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Ai miei cari genitori Mauro e Catia

Contents

List of Figures **ix**

List of Tables **xi**

Acknowledgements **xiv**

Vita and Publications **xv**

Introduction **1**

**1 Not Always Rising.
Supply Chains, Takeovers, and Market Power** **8**

1.1 Introduction 9
1.2 Related literature 13
1.3 Data and Preliminary Evidence 16
1.4 Empirical Strategy 22
1.4.1 Market power and takeovers 23
1.4.2 Vertical vs. horizontal integration strategies 26
1.5 Robustness and sensitivity analysis 32
1.6 Conclusion 40

**2 Navigating Uncertainty:
Multinationals' Investment Strategies after the Pandemic Shock** **41**

2.1 Introduction 42
2.2 Data and descriptive evidence 46
2.3 Investment decisions in periods of uncertainty 57
2.3.1 Country-level investment and divestment patterns 57

2.3.2 Firm-level choices 60
2.4 Limitations of this study 65
2.5 Conclusion 67

3 Better Together: How Digital Connectivity and Regulation Reduce Trade Costs 69
3.1 Introduction 70
3.2 Data and descriptive statistics 75
3.2.1 Trade costs 75
3.2.2 Digital connectivity 77
3.2.3 Digital trade regulation 78
3.3 Empirical strategy 79
3.4 The impact of digital connectivity on trade costs 82
3.5 The interaction between technology and regulation 85
3.6 Conclusion 91

Conclusions and policy remarks 92

A Appendix Chapter 1 98

B Appendix Chapter 2 109

C Appendix Chapter 3 119

List of Figures

1 Distribution of markups in the European Union 18
2 Evolution of aggregate markups 18
3 Sales-weighted average markup in the European Union, 2007-2021 19
4 Event study after vertical takeovers 30
5 Goodness of matching process on observable covariates . . 35

6 Divestments over investments ratio at global level 51
7 Domestic and foreign net divestment ratios in 2019-2022 . 54
8 Domestic vs foreign investment rates 55
9 Predicted probability of divestment at changing COVID Risk 64
10 Predicted probability of divestment on intermediates at changing distance 65

11 Global Trade Cost Index by income groups 76
12 Global Trade Cost Index by economic sectors 77
13 Active mobile broadband subscriptions per capita 78
14 Restrictiveness of digital regulation 80
15 Counterfactual reductions in trade costs by sector group and restrictiveness of regulation 89
16 Counterfactual reductions in trade costs by income group and restrictiveness of regulation 90

17 Divestments flows 2019-2022 111
18 Investments flows 2019-2022 111

19 Size and probability of investment and divestment 112
20 Heterogeneity of COVID-19 exposure across countries in 2020 114
21 Heterogeneity of COVID-19 exposure across countries in 2022 114
22 Average COVID-19 risk across years 115
23 Changing attractiveness of FDI destinations 118

24 Counterfactual reductions in trade costs by income group . 124
25 Counterfactual reductions in trade costs in goods by region 125
26 Counterfactual reductions in trade costs in services by region 126
27 Counterfactual reductions in trade costs in digitally deliverable services by region 127

List of Tables

1 Variables' description 21
2 Targeted firms vs. non-targeted firms 21
3 Average treatment effect (ATE) of takeovers on firm-level outcomes 25
4 Average treatment effect (ATE) of takeovers: vertical vs. horizontal integration strategies 27
5 Average treatment effect (ATE) on markups: sensitivity to measures of markups 34
6 Average treatment effect (ATE) on markups: sensitivity to methodologies 36
7 Average treatment effect (ATE): classification by technology intensity after vertical integration 38
8 Average treatment effect (ATE): classification by technology intensity after vertical integration 39

9 Sample coverage by hosting economy: parents and affiliates, year 2019 50
10 Changes in parent-affiliate linkages, 2019-2022 51
11 Distribution of MNEs choices by affiliates' size 52
12 Difference in means and standard deviations of main descriptive statistics 56
13 COVID-19 and the preference for domestic subsidiaries . . 60
14 Firm-level divestment choices 62
15 Firm-level divestment choices and reshoring 66

16 The impact of digital connectivity on trade costs 84
17 The channels through which digital connectivity reduces trade costs 86
18 The impact of digital connectivity depends on digital trade regulation 87

19 Time coverage of takeovers 100
20 Industry coverage of firms' acquisitions 101
21 Correlation matrix 101
22 Sample coverage by technology intensity 102
23 Average treatment effect (ATE) of takeovers on parent companies 103
24 Average treatment effect (ATE) of vertical takeovers on parent companies 104
25 Average treatment effect (ATE) of vertical takeovers on markups by industry 104
26 Average treatment effect (ATE): classification by technology intensity after takeovers 105
27 Average treatment effect (ATE): classification by technology intensity after takeovers 106
28 Average treatment effect (ATE) on takeovers: Former vs. New EU Member States 107
29 Average treatment effect (ATE) after vertical integrations: Former vs. New EU Member States 108

30 Number of investment and divestment operations, 2019-2022 110
31 Variables description 110
32 Investment, divestment and affiliates' size 112
33 Firm-level divestment choices, excluding the financial industry 113

34 Economies included in the econometric analysis 120
35 List of sectors included in the econometric analysis 121

36 The impact of digital connectivity on trade costs: alternative measures of connectivity 122
37 Impact of digital connectivity on trade flows 123
38 Impact of digital connectivity depending on digital trade regulation across income groups 123

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Vita

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Publications

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Introduction

Globalization has significantly impacted global economic growth by enhancing the flows and integration of goods, human capital, and knowledge. This process has facilitated the exchange of know-how, promoted specialization, and led to more efficient resource allocation, thus accelerating global growth and helping to reduce inequalities between developing and developed countries. Some of the main drivers through which globalization pushed economic growth include the reduction of tariff barriers through extensive free trade agreements, a new organization of production that has been increasingly fragmented across global supply chains and the rise of digital technologies. The reorganization of production along supply chains that span across countries promoted innovation and technological advancements by enabling technological spillovers. Many firms managed to become multinationals thanks to cross-border investments that played a crucial role in boosting productivity and sustaining competition across markets. Moreover, digital technologies further supported the integration of the global economy by creating new job opportunities and innovative tools for conducting business. The digital revolution has also empowered developing countries, enabling them to better integrate into the global economy.

Despite these advancements, recent trends are showing signs of *slowbalization* that threaten to reverse the gains made in the past decades. The slowdown in trade flows, a halt in productivity growth, and increasing inequalities both within countries and globally, pose significant concerns. The benefits of globalization are at risk of being overshadowed by the negative consequences of having a globally integrated economy. Crises such as the COVID-19 pandemic, geopolitical conflicts and trade wars have revealed the fragility of the current international production system, leading to widespread uncertainty that affects market dynamics and firms' behaviour. Supply chains, essential to the global production network, have struggled to manage these disruptions. The reliance on specific countries for critical intermediate inputs has led to significant bottlenecks, demonstrating the vulnerabilities inherent in a highly interconnected economy.

Globalization has also impacted competition, enabling many firms to consolidate their market position, leading to a higher concentration of firms with high market power across industries. This concentration has sparked a debate among policymakers and scholars about the implications of higher market power on competition levels and consumer welfare.

Related to the digital revolution, while digital technologies have driven remarkable progress, there remains a gap in the governance and regulatory frameworks necessary to manage these advancements effectively. The lag in policy development to govern digital technologies creates challenges that need to be addressed to fully leverage the benefits of digitalization. Efforts to harmonize existing regulatory frameworks are crucial to ensuring that the digital economy can continue to thrive and contribute to reducing trade costs and enhancing economic growth.

In summary, while globalization has driven considerable economic growth and technological progress, it also presents significant challenges that need to be addressed. This thesis focuses on analyzing some aspects of globalization previously described, and its consequences.
In particular, the first chapter[1] analyzes the status of competition across

[1]This chapter is based on the working paper "Supply Chains, Takeovers, and Market Power" by Bellucci and Rungi (2022).

European markets by focusing on the heterogeneous impact of vertical vs. horizontal takeovers on firms' performances including market power, productivity, economies of scale, etc. Most of the empirical evidence found in recent literature shows that concentration within industries and market power has risen in the last decades. This increase can be driven by a reallocation of market shares towards firms with high markups or an actual increase in markups of active firms. During the same period, there has been a significant increase in the volume of M&A deals in Europe and the US. These operations represent one of the common strategies used by firms to consolidate their position in the market and eliminate competitors. For this reason, antitrust authorities usually focus on preventing deals that can concentrate markets and ultimately harm consumer welfare. On the other hand, the consequences of vertical M&A agreements have not been a major source of concern until recently, when in 2020 the U.S. Department of Justice and the Federal Trade Commission issued the Guidelines on Vertical Mergers, in which they assess that vertical integration strategies can also produce pro-competitive effects from eliminating double marginalization. This empirical study contributes to the literature by providing evidence of the impact of takeovers, i.e., when one company acquires corporate control over another after purchasing the majority of its equity stakes, on firms' performances in the European manufacturing sectors. Looking at firms' characteristics, targeted firms are significantly bigger, more productive, and more efficient than the average manufacturing firms in the European Union. However, by studying the causal impact of takeovers on several firms' outcomes, there is evidence that targeted firms increase their scale of operations after the integration, increase their return on investments, and decrease their capital intensity. At the same time, there is no evidence of significant changes in the level of markups. Nevertheless, average estimates obtained by considering the whole sample of takeovers can hide heterogeneous effects stemming from different integration strategies. For this reason, after separating into horizontal and vertical takeovers, the results confirm that targeted firms increase their scale of operation and decrease their capital intensity, both for horizontal and vertical integration. Interestingly, there is no evidence of changes in the markup level for horizontal cases. At the same time, results show a significant, despite a small, decrease in markups and an increase in profitability for vertical acquisitions. Vertical integration within a supply chain means that the parent company is acquiring control over a supplier or buyer, establishing an intra-firm exchange of cheaper or better intermediate inputs. In this way, having more than one firm under the same majority shareholder reduces the markups previously charged on inputs produced along that supply chain segment. For this reason, vertical acquisitions can contribute to the elimination of double marginalization. Overall, the evidence found in this study suggests that despite the horizontal acquisitions in the European manufacturing sector in the last decade, competition authorities managed to preserve a stable level of competition. In contrast, evidence suggests that vertical acquisitions contributed to achieve sustained volume growth in the markets and efficiency gains that could be translated into higher consumer welfare.

Chapter two[2] investigates the phenomenon of ”slowbalization”. This concept has increasingly been associated with a shift towards domestic economies and the creation of regional production networks. Recent shocks that hit the global economy, like the pandemic crises and the conflict in Ukraine, may have accelerated this process by creating severe disruptions in supply chains like bottlenecks and shortages of critical intermediate goods. As a result, foreign direct investments significantly decreased in 2022, especially in developed economies. In this context of heightened uncertainty, academics and policymakers have started to investigate how to make supply chains more resilient and able to contain the next shocks that will hit the economy. This chapter focuses on analyzing the strategic decisions related to investments and divestments made by firms during the period of uncertainty that started in 2019 with the COVID-19 pandemic and that is still going on. The analysis is built on a unique dataset that compiles firm-level information to

[2]This chapter is based on the paper ”Navigating Uncertainty: Multinationals’ Investment Strategies after the Pandemic Shock” by Bellucci and Rungi (2023).

reconstruct parent-affiliate linkages in 2019 and 2022. This dataset enables the study of investment and divestment decisions undertaken by multinational enterprises (MNEs) at the global level. Descriptive analysis reveals that MNEs made significantly more divestments than investments in the period under study, with a significant preference towards domestic investments. Unsurprisingly, the Russian Federation and Ukraine experienced the highest share of divestments over investments, mainly due to ongoing conflicts and sanctions, while countries sharing a border with Ukraine saw a significant inflow of investments. European countries have generally suffered from a relevant investment turnover, where divestment choices are, on average, higher than new investment choices. Interestingly, due to a reconfiguration of investment strategies, the evidence shows that, on average, parent companies started investing in more distant locations in 2022 compared to 2019. The analysis proposes a basic empirical strategy to study changing investment patterns. First, a simple gravity model for corporate control á la Head and Ries (2008) is estimated to study investment and divestment choices at the country level. The model is augmented with a COVID-19 measure of firms' risk exposure. This variable catches investors' uncertainty when dealing with an unprecedented shock, and it is proxied by the measure proposed by Hassan et al. (2020). Findings suggest that a higher COVID-19 risk correlates with more domestic investment decisions. On the other hand, COVID-19 risk is negatively correlated with the propensity to invest in new investment projects abroad. In the second stage of the empirical strategy, the analysis delves deeper into the decision to divest by introducing a parent-level specification that better catches the reshoring decision at the granular level. It is assumed that reshoring occurs when a multinational parent company associates foreign divestment choices in an industry with domestic investments in the same industry. Interestingly, it appears that this is the case during the period of analysis. Finally, results prove that parent firms are less likely to divest from an affiliate that provides intermediate inputs and is located at a higher geographical distance. This result suggests that intermediate inputs are not easy to substitute with others produced in nearby countries to the parent's.

The third chapter[3] is the result of a visiting period I spent at the Economic Research and Statistics Division of the World Trade Organization.

