measures of distance (QPMLE)

	US		China		Adv. Europe	
	Immediate	Ultimate	Immediate	Ultimate	Immediate	Ultimate
2014-2017	0.391*** (2.16e-16)	0.194*** (2.47e-16)	0.926*** (1.89e-15)	0.555*** (2.11e-15)	0.243*** (4.59e-17)	0.278*** (2.02e-16)
2018-2021	0.881*** (3.79e-16)	0.481*** (7.33e-17)	1.615*** (1.21e-15)	1.469*** (7.53e-16)	0.516*** (1.06e-16)	0.516*** (1.22e-16)
Americas (excl US) × 2014-2017	0.201*** (4.80e-16)	0.247*** (3.48e-16)	-0.311*** (2.97e-15)	0.00874*** (2.11e-15)	0.492*** (1.99e-15)	0.557*** (1.40e-15)
Americas (excl US) × 2018-2021	0.702*** (5.77e-16)	0.968*** (2.41e-16)	0.715*** (3.09e-15)	0.820*** (1.45e-15)	1.932*** (1.85e-15)	2.065*** (1.33e-15)
Asia (excl China) × 2014-2017	0.225*** (2.66e-16)	0.172*** (4.17e-16)	0.0749*** (2.29e-15)	0.185*** (2.11e-15)	0.193*** (2.34e-15)	0.0950*** (2.02e-16)
Asia (excl China) × 2018-2021	0.0953*** (4.33e-16)	0.281*** (3.13e-16)	-0.0430*** (1.22e-15)	-0.160*** (8.31e-16)	0.308*** (2.59e-15)	0.342*** (1.91e-15)
China × 2014-2017	-0.242*** (6.06e-16)	-0.0807*** (4.86e-16)	-0.570*** (1.94e-15)	-0.548*** (2.20e-15)	0.258*** (1.03e-15)	0.478*** (2.70e-15)
China × 2018-2021	-0.561*** (6.94e-16)	-0.0516*** (1.06e-15)	-0.875*** (1.20e-15)	-0.915*** (9.89e-16)	0.243*** (1.89e-15)	0.503*** (1.21e-15)
Emerging Europe × 2014-2017	-0.205*** (2.81e-15)	0.522*** (6.89e-16)	-0.372*** (8.03e-15)	-0.337*** (2.45e-15)	0.540*** (3.66e-15)	0.521*** (1.68e-15)
Emerging Europe × 2018-2021	-0.508*** (2.55e-15)	-0.165*** (1.74e-15)	-0.203*** (7.88e-15)	-0.0923*** (1.23e-15)	0.840*** (2.50e-15)	0.855*** (1.47e-16)
Rest of World × 2014-2017	0.165*** (1.59e-15)	0.355*** (1.90e-15)	0.0648*** (2.40e-15)	0.356*** (2.85e-15)	0.854*** (1.94e-15)	0.870*** (1.33e-15)
Rest of World × 2018-2021	0.370*** (1.74e-15)	0.738*** (8.99e-17)	0.172*** (1.78e-15)	0.204*** (9.69e-16)	0.997*** (3.05e-15)	1.044*** (9.78e-16)
US × 2014-2017			0.180*** (1.96e-15)	0.550*** (4.90e-15)	0.0399*** (2.56e-16)	0.00525*** (1.14e-15)
US × 2018-2021			-0.124*** (1.48e-15)	0.0228*** (2.54e-15)	-0.0464*** (1.12e-16)	-0.0460*** (1.51e-16)
Host bloc FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	78	78	91	91	91	91

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The base time period is 2009-2013 and the reference Host bloc is advanced Europe. For brevity, the coefficients on host blocs in the base period are not displayed.

Table 7: Real FDI Fragmentation by regional blocs (QPMLE)

	US		China		Adv. Europe	
	Immediate	Ultimate	Immediate	Ultimate	Immediate	Ultimate
2014-2017	0.302*** (9.03e-16)	0.0762*** (4.61e-16)	0.881*** (2.51e-15)	0.482*** (2.24e-15)	0.257*** (1.48e-16)	0.318*** (7.11e-16)
2018-2021	0.763*** (2.31e-16)	0.281*** (5.09e-18)	1.535*** (1.53e-15)	1.359*** (2.64e-15)	0.529*** (1.33e-16)	0.532*** (3.22e-16)
Americas (excl US) × 2014-2017	-0.177*** (9.16e-16)	0.0331*** (9.27e-16)	-0.450*** (3.14e-15)	-0.102*** (2.31e-15)	0.159*** (2.44e-15)	0.216*** (1.10e-15)
Americas (excl US) × 2018-2021	-0.0683*** (2.42e-16)	0.327*** (1.08e-15)	-0.429*** (1.59e-15)	-0.299*** (2.68e-15)	0.411*** (1.40e-15)	0.617*** (1.18e-15)
Asia (excl China) × 2014-2017	0.244*** (9.91e-16)	0.243*** (4.62e-16)	-0.0350*** (3.25e-15)	0.0830*** (2.25e-15)	-0.00697*** (1.48e-16)	-0.0562*** (7.66e-16)
Asia (excl China) × 2018-2021	0.140*** (2.98e-16)	0.402*** (8.16e-16)	-0.158*** (2.33e-15)	-0.284*** (2.66e-15)	0.0727*** (1.15e-15)	0.163*** (1.43e-15)
China × 2014-2017	0.0483*** (2.45e-15)	0.0669*** (6.43e-16)	-0.571*** (2.60e-15)	-0.557*** (3.50e-15)	0.300*** (1.50e-16)	0.433*** (4.81e-15)
China × 2018-2021	-0.370*** (3.64e-15)	0.0615*** (1.45e-15)	-0.775*** (1.63e-15)	-0.817*** (3.87e-15)	0.253*** (2.07e-15)	0.466*** (2.79e-15)
Emerging Europe × 2014-2017	-0.382*** (9.03e-16)	0.423*** (1.99e-15)	-0.856*** (2.59e-15)	-0.736*** (2.28e-15)	0.179*** (1.56e-16)	0.133*** (1.08e-15)
Emerging Europe × 2018-2021	-0.807*** (2.75e-15)	-0.386*** (1.80e-15)	-0.731*** (1.88e-15)	-0.655*** (2.65e-15)	0.302*** (7.80e-16)	0.309*** (1.96e-15)
Rest of World × 2014-2017	0.131*** (1.00e-15)	0.415*** (1.73e-15)	-0.151*** (3.37e-15)	0.149*** (2.62e-15)	0.377*** (9.02e-16)	0.348*** (4.38e-15)
Rest of World × 2018-2021	0.190*** (3.01e-15)	0.671*** (1.82e-15)	-0.311*** (2.47e-15)	-0.293*** (2.65e-15)	0.505*** (9.15e-16)	0.518*** (2.73e-15)
US × 2014-2017			0.223*** (3.11e-15)	0.617*** (2.25e-15)	0.0260*** (2.51e-16)	-0.0408*** (8.94e-16)
US × 2018-2021			-0.0401*** (3.18e-15)	0.127*** (2.67e-15)	-0.0551*** (4.56e-16)	-0.0658*** (4.05e-16)
Host bloc FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	78	78	91	91	91	91

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The base time period is 2009-2013 and the reference Host bloc is advanced Europe. For brevity, the coefficients on host blocs in the base period are not displayed.

Table 8: Vertical real FDI Fragmentation by regional blocs (QPMLE)

5.4 Fragmentation at the industry level

While FDI does not seem to have fragmented on a global scale, one may expect the findings to differ across industries. Furthermore, in the particular case of US investment in China, the decline in immediate investment may be driven by parent companies in certain industries. In this sub-section, I repeat the estimation exercise in Tables 5 and 6 for selected parent company industries, using Orbis data aggregated to the country pair-industry level.²⁹

Tables 9, 10, 11, A5 and A6 present the gravity estimates for the immediate FDI in computer manufacturing (NAICS code 334), information (NAICS code 51), professional, scientific and technical services (NAICS code 54), agriculture (NAICS code 11) and transport (NAICS code 48 and 49) respectively. While not exhaustive, these industries may presumably have some strategic value and may be most impacted by geopolitical tensions.³⁰ Together, the tables provide evidence of fragmentation along geopolitical lines in these strategic industries apart from agriculture. For instance, in the computer manufacturing industry, a 0.1 unit (5 percentage point) increase in geopolitical proximity between source and host countries leads to a $(e^{1.09} - 1) * 100/10 = 19.89$ percent greater increase in real FDI in 2018-2021 than in 2009-2013, as shown in the fourth column of Table 9.

The findings on geopolitical fragmentation are even more robust across geopolitical distance measures for immediate FDI in transport as well as professional, scientific and professional services, shown in Tables 10 and 11 respectively. In the latter, significant fragmentation is observed along all 3 measures of geopolitical distance. For instance, from column 2 of Table 11, country pairs that share similar geopolitical distance (*same_rank*) from the US experienced a significant increase in FDI in both 2014-2017 $((e^{0.857} - 1) * 100 = 135.60$ percent) and 2018-2021 $((e^{1.102} - 1) * 100 = 201.01$ percent) relative to country pairs that do not, from the base period 2009-2013. The results are qualitatively similar when the other measures of geopolitical distance, namely UN voting pattern (*same_UN_vote*) and bilateral geopolitical distance (*geopol_prox*) are used.

²⁹For the sake of brevity, some of the industry-level results referred to in this sub-section are placed in the Appendix.

³⁰Gravity estimates for omitted industries did not yield significant fragmentation and are available upon request.