This work delves into the ongoing debate surrounding how digital technologies interact with regulatory frameworks. Over recent decades, trade costs have constantly decreased thanks to the reduction of tariff and non-tariff barriers. Among the channels that lead to lower trade costs, digitalization is an important one. Indeed, the rapid evolution of information and communication technology (ICT) and digitalization have reshaped global trade dynamics. These advancements allowed to connect producers and consumers worldwide, fostered the dissemination of ideas and technologies, and streamlined the management of global value chains (GVCs). As a result, trade costs have plummeted, and trade volumes have surged. At the same time, regulatory frameworks started to evolve to keep pace with advancements in digital technologies. Policymakers face the challenge of balancing digital trade's economic gains and addressing pressing public concerns such as data privacy, consumer rights, and cybersecurity. Typically, developed economies started to impose restrictions on cross-border data flows and mandate local data storage. On the other hand, in many developing economies, the openness in data to transfer policies often results from a lack of comprehensive regulation rather than a strategic policy decision. The main goal of this study is to estimate how digital connectivity affects trade costs across different dimensions. The main finding is that having a more open regulatory regime amplifies the effect of digital connectivity. Domestic policies ensuring seamless cross-border access to communication infrastructure and facilitating data flows magnify the impact of digital connectivity substantially, especially in economies with low and middle-income levels. This finding has important policy implications, considering that the regulatory framework has been lagging in many cases, and some governments have also introduced policies that tighten the regulatory environment (Organization for Economic Co-operation and De-

[3]This chapter is based on the working paper "Better together: How digital connectivity and regulation reduce trade costs" by Bellucci, Rubínová, and Piermartini (2023).

velopment (OECD), 2023). The empirical strategy follows a two-step approach. First, it estimates bilateral sector-level trade costs using a theory-consistent fixed-effects gravity model. Second, the analysis exploits the variation in trade costs within country-sector-year across partners and within sector-country-pair over time to estimate the impact of digital connectivity. The results reveal a significant reduction in trade costs across all economic sectors. By examining the interplay between digital connectivity and regulation, the study finds that the trade-cost-reducing effect of improved connectivity is significantly amplified by an open regulatory environment, particularly concerning digitally deliverable services proxied by the professional and business sectors. Counterfactual analysis reveals that if all economies were to enhance their connectivity to at least the 75th percentile of the global distribution, the predicted decline in trade costs would be significantly smaller at the current average level of digital trade regulation compared to scenarios where economies align with the global best level of regulation. Again, this effect is particularly pronounced for trade costs associated with digitally deliverable services, which would experience nearly a fourfold reduction in the most open regulatory environment.

Chapter 1

Not Always Rising. Supply Chains, Takeovers, and Market Power

[1]Rising market power can threaten competition and business dynamism, resulting in lower levels of welfare. To date, a few works has shown decreasing global competition as firm-level markups increase, but there is scant evidence about the channels through which markups change. This study investigates the role of firms' takeovers as a driver of change in their markups, market shares, productivity and profitability. Interestingly, our results suggest that takeovers aimed at vertical integration strategies result in lower markups of about 0.5% and higher returns on investments of 2.5%. On the other hand, we do not find significant changes in the case of horizontal integrations after controlling for reverse causality. Thus, in line with the U.S. Vertical Merger Guidelines of 2020, we emphasize the pro-competitive effects deriving from vertical integrations that stem from eliminating frictions on the inputs markets, after reducing double marginalization in the presence of market power.

[1]This chapter is inspired by the working paper "Supply Chains, Takeovers, and Market Power" by Bellucci and Rungi (2022).

1.1 Introduction

Recent evidence of rising market power on a global scale is attracting the attention of many among scholars and policymakers (De Loecker, Eeckhout, and Unger (2020)). The main concern is that a higher monopoly power by a few firms with a dominant position can endanger consumers' welfare. Yet, despite an intense debate, we argue that further research is needed to understand the whys and wherefores of global market power. Right now, the most accredited argument suggests that firms with higher markups charge higher prices, thus leading to suboptimal levels of market competition and welfare. Yet, rising markups may also be associated with endogenous increases in fixed costs, depending on changing market structures[2]. From the latter perspective, one cannot exclude that higher markups can eventually be associated with cost reductions, representing an incentive for incumbent firms to invest and for new firms to enter the market. In this case, higher markups could bring about a counter-intuitive association with higher levels of competition and a wave of innovation investments that can result in higher welfare.

We contribute to the ongoing debate with an empirical study in which we focus on the manufacturing firms in the European Union to test the causal impact of takeovers on firm-level markups when one company acquires corporate control over another after purchasing the majority of its equity stakes. Takeovers are one way to increase market power, and they have been on the rise in recent decades, both in Europe and in the United States. According to the Institute for Mergers, Acquisitions and Alliances (IMAA), the number of M&A deals was 5,009 in 1990 for a value of about 203 billion dollars, but it steadily increased over time, peaking at 23,554 in 2021, reaching a value of about 2,634 billion dollars. A company can acquire a competitor in the same industry to add together market shares. A company can acquire another company along the supply chain, either downstream among buyers or upstream among suppliers, to obtain the

[2]For a review of seminal works in industrial organization explaining sources of rising markups, please see Berry, Gaynor, and Scott Morton (2019)

delivery of cheaper or better intermediate inputs and hence gain an indirect competitive edge over competitors. Acquisitions can significantly influence different channels affecting firms' performance. Technological advances often occur when one company acquires another with superior technology, benefiting from the resulting technological spillovers. Moreover, acquisitions can change market structures, facilitating the entry of new competitors or the exit of existing ones. Also, acquisitions may improve the economies of scale and scope of the companies involved, allowing them to operate more efficiently and to diversify their product or service offering. Therefore, studying the impact of acquisitions on firm performance allows these channels to be addressed indirectly as well.

At first, while aggregate stylized facts indicate a rising trend in markups, this is not consistently observed when we delve into industry heterogeneity. Looking at firms' characteristics, we find that targeted firms are significantly bigger, more capital intensive and have higher market shares than the average manufacturing firms in the European Union. Yet, and most interestingly, when we challenge causality, we find evidence that targeted firms increase the scale of operations after a new parent company's takeover, but we do not observe significant changes in the level of markups. Our findings point to a combination of increasing sales and variable costs and decreasing capital intensity after the takeover once we control for reverse causality.

Thus, against previous evidence, we decided to further investigate by separating takeover strategies. We find that lower markups are actually charged after vertical integration on a supply chain, i.e., when a parent company acquires control over a supplier or a buyer, and parties can establish intra-firm trade by exchanging cheaper or better intermediate inputs. On the other hand, when we look at horizontal takeovers, i.e., when parents and companies operate in the same industry, we do not record any significant impact on either average markups, market shares, or profitability.

Eventually, we argue that our findings suggest that vertical integrations along supply chains can contribute to eliminating externalities derived from double marginalization. Integration of a buyer and a supplier under a unique headquarters reduces the chain of successive markups along supply chains. After becoming part of the same corporate entity, it is possible for buyers and suppliers together to increase market efficiency and potentially charge lower final prices. From a more general perspective, vertical integration strategies can yield overall efficiency gains while sustaining volume growth. In other words, vertically integrated companies may reduce overall welfare inefficiencies by internalizing part of the upstream production processes.

Our identification strategy combines a difference-in-difference specification with a propensity score matching exercise to control for an endogenous selection of targeted firms based on observable financial information. The aim is to consider cherry-picking when parent companies acquire control over firms after anticipating their market potential. Following most recent developments by Callaway and Sant'Anna (2021), our specification is robust to the presence of staggered treatments (in our case, the takeovers) that can occur in different periods, i.e., when cohorts of acquisitions distribute unevenly on the observed timeline. We finally make our results robust also to the presence of a weaker assumption of parallel trends, when the latter holds potentially only after conditioning on *ex-ante* firms' characteristics.

Eventually, we reconnect with the debate on the health of competition policies in the European Union. Indeed, none of our results shows any systematic increasing trend in European markups after takeovers. They are either lower after vertical integration or not statistically significant after horizontal integration. As takeovers have been largely acknowledged as a fundamental channel through which markets can concentrate, they have always been under the scrutiny of competition authorities. In the European Union, however, cases of mergers and takeovers fall under the European Competition Law to preserve the benefits of the Single Market. Under the European Union Merger Regulation (EUMR), art. 2(3), for a merger to be declared compatible with the Single Market, it must not create or strengthen a dominant position. Therefore, there is a general acknowledgement that the intention of the regulators has been to establish a way first to prevent and then to sanction the emergence of dominant positions. We can comment against previous evidence that the European mechanism apparently works to prevent the negative impact of takeovers as long as we consider markups as a proxy for how dominant a firm can become in a market. On the other hand, our results point to what the U.S. Vertical Merger Guidelines of 2020 already emphasize. Vertical integration strategies can bring about pro-competitive effects in the presence of market power, when they are able to eliminate frictions on the inputs markets, after firms reduce the phenomenon of double marginalization.

Despite the well-known efficiency gains from eliminating double marginalization (EDM) highlighted by theoretical models, recent debates triggered by the US Vertical Merger Guidelines 2020 have focused on whether consumers actually benefit from EDM, whether efficiency gains are merger-specific, and how EDM relates to foreclosure effects in vertical integration. The severity of double marginalization varies with the degree of information asymmetry between the counterparts and is more severe when the buyer has all bargaining power. It decreases when the bargaining weights of buyer and supplier are balanced (Choné, Linnemer, and Vergé (2023)). Although in our setting it is not possible to determine the extent of double margins before the acquisition, we found evidence of a reduction in markups of the target company after vertical integration, suggesting that such integration may contribute to eliminating double margins. This reduction in markups, defined as the ratio of price to marginal cost, can occur whether the target firm is upstream or downstream to the parent company. In cases where the target company is upstream, it can sell intermediate inputs at a lower price without altering marginal costs, thereby reducing markups and allowing the parent company to internalize part of its profits. In addition, markup reductions may be the result of a decrease in selling prices that is more than proportional to the decrease in marginal costs, considering that marginal costs may decrease due to acquisition synergies. When the target company is downstream to the parent, a reduction in its markup may again be the result of a reduction in prices more than proportional to that of marginal costs. In this case, however, the objective is to increase the volume of growth by lowering prices and selling higher quantities in the market.

The remainder of the chapter is organized as follows. The next section 1.2 relates our contribution to previous scholarly literature. Section 1.3 describes our data structure and provides preliminary evidence on the evolution of markups and other economic variables of interest. Section 1.4 describes the identification strategy to derive the impact of takeovers on market power, productivity, and other firms' dimensions. Section 1.5 controls for the robustness and sensitivity of our findings. Finally, Section 1.6 concludes.

1.2 Related literature

Our contribution relates to recent works that signal rising market power and higher industrial concentration. In recent years, empirical studies document a rise in market power (Robert E Hall, 2018; De Loecker, Eeckhout, and Unger, 2020; Díez, J. Fan, and Villegas-Sánchez, 2021; Bighelli et al., 2022). Yet, evidence for the European Union is mixed. Bighelli et al. (2022) show that firm concentration has increased in Europe in the last decade. At the same time, they find a positive and significant correlation between rising sector-level concentration and increases in sector-level productivity. Differently, McAdam et al. (2019) find that concentration ratios in the euro area have remained broadly flat in the last ten years, thus suggesting that competition intensity may have been reasonably stable, while markups have declined marginally since the late 1990s. Aggregate estimates at the world level (De Loecker and Eeckhout, 2018) report a stable increase in global markups, even though it is reasonable to expect a certain degree of heterogeneity among different countries and markets.

When it comes to explaining the trends, De Loecker, Eeckhout, and Unger (2020) noticed for the U.S. that it is the upper tail of the distribution that mainly drives the rise in markups. Market shares are reallocated toward *superstar firms* with higher markups and lower labour shares (Van Reenen, 2018; Autor et al., 2020; Alviarez, Head, and Mayer, 2020). The latter emerge thanks to new available technologies, declining trade costs and the fall of non-tariff barriers enabled by globalization and deep regional integration agreements. In this sense, the general idea is that markups are a possible threat to competitive markets and business dynamism, resulting in lower levels of social welfare through a misallocation of productive resources (Baqaee and Farhi (2020)) and possibly lower labour shares (Deb et al. (2022)).

Yet, when we discuss our findings, we point to the existence of important streams of literature (Berry, Gaynor, and Scott Morton, 2019) according to which higher markups and market concentration *per se* do not imply lower social welfare. The heterogeneity of market structures across industries can offer differing explanations for rising markups, such as in the case of rising endogenous fixed costs that could be associated with lower marginal costs. It is for example the case of technology intensive industries in which the reliance on R&D efforts is higher than in lower tech industries. Therefore, this work also relates to previous works showing how different institutional settings in the EU and the U.S., including antitrust and regulation by competition authorities, may lead to different patterns of market power across countries. A decline in antitrust enforcement in the United States has led to harmful market concentration and increased prices and barriers (Grullon, Larkin, and Michaely (2019)), whereas European markets have become more competitive due to stronger and more independent enforcement (Gutierrez and Philippon (2023)).

Mergers and takeovers are one important way to increase market power. On the one hand, M&As can increase market power and prices at the expense of consumers; on the other hand, productivity gains due to knowledge transfer, lower marginal costs due to cheaper intermediate inputs and the reallocation of resources to more efficient uses may benefit consumers in the form of improved products or lower prices. Recent empirical studies have found contrasting results about the final impact of M&A activities on market power, concentration and productivity. Stiebale and Vencappa (2018) find that acquisitions in India are associated with increases in quantities and markups but with lower marginal costs. Blonigen and Pierce (2016) use U.S. Census Bureau data on manufacturing plants to find significant increases in average markups from M&A activity but little evidence for productivity gains. Also, McGuckin and Nguyen (1995), Gugler et al. (2003) and Maksimovic, Phillips, and Prabhala (2011) rely on firm-level data to estimate the impact of firms' acquisition on market power and productivity and find evidence of a positive impact on productivity measures.

Yet, firms may engage in different M&A strategies depending on the goal they want to achieve. Changes in market power after the acquisition may occur due to horizontal integration, when a market player absorbs a direct competitor and adds market share and profits. In this case, the objective of the firm is to increase its market share and achieve economies of scale in order to increase profits. Although many empirical studies find evidence of increased market power after acquisitions, others, such as Bertrand and Zitouna (2008), do not find significant changes in profit margins after horizontal integration. On the other hand, when one company takes over a customer or a supplier as in the case of vertical integration, the gains can be directly related to the access of either tangible or intangible inputs at a lower cost (Atalay, Hortaçsu, and Syverson (2014)), eventually obtaining productivity gains achieved through more efficient use of, for example, technology and logistics (Hortaçsu and Syverson (2007)).

Several empirical works (Berto Villas-Boas, 2007; Gil, 2015; Crawford et al., 2018), following theoretical seminal papers as Spengler (1950), argue that vertical integration can lead to efficiency gains by eliminating double profit margins. Duran-Micco and Perloff (2022) estimates the size of double markups across many industries accounting for direct and indirect upstream markups. Previous works show how backward integration between firms vertically integrated along supply chains can facilitate access to upstream inputs at lower prices, leading to lower costs for the downstream firm. The lower prices paid by the downstream firm could be a consequence of the buying power the firm has over the upstream supplier, resulting in markdowns for upstream firms (Morlacco, 2019; Rubens, 2023). On the other side, firms might engage in forward integration to reduce average costs and achieve economies of scale (Antràs (2020)).