	(1)	(2)	(3)	(4)
	Real FDI (immediate)			
<i>Distance</i>	-0.622*			
	(0.375)			
2014-2017	0.850***	1.280***	1.242***	0.848***
	(0.250)	(0.261)	(0.275)	(0.291)
2018-2021	1.185***	1.416***	1.352***	0.858**
	(0.283)	(0.416)	(0.440)	(0.381)
<i>Distance</i> × 2014-2017	-0.0108			
	(0.0259)			
<i>Distance</i> × 2018-2021	-0.0446*			
	(0.0258)			
<i>same_rank</i> × 2014-2017		0.0227		
		(0.287)		
<i>same_rank</i> × 2018-2021		0.411		
		(0.422)		
<i>same_UN_vote</i> × 2014-2017			0.0632	
			(0.298)	
<i>same_UN_vote</i> × 2018-2021			0.476	
			(0.442)	
<i>geopol_prox</i>				-1.273**
				(0.608)
<i>geopol_prox</i> × 2014-2017				0.609*
				(0.355)
<i>geopol_prox</i> × 2018-2021				1.095**
				(0.430)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	9612	10104	10104	9756

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 9: Immediate Real FDI Fragmentation (Computer Manufacturing)

	(1)	(2)	(3)	(4)
	Real FDI (immediate)			
<i>Distance</i>	0.464 (1.159)			
2014-2017	0.444 (0.537)	1.591* (0.910)	2.521*** (0.832)	0.302 (0.806)
2018-2021	0.835 (0.600)	0.566 (0.663)	1.279*** (0.487)	-0.407 (1.006)
<i>Distance</i> × 2014-2017	0.0704 (0.0674)			
<i>Distance</i> × 2018-2021	-0.00205 (0.0981)			
<i>same_rank</i> × 2014-2017		-0.136 (0.929)		
<i>same_rank</i> × 2018-2021		1.121* (0.632)		
<i>same_UN_vote</i> × 2014-2017			-1.091 (0.851)	
<i>same_UN_vote</i> × 2018-2021			0.389 (0.417)	
<i>geopol_prox</i>				-1.624 (1.618)
<i>geopol_prox</i> × 2014-2017				1.209 (0.891)
<i>geopol_prox</i> × 2018-2021				2.157** (1.044)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	8422	9070	9070	8698

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 10: Immediate Real FDI Fragmentation (Information)

	(1)	(2)	(3)	(4)
	Real FDI (immediate)			
<i>Distance</i>	1.710*** (0.493)			
2014-2017	0.666*** (0.183)	0.421* (0.235)	0.424 (0.260)	0.175 (0.188)
2018-2021	1.131*** (0.219)	0.465 (0.361)	0.410 (0.404)	0.378 (0.234)
<i>Distance</i> × 2014-2017	0.0484** (0.0238)			
<i>Distance</i> × 2018-2021	0.00455 (0.0295)			
<i>same_rank</i> × 2014-2017		0.586** (0.260)		
<i>same_rank</i> × 2018-2021		0.998*** (0.378)		
<i>same_UN_vote</i> × 2014-2017			0.579** (0.282)	
<i>same_UN_vote</i> × 2018-2021			1.049** (0.413)	
<i>geopol_prox</i>				-1.070* (0.573)
<i>geopol_prox</i> × 2014-2017				0.857*** (0.215)
<i>geopol_prox</i> × 2018-2021				1.102*** (0.286)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	14148	14808	14808	14196

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 11: Immediate Real FDI Fragmentation (Professional, Scientific and Technical Services)

Fragmentation at the industry level is muted when considering ultimate instead of immediate FDI, as shown in Tables 12 to 14, as well as Tables A7 and A8 . From the tables, it can be observed that there is no significant fragmentation in any of the selected industries for ultimate FDI, apart from professional, scientific and technical services. As shown in column 3 of Table 14, source countries invest relatively more $((e^{0.591} - 1) * 100 = 80.57$ percent) in countries with the same UN voting stance in 2018-2021 compared to 2009-2013. One should note however that this result is not robust to alternative measures of geopolitical distance.

To summarize, the industry-level results here suggest that geopolitical fragmentation in immediate real FDI has occurred on a global scale for some strategic industries such as computer manufacturing, transport as well as professional, scientific and technical services. While fragmentation in these industries appears to begin in 2014-2017, it is more stark in 2018-2021. However, these findings do not carry over to ultimate real FDI, with only FDI in professional, scientific and technical services showing evidence of fragmentation in 2018-2021. Together, these results suggest that FDI in these industries may have fragmented on a superficial level, but does not fragment significantly when one accounts for the residence of ultimate parent companies. Since the industry results here are based on incomplete Orbis coverage, the next section narrows the focus to US outward FDI, for which comprehensive industry information on FDI is available.

	(1)	(2)	(3)	(4)
	Real FDI (ultimate)			
<i>Distance</i>	0.857*			
	(0.440)			
2014-2017	0.794***	1.411***	1.407***	0.652
	(0.283)	(0.327)	(0.343)	(0.483)
2018-2021	0.990***	1.687***	1.684***	0.676
	(0.329)	(0.517)	(0.543)	(0.718)
<i>Distance</i> × 2014-2017	-0.0141			
	(0.0276)			
<i>Distance</i> × 2018-2021	-0.00727			
	(0.0326)			
<i>same_rank</i> × 2014-2017		-0.843**		
		(0.327)		
<i>same_rank</i> × 2018-2021		-0.892*		
		(0.525)		
<i>same_UN_vote</i> × 2014-2017			-0.839**	
			(0.343)	
<i>same_UN_vote</i> × 2018-2021			-0.888	
			(0.551)	
<i>geopol_prox</i>				-1.507
				(1.283)
<i>geopol_prox</i> × 2014-2017				-0.126
				(0.489)
<i>geopol_prox</i> × 2018-2021				0.138
				(0.724)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	7824	8388	8388	8076

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 12: Ultimate Real FDI Fragmentation (Computer Manufacturing)

	(1)	(2)	(3)	(4)
	Real FDI (ultimate)			
<i>Distance</i>	0.211 (1.428)			
2014-2017	0.414 (0.800)	2.630*** (1.011)	2.059** (0.902)	2.157*** (0.630)
2018-2021	0.592 (1.000)	1.177 (1.270)	-0.416 (1.726)	2.120*** (0.814)
<i>Distance</i> × 2014-2017	0.143* (0.0800)			
<i>Distance</i> × 2018-2021	0.110 (0.116)			
<i>same_rank</i> × 2014-2017		-2.228** (1.032)		
<i>same_rank</i> × 2018-2021		-0.571 (1.269)		
<i>same_UNvote</i> × 2014-2017			-1.657* (0.919)	
<i>same_UNvote</i> × 2018-2021			1.021 (1.731)	
<i>geopol_prox</i>				0.889 (1.767)
<i>geopol_prox</i> × 2014-2017				-1.757*** (0.652)
<i>geopol_prox</i> × 2018-2021				-1.502* (0.822)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	6442	7126	7126	6814

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 13: Ultimate Real FDI Fragmentation (Information)

	(1)	(2)	(3)	(4)
	Real FDI (ultimate)			
<i>Distance</i>	1.431*			
	(0.864)			
2014-2017	0.703**	0.659***	0.576***	0.409*
	(0.337)	(0.202)	(0.214)	(0.209)
2018-2021	0.529	0.621**	0.426*	0.492
	(0.342)	(0.253)	(0.232)	(0.337)
<i>Distance</i> × 2014-2017	0.0265			
	(0.0350)			
<i>Distance</i> × 2018-2021	0.0793*			
	(0.0415)			
<i>same_rank</i> × 2014-2017		-0.0664		
		(0.215)		
<i>same_rank</i> × 2018-2021		0.396		
		(0.261)		
<i>same_UN_vote</i> × 2014-2017			0.0169	
			(0.226)	
<i>same_UN_vote</i> × 2018-2021			0.591**	
			(0.241)	
<i>geopol_prox</i>				-1.141*
				(0.586)
<i>geopol_prox</i> × 2014-2017				0.173
				(0.223)
<i>geopol_prox</i> × 2018-2021				0.534
				(0.361)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	12024	12696	12696	12156

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 14: Ultimate Real FDI Fragmentation (Professional, Scientific and Technical Services)

5.5 Fragmentation of FDI from the US at the industry level

Given that FDI information by partner country and industry is provided by the BEA for the US and since fragmentation appears to be most pronounced in outward US FDI, this section explores fragmentation trends in FDI from the US for selected industries. Before proceeding, it should be noted that the BEA data considers investment by US immediate shareholders, meaning that the results shown below are for fragmentation in immediate FDI and not ultimate FDI. Also, it does not distinguish between real and phantom FDI. The dependent variable in these tables is therefore immediate total outward FDI from the US.

Tables A9 presents the gravity equation estimates for outward FDI from the US for all industries, using BEA data. Results for the US are qualitatively similar to the results in the previous sub-section. As shown in the table, there is no evidence of fragmentation in outward FDI from the US, by geographic or geopolitical distance, when all industries are considered. On the contrary, from column 2, there appears to be less geopolitical fragmentation in FDI from the US over time, with a significant decline of 24.5 percent ($(e^{-0.281} - 1) * 100 = -24.49$) to host countries in the same geopolitical rank in 2018-2021, relative to host countries in a different geopolitical rank. Likewise, from the last column of the table, geopolitical proximity plays a significantly smaller role in attracting US FDI over time, especially so in 2018-2021 compared to the base period.

The estimates, however, differ starkly when one considers specific industries. Tables 15 to 17 display the estimation results for computer manufacturing, information, and professional, scientific and technical services respectively.³¹ From the last column of Table 15, there is some evidence of greater geopolitical fragmentation in US FDI for US firms involved in the computer manufacturing industry, with geopolitical proximity mattering more for attracting US FDI in 2018-2021 relative to the base period. For the information industry, countries that voted to condemn the Russian invasion of Ukraine received significantly larger increase in FDI from the US ($(e^{0.298} - 1) * 100 = 34.71$ percent) in 2018-2021 compared to countries that did not do so. Similarly, in the professional, scientific and technical services industry, there is some evidence of a relative rise in US FDI ($(e^{0.431} - 1) * 100 = 53.87$ percent) in the period 2018-2021 to those countries that voted to condemn the Russian invasion, as shown in column 3 of Table 17. However, the coefficient is only statistically significant at the ten percent level.

³¹These industries were selected for their potential strategic importance. The estimation results for other industries did not yield any notable results for fragmentation and are omitted for brevity. These results are available upon request.

Overall, the estimation results by industry suggest that fragmentation in FDI is confined to certain industries, namely in transport, computer manufacturing, information and professional, scientific and technical services. In addition, fragmentation appears to be most pronounced in outward FDI from the US. Together with the results across regional blocs, FDI fragmentation seems to be confined mainly to the US, with US firms investing relatively less in geopolitically distant countries and less in particular in China. In all, the empirical findings indicate that FDI fragmentation is, at least for now, not a widespread phenomenon. Instead, it seems to be driven by key industries and also by US-China FDI. Furthermore, fragmentation appears to be more pronounced for immediate rather than ultimate FDI, suggesting that ultimate ownership links have been less influenced by geopolitical tensions.

These findings appear to fall in line with the facts presented in Section 2. Indeed, just as there appears to be no systemic rise in FDI restrictions globally, this paper finds no evidence to support generalized geo-economic fragmentation in FDI. Rather, the results in this section suggest that FDI has mostly fragmented along the lines drawn by targeted FDI barriers, notably between the US and China. Furthermore, this fragmentation is mainly driven by key strategic industries with national security implications. For a closer examination of the shift of US FDI, the next sub-section delves further into the firm-level data and tries to draw some conclusions on the intensive and extensive margins of FDI.