Nonetheless, we cannot exclude that a vertical integration strategy might create distortions in the rest of the market through the foreclosure of other competitors or a strategic rise in prices of other goods or services in a portfolio of multiproduct firms (Spengler, 1950; Comanor, 1967; Hastings and Gilbert, 2005; Luco and Marshall, 2020). Eventually, the overall welfare effects from the elimination of double margins are ambiguous, as pointed out by Choné, Linnemer, and Vergé (2023), because they depend on the distribution of bargaining power in upstream and downstream markets, possibly bringing heterogeneous impacts on the ability to source from other independent suppliers.

1.3 Data and Preliminary Evidence

We source firm-level financial accounts and ownership information from the Orbis database compiled by the Bureau Van Dijk[3]. First, we collect financial information on 384,380 European subsidiaries in the manufacturing industries from 2007 to 2021. Among them, we define a subsidiary as a company that a corporate shareholder controls thanks to an absolute majority of voting rights at the shareholder assembly. Therefore, we can

[3]The Orbis database standardizes firm-level financial accounts and ownership on a global scale. It also includes an ownership module that allows tracking changing shareholding information at the firm level. Orbis data have been increasingly used for firm-level studies on multinational enterprises. See for example Cravino and Levchenko (2016), Del Prete and Rungi (2017), Del Prete and Rungi (2020), Alviarez, Head, and Mayer (2020)

follow acquisition cases when a corporate shareholder reaches more than 50% of equity stakes in our observation period.

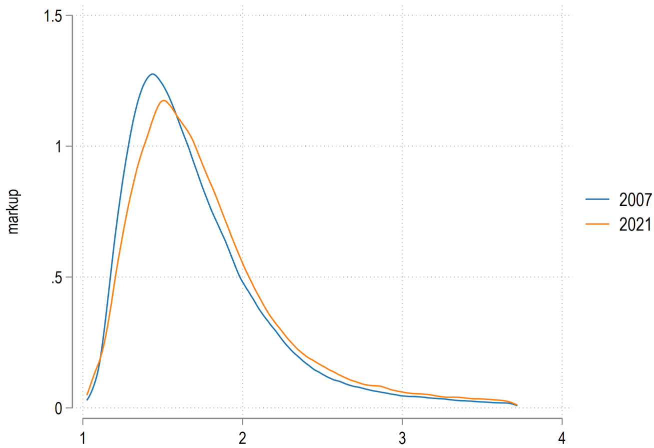
For the scope of our study, we estimate firm-level markups as a proxy for market power following the methodology proposed by De Loecker and Warzynski (2012)[4]. In Figure 1, we show the distribution of markups we obtained for all firms in 2007 and 2021. In line with previous studies, most firms have relatively low markups, while only a few firms on the right tail have disproportionately higher market power. We observe a slight shift in the distribution of markups at the beginning and end of the period, suggesting that markups have increased over time and that there is a reallocation towards firms with high markups. To provide evidence about changing patterns of markups, we aggregate sales-weighted markups as in Figure 2. Even though the time span covered in our analysis is insufficient to provide a long-term trend of market power, we can fairly notice that markups are volatile, albeit generally increasing from 2007 to 2021. However, aggregate estimates might hinder likely heterogeneity emerging when considering different industries. For this reason, we plot separate trends by 2-digit NACE industries in Figure 3.

Despite the great degree of heterogeneity in average markups across sectors, we can notice a general increasing trend over time with several exceptions such as the manufacturing of food and textiles products as well as wood, paper and printing.

Taken together, descriptive evidence confirm also for the manufacturing firms in the European Union, the increasing trend of market power already observed in the literature. In the remainder of the chapter, we shed light on the peculiar role of M&A activities in affecting the trends of markups and other firms' outcomes. In particular, in the empirical analysis, on top of markups, we will look at different variables that can help understand the overall impact of takeovers on firms' performance. The empirical analysis will, therefore, focus on several outcome vari-

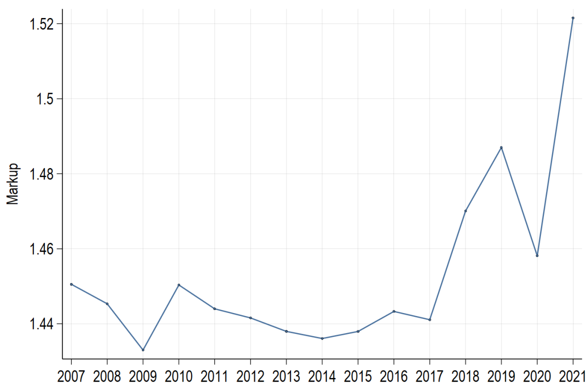
[4] In Appendix A, we describe the details of the procedure while in section 1.5 we address potential concerns related to the estimation of the markup ratios following the most recent lines of literature.

Figure 1: Distribution of markups in the European Union



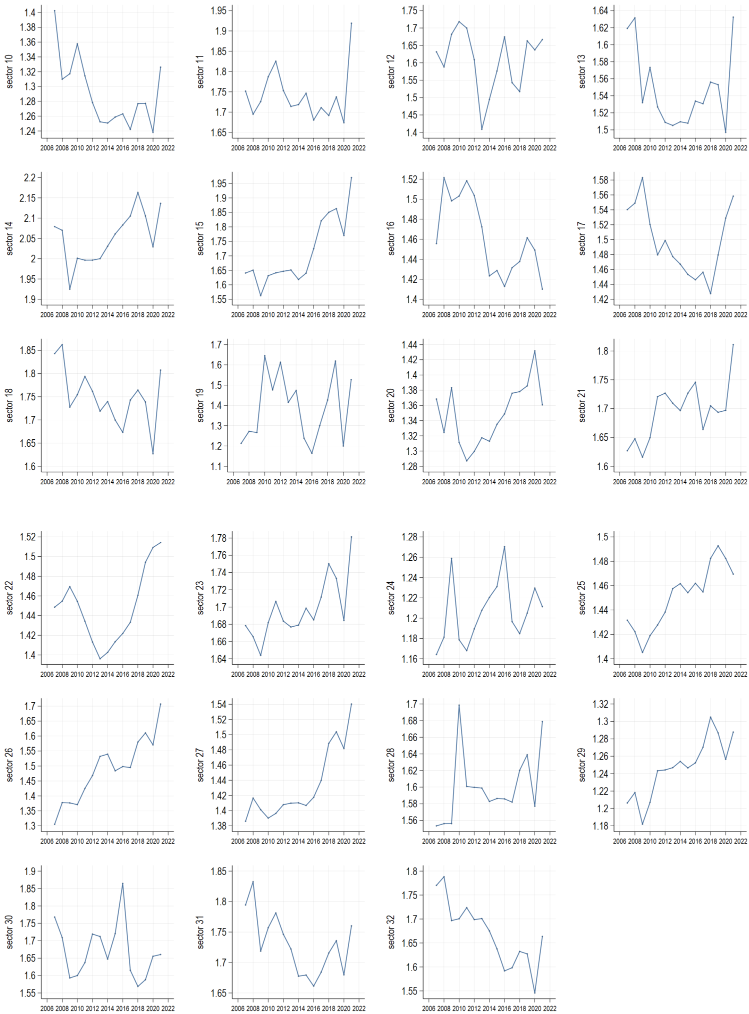
Note. Distribution of markups of European manufacturing firms in 2007 and 2021. Markups are estimated following De Loecker and Warzynski (2012). The distribution presents a mean value of 1.74 with a median equal to 1.63 and a standard deviation of 0.47.

Figure 2: Evolution of aggregate markups



Note. The figure reports European manufacturing firms' sales-weighted average markup over time in 2007-2021. Markups are estimated following De Loecker and Warzynski (2012).

Figure 3: Sales-weighted average markup in the European Union, 2007-2021



Note. The figure reports the sales-weighted average markup for 2-digit NACE rev. 2 manufacturing industries. Markups are estimated following De Loecker and Warzynski (2012).

ables: markups, market shares, sales, variable costs, TFP, return on investments, capital intensity, liquidity, and solvency ratios. It is reasonable that firms, after a takeover, will experience changes in their business strategy and organizational structure that will likely affect the overall performance. Thus, we first look at market shares to check whether there is a direct effect, especially in cases of horizontal integration. We analyze the impact on sales and variable costs as proxies of the firm's growth volume. We measure productivity by looking at TFP, estimated following Ackerberg, Caves, and Frazer (2015). We also analyze the impact of takeovers on return on investments, measured as the ratio between profits and lagged fixed assets, and capital intensity. In conjunction with markup changes, return on investments can increase or decrease due to price changes that will affect profits, unless we observe an increase in the growth volume. Also, capital intensity, measured as fixed assets per employee, can be impacted due to synergies resulting from rationalizing the organizational structure and production process. Table 1 shows summary statistics for the variables included in the analysis, while Table 21 in the Appendix shows pairwise correlation between variables. For our purpose, we extract from our general sample a total of 4,047 cases of firm-level takeovers distributed over time, whose coverage is reported in Appendix Table 19. Please note that we exclude from the analysis cases of multiple acquisitions of the same subsidiary in our period of analyses, assuming that treatment can occur at most once for each firm. This is consistent with the idea that direct investment has a longer-term perspective and, thus, any shorter-run management of equity in an investor's portfolio is not able to significantly have an impact on the management of economic activities. In Appendix Table 20 we have a look at the sample coverage of takeovers across sectors, revealing that there is a substantial degree of heterogeneity, with the highest number of takeovers in the manufacturing of metal products, machinery and equipment and manufacture of food products.

A preliminary analyses on how firms that have been taken over compare with other firms in the sample is reported in Table 2. We perform

Table 1: Variables' description

Variables	Description	Mean	St. Deviation
Markup	estimated following De Loecker and Warzynski (2012)	1.73	0.46
Sales	as from original financial information	9,090,705	185,000,000
ROI	return on investment: profits on fixed assets	9.49	1,746
Capital intensity	fixed assets per employee	57,658	164,987
TFP	estimated following Ackerberg, Caves, and Frazer (2015)	6.63	2.41
Fixed assets	as from original financial information	4,327,012	2,000,000
Value added	as from original financial information	2,736,420	5,570,000
Number of employees	as from original financial information	42	419
Market Share	firm's revenues over total by country-sector-year	0.009	0.008
Variable costs	sum of costs of materials and employees	6,616,800	149,000,000

Note. The table provides description and summary statistics of the variables used in the analysis.

Table 2: Targeted firms vs. non-targeted firms

Variable	Average target firm	Average non-target firm	t-test $\Delta \neq 0$
Markup	1.57	1.73	-0.16***
Sales	35,500,000	8,609,737	26,900,000***
ROI	6.07	9.56	-3.49***
Capital intensity	93,956	56,999	36,957***
(log of) TFP	6.31	6.64	-0.33***
Fixed assets	15,000,000	4,133,028	10,900,000***
Added value	8,528,065	2,619,259	5,908,805***
N. of employees	121	41	80***
Market share	0.003	0.0008	0.002***
Variable costs	26,300,000	6,259,894	20,000,000***

The table reports average values of variables of interest with a t-test for significance. Markups are estimated following De Loecker and Warzynski (2012). *** stands for $p < 0.001$.

t-tests for a set of variable of interest to check whether there is any systematic difference across the two subset. Indeed, we acknowledge that the average values of sales, capital intensity, fixed assets, added value, number of employees, market shares and variable costs are higher in the case of firms that have been acquired (i.e, our treatment group) vs. the ones that never changed ownership majorities. On the other side, we find lower average values for markups, profitability and productivity for targeted firms. From another perspective, we can say that it is very likely that bigger firms are more attractive targets for acquisitions. It is clear that differences in firms' performances can be endogenously related to events of acquisitions. Therefore, the following analyses will take care of randomization to challenge reverse causality and establish the causal contribution of takeovers to firm-level outcomes, with a special focus on market power, which we proxy with firm-level markups.

1.4 Empirical Strategy

In this section, our aim is to test the impact of takeovers on firm-level outcomes. For our purpose, we implement an empirical strategy in two steps. First, we combine a propensity score matching with a difference-in-difference model with a panel data setting, when staggering treatments can occur in multiple periods. For our exercise we rely on the procedure proposed by Callaway and Sant'Anna (2021). We consider as treated those firms that were taken over compared to a control group obtained after a propensity score matching. In this case, Callaway and Sant'Anna (2021) propose a match procedure that exploits all available information on untreated companies with the adoption of inverse probability of treatment weights. The scope is to eliminate the endogenous selection bias of targeted firms into the treatment, since we assume that firms with the best economic potential were screened by acquirers before a bid. On the other hand, the methodology by Callaway and Sant'Anna (2021) improves on a classical difference-in-difference approach because it considers the bias of heterogeneity in treatment timing, i.e. when takeovers can occur endogenously and asymmetrically over the timeline we can observe. At a second step, we separate events of vertical integration from the rest of the takeovers, as the first indicate an organization of supply chains within or across national borders. The intuition is that the vertical integration of supply chains under the coordinated management of a parent company implies a different organization of production processes whose impact on market power has been neglected by previous literature.

1.4.1 Market power and takeovers

First, we estimate firm-level markups using the well established methodology proposed by De Loecker and Warzynski (2012). Please refer to Appendix A for a detailed description on how to recover firm-level markup using the production function approach. We discuss some of the main limitations and concerns related to this estimation method in Section 1.5. To estimate the causal impact of firms' acquisitions, we follow the difference-in-difference strategy proposed by Callaway and Sant'Anna (2021) in a panel setting, since: i) takeovers can occur in multiple time periods; ii) we have variation in treatment timing, as we observe an increasing trend in takeovers; iii) we can assume that the parallel trends assumption holds only after conditioning on observed firm-level characteristics.