	(1)	(2)	(3)	(4)
	US outward FDI			
<i>Distance</i>	-0.716** (0.312)			
2014-2017	-0.156 (0.214)	-0.251** (0.123)	-0.508** (0.218)	-0.170 (0.139)
2018-2021	-0.275 (0.318)	-0.869*** (0.244)	-0.837** (0.327)	-0.652*** (0.204)
Distance × 2014-2017	-0.00365 (0.0119)			
Distance × 2018-2021	-0.0412 (0.0255)			
<i>same_rank</i> × 2014-2017		0.0529 (0.126)		
<i>same_rank</i> × 2018-2021		0.294 (0.281)		
<i>same_UN_vote</i> × 2014-2017			0.326 (0.222)	
<i>same_UN_vote</i> × 2018-2021			0.178 (0.325)	
<i>geopol_prox</i>				-0.462 (0.338)
<i>geopol_prox</i> × 2014-2017				0.0262 (0.158)
<i>geopol_prox</i> × 2018-2021				0.563** (0.244)
Host Country FE	Yes	Yes	Yes	Yes
Observations	1118	1118	1118	1105

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 15: Fragmentation of US FDI (Computer Manufacturing)

	(1)	(2)	(3)	(4)
	US outward FDI (in millions)			
<i>Distance</i>	0.540** (0.269)			
2014-2017	0.544* (0.322)	0.489*** (0.174)	0.464 (0.341)	0.299*** (0.113)
2018-2021	0.822** (0.344)	0.720** (0.289)	0.207* (0.115)	0.346** (0.169)
<i>Distance</i> × 2014-2017	-0.0281 (0.0419)			
<i>Distance</i> × 2018-2021	-0.0408 (0.0329)			
<i>same_rank</i> × 2014-2017		-0.248 (0.193)		
<i>same_rank</i> × 2018-2021		-0.292 (0.362)		
<i>same_UN_vote</i> × 2014-2017			-0.175 (0.344)	
<i>same_UN_vote</i> × 2018-2021			0.298** (0.127)	
<i>geopol_prox</i>				-0.176 (0.166)
<i>geopol_prox</i> × 2014-2017				-0.339* (0.195)
<i>geopol_prox</i> × 2018-2021				-0.132 (0.390)
Host Country FE	Yes	Yes	Yes	Yes
Observations	1555	1555	1555	1542

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 16: Fragmentation of US FDI (Information)

	(1)	(2)	(3)	(4)
	US outward FDI (in millions)			
<i>Distance</i>	-0.801*** (0.145)			
2014-2017	0.0507 (0.127)	0.348*** (0.111)	0.145 (0.134)	0.242*** (0.0827)
2018-2021	0.0906 (0.196)	0.252 (0.157)	-0.175 (0.209)	0.255* (0.149)
<i>Distance</i> × 2014-2017	0.0195* (0.0117)			
<i>Distance</i> × 2018-2021	0.0108 (0.0196)			
<i>same_rank</i> × 2014-2017		-0.167 (0.162)		
<i>same_rank</i> × 2018-2021		-0.0805 (0.236)		
<i>same_UN_vote</i> × 2014-2017			0.0899 (0.169)	
<i>same_UN_vote</i> × 2018-2021			0.431* (0.245)	
<i>geopol_prox</i>				0.0759 (0.308)
<i>geopol_prox</i> × 2014-2017				0.0117 (0.157)
<i>geopol_prox</i> × 2018-2021				0.149 (0.247)
Host Country FE	Yes	Yes	Yes	Yes
Observations	1430	1430	1430	1417

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 17: Fragmentation of US FDI (Professional, Scientific & Technical Services)

5.6 Firm-level study of US investors

Given the findings presented so far, I now turn to focus on the FDI movements of US investors. In this sub-section, I first use Orbis firm-level data on US shareholder firms and study the intensive and extensive margin of US investment. Following the findings above, this exercise is restricted to industries for which significant fragmentation was found, namely Professional, Scientific and Technical Services, Transport, Information and Communication, as well as Computer Manufacturing.

Tables 18 to 21 present the estimation results for a modified version of Equation 2 at the firm level, as follows.

$$F_{hsit} = \exp(\theta_h + \rho_s + \psi_{hs} + X_{ht}\beta_h + Z_{st}\beta_s + \beta_d \text{Dist}_{hst} + \beta \text{Dist}_{hst} \times \text{Year}_t + \text{Year}_t + \phi_i + \epsilon_{hsit}) \quad (3)$$

One can observe that Equation 3 differs from Equation 2 in that it is at the firm level (i), where, as before, h and s refer to the host and source country respectively and t refers to the time period. An extra term, ϕ_i is added, representing firm fixed effects, such that the results are driven by the within-firm variation in FDI. Since only US shareholder firms are included in the regression, $s = US$ and Host and Source country pairwise fixed effects are fully captured by host fixed effects θ_h . To capture the intensive margin, the regression sample is restricted to US shareholder firms that have positive FDI positions in China at least once in each of the year intervals considered - 2009-2013, 2014-2017, 2018-2021. The coefficient of interest, β can then be interpreted as the effect of distance (geographic or geopolitical) over time on FDI for firms that consistently maintain FDI presence in the host country.

From the estimation results in the tables, the intensive margin appears to significantly contribute to the fragmentation of US outward FDI for half of the industries. In particular, for Transport as well as Professional, Scientific and Technical Services, there is evidence both greater geographic and geopolitical fragmentation, with significantly negative interaction between geographic distance and the time dummy, and positive interaction between at least one measure of geopolitical distance and time. While US FDI in the Transport industry appears to only have fragmented in 2018-2021, that in the Professional, Scientific and Technical Services industry seems to have done so from 2014-2017. In the Computer Manufacturing and Information sectors, there is no statistically significant evidence of fragmentation at the intensive margin.

	(1)	(2)	(3)	(4)	(5)
	Real FDI (ultimate)				
<i>Distance</i>	0.312*				
	(0.163)				
2014-2017	0.125	0.503**	0.503**	0.214	0.165
	(0.211)	(0.217)	(0.217)	(0.184)	(0.221)
2018-2021	-0.193	0.903**	0.903**	0.400	0.228
	(0.345)	(0.424)	(0.424)	(0.349)	(0.368)
<i>Distance</i> × 2014-2017	0.0192				
	(0.0193)				
<i>Distance</i> × 2018-2021	0.0730***				
	(0.0157)				
<i>same_rank</i> × 2014-2017		-0.326			
		(0.266)			
<i>same_rank</i> × 2018-2021		-0.655			
		(0.498)			
<i>same_rank</i> × 2014-2017			-0.326		
			(0.266)		
<i>same_rank</i> × 2018-2021			-0.655		
			(0.498)		
<i>geopol_prox</i>				-0.441	
				(0.319)	
<i>geopol_prox</i> × 2014-2017				0.413	
				(0.308)	
<i>geopol_prox</i> × 2018-2021				1.129*	
				(0.637)	
China × 2014-2017					0.498*
					(0.274)
China × 2018-2021					0.933*
					(0.538)
Host Country FE	Yes	Yes	Yes	Yes	Yes
Shareholder Firm FE	Yes	Yes	Yes	Yes	Yes
Observations	2058	2058	2058	2039	2058

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 18: Intensive margin of US ultimate shareholders - Computer Manufacturing

	(1)	(2)	(3)	(4)
	Real FDI (ultimate)			
2014-2017	0.876*** (0.0948)	0.954*** (0.263)	0.954*** (0.263)	0.118 (0.206)
2018-2021	2.024** (0.982)	-2.266*** (0.361)	-2.266*** (0.361)	0.336 (0.728)
<i>Distance</i> × 2014-2017	-0.118*** (0.0139)			
<i>Distance</i> × 2018-2021	-0.228*** (0.0813)			
<i>same_rank</i> × 2014-2017		-0.985*** (0.320)		
<i>same_rank</i> × 2018-2021		2.688*** (0.315)		
<i>same_UN_vote</i> × 2014-2017			-0.985*** (0.320)	
<i>same_UN_vote</i> × 2018-2021			2.688*** (0.315)	
<i>geopol_prox</i>				-0.0245 (0.396)
<i>geopol_prox</i> × 2014-2017				-0.512 (0.553)
<i>geopol_prox</i> × 2018-2021				0.0153 (1.395)
Host Country FE	Yes	Yes	Yes	Yes
Shareholder Firm FE	Yes	Yes	Yes	Yes
Observations	201	201	201	201

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013. The number of US ultimate investors in China present in every time period is insufficient to estimate the coefficients on $\text{China} \times 2014\text{-}2017$ and $\text{China} \times 2018\text{-}2021$ and this regression is therefore not displayed.

Table 19: Intensive margin of US ultimate shareholders - Transport

Lastly, for each of the selected industries, I run a regression including with a China dummy, interacted with time period effects, the results of which are displayed in the

	(1)	(2)	(3)	(4)	(5)
	Real FDI (ultimate)				
<i>Distance</i>	0.450** (0.228)				
2014-2017	-1.677 (1.058)	6.523*** (2.329)	6.523*** (2.329)	1.536 (1.067)	1.123 (0.738)
2018-2021	2.419 (2.649)	10.10** (3.948)	10.10** (3.948)	1.653 (1.683)	3.291* (1.822)
<i>Distance</i> × 2014-2017	0.417*** (0.0759)				
<i>Distance</i> × 2018-2021	0.195* (0.116)				
<i>same_rank</i> × 2014-2017		-5.406*** (1.864)			
<i>same_rank</i> × 2018-2021		-6.821* (3.792)			
<i>same_UN_vote</i> × 2014-2017			-5.406*** (1.864)		
<i>same_UN_vote</i> × 2018-2021			-6.821* (3.792)		
<i>geopol_prox</i>				-3.189*** (1.108)	
<i>geopol_prox</i> × 2014-2017				-2.145 (2.008)	
<i>geopol_prox</i> × 2018-2021				-2.656* (1.590)	
China × 2014-2017					5.454*** (1.877)
China × 2018-2021					6.909* (3.815)
Host Country FE	Yes	Yes	Yes	Yes	Yes
Shareholder Firm FE	Yes	Yes	Yes	Yes	Yes
Observations	399	399	399	399	399

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table 20: Intensive margin of US ultimate shareholders - Information and Communication

fifth column of Tables 21 to 21. The coefficients on China × 2014-2017 and China × 2018-2021 measure the rise of FDI to China from the US, on the intensive margin, from the base period relative to other countries. Where the coefficients are omitted, it means that

	(1)	(2)	(3)	(4)
	Real FDI (ultimate)			
2014-2017	0.958** (0.478)	-0.205 (0.505)	-0.205 (0.505)	-0.443** (0.175)
2018-2021	1.953*** (0.568)	-0.474 (0.331)	-0.474 (0.331)	-0.435* (0.262)
Distance × 2014-2017	-0.167*** (0.0369)			
Distance × 2018-2021	-0.298*** (0.0407)			
<i>same_rank</i> × 2014-2017		-0.366 (0.538)		
<i>same_rank</i> × 2018-2021		-0.0599 (0.456)		
<i>same_UN_vote</i> × 2014-2017		-0.366 (0.538)		
<i>same_UN_vote</i> × 2018-2021			-0.0599 (0.456)	
<i>geopol_prox</i>				-1.781*** (0.272)
<i>geopol_prox</i> × 2014-2017				1.379*** (0.266)
<i>geopol_prox</i> × 2018-2021				1.379*** (0.266)
Host Country FE	Yes	Yes	Yes	Yes
Shareholder Firm FE	Yes	Yes	Yes	Yes
Observations	939	939	939	930

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013. The number of US ultimate investors in China present in every time period is insufficient to estimate the coefficients on China × 2014-2017 and China × 2018-2021 and this regression is therefore not displayed.

Table 21: Intensive margin of US ultimate shareholders - Professional, Scientific and Technical services

there were insufficient number of firms present in China in the industry in all periods in that industry for the estimation. From the estimates available for Computer Manufacturing and Information and Communication, one can observe that there is no evidence of a significant shift of US FDI away from China on the intensive margin.