Briefly, our doubly robust estimator identifies multiple $ATE(g,t)$ for each cohort of treated firms. Each cohort represents a group g of firms that have been taken over in the same year t. It is therefore possible to estimate a set of coefficients, one for each cohort, to track down the impact of the takeover over time. Thus, one can aggregate and obtain a unique coefficient that aggregates the impact of takeovers over the entire timeline. The estimator is obtained as follows:

$$ATE(g,t) = \mathbb{E}\left[\left(\frac{G_g}{\mathbb{E}[G_g]} - \frac{\frac{p_g(X)C}{1-p_g(X)}}{\mathbb{E}\left[\frac{p_g(X)C}{1-p_g(X)}\right]}\right)(Y_t - Y_{g-1} - m_{g,t}(X))\right] \quad (1.1)$$

where G_g is a binary variable that is equal to 1 if a unit is first treated in period g and C is a binary variable equal to 1 for firms never object of an acquisition; $p_g(X) = P(G_g = 1|X, G_g + C = 1)$ is the probability of being acquired for the first time in the period g conditional on observed financial information and either being a member of group g or not being acquired in any time period; $m_{g,t}(X) = \mathbb{E}[Y_t - Y_{g-1}|X, C = 1]$ is the population outcome regression for the control group of firms that have never been acquired. We refer to Callaway and Sant'Anna (2021) for a more complete discussion on the methodology. We choose to use the doubly robust alternative as it provides for a combination of inverse probability weights with an outcome regression approach[5] That is, the counterfactual group is obtained by using information about all units that are untreated, assigning to each unit an inverse probability weight of being similar to one that is actually being treated. To further attenuate the selection bias, we also include in the control group the not yet treated units, i.e. firms that are subject to takeovers in subsequent periods.

By estimating separate $ATE(g,t)$ we can therefore identify differences in the causal effect of the treatment for each cohort and we are therefore able to determine the degree of heterogeneity of the treatment across groups over time. To estimate the aggregate effect of firms' takeovers on markups we can finally compute a weighted average of previously defined $ATE(g,t)$ in the following way:

$$\theta_s^O = \sum_{g=2}^{T} \theta_s(g) P(G=g) \tag{1.2}$$

where,

$$\theta_s(g) = \frac{1}{T-g+1} \sum_{t=2}^{T} \mathbf{1}\{g \leq t\} ATE(g,t) \tag{1.3}$$

and T denotes the number of years. $\theta_s(g)$ allows to highlight treatment effect heterogeneity with respect to the year in which the firm has been acquired. We can aggregate the latter parameter at a higher level and get θ_s^O that is the overall estimate of the impact of takeovers on firms' outcomes. In other words, the aggregate coefficient is computed as a weighted average of the time-specific parameters $\theta_s(g)$ using group-specific weights, $P(G=g)$'s, that are obtained considering the relevance of each group over the total sample.

Table 3 shows the baseline results[6], where we control for firm-level

[5]Note that we cannot provide statistics related to the matching procedure, i.e. balance tests after reweighting or distributions after matching, because the IPW and related P-scores are estimated separately for each cohort ($ATT_{g,t}$). In our case, the estimations rely on the *csdid* command in Stata which automatically runs all the relevant logit regressions to estimate the P-scores for each cohort.

[6]Note that the sample size varies depending on the specification due to the presence

characteristics and industry fixed effects. After the takeover, we observe an increase in the scale of operations, evidenced by higher sales of about 2% and variable costs of 2.6% as shown in columns (3) and (4). Notably, the variable cost ratio, as displayed in column (5), remains largely unchanged, implying that the rise in sales and variable costs is balanced. Moreover, the evidence suggests a marked decrease in the capital intensity of the targeted firm of about 6.2% and an increase in return on investments (ROI) of about 2%. This could be the result of the acquiring company's strategic decisions, such as optimizing operations and reducing unnecessary assets, or the merging of overlapping operations post-acquisition, which results in a more streamlined asset base and a higher profitability. Interestingly, we do not observe significant changes in market power, market shares and TFP.

Table 3: Average treatment effect (ATE) of takeovers on firm-level outcomes

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Markup	Market share	Sales	Variable cost	Variable cost ratio
Post Treatment	-0.003	0.003	0.020***	0.026***	0.003
	(0.002)	(0.008)	(0.006)	(0.007)	(0.003)
Observations	3,641,976	3,641,976	3,641,976	3,641,976	3,625,187
Controls	YES	YES	YES	YES	YES
	(6)	(7)	(8)	(9)	(10)
VARIABLES	TFP	ROI	Capital Intensity	Liquidity Ratio	Solvency Ratio
Post Treatment	-0.003	0.021**	-0.064***	-0.035	-0.059*
	(0.003)	(0.010)	(0.012)	(0.028)	(0.035)
Observations	3,641,976	3,251,840	3,641,976	2,682,148	2,492,879
Controls	YES	YES	YES	YES	YES

The table reports results following the difference-in-difference approach by Callaway and Sant'Anna (2021). ATE coefficients are obtained as a weighted average that considers the importance of each cohort of firms. The estimator is doubly robust, and we control for firm size, age, capital intensity, TFP and 2-digit industry. The control group includes firms that are never treated and firms that are not treated yet. Standard errors clustered at the firm level are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

of missing values. Although we are aware that the sample of companies included in each specification varies slightly, this allows us to avoid losing information when available.

1.4.2 Vertical vs. horizontal integration strategies

To identify whether heterogeneous changes in markups stem from different integration strategies, our next step is to separate cases of vertical and horizontal integration. The rationale for separating strategies is that there are different mechanisms at play. Firms engaging in horizontal takeovers absorb a direct competitor, possibly achieving economies of scale. Vertical integration strategies aim at absorbing a buyer or a supplier, therefore possibly pursuing cost-saving strategies along a supply chain, when intermediate inputs are delivered intra-firm, after the acquisition. On the other hand, one cannot exclude that there are indirect anti-competitive effects when a dominant position in the markets for inputs allows a competitive advantage over direct competitors.

To identify horizontal mergers, we check whether the corporate shareholder and its subsidiary belong to the same industry at the 2 digit level of the NAICS 2002 classification. To identify vertical integration we follow J. P. Fan and Lang (2000), Acemoglu, Johnson, and Mitton (2009), Alfaro, Conconi, et al. (2016), and Del Prete and Rungi (2017) by using Input-Output coefficients derived from the Bureau of Economic Analysis (BEA). We compare technical coefficients of the industry in which the subsidiary operates with the median coefficient of inputs required by the industry in which the parent company operates. We assume that a subsidiary is in a vertical relationship with the parent company if the I-O technical coefficient between the subsidiary industry and the parent industry is above the median. Out of the 4,047 cases of acquisition in our sample, we can distinguish 852 events of horizontal acquisitions and 1,677[7] of vertical acquisitions. Table 4 reports results for vertical and horizontal acquisitions[8] as shown in panels (a) and (b), respectively.

[7] Almost 57% of vertical takeovers refer to cases where the target firm is upstream with respect to the acquiror, while about 43% of cases are those where the target firm is downstream with respect to the acquiror.

[8] For vertical integration, horizontal acquisition cases are excluded from the sample and vice versa. Also, cases of alternative integration strategies, i.e. neither vertical nor horizontal, are always excluded. Thus, in both cases, the control group includes companies that have never been treated. In addition, the control group includes companies that will be

Table 4: Average treatment effect (ATE) of takeovers: vertical vs. horizontal integration strategies

(a) Vertical integrations

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Markup	Market share	Sales	Variable cost	Variable cost ratio
Post Treatment	-0.005**	0.007	0.025***	0.032***	0.003
	(0.002)	(0.010)	(0.008)	(0.009)	(0.004)
Observations	3,617,761	3,617,761	3,617,761	3,617,761	3,600,976
Controls	YES	YES	YES	YES	YES
	(6)	(7)	(8)	(9)	(10)
VARIABLES	TFP	ROI	Capital Intensity	Liquidity Ratio	Solvency Ratio
Post Treatment	-0.004	0.025**	-0.077***	-0.130***	-0.088***
	(0.004)	(0.012)	(0.016)	(0.024)	(0.029)
Observations	3,617,761	3,229,453	3,617,761	2,665,475	2,476,635
Controls	YES	YES	YES	YES	YES

(b) Horizontal integrations

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Markup	Market share	Sales	Variable cost	Variable cost ratio
Post Treatment	-0.002	0.011	0.029***	0.037***	0.004
	(0.003)	(0.014)	(0.011)	(0.012)	(0.006)
Observations	3,604,478	3,604,478	3,604,478	3,604,478	3,587,698
Controls	YES	YES	YES	YES	YES
	(6)	(7)	(8)	(9)	(10)
VARIABLES	TFP	ROI	Capital Intensity	Liquidity Ratio	Solvency Ratio
Post Treatment	-0.002	0.014	-0.050**	0.129***	0.319***
	(0.006)	(0.020)	(0.022)	(0.036)	(0.059)
Observations	3,604,478	3,217,185	3,604,478	2,655,453	2,466,772
Controls	YES	YES	YES	YES	YES

Table shows results of the doubly robust Callaway and Sant'Anna (2021) estimator, using both never treated and not-yet-treated units in the control group. Variables are in logs. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** $p<0.01$ ** $p<0.05$ * $p<0.1$

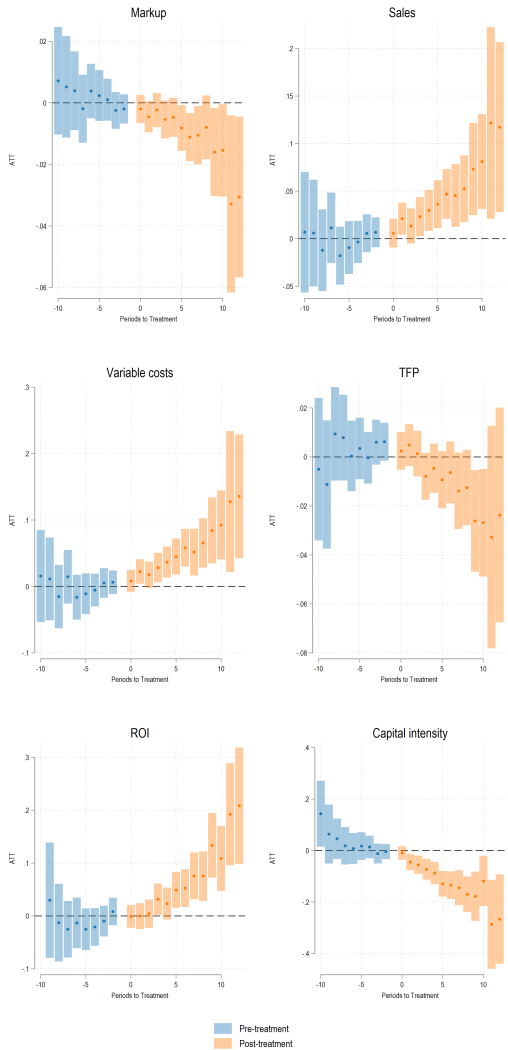
At this stage, we find a significant impact of the takeover on markups only in the case of vertical integration strategies. In particular, we ob-

subject to vertical acquisitions in future periods for vertical cases and horizontal acquisitions for horizontal cases.

serve in Table 4 Panel (a) that the acquired firm shows on average a 0.5% lower markup, as in column (1) together with an increase of return on investments of 2.5%, an increase in the scale of operations and a decrease in capital intensity of 7.4%. The gains stemming from vertical integration can be directly related to the access of either tangible or intangible inputs at a lower cost (Atalay, Hortaçsu, and Syverson (2014)), eventually obtaining productivity gains achieved through more efficient use of, for example, technology and logistics (Hortaçsu and Syverson (2007)). Notably, in our case, we find robust evidence that targeted firms in the European Union increase their profitability and their scale of operations after the takeover, but, differently from other works in the literature (McGuckin and Nguyen, 1995; Gugler et al., 2003; Maksimovic, Phillips, and Prabhala, 2011) that find evidence of a positive impact on productivity measures, we find significant evidence of lower productivity and capital intensity. In Panel (b), when we look at horizontal acquisitions, we find significant changes in the firm-level outcomes we test, only for sales and variable costs, which increase at a similar rate suggesting the presence of economies of scale, while we do not find significant changes in profit margins, as Bertrand and Zitouna (2008). As for vertical takeovers, we find a significant decrease for capital intensity, while liquidity and solvency ratios show an opposite trend. Indeed, liquidity and solvency ratios are intended to assess the financial stability of the firm. The solvency ratio considers all of a company's assets, including long-term debt such as bonds with a maturity of more than one year, while the liquidity ratio, on the other hand, takes into account only the most liquid assets, such as cash and marketable securities, and how these can be used to cover upcoming obligations in the short term. We find opposite results for vertical and horizontal integration strategies: while after a vertical acquisition firm often experience lower liquidity and solvency ratios due to increased inventories, higher integration costs, and additional debt, in contrast, horizontal acquisitions typically result in higher liquidity and solvency ratios due to operational efficiency, synergies, and a stronger combined balance sheet. In summary, the results indicate that following a vertical integration, targeted firms become more profitable by reducing their markups and increasing the scale of operations, while they decrease capital intensity. Notably, this decrease in capital intensity, despite a decline in fixed assets per employee, aligns with improved operational efficiency, consequently facilitating an expansion in production volume and a reduction in markup. Figure 4 shows the results of an event study setting for the impact of vertical takeovers on the main outcome variables, providing evidence of stronger results in the periods following the takeover and suggesting that the effects of the acquisitions are not temporary in the medium term.

Eventually, our results align with other works (Berto Villas-Boas, 2007; Gil, 2015; Crawford et al., 2018), as we argue that lower markups by acquired firms can be the consequence of efficiency gains obtained after the elimination of double margins. Double marginalization is an externality that occurs when two firms that have market power, being involved in a supply chain relationship, both apply an optimal markup to their prices beyond marginal costs, while facing a steep demand curve. Despite of the efficiency gains stemming from the elimination of double margins, we cannot exclude that a vertical integration strategy might create distortions in the rest of the market through the foreclosure of other competitors or a strategic rise in prices of other goods or services in a portfolio of multiproduct firms (Spengler, 1950; Luco and Marshall, 2020). Morevoer, from a welfare point of view, double marginalization along supply chains has a negative impact. It induces deadweight losses because the final consumer price is higher than the price in a context of vertical integration. Therefore, the elimination of double margins can be considered an efficiency gain although in presence of a market power by a vertically integrated production unit. In this event, the upstream firm can decrease its margin selling its products at the downstream company at a lower price, decreasing therefore the total markup on consumers. It is beyond the scope of our analyses whether there is indeed an overall welfare effect in Europe from takeovers' activities. Yet, we refer to the theoretical work of Choné, Linnemer, and Vergé (2023), who discuss how the elimination of double margins can have an ambiguous effect on total welfare. Depending on the distribution of the bargaining power among

Figure 4: Event study after vertical takeovers



The figure shows the effect of vertical takeovers in an event study setting following Callaway and Sant'Anna (2021). The event study plots consider symmetric differences before and after the treatment.

the parts involved in the acquisition, a vertical integration strategy can threaten the market position of the other independent suppliers, therefore leading to foreclosure effects. When the buyer has full bargaining power over prices and quantities, the vertical acquisition always benefits final consumers, while in cases of reduced bargaining power after the buyer has committed to deal exclusively with a more limited set of suppliers, exclusion of efficient suppliers potentially harms final consumers.