Finally, while the Orbis firm-level data should in principle allow for an estimate of the extensive margin, the coverage of Orbis within countries varies widely. It would therefore be unclear whether differences in the number of US investors in each host country is due to changes in coverage across countries. However, to at least get a rough sense of how the extensive margin contributes to the trends in US FDI to China, Figure 18 plots the number of US firms with positive FDI in China recorded in Orbis over time, as well as the percentage of all reporting US firms investing in China over time. From the Figure, after a fall in 2011, the number of US ultimate investor firms in China rose from 2013 to a peak in 2015 and then declined subsequently. Changes in firm coverage in the US or China may have also affected the results. Moreover, while Orbis coverage of firms generally increases over time, changes in corporate inversions in either the US or China could also negatively affect Orbis coverage.³² Lastly, for the interested reader, Figure A6 in the Appendix shows the trends in the regional distribution of FDI for four key US investors in China - Microsoft, Apple, Ford and Dell, as an illustrative example.

To summarize, the empirical findings suggest that FDI has not fragmented significantly on a global scale. This result is robust to various empirical specifications (OLS and QPMLE) and the addition of a range of controls. Instead, fragmentation appears to be a circumscribed phenomenon. In particular, significant geo-economic fragmentation has been found across countries in strategic industries including computer manufacturing, information and communication, transport, as well as professional, scientific and technical services. In addition, this section has shown the decoupling of FDI from the US to China has been especially pronounced, driven by these strategic sectors. From the empirical analysis using firm-level data, it seems that the intensive margin plays a role in the fragmentation of FDI from US firms only for some industries. Moreover, the decoupling of US FDI from China appears not to be driven by the intensive margin, implying that the extensive margin likely plays a bigger role there. Nevertheless, given the incompleteness of Orbis coverage, the results for fragmentation on the intensive and extensive margin should be taken with some skepticism. In all, the localised and targeted fragmentation of FDI is in line with the similarly localised and targeted nature of FDI barriers raised since

³²In the absence of access to data on corporate inversions in the US and China, it is difficult to assess whether the extensive margin result can be interpreted as a lower or upper bound.



Figure 18: Extensive margin of US ultimate investors in China

the 2010s.

5.7 The choice of intermediaries by ultimate parent companies

Apart from the choice of host countries, the channels through which firms invest in these host countries may also evolve in response to rising geopolitical tensions. As a final exercise, I examine whether parent companies change their mix of intermediary subsidiaries depending on their intended FDI destination. To do so, I exploit the Orbis data once more, in particular its distinction between immediate and ultimate shareholder and the ownership links between companies in the dataset.

One plausible strategy of parent companies, in the face of geopolitical tensions, is to choose intermediaries located in countries that geopolitically closer to the final host destination, so as to circumvent future FDI barriers. As a first investigative step, Figure 19 plots the mean geopolitical proximity of ultimate shareholders (right y-axis) and that of their intermediaries (left y-axis) to their host countries for all ultimate parent companies.³³ As before, the variable used to measure bilateral geopolitical proximity is $geopol_prox \in [-1, 1]$, where a more value closer to 1 corresponds to greater geopolitical proximity between source and host countries. From 19, after 2016, the ultimate sources are, on average, less geopolitically close to their FDI destination countries than their intermediaries. However, the gap in geopolitical proximity is small and the mean geopolitical proximity between ultimate source and host destination, and between intermediary and host destination co-move closely. As such, there is no prima facie evidence that the average ultimate parent company is changing its intermediary mix along geopolitical lines over time.

Another possibility is that the geopolitical proximity of intermediaries to host countries only matters when ultimate parent companies are located in countries that are sufficiently geopolitically distant. On the other hand, when ultimate parent companies are already close to their FDI destinations, the location of the intermediaries used to channel their FDI may be less consequential. To test this hypothesis, I run the following regressions at the firm-level:

$$\overline{geopol_prox}_{uht} = \theta_h + \phi_u + \rho_{hst}\beta_{hs} + X_{ht}\beta_h + Z_{st}\beta_s + Year_t + \epsilon_{uht}$$

³³Ultimate parent companies that are also the immediate investor in their FDI destination countries without going through any intermediary country are excluded from the analysis.

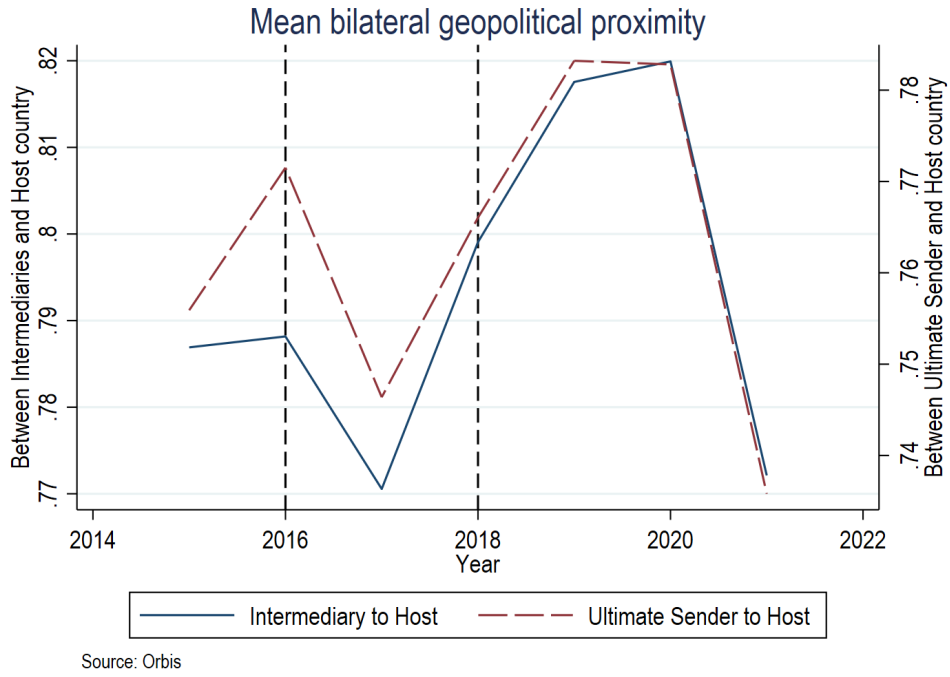


Figure 19: The mean geopolitical proximity ($geopol_prox$) of ultimate shareholders and their intermediaries to FDI host destinations

Where

$$\overline{geopol_prox}_{uht} = \frac{1}{N_I^u} \sum_{i=1}^{N_I^u} \omega_i \times geopol_prox_{iht}^u, \quad \sum_i \omega_i = 1$$

is the average geopolitical proximity of intermediary countries i to host country h of ultimate parent company u at time t , weighted by the share of real FDI sent from intermediary i to host h out of all intermediaries. Note that N_I^u refers to the total number of intermediary countries between ultimate parent company u and host country h at time t . As before θ_h , X_{ht} and Z_{st} refer to the host country fixed effects, time-varying controls for host and source country respectively. ϕ_u refers to ultimate parent company fixed effects, while ρ_{hst} refers to the time-varying host-source pair controls. The estimate of interest is now the the $Year_t$ dummy which now takes the value 1 if the period t falls between 2018 and 2021 and 0 if it falls between 2015 and 2017. A significantly positive coefficient on $Year_t$ would mean that the intermediary mix chosen by ultimate parent companies is geopolitically closer to the host country in 2018-2021 compared to 2015-2017. To explore whether the geopolitical mix of intermediaries differs by the proximity of ultimate parent companies to the host countries, I also run the above regression after dividing the sample of ultimate parent companies into i) those located in countries that are above the median

in terms of geopolitical proximity to host destination and ii) those located in countries that are below the median in terms of geopolitical proximity to host destination.

The results are presented in Table 22 for ultimate parent companies in all countries and in Table 23 for ultimate parent companies residing in the US. From column 1 of Table 22, one can observe that, after including controls, there has been no significant change in the average geopolitical proximity of intermediaries to FDI host countries from the period 2015-2017 to 2018-2021 when all ultimate parent companies are pooled in the sample. However, a clear distinction can be noted when the sample is split between ultimate parent companies that are geopolitically closer to their FDI host countries (column 2) and those that are geopolitically farther (column 3). For the former, their mix of intermediary FDI locations is, on average, significantly less geopolitically close in 2018-2021 compared to 2015-2017. In contrast, for the latter, the mix of intermediary FDI locations has become significantly geopolitically closer to host countries over time. There therefore appears that ultimate parent companies facing potential geopolitical barriers to FDI in their destination countries are choosing intermediary shareholders located in countries that are less likely to face such barriers.

	(1)	(2)	(3)
	All	Above median proximity	Below median proximity
2018-2021	0.0196*** (0.00120)	-0.00898*** (0.00203)	0.0430*** (0.00185)
Constant	0.854*** (0.0124)	0.825*** (0.0127)	0.874*** (0.0397)
Host Country FE	Yes	Yes	Yes
Ultimate Parent FE	Yes	Yes	Yes
No. of Observations	65035	32510	29390

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Column 1 shows the results for the full sample, column 2 shows the results for ultimate parent companies that are above the median in terms of geopolitical proximity to their hosts, while column 3 presents the results for ultimate parent companies that are below the median in terms of geopolitical proximity to their hosts. Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2015-2017. Standard errors are clustered at the ultimate parent firm level.

Table 22: Intermediary mix of all ultimate parent companies

The findings are qualitatively similar for US-based ultimate parent companies. While the increase in the average geopolitical proximity between intermediaries and the host destination is only significant at the ten percent level when all US parent companies are pooled together (column 1), that for the sub-sample of US parent firms that are geopoliti-

cally distant from their host destinations (column 3), there is a larger increase in average intermediary geopolitical proximity (0.127) in 2018-2021 compared to 2015-2017. No significant change in intermediary geopolitical proximity is observed for US parent firms that are geopolitically closer to their FDI host countries.

	(1)	(2)	(3)
	All	Above median proximity	Below median proximity
2018-2021	0.0291*** (0.00975)	0.0110 (0.0151)	0.0744*** (0.0169)
Constant	0.515 (0.491)	-0.606 (0.876)	0.828* (0.435)
Host Country FE	Yes	Yes	Yes
Ultimate Parent FE	Yes	Yes	Yes
No. of Observations	2740	1273	1238

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variable is the average geopolitical proximity of ultimate parent companies to their host countries. Column 1 shows the results for the full sample, column 2 shows the results for ultimate parent companies that are above the median in terms of geopolitical proximity to their hosts, while column 3 presents the results for ultimate parent companies that are below the median in terms of geopolitical proximity to their hosts. Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2015-2017. Standard errors are clustered at the ultimate parent firm level.

Table 23: Intermediary mix of US ultimate parent companies

In short, where ultimate parent companies invest indirectly in FDI host destinations, there is some evidence of ultimate parent companies choosing intermediaries that are geopolitically closer to these destinations, but only when the geopolitical distance between ultimate parent company and host destination is sufficiently large. While inconclusive, the evidence is consistent with the hypothesis that parent companies seeking to circumvent potential FDI barriers in host countries by channeling their FDI through geopolitically friendly countries. This change in intermediary mix could also plausibly explain why immediate FDI displayed a greater increase in geo-economic fragmentation over time compared to ultimate FDI. That indirect investment links between geopolitically distant countries have been bolstered over time is in line with recent work on trade, which has found that indirect trade links between the US and China have risen despite heightened geopolitical tensions.³⁴

Yet, these findings raise a puzzling question. If these firm ownership links are public information, why should altering their mix of intermediaries impact their potential FDI

³⁴See <https://www.economist.com/finance-and-economics/2024/02/27/how-trump-and-biden-have-failed-to-cut-ties-with-china> and [Alfaro and Chor, 2023](#).

barriers in a given host country? Indeed, if a given host country is intent on blocking FDI from a given foreign country, it should be relatively straightforward to trace the ownership links of any investor to their ultimate parent company. One possible answer is that ultimate parent companies do not expect host countries to do extensive due diligence on the ownership links of their immediate investors. As an additional exercise, I examine whether having intermediaries that are geopolitically closer to their FDI destination countries reduces FDI fragmentation significantly compared to having intermediaries that are geopolitically distant, with the standard controls used in the analysis so far. I do not find any significant impact. In the interest of brevity, this supplementary result is omitted and is available upon request. Nevertheless, it suggests that while parent companies may alter their intermediary mix if they are geopolitically distant, there is no tangible impact on their relative FDI to their host destinations. In the absence of further evidence, I leave this intriguing subject to future research.

6 Conclusion

Rather than a widespread phenomenon, this paper finds FDI geo-economic fragmentation to be confined to specific industries with some strategic value. Also, when looking at fragmentation between geographic regions, the paper finds that FDI fragmentation is more pronounced for outward FDI from the US, expressed notably as a shift of US investment away from China to advanced Europe and the rest of Asia. These results are generally robust to the inclusion of a rich set of controls and to a number regression specifications, using a gravity model of FDI.

In all, the targeted and localised fragmentation of FDI appear to be in line with specific changes in policies from the 2010s, as laid out in Section 2. Indeed, while the paper does not observe a general rise in FDI barriers, it notes a number of potential obstacles to inward and outward FDI raised since 2012, on the grounds of national security for key players in the global investment network.

As such, rather than shifting out of geopolitically distant host countries *en masse*, investors seem to be making conscious choices to limit FDI in industries and recipient countries that are subject to FDI barriers. Moreover, where found, fragmentation appears to be less pronounced for ultimate FDI compared to immediate FDI, as well as for vertical FDI compared to overall (vertical and horizontal) FDI, suggesting that ultimate ownership links in supply chains are less affected by these FDI barriers. Evidence showing the shift in the mix of intermediaries by ultimate parent companies along geopolitical lines supports the

hypothesis that firms are seeking to circumvent potential FDI barriers in host countries by channeling their FDI through geopolitically friendly countries. This would also explain why geo-fragmentation is found to be less significant for ultimate FDI than immediate FDI.

While FDI fragmentation appears to be focused on areas targeted by recent policies, it remains to be seen if the mounting rise in geopolitical tensions, exacerbated by the Ukraine war and more recently by the Israel-Palestine conflict, will lead to a more widespread and generalized fragmentation, as investors decide to relocate their supply chains. This question is left for for future research.

7 References

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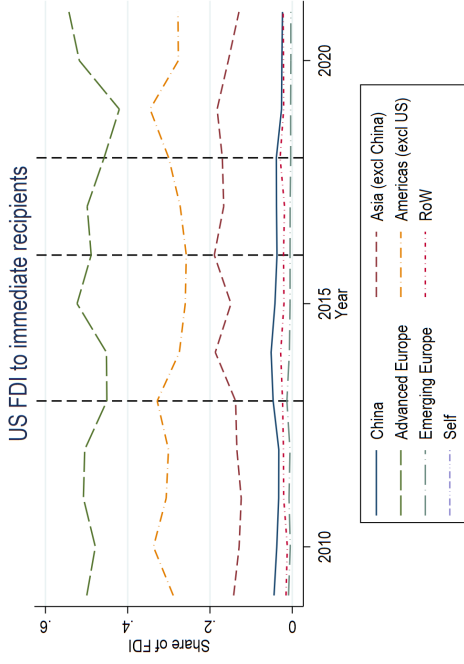
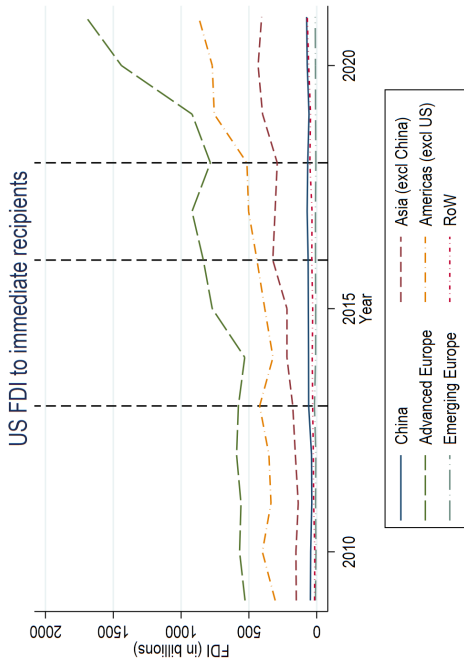
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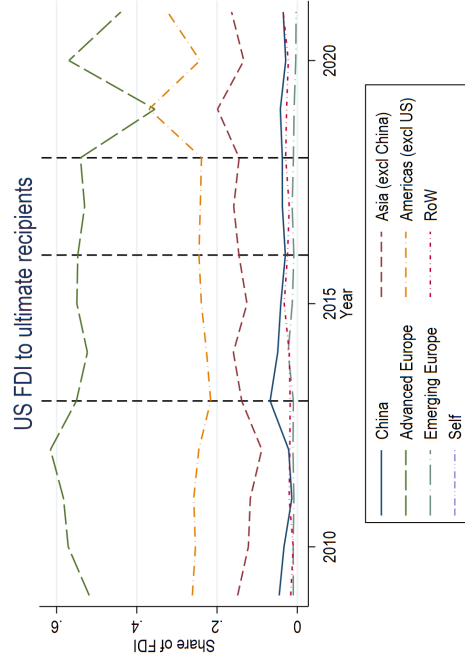
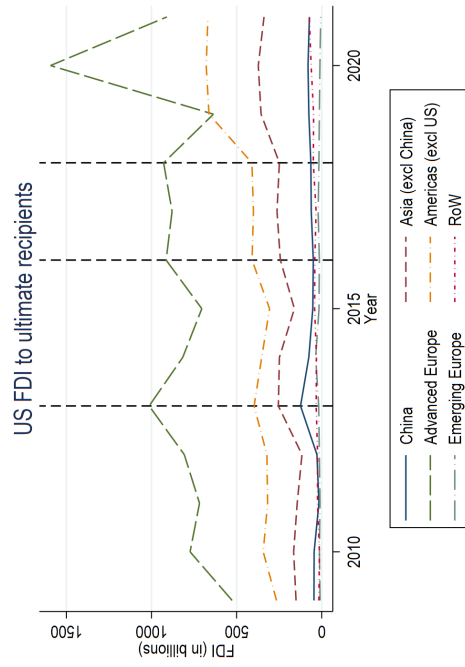
8 Appendix

8.1 Figures



(a) Immediate FDI

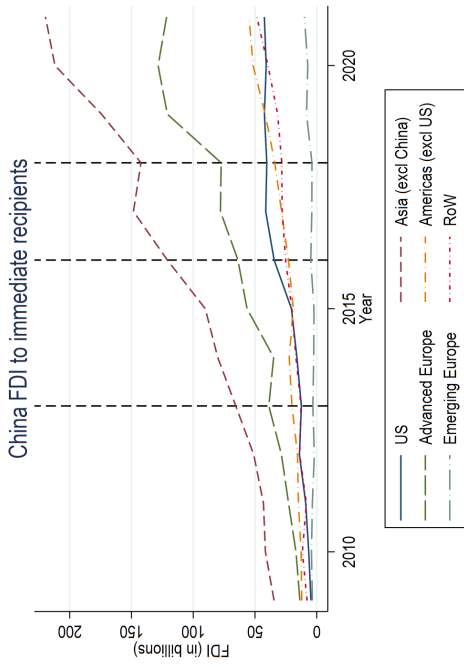
(b) Distribution of immediate FDI



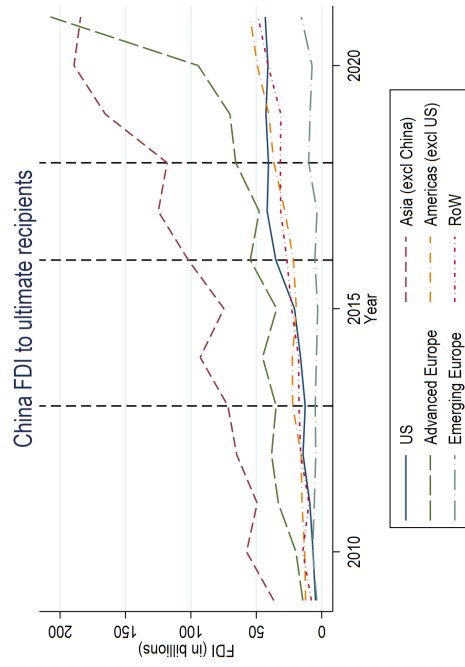
(c) Ultimate FDI

(d) Distribution of ultimate FDI

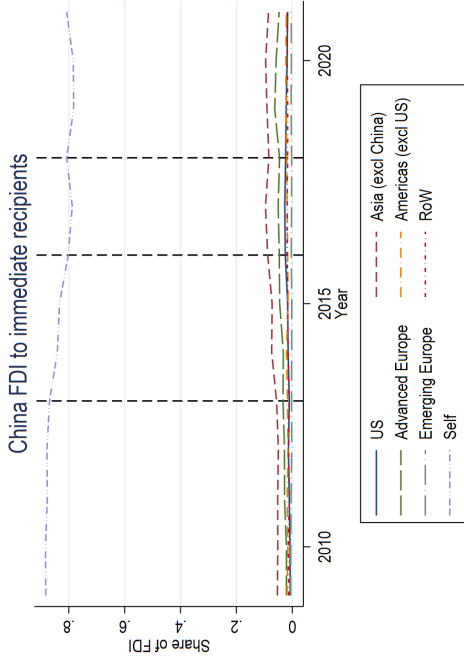
Figure A1: Immediate and ultimate outward vertical real FDI from the US