The issue of double margins attracted renewed interest by policymakers especially after the publication of the U.S. Vertical Merger Guidelines in 2020, according to which pro-competitive effects deriving from vertical integration are almost entirely to be attributed to the elimination of double margins.

Although we do not find, at the aggregate level, a major decrease in markups after acquisitions, this may be the consequence of a composition effect resulting from firms lowering their markups as a result of the elimination of double marginalization, while others are able to strengthen their market power even though they are in a vertical relationship. We further test this hypothesis by examining the impact of acquisitions on market power within industries. The table 25 in the Appendix shows the results for industries where statistically significant markup changes is observed. With the exception of firms operating in the production of wood products and pharmaceuticals, which significantly increase their markups (2-5%), the rest of the firms have a substantial decrease in their markups, particularly those producing chemicals (-2.7%) and electronics (-3.4%).

By looking at horizontal takeovers in panel (b) of Table 4, we find that they do not have any significant impact either on markups or market shares in our sample of European takeovers. This is also an important result, as it could indicate that the European competition policy is successful in limiting market abuses in the case of mergers and takeovers. Nonetheless, we find evidence that both sales and variable costs are higher after a horizontal integration, pointing to an overall impact on firm size.

1.5 Robustness and sensitivity analysis

In this section, we perform a battery of robustness and sensitivity checks on our previous analyses. The first concern is that, up to now, we focused exclusively on the impact on subsidiary firms. We can check now the consistency of our results looking at changes in the outcomes of the parent companies, after considering as treated those that have acquired a majority equity stake in at least one subsidiary in our period of analysis. Tables 23 and 24 in Appendix shows the results obtained after our baseline methodology. Notably, we do not find any significant change in the level of markups of parent companies. We argue that our findings are compatible with an elimination of double margins. In line with expectations, the reduction would be mainly on the side of integrated suppliers, who deliver cheaper intermediate inputs to the downstream company after an intra-firm coordination of economic activities.

A second concern relates to the methodology we adopt to estimate markups. We rely on the production function approach following De Loecker and Warzynski (2012), who adapt the cost-based approach initially developed by Robert E. Hall (1988). In particular, exploiting firm-level data, markups are computed as an estimate of price over marginal cost, as proxied by the output elasticity of an input over the expenditure share on that input. The advantage of this method with respect to the demand approach is that it requires minimal data and relatively weak assumptions. Nevertheless, important pitfalls have been discussed by Basu (2019), Syverson (2019) and Traina (2018). Recent work by Bond et al. (2021) highlights identification and estimation issues, when firm-level output prices are not directly observed. To address a potential omitted price bias, we convert revenues to quantities using industry-wide price deflators and we estimate the output elasticity of materials across sectors, holding fixed the time dimension. We assume that materials are a flexible input and that there are no adjustment costs. In this way, as already pointed out by De Loecker et al. (2021), the change in the ratio of revenue to the materials' expenditure is a direct estimate of the change in the markup. We conduct a sensitivity analysis on the markup measure by varying our choice of flexible inputs. Specifically, we examine whether the observed decrease in markup following vertical takeovers is driven by the selection of the flexible input. Table 5 presents the results using either labor or a composite input. The composite input is constructed as the sum of materials and labor as in Raval (2023), representing our best approximation of the cost of goods sold, although it does not include information on overhead costs, which may be fixed, such as rent, mortgage, government and property taxes, and variable, such as operating utilities like electricity, gas and light. Once again, we observe a substantial reduction in markups after vertical integration in column (4), with a magnitude similar to our findings in the baseline estimation and we also find an overall decrease of markups in column (2). However, we do not find significant changes of the level of markups when we consider labor markups. This evidence is in line with Raval (2023), who finds empirical support that markups estimated using labor and materials are negatively correlated and have opposite time trends, possibly due to non-neutral productivity differences across firms. Overall, our evidence demonstrates the consistency of the results considering that we never find any significant increase in markups, independently of the choice of the flexible input.

In the main analysis we estimate firm level markups using the output elasticity derived with the methodology proposed by Ackerberg, Caves, and Frazer (2015). We compare it with the output elasticity obtained with an OLS estimation of the revenue production function with labor and materials as intermediate inputs. Column (1) of Table 6 shows the results of the baseline Callaway and Sant'Anna (2021) with markups derived from the OLS estimator. We get consistent results as subsidiary firms subject to vertical takeovers reduce their level of markups of about 0.4%, as in column (3).

Another methodological concern is about the adoption of a panel set-

Table 5: Average treatment effect (ATE) on markups: sensitivity to measures of markups

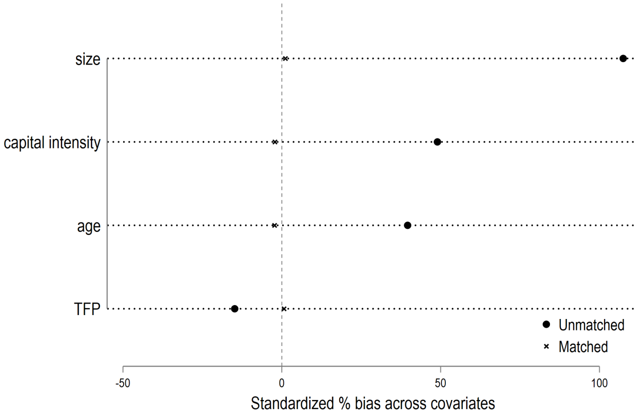
	Baseline		Vertical	
	(1)	(2)	(3)	(4)
	Markup Labor	Markup composite input	Markup Labor	Markup composite input
Post Treatment	-0.004	-0.001**	-0.002	-0.001*
	(0.005)	(0.000)	(0.006)	(0.001)
Observations	3,641,976	3,641,976	3,617,761	3,617,761

Note. The table shows results using estimations of firm-level markups à la De Loecker and Warzynski (2012) relying on different variable inputs: columns (1) and (3) reports results using labor for the baseline and vertical integrations respectively. Columns (2) and (4) report results using a composite input given by the sum of labor and materials as variable input. Variables are in logs. Control variables are included but not reported. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** p<0.01 ** p<0.05 * p<0.1

ting. Our preferred approach á la Callaway and Sant'Anna (2021) is able to catch variation in treatment timing, as we explained in Section 1.4. Yet, we may want to compare with a more classical combination of propensity score matching with a two-periods difference-in-difference approach, to check the sensitivity of our results to the empirical strategy. For our purpose, we first derive a control group made of firms with similar characteristics, which we use as a counterfactual for the absence of treatment. Our aim is to control for potential self-selection of firms into a treatment status, as in the case of cherry-picking by parent companies that screen for companies with the best economic potential. We implement our propensity score matching using a 4-nearest neighbor matching scheme with the assumption of a common support[9]. The match is obtained after a logit regression that predicts the probability of receiving the treatment based on firms' size, capital intensity, productivity and age. We perform the matching process separately for firms in the same 2-digit industry in a given year. To assess the overall goodness-of-fit of the matching procedure, Figure 5 shows the standardized % bias across covariates before and after matching for the entire sample.

[9]Unlike the matching process implemented in the main analysis, in which all observations are retained and have an assigned weight, in this case we use a subsample in which for each treated unit, 4 control units are associated through the similarity of the P-scores.

Figure 5: Goodness of matching process on observable covariates



Note. The figure shows the standardized bias % across the covariates used in the matching process. The matching succeeds in nulling the bias for each covariate after matching.

Having a suitable control group, we proceed by estimating the usual difference-in-difference specification on our matched sample:

$$y_{i,t} = \beta_0 + \beta_1 T_i + \beta_2 Post_{i,t} + \beta_3 T_i * Post_{i,t} + \beta_4 X_{i,t} + \gamma_t + \delta_k + \omega_l + \epsilon_{i,t} \quad (1.4)$$

where $y_{i,t}$ represents the logarithm of the outcome variables considered (markups, TFP, market shares, profitability, sales, variable costs, and profits), T_i is a dummy to identify treated firms, $Post_{i,t}$ is a dummy variable equal to 1 if the firm has been the target of a takeover at time t. In the above specification γ_t, δ_k and ω_l represent fixed effects for years, countries[10] and 2-digit NACE rev. 2 sectors, respectively, while $X_{i,t}$ is a set of control variables including capital intensity, age, TFP and firm size. β_3 is our coefficient of interest, indicating the effect of the takeover on the outcome variable capturing the average difference on treated firms be-

[10]Note that in the main estimation à la Callaway and Sant'Anna we are not able to include country fixed effects as the ATE for many groups would not be identified.

fore and after the treatment. Column (2) of Table 6 shows the impact on markups, and we record a decreasing markup (3.4%) also in the baseline, while we find lower markups with a higher magnitude than previous results (3%) for vertical takeovers, as in column (4).

Table 6: Average treatment effect (ATE) on markups: sensitivity to methodologies

	Baseline		Vertical	
	(1)	(2)	(3)	(4)
VARIABLES	OLS Markup	DID Markup	OLS Markup	DID Markup
Post Treatment	-0.003	-0.035***	-0.004*	-0.030***
	(0.002)	(0.005)	(0.002)	(0.006)
Observations	3,569,458	139,338	3,545,888	126,322
Controls	YES	YES	YES	YES

The table shows results on markups adopting an OLS revenue production function estimation (columns 1 and 3) and a two-period difference-in-difference after a propensity score matching (columns 2 and 4). Standard errors clustered at the firm level are reported in parentheses and significance levels are *** p<0.01 ** p<0.05 * p<0.1

A third concern relates sample composition, as the takeovers can have a different industrial or geographical coverage. In the first case, we want to check whether a different impacts of takeovers can arise from an implicit changing level of technology intensity of the production processes. We know from previous industrial organization literature (Berry, Gaynor, and Scott Morton, 2019), that technology does have an impact on market structures. Based on industrial affiliations, we perform an exercise to classify subsidiary firms following Eurostat that separates Low, Medium-Low, Medium-High, and High technological intensity. The classification is based on the sector-level amount of Research and Development expenses and on the propensity to generate intellectual property rights. Appendix Table 22 reports sample coverage along this dimension, showing that almost half of the firms are active in Low Tech industries, while High Tech represents just 3% of the sample. Eventually, we estimate the impact of acquisition on each subsample using our baseline methodologies. As shown in Table 8, the negative impact on markups after vertical strategies on supply chains is mainly explained by the integration of suppliers active in medium-high tech industries. Other categories by technology intensity do not show any statistical significance on *ex-post* markups. We argue that the latter evidence is consistent with the intuition that in medium-high tech industries there is more room to reduce margins for an intra-firm delivery of intermediate inputs, thus reducing frictions from double marginalization. The rationale behind this is that high-tech companies, by nature, tend to make substantial investments in innovation and R&D, leading to higher prices and consequently, higher markups on their products. In Appendix Table 26 and 27, we also show results on the sample that includes horizontal integrations, eventually confirming results from previous analyses.

Finally, we test whether the impact of takeovers is heterogeneous depending on the location of the subsidiaries. We separate target firms located in so-called New Members of the European Union from the ones that locate in former EU members[11]. Our prior is that New EU Member countries have a relatively younger industrial structure, mainly built in the recent decades after the transition from a planned economic system, where there has been less room for brownfield investment operations in recent years, and where frictions from double marginalization could be less relevant. Indeed, when we check for sample coverage, we find that we have a strong prevalence of acquisitions in former EU Member countries. Appendix Tables 28 and 29 show the impact on the main outcomes of interest. We find consistent evidence that takeovers have an impact on the size of operations and the reduction on capital intensity mainly thanks to operations occurring in the former EU members, while we do not observe significant changes in markups.

[11]Former EU members include: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, Sweden and UK. New EU members include: Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

Table 7: Average treatment effect (ATE): classification by technology intensity after vertical integration

(a) Low Tech

VARIABLES	(1) Markup	(2) Market share	(3) Sales	(4) Variable cost	(5) Variable cost ratio
Post Treatment	0.002	-0.019	-0.014	-0.007	0.008*
	(0.005)	(0.021)	(0.016)	(0.018)	(0.005)
Observations	1,551,923	1,551,923	1,551,923	1,551,923	1,544,077
VARIABLES	(6) TFP	(7) ROI	(8) Capital Intensity	(9) Liquidity Ratio	(10) Solvency Ratio
Post Treatment	0.001	-0.012	-0.083***	0.002	0.054*
	(0.008)	(0.020)	(0.030)	(0.028)	(0.029)
Observations	1,551,923	1,377,355	1,551,923	1,154,821	1,048,313

(b) Medium-low Tech

VARIABLES	(1) Markup	(2) Market share	(3) Sales	(4) Variable cost	(5) Variable cost ratio
Post Treatment	-0.002	0.026	0.021	0.031**	0.008
	(0.004)	(0.019)	(0.014)	(0.015)	(0.007)
Observations	1,286,707	1,286,707	1,286,707	1,286,707	1,280,582
VARIABLES	(6) TFP	(7) ROI	(8) Capital Intensity	(9) Liquidity Ratio	(10) Solvency Ratio
Post Treatment	-0.005	0.039*	-0.053*	-0.029	-0.020
	(0.010)	(0.021)	(0.031)	(0.025)	(0.032)
Observations	1,286,707	1,151,441	1,286,707	941,750	882,947

The table shows results after the doubly robust estimator proposed by Callaway and Sant'Anna (2021), using never-treated and not-yet-treated units in the control group. Variables are in logs. Control variables are included but not reported. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** p<0.01 ** p<0.05 * p<0.1

Table 8: Average treatment effect (ATE): classification by technology intensity after vertical integration

(a) Medium-high Tech

VARIABLES	(1) Markup	(2) Market share	(3) Sales	(4) Variable cost	(5) Variable cost ratio
Post Treatment	-0.014***	0.016	0.050***	0.057***	0.003
	(0.004)	(0.017)	(0.013)	(0.014)	(0.005)
Observations	665,070	665,070	665,070	665,070	662,707

VARIABLES	(6) TFP	(7) ROI	(8) Capital Intensity	(9) Liquidity Ratio	(10) Solvency Ratio
Post Treatment	-0.007	0.041*	-0.086***	-0.109***	-0.066*
	(0.007)	(0.021)	(0.028)	(0.026)	(0.038)
Observations	665,070	597,932	665,070	480,918	461,031

(b) High Tech

VARIABLES	(1) Markup	(2) Market share	(3) Sales	(4) Variable cost	(5) Variable cost ratio
Post Treatment	-0.016	-0.036	0.037	0.043	-0.017
	(0.014)	(0.045)	(0.034)	(0.035)	(0.028)
Observations	112,297	112,297	112,297	112,297	111,857

VARIABLES	(6) TFP	(7) ROI	(8) Capital Intensity	(9) Liquidity Ratio	(10) Solvency Ratio
Post Treatment	0.010	0.013	-0.040	-0.044	-0.021
	(0.017)	(0.053)	(0.064)	(0.053)	(0.058)
Observations	112,297	101,187	112,297	81,760	78,502

The table shows results after the doubly robust estimator proposed by Callaway and Sant'Anna (2021), using never-treated and not-yet-treated units in the control group. Variables are in logs. Control variables are included but not reported. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** $p<0.01$ ** $p<0.05$ * $p<0.1$

1.6 Conclusion

Rising market power at a global level is an essential concern of policymakers, who interpret it as a sign of *bad market concentration* and declining consumers' welfare. While most of the empirical studies of the literature are focused on what is happening in the United States, there still needs to be more evidence about Europe. This work focuses on the effects of takeovers on market power, as proxied by markups and market shares, as M&A activities are rising in the European Union. Notably, we propose to differentiate between horizontal integration strategies, when parent companies integrate subsidiaries that operate in the same industry, and vertical integration strategies, when parent companies integrate subsidiaries on the same supply chain. Interestingly, we find evidence that target firms lower their markups and that such a decrease is due to vertical integration strategies implemented by takeovers in Europe. Therefore, we argue that our results signal the possible presence of welfare gains achieved through eliminating double margins. A vertically integrated company can reduce the chain of markups along a supply chain, thus enhancing consumer welfare when there is high market power in the inputs markets. On the other hand, we do not find significant markup changes after horizontal integration cases. Further investigations are needed to understand whether global vertical integration waves are finally beneficial to consumers from a general equilibrium perspective after also considering possible foreclosure effects along supply chains. Yet, we argue that efficiency gains brought about by vertically integrated supply chains deserve more attention by policymakers and scholars to understand the whys and wherefores of global market power.

Chapter 2

Navigating Uncertainty: Multinationals' Investment Strategies after the Pandemic Shock

[1]Recent debates suggest that the global economy may enter a deglobalization phase accelerated after COVID-19 and the ongoing conflict in Ukraine. This study investigates the investment decisions by multinational enterprises (MNEs) in 2019-2022. We build on a unique data set of about 2 million parent-affiliate linkages to show that there has been a general reorganization of MNEs' investment strategies since: i) a relevant share of divestments (33%) has not been compensated by new investment decisions (14%); ii) domestic subsidiaries are more likely to be established and less likely to be divested; iii) the average distance of a subsidiary from a parent company has increased; iv) the number of countries in which the average MNE operates is higher than before. Therefore, after a basic empirical strategy for foreign direct investments and gravity controls, we first confirm a higher revealed preference for

[1]This chapter is inspired by the paper "Navigating Uncertainty: Multinationals' Investment Strategies after the Pandemic Shock" by Bellucci and Rungi (2023).

domestic investment by MNEs, among others, induced by higher exposure to COVID-19. When we delve deeper into divestment choices at the firm level, we find evidence of reshoring, i.e., when a divestment abroad by a parent company in a specific industry is positively associated with a domestic investment in the same industry.

2.1 Introduction

Are we living in an era of *deglobalization*? Prior to the emergence of the COVID-19 pandemic, the terms *deglobalization* and *slowbalization* had already gained traction to describe the evolving global economic landscape, marked by a return to domestic economies and a gradual regionalization of production networks. The pandemic crisis may have accelerated this process, as unprecedented disruptions to supply chains resulted in bottlenecks and shortages of intermediate goods. Eventually, the conflict in Ukraine started in February 2021 and led to a severe energy crisis, with direct consequences in Europe and indirect effects felt in countries worldwide. According to UNCTAD (2023), foreign direct investment fell globally by 12% in 2022 to 1.3 trillion dollars, and the decline has been mainly driven by developed economies, where foreign direct investment fell by 37% to 378 billion dollars. Therefore, scholars and policymakers underscore the essential role of enhanced supply chain resilience in times of increased uncertainty. Companies have already become aware of the need to build supply chains that prioritize profitability, resilience, and adaptability in the face of unforeseen disruptions. This recognition has triggered a reevaluation of business models and investment strategies, emphasizing the strength of production networks over cost-saving strategies.

Against the previous background, this study examines firms' investment and divestment decisions in times of heightened uncertainty, like a pandemic shock and an armed conflict. The objective of the analysis is twofold: first we shed light on the changes in the geography of MNEs caused by Covid-19, Russian aggression on Ukraine and other relevant factors through a descriptive analysis; then we empirically address how the Covid-19 shock is associated with changes in investment and divestment at both aggregate and micro levels. We argue that the Covid-19 shock can be seen as a proxy for the uncertainty faced by MNEs, although it is worth noting that the shocks that occurred in the period of analysis are unprecedented in modern history, as they did not only affect a specific region but had global consequences, and thus can be very specific. As far as we know, ours is the first attempt to catch how MNEs are changing their location investment strategies, driving a reconfiguration of global economic activities that can have a long-lasting impact on the degree of global economic integration in the long run. For our scope, we employ an innovative data set that compiles firm-level information to reconstruct parent-affiliate linkages and aggregate them at the country level. This data set enables us to identify the number of investment and divestment decisions made by multinational enterprises (MNEs) between 2019 and 2022, thus offering novel insights into MNEs' location choices at a granular level. While FDI data is typically available in terms of stocks and flows at the country level, such information does not allow for the differentiation of investments from divestments. Our data set, instead, permits us to isolate these strategic choices and analyze investment and divestment patterns using the most recent data up to the end of 2022. Note that we are able to identify investment and divestment choices for a given set of MNEs. Therefore, we are not capturing all aspects of the international reorganisation of firms, as we do not track whether a divested subsidiary is acquired by another MNE or whether a new MNE is created during the period under analysis. Therefore, our study focuses on the strategic choices of existing MNEs in 2019.

At first, looking at descriptive evidence, we find that between 2019 and 2022, multinational enterprises (MNEs) made nearly twice as many divestments as new investments. Across all sectors, we observe that the number of divestments exceeds that of investments, although there is a relevant country-level heterogeneity that we describe. Notably, we find that, on average, a parent company establishes in the domestic country about three out of four new investment projects in 2019-2022. Unsurprisingly, the highest ratio of divestment to investment decisions by MNEs is in the Russian Federation due to the ongoing conflict and economic sanctions. In general, European countries have suffered from a relevant investment turnover, where divestment choices are, on average, higher than new investment choices.

Interestingly, as a result of a reconfiguration of investment strategies, we find that, on average, foreign subsidiaries are geographically more distant from parent companies in 2022 than in 2019. The latter evidence should not come as a surprise to us. After the disruptions due to COVID-19 and the conflict, headquarters chose to differentiate the locations of their economic activities (Javorcik, 2020). Our conjecture is confirmed by statistical evidence, as we also find that MNEs are present, on average, in more countries in 2022 than in 2019.

Eventually, we propose a basic empirical strategy to catch changing investment patterns. First, we estimate a simple gravity model for corporate control á la Head and Ries (2008) to study investment and divestment choices at the country level, which we augment with a COVID-19 measure of risk. From our perspective, COVID-19 risk catches investors' uncertainty when dealing with an unprecedented shock, and we measure it by borrowing from Hassan et al. (2020). The authors develop a metric based on a text-classification method, which identifies firms' exposure to the COVID-19 outbreak. This is achieved by counting the times the virus is mentioned during the quarterly earnings conference calls that publicly listed firms had with financial analysts. We find that a higher COVID-19 risk correlates with more domestic investment decisions. On the other hand, COVID-19 risk is negatively correlated with the propensity to invest in new investment projects abroad.

In the second stage of our basic analysis, we delve deeper into the decision to divest by introducing a parent-level specification that better catches the reshoring decision. We assume that reshoring occurs when a multinational parent company associates foreign divestment choices in an industry with domestic investments in the same industry. Interestingly, we find that this is the case in our period of analysis.

Our investigation contributes to the existing literature addressing the effects of uncertainty on firms' and market's behaviour (Bloom, 2009; Bloom, 2014) and the rapidly expanding body of literature assessing the consequences of the COVID-19 pandemic on the economy, specifically regarding investment strategies and their influence on global supply chains. Espitia et al. (2022) study the trade effects of COVID-19 using a gravity model and find that participation in global value chains increased traders' vulnerability to shocks suffered by trading partners. Still, it also reduced their vulnerability to domestic shocks. Javorcik (2020) advocates for reevaluating global value chains post-pandemic and diversifying suppliers directed towards new destinations. On the contrary, Di Stefano et al. (2022) look at Italian MNEs and find that COVID-19 did not spur large waves of reshoring nor plant closures, but rather, trade policy uncertainty is more likely to provoke such outcomes in the medium term. Muzi et al. (2022) examine whether the COVID-19 pandemic exhibits a Schumpeterian "cleansing" of less productive firms and find that less productive firms have a higher probability of permanently closing during the crisis, especially smaller businesses. Hassan et al. (2020) delve into the granular level by constructing text-based measures of the primary concerns listed firms associated with the spread of COVID-19 and identify which firms perceive to lose or gain from the epidemic. Their findings reveal that the effects of COVID-19 manifest as a simultaneous shock to demand and supply, with both shocks affecting firms' market valuations in equal measure on average.

When it comes to our choice of an empirical strategy, our work relates to a substantial body of literature that has expanded the application of gravity models — initially developed to estimate trade flows among countries (Anderson and Van Wincoop, 2003; Yotov, Piermartini, Larch, et al., 2016) — to the context of FDIs (Bergstrand and P. Egger, 2007; Baltagi, P. Egger, and Pfaffermayr, 2008; S. L. Baier, Yotov, and Zylkin, 2019; Anderson, Larch, and Yotov, 2019). In fact, the theory that derives determinants of trade flows posits that similar frictions apply to FDIs. Numerous empirical studies have sought to identify the most significant determinants of FDIs (Blonigen and Piger, 2014; Bruno et al., 2017; Blonigen, Davies, et al., 2007). Agglomeration effects (Crozet, Mayer, and Mucchielli (2004)), quality of institutions (Alfaro, Kalemli-Ozcan, and Volosovych (2007)) and bilateral investment agreements are examples of well-studied determinants. Gravity models for FDIs have already been used to analyze investment decisions following shocks. Specifically, several works have focused on Brexit as a source of shock and investigated market exits (Bruno et al., 2017; Welfens and F. J. Baier, 2018). On the contrary, few studies have focused on the drivers of divestment decisions (Borga, Flores, and Sztajerowska, 2020). To the best of our knowledge, our study represents the first application of a gravity model for FDI to examine the effects of COVID-19 with global coverage. We employ the structural gravity model for FDI initially proposed by Head and Ries (2008) and augmented with the COVID-19 risk measure sourced from Hassan et al. (2020).

The remainder of the chapter is structured as follows. Section 2.2 outlines the data used and offers descriptive evidence. Section 2.3 details the empirical strategy and the analysis results. Specifically, Section 2.3.1 investigates the impact of COVID-19 on domestic versus foreign investment strategies at the aggregate level, while Section 2.3.2 explores divestment choices at the parent level. Section 2.4 discusses the main limitations of our study and how they could be overcome in the next future, when the right data will be available. Section 2.5 offers a few conclusive remarks.

2.2 Data and descriptive evidence

We obtain firm-level financial accounts and ownership information from the Orbis database, compiled by Bureau Van Dijk[2]. Our data set com-

[2] The Orbis database standardizes firm-level financial accounts and ownership on a global scale. It also includes an ownership module that tracks changing shareholding information at the firm level. Orbis data have been increasingly used for firm-level studies on multinational enterprises. See for example Cravino and Levchenko (2016), Del Prete and Rungi (2017), Del Prete and Rungi (2020), Alviarez, Head, and Mayer (2020), Rungi, Fattorini, and Huremović (2023), Miricola, Rungi, and Santoni (2023)

prises information on 219,365 multinational enterprises (MNEs) and their 2,066,428 affiliates worldwide, accounting for changes in parent-affiliate linkages between 2019 and 2022. Notably, ownership changes are updated regularly as soon as original providers retrieve new information. Usefully, ownership changes allow us to track changes in the set of subsidiaries controlled by multinational enterprises at the end of 2022. However, firm-level financial accounts for that year are still unavailable when we write[3]. Nonetheless, we can always control for firm size with a categorical variable that indicates whether the subsidiary is small, medium, large, or very large, according to a combination of thresholds on basic accounts at the moment of the registration[4].

We define an affiliate as a company controlled by a multinational enterprise possessing an absolute direct or indirect majority ($> 50\%$) of voting rights at the shareholder assembly[5]. A company is considered a multinational if it has at least one affiliate in a country other than that of the parent company. Eventually, we show how our sample exhibits extensive country coverage, encompassing both parent companies and their affiliates worldwide. In Table 9, we report sample coverage by hosting economies in 2019, i.e., before the pandemic shock and the conflict in Ukraine. That year, we had 219,365 parent companies controlling 1,785,368 affiliates worldwide. The most represented area is the European Union, where we have 32.25% of affiliates, followed by the United States (21.82%), while Asian countries host 20.08% of affiliates altogether. As expected, these three areas collect the bulk of activities by multinational enterprises.