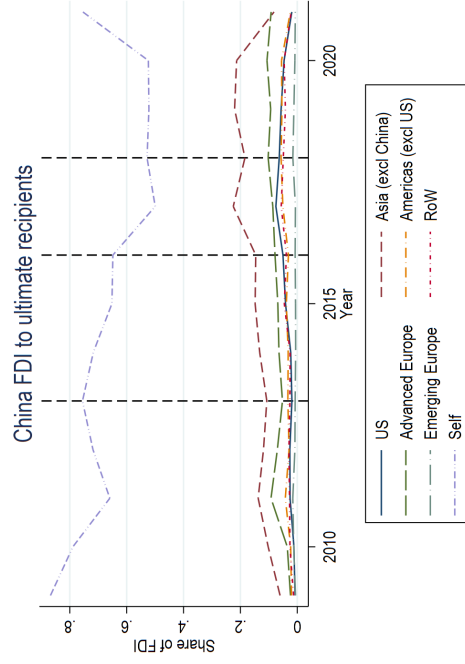
(a) Immediate FDI



(c) Ultimate FDI

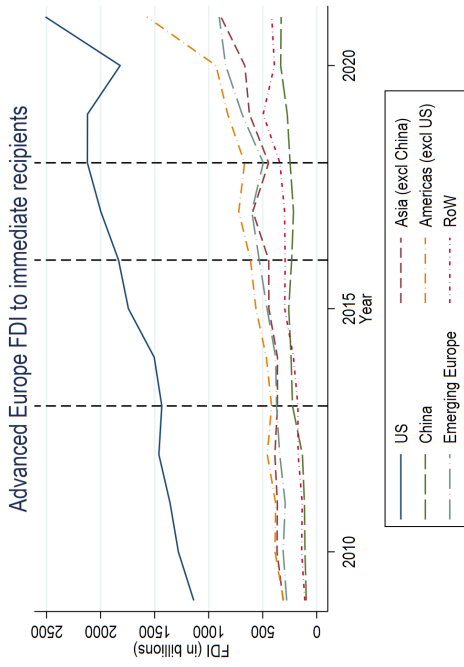


(b) Distribution of immediate FDI

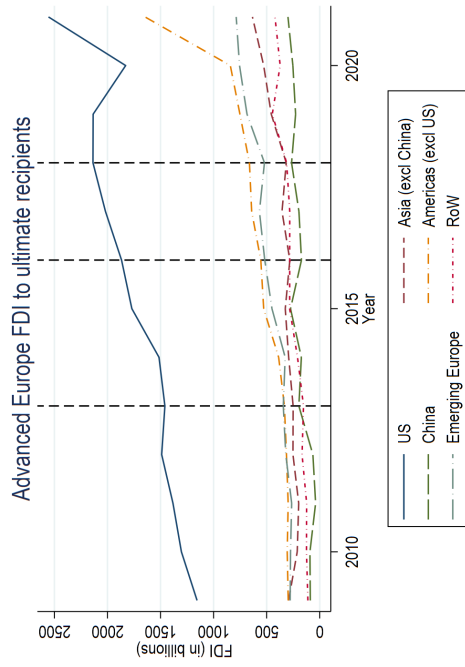


(d) Distribution of ultimate FDI

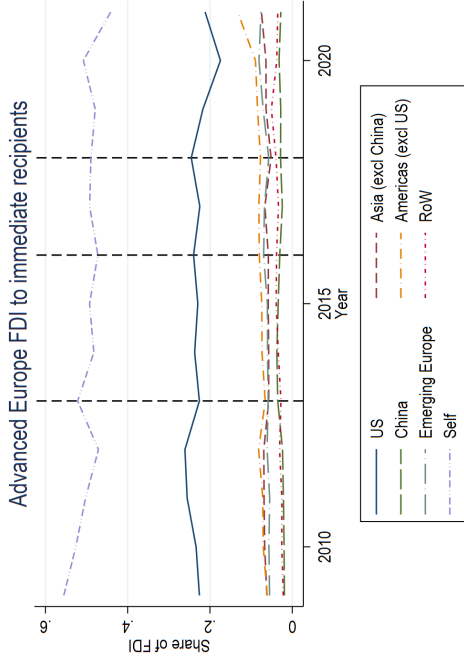
Figure A2: Immediate and ultimate outward vertical real FDI from China



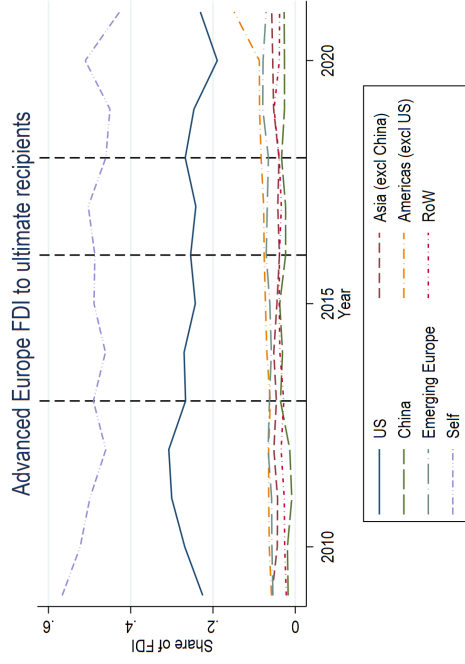
(a) Immediate FDI



(c) Ultimate FDI



(b) Distribution of immediate FDI



(d) Distribution of ultimate FDI

Figure A3: Immediate and ultimate outward real FDI from Advanced Europe

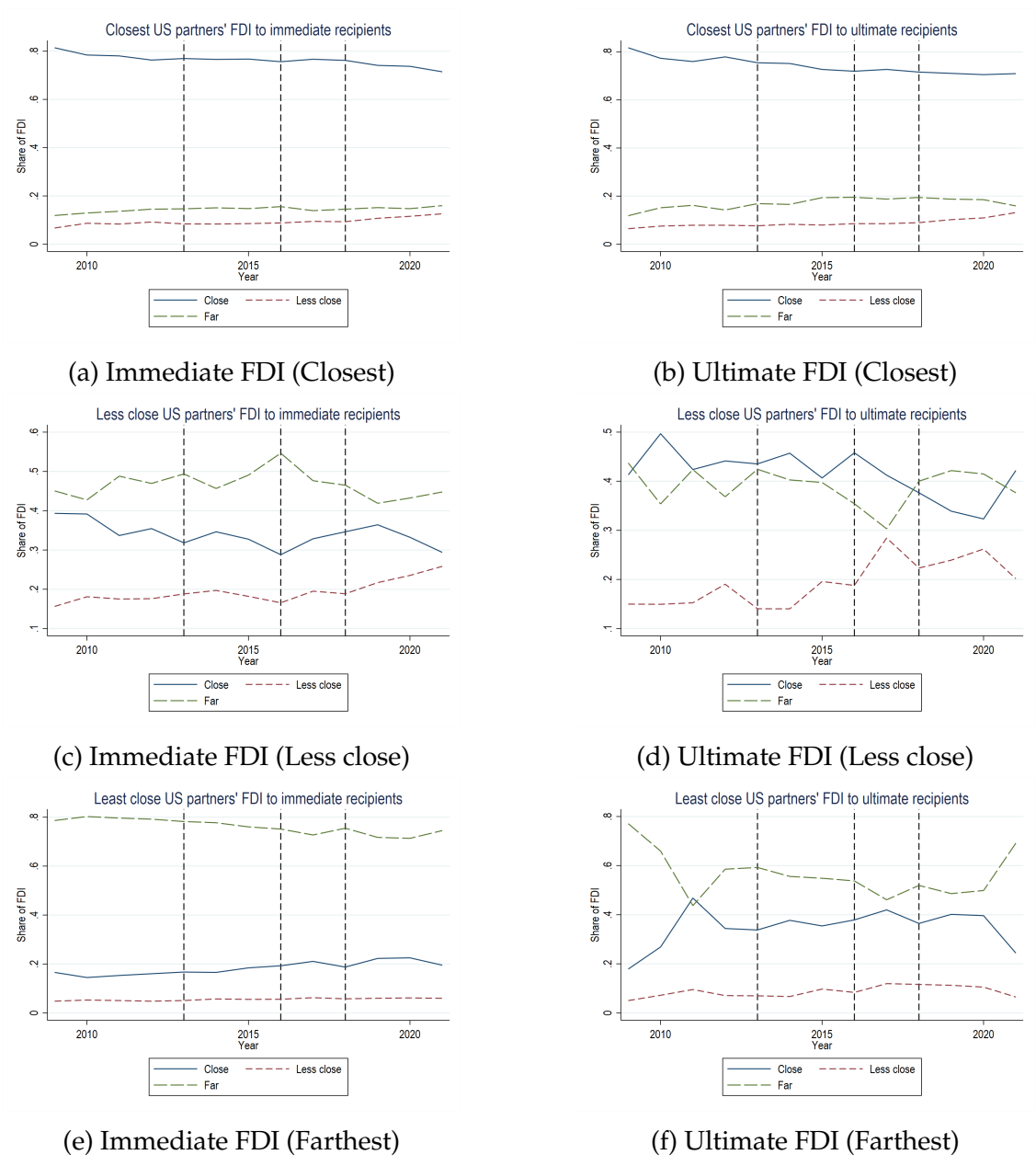
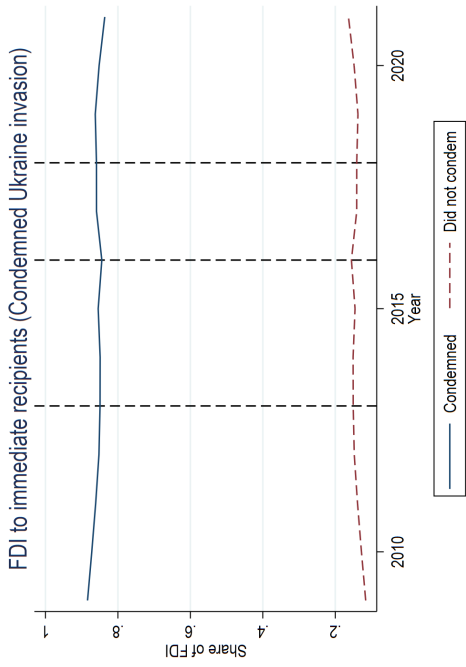
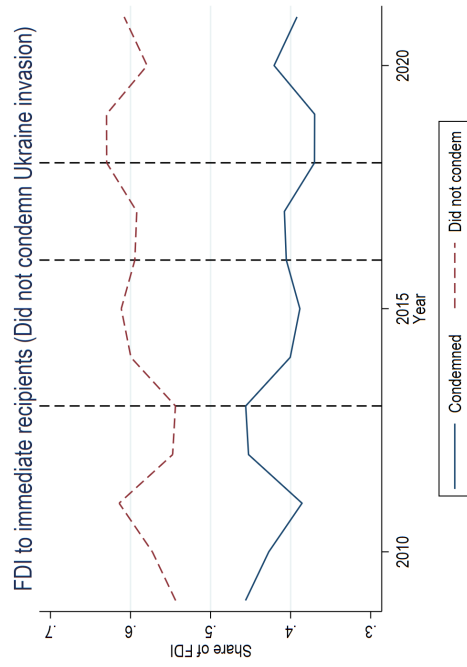