[3] A firm produces records of financial accounts only at the end of the fiscal year, which in most countries is usually well into the following calendar year. According to our experience, we can expect full financial accounts with about one year lag in our source.

[4] Companies on Orbis are considered to be very large when they match at least one of the following: i) revenue $\geq$ 100 million EUR; ii) total assets $\geq$ 200 million EUR; iii) number of employees $\geq$ 1,000; iv) they are listed. Large companies match at least one of the following conditions: i) revenues $\geq$ 10 million EUR; ii) total assets $\geq$ 20 million EUR; iii) number of employees $\geq$ 150. Medium companies match at least one of the following: revenues $\geq$ 1 million EUR; ii) total assets $\geq$ 2 million EUR; number of employees $\geq$ than 15. Small companies are companies that do not fit into previous categories.

[5] The majority of voting rights is a standard set by international definitions of multinationals' perimeters (OECD, 2005; OECD, 2008; UNCTAD, 2009).

To proceed with our analysis, we need to derive changes in the corporate perimeter in the following years, up to 2022, with an eye on the changing geography. For the scope of our analysis, we keep fixed the set of parent firms in the sample to study within-MNE decisions; therefore, it is not relevant for us whether divested affiliates have been acquired by other parent firms that were not active in 2019. Thus, investment operations are proxied by the changes in parent-affiliate linkages observed in our data[6]. Therefore, by comparing parent-affiliate linkages before and after the shocks, we can identify three possible investment strategies:

1. maintaining the affiliates that existed in 2019, henceforth *incumbent* affiliates;
2. divesting from an affiliate because the majority link with the parent is not retrieved in 2022[7], henceforth *divestments*;
3. acquiring/establishing a new affiliate, when we find a new majority link that did not exist in 2022, henceforth *investments*.

Eventually, changes in the corporate perimeters of multinational enterprises provide us with a broader picture of the geography trends emerging as a response to the changing economic environment. In Table 10, when we consider the picture at the end of 2022, we observe that there has been an important reorganization by multinational enterprises. Only 53% of parent-affiliate linkages that existed in 2019 were also found in 2022. Interestingly, we record a relevant number of divestment operations (33%) that have been only partially compensated by new investment operations (14%).

At this stage, we assume that the high proportion of divestment operations in our sample is due to the unprecedented shocks in recent years, first the spread of the COVID-19 pandemic and then the outbreak of the conflict in Ukraine. In regular times, we would not observe such

[6]Please note how, in this way, we can catch both cases of brownfield investment, when a parent acquires an existing firm, and greenfield investment, when a parent decides to establish a new affiliate.

[7]In this way, we consider a case of divestment when the parent firm no longer holds an absolute majority, completely divests from the firm, or if the affiliate firm ceases to exist.

a high turnover in corporate control. Our preliminary evidence seems in line with the most recent data provided by UNCTAD (2023), which indicate that FDI flows dropped significantly at the global level on a year-to-year basis (12%), and the trend is mainly driven by developed economies (37%). On the one hand, disruptions caused by the pandemic have prompted many firms to reconsider their global supply chain organization and prioritize resilience over cost savings. On the other hand, after the sanctions against the Russian Federation, high energy and material costs have reduced the scope of new investment operations while imposing a burden on existing subsidiaries that the parent companies can decide to divest because they are no longer profitable.

A snapshot of the geography of the changing investment strategies is provided by the map of Figure 6, where we display the ratio of divestments over investments made between 2019 and 2022 by destination countries. Specifically, we observe how the Russian Federation experienced the largest amount of divestment operations from MNEs if compared to new investments, as expected after the beginning of the conflict in Ukraine. On one hand, Western firms may have been incentivised to divest from the Russian Federation due to economic sanctions. On the other hand, the ongoing war has increased geopolitical and economic uncertainty, which could have motivated firms to give up on investment projects in that area. Interestingly, a few countries sharing a border with Ukraine, such as Hungary, Belarus, and Moldova, actually experienced more investments over divestments, as indicated by their yellow shading in the map. This suggests that the war possibly prompted firms to relocate some operations to the nearest safe countries that were not directly involved in the conflict. More notably, as displayed in Appendix Figures 17 and 18, we observe a significant amount of divestments by parent companies in Asia and Western Europe from their affiliates located in Eastern Europe. Conversely, we note a higher amount of domestic investment in Eastern Europe, which could also reflect changes scenarios after the Russian invasion of Ukraine in February 2021. Similarly, Figure 6 shows that Asian countries close to China have experienced more investments than divestments, while China has experienced

Table 9: Sample coverage by hosting economy: parents and affiliates, year 2019

	Affiliates		Parent companies	
Hosting Economy	**N. obs.**	**%**	**N. obs.**	**%**
European Union	576,015	32.26%	80,281	36.60%
of which				
Germany	107,643	6.03%	9,919	4.52%
France	51,442	2.88%	6,640	3.03%
Italy	41,623	2.33%	7,416	3.38%
Spain	43,432	2.43%	5,508	2.51%
United States	389,635	21.82%	23,367	10.65%
Russian Federation	37,287	2.09%	2,979	1.36%
Other Europe	71,387	4.00%	32,276	14.71%
of which				
United Kingdom	133,422	7.47%	14,112	6.43%
Asia	358,577	20.08%	43,667	19.91%
of which				
Japan	33,359	1.87%	4,886	2.23%
China	127,203	7.12%	5,558	2.53%
India	19,585	1.10%	2,971	1.35%
Africa	43,682	2.45%	5,891	2.69%
Latin America	80,911	4.53%	22,414	10.22%
of which				
Brazil	11,791	0.66%	443	0.20%
Argentina	3,451	0.19%	132	0.06%
Mexico	11,903	0.67%	310	0.14%
the Caribbean countries	4,571	0.26%	1,619	0.74%
Australia	41,358	2.32%	4,281	1.95%
Rest of the world	186,516	10.45%	4,209	1.92%
TOTAL	1,785,368	100%	219,365	100%

Note: The table reports geographic coverage of multinational enterprises at the beginning of the period, in 2019, considering affiliates and parent companies, respectively, by hosting economy.

more divestments than investments. This could be a consequence of the trade war between the US and China, which has pushed companies to shift their investments from China to other Asian countries where they can find cheaper inputs and lower labour costs, such as Vietnam. Moreover, China itself is increasingly relying on cheaper labour from nearby

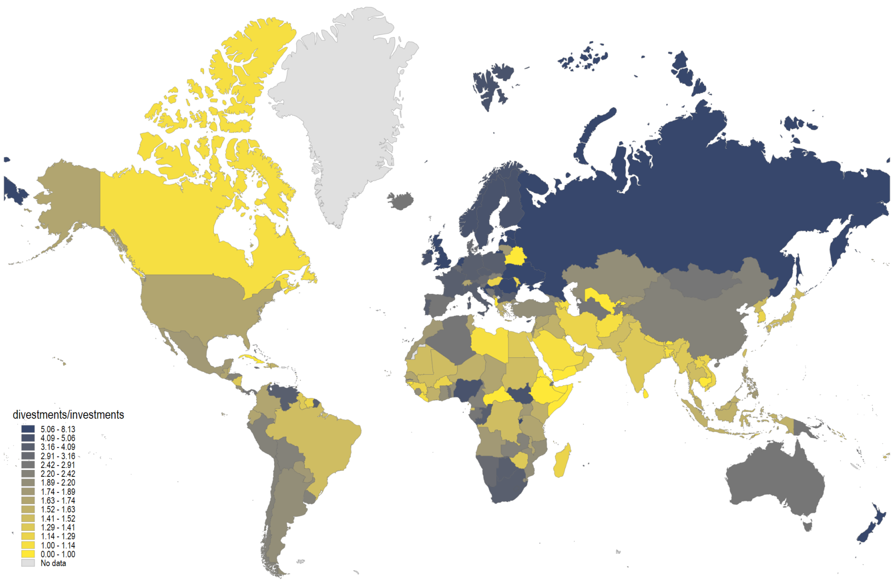
Table 10: Changes in parent-affiliate linkages, 2019-2022

	Parents	Affiliates	%
Incumbents		1,100,262	53%
Divestments		685,106	33%
Investments		281,060	14%
Total	219,365	2,066,428	100%

Note: The table records the changing corporate perimeter of multinational enterprises after we compare the years 2019 and 2022. Incumbents are subsidiaries that existed in both periods. Divestments are subsidiaries that are not controlled anymore in 2022. Investments are subsidiaries that were not controlled in 2019, but they are in 2022.

developing countries.

Figure 6: Divestments over investments ratio at global level



Note: The map shows the ratio of divestments over investments of affiliates at the global level between 2019 and 2022. The yellow shade indicates a higher proportion of investments over divestments, while shades towards blue suggest a higher proportion of divestments.

Eventually, in Table 11, we provide evidence of the changing distributions by firm size. Consistent with expectations, most affiliates fall within the category of small firms, accounting for nearly 60% of the incumbents, while approximately 7% of incumbents are classified as very large companies. Generally, the percentage of investments is higher for small firms, while divestments outweigh investments for all other size categories. In Appendix Table 30, we also present evidence of the changing patterns across industries, and we notice that all sectors experienced a relatively higher number of divestment operations if compared to new investments, with the manufacturing and financial sectors showing the highest proportions.

Table 11: Distribution of MNEs choices by affiliates' size

	divestments		investments		incumbents	
Size classification	Freq.	Percent	Freq.	Percent	Freq.	Percent
Small	366,719	63.51	209,583	75.15	656,273	59.77
Medium sized	105,953	18.35	37,965	13.61	203,281	18.52
Large	73,835	12.79	22,754	8.16	160,057	14.58
Very large	30,935	5.36	8,567	3.07	78,299	7.13
Total	577,442	100	278,869	100	1,097,910	100

Note: The table reports firm size by main categories for incumbent subsidiaries, new investment operations, and divestment operations following a combination of thresholds (revenues, employees, total assets) as provided by our official source.

In the following analysis, after a snapshot of what happens at the country level, we delve deeper into the decision of the parent companies to invest or divest, specifically exploring the presence of home bias in MNEs' choices. To this end, we construct a ratio that catches how the parent company combined divestment and investment operations in 2019-2022. We measure the net divestment ratio at the level of parent companies, eventually separating domestic and foreign operations. We propose two alternative ratios, calculated as:

$$divestment\,ratio_i = \frac{divestments_i - investments_i}{divestments_i + incumbents_i} \tag{2.1}$$

and

$$divestment\ balance_i = \frac{divestments_i - investments_i}{divestments_i + investment_i} \tag{2.2}$$

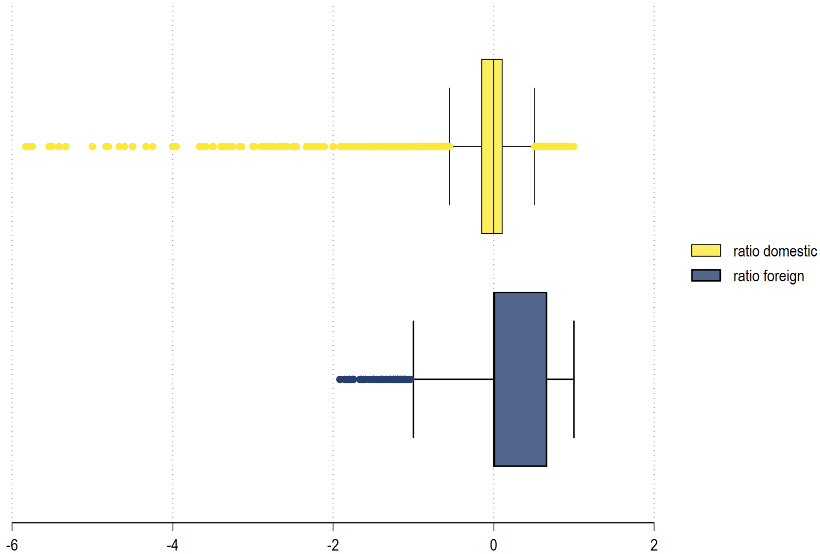
In the first case, eq. 2.1, the denominator indicates the stock of affiliates at the beginning of the period at the end of 2019, before the shocks occur. Please, note that the divestment ratio has an upper bound of 1 when there are zero incumbent links and zero new investment operations. In the second case, eq. 2.2, the denominator focuses on new operations, thus excluding subsidiaries that persist at the end of the period. In either case, positive values indicate that the number of divestments exceeds investments, while negative values suggest the opposite. Eventually, we calculate the indicators of eqs. 2.1 and 2.2 separately for domestic and foreign choices.

Figure 7 illustrates the distribution of the divestment ratio with a box plot format, while Table 12 reports difference in means with t-tests for statistical significance. Notably, the distribution for domestic cases exhibits skewness on the left, indicating that, on average, the amount of domestic investments exceeds divestments (-0.17), although with many outliers before the first quartile of the ratio. Conversely, the distribution for foreign activities reveals a higher average of divestments (0.25). Please note how the central quartile of the distribution insists entirely on the positive side of the x-axis, indicating an excess of divestments. Latter evidence suggests a potential substitution pattern in investment choices at the aggregate level, such that MNEs are more inclined to invest at home than abroad, which we will investigate further in the following analyses.