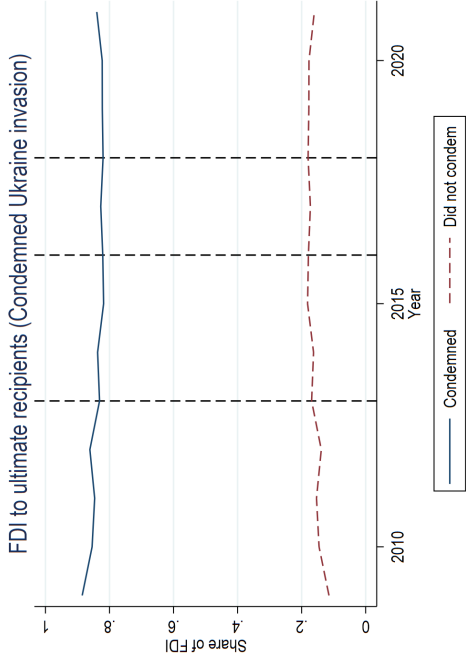
Figure A4: Distribution of immediate and ultimate outward vertical real FDI by geopolitical proximity to the US



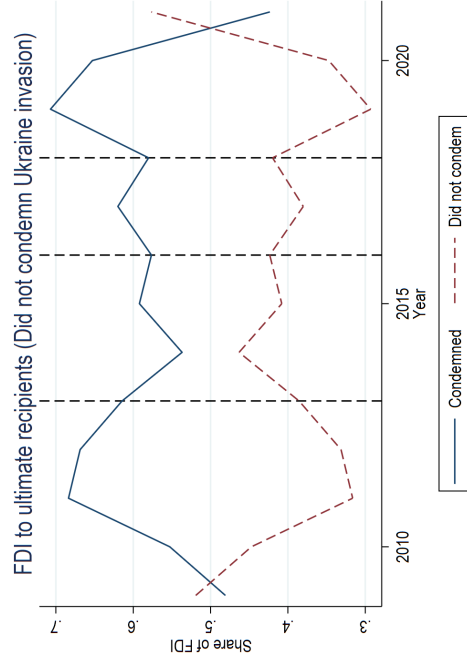
(a) Immediate FDI (Voted 'Yes')



(c) Immediate FDI (Did not vote 'Yes')

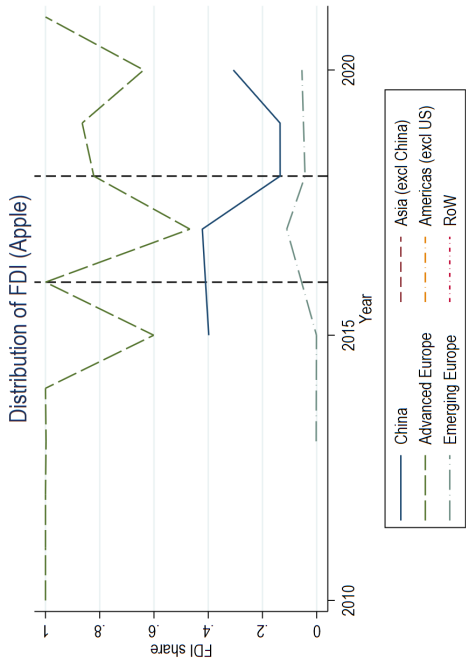


(b) Ultimate FDI (Voted 'Yes')

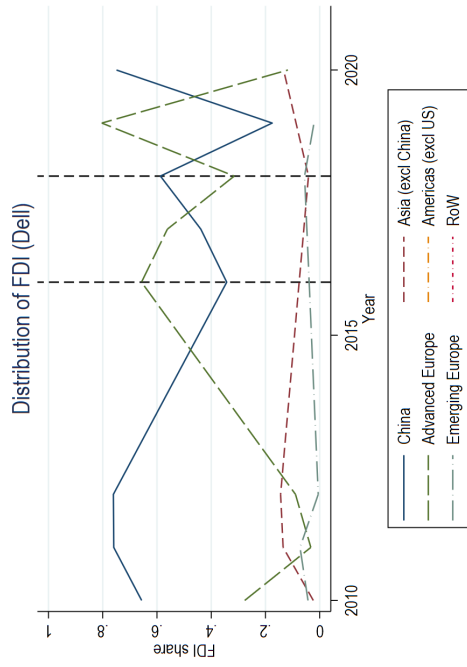


(d) Ultimate FDI (Did not vote 'Yes')

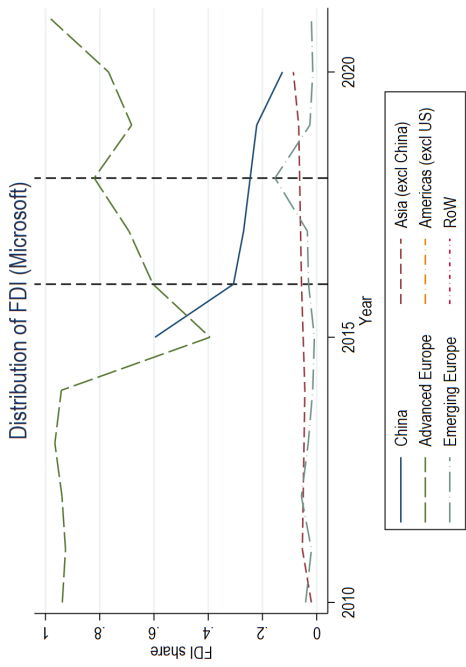
Figure A5: Distribution of immediate outward vertical real FDI by UN voting bloc



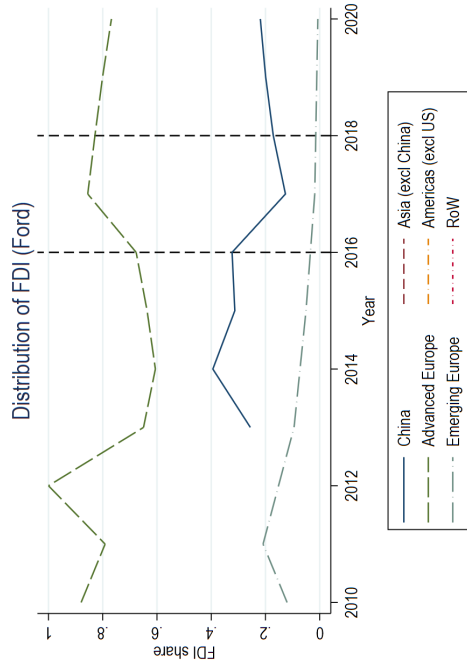
(b) Apple



(d) Dell



(a) Microsoft



(c) Ford

Figure A6: Distribution of ultimate FDI among selected top US investors in China

8.2 Tables

Correlation matrix						
	ISH real FDI	GUO real FDI	ISH vertical real FDI	GUO vertical real FDI	ISH FDI	GUO FDI
ISH real FDI	1					
GUO real FDI	0.766	1				
ISH vertical real FDI	0.989	0.751	1			
GUO vertical real FDI	0.779	0.976	0.775	1		
ISH FDI	0.839	0.662	0.823	0.678	1	
GUO FDI	0.663	0.778	0.650	0.774	0.845	1

ISH refers to immediate shareholder while GUO refers to global ultimate owner. ISH FDI refers to bilateral country-level immediate total FDI, while GUO FDI refers to bilateral country-level ultimate total FDI.

Table A1: Correlations between FDI measures

	(1)	(2)	(3)	(4)
	Immediate Log(FDI)			
<i>Distance</i>	-0.239*** (0.00715)	-0.233*** (0.00728)	-0.239*** (0.00715)	-0.229*** (0.00722)
Trade agreement	0.933*** (0.0589)	0.877*** (0.0594)	0.919*** (0.0591)	0.811*** (0.0594)
Common language	1.206*** (0.0794)	1.191*** (0.0791)	1.208*** (0.0794)	1.171*** (0.0792)
Common border	1.756*** (0.120)	1.733*** (0.121)	1.742*** (0.120)	1.711*** (0.122)
Colonial link	1.088*** (0.138)	1.124*** (0.138)	1.087*** (0.138)	1.192*** (0.141)
2014-2017	0.351*** (0.0225)	0.354*** (0.0225)	0.351*** (0.0225)	0.378*** (0.0227)
2018-2021	0.690*** (0.0286)	0.697*** (0.0286)	0.691*** (0.0286)	0.753*** (0.0292)
<i>same_rank</i>		0.245*** (0.0521)		
<i>same_un_vote</i>			0.0971 (0.0676)	
<i>geopol_prox</i>				0.501*** (0.0580)
Source Country FE	Yes	Yes	Yes	Yes
Host Country FE	Yes	Yes	Yes	Yes
Observations	95552	95552	95552	95287

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013. Source and Host country pair fixed effects are controlled for in the estimation.

Table A2: Determinants of real immediate FDI (OLS)

	(1)	(2)	(3)	(4)
	Immediate Log(FDI)			
<i>Distance</i>	-0.0277 (0.292)			
2014-2017	0.497*** (0.0277)	0.543*** (0.0250)	0.590*** (0.0321)	0.517*** (0.0217)
2018-2021	0.983*** (0.0339)	1.029*** (0.0321)	1.077*** (0.0414)	0.987*** (0.0280)
<i>Distance</i> × 2014-2017	0.00252 (0.00375)			
<i>Distance</i> × 2018-2021	-0.00149 (0.00458)			
<i>same_rank</i> × 2014-2017		-0.0673** (0.0341)		
<i>same_rank</i> × 2018-2021		-0.126*** (0.0422)		
<i>same_un_vote</i> × 2014-2017			-0.110*** (0.0376)	
<i>same_un_vote</i> × 2018-2021			-0.146*** (0.0472)	
<i>geopol_prox</i>				-0.105** (0.0435)
<i>geopol_prox</i> × 2014-2017				-0.0245 (0.0350)
<i>geopol_prox</i> × 2018-2021				-0.103** (0.0436)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	94556	94556	94556	94295

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013. Source and Host country pair fixed effects are controlled for in the estimation.

Table A3: Real immediate FDI fragmentation along different measures of distance (OLS)

	(1)	(2)	(3)	(4)
	Immediate Log(FDI)			
<i>Distance</i>	-0.0763 (0.296)			
2014-2017	0.551*** (0.0286)	0.548*** (0.0254)	0.600*** (0.0325)	0.524*** (0.0221)
2018-2021	1.054*** (0.0350)	1.021*** (0.0325)	1.078*** (0.0418)	0.995*** (0.0285)
<i>Distance</i> × 2014-2017	-0.00151 (0.00383)			
<i>Distance</i> × 2018-2021	-0.00758 (0.00466)			
<i>same_rank</i> × 2014-2017		-0.00933 (0.0352)		
<i>same_rank</i> × 2018-2021		-0.0257 (0.0432)		
<i>same_un_vote</i> × 2014-2017			-0.0819** (0.0383)	
<i>same_un_vote</i> × 2018-2021			-0.0964** (0.0478)	
<i>geopol_prox</i>				-0.121*** (0.0448)
<i>geopol_prox</i> × 2014-2017				0.0679* (0.0367)
<i>geopol_prox</i> × 2018-2021				0.0304 (0.0453)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	94659	94662	94662	94306

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013. Source and Host country pair fixed effects are controlled for in the estimation.

Table A4: Real ultimate FDI fragmentation along different measures of distance (OLS)

	(1)	(2)	(3)	(4)
	Real FDI (immediate)			
<i>Distance</i>	-4.911*** (1.898)			
2014-2017	0.702 (0.460)	1.410* (0.808)	3.000*** (1.094)	1.295* (0.738)
2018-2021	-0.166 (0.688)	0.420 (1.152)	2.955*** (1.016)	0.994 (1.087)
<i>Distance</i> × 2014-2017	0.0708* (0.0412)			
<i>Distance</i> × 2018-2021	0.265*** (0.0818)			
<i>same_rank</i> × 2014-2017		-0.289 (0.815)		
<i>same_rank</i> × 2018-2021		1.216 (1.162)		
<i>same_UN_vote</i> × 2014-2017			-1.860* (1.100)	
<i>same_UN_vote</i> × 2018-2021			-1.362 (1.009)	
<i>geopol_prox</i>				-0.585 (0.915)
<i>geopol_prox</i> × 2014-2017				-0.132 (0.753)
<i>geopol_prox</i> × 2018-2021				0.683 (1.119)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	3660	4272	4272	4044

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table A5: Immediate Real FDI Fragmentation (Agriculture)

	(1)	(2)	(3)	(4)
	Real FDI (immediate)			
<i>Distance</i>	-2.066 (1.352)			
2014-2017	0.274** (0.134)	0.330** (0.166)	0.330** (0.158)	-0.106 (0.194)
2018-2021	-0.0753 (0.367)	-0.678 (0.625)	-1.054** (0.517)	-1.115* (0.593)
<i>Distance</i> × 2014-2017	0.0333 (0.0337)			
<i>Distance</i> × 2018-2021	0.0516 (0.0468)			
<i>same_rank</i> × 2014-2017		0.641** (0.290)		
<i>same_rank</i> × 2018-2021		1.945*** (0.675)		
<i>same_UN_vote</i> × 2014-2017			0.640** (0.281)	
<i>same_UN_vote</i> × 2018-2021			2.321*** (0.573)	
<i>geopol_prox</i>				-2.610*** (0.478)
<i>geopol_prox</i> × 2014-2017				1.103*** (0.384)
<i>geopol_prox</i> × 2018-2021				2.424*** (0.701)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	12792	13920	13920	13500

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table A6: Immediate Real FDI Fragmentation (Transport)

	(1)	(2)	(3)	(4)
	Real FDI (ultimate)			
<i>Distance</i>	3.065 (2.852)			
2014-2017	0.902** (0.371)	1.565*** (0.432)	1.059* (0.562)	2.319*** (0.631)
2018-2021	-0.0572 (0.507)	1.433** (0.663)	2.097** (0.910)	2.162*** (0.767)
<i>Distance</i> × 2014-2017	0.110 (0.0879)			
<i>Distance</i> × 2018-2021	0.220** (0.0886)			
<i>same_rank</i> × 2014-2017		-1.112*** (0.428)		
<i>same_rank</i> × 2018-2021		-0.641 (0.659)		
<i>same_UN_vote</i> × 2014-2017			-0.601 (0.579)	
<i>same_rank</i> × 2018-2021			-1.303 (0.918)	
<i>geopol_prox</i>				1.929** (0.950)
<i>geopol_prox</i> × 2014-2017				-1.869*** (0.631)
<i>geopol_prox</i> × 2018-2021				-1.367* (0.775)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	2760	3408	3408	3264

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table A7: Ultimate Real FDI Fragmentation (Agriculture)

	(1)	(2)	(3)	(4)
	Real FDI (ultimate)			
<i>Distance</i>	-0.794 (0.825)			
2014-2017	-0.225 (0.333)	0.318 (0.256)	0.294 (0.251)	0.331 (0.358)
2018-2021	-0.610 (0.555)	0.0432 (0.594)	-0.107 (0.561)	0.329 (0.735)
<i>Distance</i> × 2014-2017	0.236*** (0.0576)			
<i>Distance</i> × 2018-2021	0.383*** (0.0722)			
<i>same_rank</i> × 2014-2017		0.400 (0.325)		
<i>same_rank</i> × 2018-2021		0.725 (0.603)		
<i>same_UN_vote</i> × 2014-2017			0.423 (0.321)	
<i>same_UN_vote</i> × 2018-2021			0.877 (0.572)	
<i>geopol_prox</i>				-1.778 (1.233)
<i>geopol_prox</i> × 2014-2017				0.384 (0.423)
<i>geopol_prox</i> × 2018-2021				0.430 (0.746)
Country Pair FE	Yes	Yes	Yes	Yes
Observations	9732	10872	10872	10488

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host and Source exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table A8: Ultimate Real FDI Fragmentation (Transport)

	(1)	(2)	(3)	(4)
	US outward FDI			
<i>Distance</i>	-0.253*** (0.0838)			
2014-2017	-0.219** (0.102)	0.0469 (0.0794)	-0.0218 (0.0954)	-0.0882* (0.0489)
2018-2021	-0.329*** (0.124)	0.0219 (0.0691)	-0.0590 (0.128)	-0.347*** (0.103)
Distance × 2014-2017	0.0198* (0.0119)			
Distance × 2018-2021	0.0179 (0.0132)			
<i>same_rank</i> × 2014-2017		-0.158 (0.101)		
<i>same_rank</i> × 2018-2021		-0.281*** (0.0984)		
<i>same_UN_vote</i> × 2014-2017			-0.0462 (0.113)	
<i>same_UN_vote</i> × 2018-2021			-0.140 (0.153)	
<i>geopol_prox</i>				-0.0751 (0.112)
<i>geopol_prox</i> × 2014-2017				-0.275*** (0.0919)
<i>geopol_prox</i> × 2018-2021				-0.409*** (0.131)
Host Country FE	Yes	Yes	Yes	Yes
Observations	2161	2161	2161	2148

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table A9: Fragmentation of US FDI (All Industries)

	(1)	(2)	(3)	(4)
	US outward FDI			
<i>Distance</i>	-0.848*** (0.191)			
2014-2017	-0.504* (0.292)	0.142 (0.248)	-0.494 (0.365)	-0.136 (0.215)
2018-2022	-0.631* (0.327)	0.142 (0.233)	-0.332 (0.242)	-0.324 (0.266)
Distance × 2014-2017	0.0477** (0.0192)			
Distance × 2018-2022	0.0598*** (0.0221)			
<i>same_rank</i> × 2014-2017		-0.467 (0.309)		
<i>same_rank</i> × 2018-2022		-0.635** (0.296)		
<i>same_UN_vote</i> × 2014-2017			0.493 (0.378)	
<i>same_UN_vote</i> × 2018-2022			0.250 (0.269)	
<i>geopol_prox</i>				0.363 (0.365)
<i>geopol_prox</i> × 2014-2017				-0.540* (0.311)
<i>geopol_prox</i> × 2018-2022				-0.791** (0.313)
Host Country FE	Yes	Yes	Yes	Yes
Observations	1225	1320	1320	1306

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Other controls include Host exchange rate with respect to the USD and the volatility of Host and Source exchange rate in each year, annual population and GDP of Source and Host countries. The reference time period is 2009-2013.

Table A10: Fragmentation of US FDI (Mining)

9 Data Appendix

In this section, I describe how I construct the measures of real FDI, ultimate and immediate real FDI as well as vertical (ultimate and immediate) real FDI for source-host country pairs. The starting point is the CDIS data, which gives bilateral total FDI positions between source-host country pairs from 2009 to the present year. Following [Damgaard and Elkjaer, 2017](#), where both host and source country are CDIS reporters, I use inward FDI reported by the host country (from the source country) instead of outward FDI reported by the source country (to the host country). In most cases, as expected, these values are similar. However, where they differ, the former is generally reported with less error.

Real FDI The construction of real FDI closely follows the steps laid out in [Damgaard et al., 2019](#).

1. For OECD countries that report bilateral SPEs, I subtract the FDI position in SPEs from total FDI to obtain bilateral real FDI.
2. For OECD countries who only report aggregate SPEs, I calculate share of SPE out of total FDI and apply that share to all bilateral FDI positions reported in the CDIS.
3. For non-OECD countries and OECD countries that don't report SPEs at all, impute real FDI using total FDI in the following way:
 - i For OECD countries (h) that report aggregate inward SPE and non-SPE breakdown, regress (with logs) the share of real FDI out of total FDI on the share of total FDI out of GDP for each period t .
 - ii Use coefficients to impute share of real FDI for non reporters based on their FDI to GDP ratio. Lower bound real FDI to 0.
 - iii Assume that the above ratio of real to total FDI is constant across all bilateral FDI for each CDIS country. I.e. apply same share of real FDI to all bilateral FDI positions of non SPE reporters.

Ultimate FDI The construction of ultimate FDI closely follows the steps laid out in [Damgaard and Elkjaer, 2017](#). Let *ISH* and *GUO* refer to an immediate shareholder and the global ultimate owner respectively. FDI from an *ISH* firm is considered immediate FDI while FDI from a *GUO* firm is considered ultimate FDI.

1. For the few OECD countries that report real FDI by ultimate investor economy, use this data.
2. For source-host country pairs that are well-represented by Orbis, such that the bilateral FDI for the country pair in Orbis does not deviate from that in the CDIS by more than 50 percent, calculate the following ratio - $\delta_{hi} = \frac{\text{FDI from } GUO \text{ in source (i) to host (h)}}{\text{FDI from } ISH \text{ in source (i) to host (h)}}$. δ_{hi} is the fraction of FDI is just passing through from (i) to (h). Multiply bilateral FDI in CDIS from source (i) to host (h) by δ_{hi} to get ultimate bilateral FDI from (i) to (h).
3. For pairs (hi) where Orbis bilateral FDI deviates by more than 50 percent from CDIS bilateral FDI, let $\delta_{hi} = \frac{\sum_i \text{FDI with ultimate investor in source i}}{\sum_i \text{FDI with immediate investor in source i}}$. Multiply bilateral FDI in CDIS from source (i) to host (h) by δ_{hi} to get ultimate bilateral FDI from (i) to (h).
4. Multiply all bilateral ultimate FDI from ultimate source (i) to host (h) by $\frac{\text{sum of all FDI from immediate to host (h)}}{\text{sum of all FDI from ultimate investor to host (h)}}$, such that sum of all ultimate FDI to host (h) = sum of all FDI from immediate FDI to host (h).

Vertical FDI The imputation of vertical FDI follows the following procedure:

1. Using industry information on shareholder and subsidiary firms from Orbis, define FDI as vertical if the four digit industry code of the shareholder differs from that of the subsidiary.
2. For each source-host country pair in Orbis, calculate the share of vertical real FDI out of total real FDI, by aggregating over shareholder and subsidiary firms for that country pair.
3. Apply this share of vertical FDI to the bilateral FDI positions in CDIS to obtain the bilateral vertical FDI positions.
4. Repeat the steps separately for immediate and ultimate FDI.



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