More simply, we can investigate whether there has been a higher increase in domestic vs. foreign operations between 2019 and 2022, and we construct a measure of investment rate for any i-th parent for domestic and foreign operations, respectively, following:

$$investment\ rate_i = \frac{investments_i}{divestments_i + incumbents_i} \tag{2.3}$$

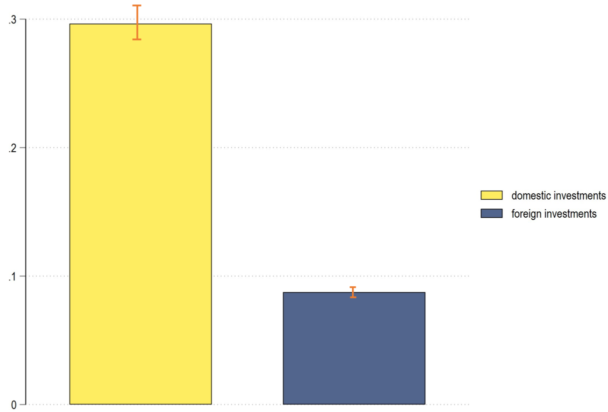
Figure 7: Domestic and foreign net divestment ratios in 2019-2022



Note: The figure reports the parent-level distribution in a box plot format of the divestment ratio for domestic (above) and foreign (below) subsidiaries by MNEs in our sample, as from eq. 2.1. A positive ratio indicates an excess of divestment operations, while a negative ratio indicates an excess of investment operations.

where the denominator indicates the stock of affiliates at the beginning of analysis period, at the end of 2019. Sample averages of investment rates by parents are reported in Figure 8 with a 95% confidence interval that accounts for standard deviations. The graphs reveal that the domestic investment rates have been, on average, significantly higher than the foreign ones. Out of four new investment operations, only one has been abroad, and three have been in the country of origin of the MNE. Once again, descriptive statistics support the idea that MNEs strongly prefer domestic investments in our analysis period.
In Table 12, we report sample means of our descriptive statistics with t-tests for the significance of the difference in means. We observe that each

Figure 8: Domestic vs foreign investment rates



Note: The figure reports the parent-level sample averages for domestic (on the left) and foreign (on the right) investment rates from 2019-2022, as from eq. 2.3.

indicator we have been using so far always points to a higher revealed preference for domestic activities. MNEs are less likely to divest from domestic subsidiaries. They are also more likely to invest in domestic subsidiaries.

Eventually, we provide three indicators that catch the changing geographical strategy by MNEs. We want to check whether they engage in nearshoring and country diversification. We define nearshoring as a transfer of production to countries close to the parent's origin. If MNEs engaged in nearshoring in 2019-2022, we would expect to observe a lower average distance between the parent company and its subsidiaries in 2022 compared to 2019. Therefore, we calculate the average distance between the parents' and affiliates' countries weighted by the number of affiliates in each country. Means and their difference are indicated in Table 12. Interestingly, we find that the average weighted distance actually increased in 2022, indicating that the necessity to diversify geographically prevailed on cost efficiency. MNEs prefer to keep more complex geographical locations to differentiate their portfolio of economic activities.

Table 12: Difference in means and standard deviations of main descriptive statistics

Indicator variable	N. obs.	Sample mean	Std. dev.
Divestment ratio - domestic subsidiaries	65,176	-0.17	0.739
Divestment ratio - foreign subsidiaries	215,783	0.25	0.486
Difference in means		-0.42***	
Divestment balance - domestic	45,827	0.002	0.88
Divestment balance - foreign	115,646	0.589	0.71
Difference in means		-0.59***	
Investment rate - domestic subsidiaries	65,174	0.30	0.675
Investment rate - foreign subsidiaries	217,170	0.08	0.291
Difference in means		0.208***	
% domestic affiliates 2019	55,280	54.71	24.183
% domestic affiliates 2022	107,611	60.81	27.330
Difference in means		-6.1***	
Weighted distance from the parent 2019	441,866	4,958	3,820
Weighted distance from the parent 2022	365,603	5,165	3,735
Difference in means		-206.8***	
Weighted distance foreign investments	186,114	5797.93	3738.32
Weighted distance foreign divestments	288,107	5067.15	3737.23
Difference in means		730.78***	
Number countries 2019	219,364	2.11	4.133
Number countries 2022	165,642	2.32	4.190
Difference in means		-0.208***	

Note: The figure reports the differences in sample means, standard deviations, and t-tests with unequal variances for descriptive statistics about MNEs' investment changing strategies. *** stands for $p < 0.001$.

Notably, we also report in Table 12 an indicator that considers the weighted distances of foreign investment and divestment operations separately, and we find that, on average, new subsidiaries abroad are more distant from the parent company than recently divested foreign subsidiaries.

Finally, we measure the geographic diversification of investments by MNEs by adopting a basic indicator that counts the number of countries in which a parent company controls subsidiaries at the beginning and at the end of our analysis period. Notably, at the bottom of Table 12, we report that MNEs are, on average, exposed in more countries in 2022 if compared to 2019.

2.3 Investment decisions in periods of uncertainty

Firms' investment decisions are influenced by a range of factors, including country-level characteristics like institutional quality, business environment, human capital, and geographic and cultural proximity. Additionally, firm-level attributes can impact the attractiveness of investment opportunities. Our empirical strategy involves two levels of analysis to account for both country-level and firm-level determinants of investment and divestment choices. Firstly, in Section 2.3.1, we estimate a gravity model for FDIs to investigate changing patterns of investment by MNEs in the aftermath of the COVID-19 shock at country level, with a specific focus on domestic versus foreign firms. Our preferred strategy is based on the structural model proposed by Head and Ries (2008), which we augment with a measure of COVID-19 risk exposure, assuming that the latter represents additional friction for the decision to invest. Second, in Section 2.3.2, we adopt the perspective of the parent company for the decision to divest. We aim to gauge evidence on whether there is, indeed, a higher preference for domestic activities, possibly pointing to a broader reshoring process at the firm level.

2.3.1 Country-level investment and divestment patterns

Firm location choices between 2019 and 2022 were significantly influenced by the shocks that afflicted the global economy. The unforeseen emergence and the spread of the COVID-19 pandemic had no precedent in modern history. As governments implemented lockdowns to restrict population movements, supply chains across various industries experienced disruptions due to workforce shortages for input production and halted transportation routes within and between countries. This chain of events increased global uncertainty and made firms aware of new problems in managing established production networks that extend across national borders.

Supply chains were revealed to be highly reliant on a few countries responsible for producing essential intermediate inputs for the fabrication of final products. The most conspicuous example is the stringent lockdown imposed in China at the outset of the pandemic, which immediately halted the production of a wide array of goods and caused a severe shortage in countries worldwide. Over recent decades, firms have shifted product manufacturing to countries with lower labour costs to pursue cost-saving strategies. Many Western firms have relocated significant portions of their assembly and manufacturing processes to Eastern European and Asian countries. The risk is that production processes can depend on a limited number of node countries where suppliers are geographically concentrated, escalating the risk of shock propagation through production networks if a supply shock occurs. This is precisely what occurred during the COVID-19 pandemic. As the recovery phase continues, firms have recognized the importance of establishing more resilient supply chains capable of withstanding shocks. This realization may have triggered a phenomenon of relocating production stages to the firms' countries of origin or geographically proximate countries, resulting in the emergence of *reshoring* or *nearshoring*. Reshoring is defined as the process of ceasing a foreign investment and substituting it with the same investment in the home country. Nearshoring encompasses geographical proximity between parent companies and subsidiaries. Recently, a new category of friendshoring has been proposed to encompass geopolitical proximity between countries that are allies or participate in the same trade bloc.

In this Section, we aim to examine how investment strategies are shaping at the aggregate level. For our scope, we draw upon the structural model proposed by Head and Ries (2008) and estimate an augmented gravity model for investment and divestment operations between 2019 and 2022. The baseline specification is as follows:

$$\begin{aligned} Y_{od} = exp[\beta_1\, Domestic_{od} + \beta_2\, log(COVID_{od}) + \\ + \beta_3\, log(COVID_{od}) \times Domestic_{od} + \beta_4\, X_{od} + \beta_5\, Z_o + \beta_6\, W_d] \times \epsilon_{od} \end{aligned} \tag{2.4}$$

where Y_{od} is the number of investments (divestments) from country o to country d, X_{od} is the vector containing the following bilateral control

variables: geographical distance, common language, colonial relationship, common legal origins, WTO affiliation, EU affiliation, and regional trade agreement (RTA) affiliations. Z_o and W_d include GDP levels and GDP per capita for origin and destination countries in 2021, respectively. The binary variable $Domestic_{od}$ takes value one if the investments are domestic, i.e., when the parent company invests in affiliates in the same country of origin, and zero otherwise. Appendix Table 31 provides a brief description of the main variables we use.
Considering that other significant shocks may have impacted the economy during the period under analysis - such as the conflict in Ukraine - it is crucial to isolate the COVID-19 shock to determine whether the pandemic drives a reorganization of investment strategies. To achieve this, we incorporate a country-level COVID-19 risk measure ($COVID$) sourced from Hassan et al. (2020). The authors develop a metric based on a text-classification method, which identifies firms' exposure to the COVID-19 outbreak. This is achieved by counting the times the virus is mentioned during the quarterly earnings conference calls that publicly listed firms conduct with financial analysts. In Appendix Figures 20 and 21, we display the measure for the 76 available countries in 2020 and 2022, respectively. Although temporal heterogeneity is detected, our analysis capitalizes on country-level heterogeneity. We observe that North America, Western Europe, and Southeast Asia - particularly China - are where firms' COVID-19 exposure remains elevated in 2022. By accounting for such variation in our gravity model, we aim to understand the association between COVID-19 risk and investment and divestment decisions. We look at COVID-19 risk at the bilateral level by taking the average observed between the origin and destination countries. Finally, to investigate whether firms have shifted their investment strategies toward a domestic dimension in the wake of the pandemic outbreak, we examine the interaction between domestic investments (divestments) and COVID-19 risk.
Results are presented in Table 13. Columns (1) and (2) display results for all sectors, while columns (3) and (4) focus on the services industries, and columns (5) and (6) on intermediate goods. Our analysis reveals that, as

expected, there is a high home bias for both investment and divestment operations. Such a bias is higher in the case of new investment operations when countries have been exposed more to the risk of COVID-19, as captured by the positive and significant interaction terms when we consider total investments (column 2) and, more specifically if we look at investment operations in services (column 4). We argue that a stronger home bias driven by the pandemic is a hint to possible reshoring decisions, which we will investigate further in the next Section.

Table 13: COVID-19 and the preference for domestic subsidiaries

	Total		Services		Intermediates	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	divestments	investments	divestments	investments	divestments	investments
Domestic	3.6191***	4.3316***	3.2370**	4.0426***	3.6894***	3.1662***
	(0.92)	(0.391)	(1.271)	(0.521)	(1.109)	(0.528)
log of (COVID)	-0.1436	-0.1939**	-0.1059	-0.1274	-0.1431	-0.1437
	(0.109)	(0.087)	(0.139)	(0.094)	(0.14)	(0.148)
log of (COVID) x Domestic	0.3988	0.3604***	0.3209	0.2491**	0.5071	0.2196
	(0.205)	(0.129)	(0.264)	(0.111)	(0.294)	(0.225)
Gravity controls	Yes	Yes	Yes	Yes	Yes	Yes
Clustered standard errors	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,711	3,711	3,711	3,711	3,711	3,711

Note: We estimate a Poisson Pseudo Maximum Likelihood (PPML) model with controls for standard gravity variables and a COVID-19 risk measure for the destination countries in 2022, which we source from Hassan et al. (2020). Standard errors in parentheses are clustered at the origin and destination level. Significance levels are: *** p<0.01; ** p<0.05; * p<0.1.

Interestingly, the intensity of the pandemic shock does not seem to correlate *per se* with any aggregate pattern in divestment operations. Although we observe a considerable share of divestment operations, demonstrated in Section 2.2, it is not the intensity of the exposure to COVID that explains them.

2.3.2 Firm-level choices

In this Section, we delve deeper into the parent-level decision to divest. Divestment decisions are not solely influenced by country-specific factors, but they also depend on firm-level characteristics. A parent company might opt to divest from an affiliate if the latter is an underperforming business, even if it is situated in a country with an attractive business environment and high-quality institutions. To this aim, we exploit the data granularity to estimate each parent firm's divestment probability conditional on other characteristics. Our baseline specification is a Linear Probability Model (LPM) that we can write as follows:

$$\begin{aligned} P(divestment_{i(o)j(d)}) =& \beta_0 + \beta_1 domestic_{ij} + \beta_2 intermediates_{ij} + \\ &+ \beta_3 log(COVID_{od}) + \beta_4 X_{od} + \beta_5 size_j + \\ &+ \alpha_o + \gamma_d + \epsilon_{i(o)j(d)} \end{aligned} \tag{2.5}$$

where the dependent variable is binary and equal to one if the i-th parent in the o-th origin country divested the j-th subsidiary in the d-th destination country, and it is equal to zero if the subsidiary was not divested. X_{od} collects standard gravity variables. We control that the parent and the affiliate are in the same country with the binary variable $domestic$ equal to one and zero otherwise. We are also interested in spotting affiliates that produce intermediate inputs with the variable $intermediate$, as we assume that, in this case, they participate in global supply chains [8]. We control for $COVID$ exposure at the bilateral level and the affiliate's size. Finally, we include fixed effects for the origin and destination countries.

Table 14 presents results. Column (1) shows our baseline specification. We find that if a parent and its affiliate are in the same country, the probability of divesting significantly decreases, similarly in the case of affiliates producing an intermediate input. We do not find significant changes in the probability of divesting in connection with the intensity of COVID-19 risk. In Column (2), we investigate whether COVID Risk has differential effects depending on whether the affiliate is domestic or foreign. Consistently with the aggregated analysis of Section 2.3.1, we find that COVID Risk has no significant impact on the probability of domestic divestments. Nonetheless, when looking at the predictive margins of the impact of COVID-19 on the probability of domestic divestments,

[8] We classify intermediate goods according to Main Industrial Grouping (MIG) classification by Eurostat.

Table 14: Firm-level divestment choices

VARIABLES	(1) LPM div. choice	(2) LPM div. choice	(3) LPM div. choice	(4) LPM div. choice
domestic	-0.028**	-0.056	-0.029**	-0.028**
	(0.012)	(0.034)	(0.012)	(0.012)
intermediate	-0.043***	-0.043***	-0.047***	0.008
	(0.009)	(0.009)	(0.007)	(0.023)
log ($COVID$)	-0.009	-0.013	-0.009	-0.009
	(0.010)	(0.010)	(0.010)	(0.010)
domestic*log ($COVID$)		-0.008		
		(0.009)		
intermediate*domestic			0.009	
			(0.014)	
intermediate*log (distance)				-0.007**
				(0.003)
Observations	1,528,978	1,528,978	1,528,978	1,528,978
R-squared	0.028	0.028	0.028	0.028
Gravity controls	YES	YES	YES	YES
Size category affiliate FE	YES	YES	YES	YES
Country-origin FE	YES	YES	YES	YES
Country-destination FE	YES	YES	YES	YES

We estimate a Linear Probability Model (LPM) with standard gravity variables and COVID-19 risk exposure, where the dependent variable indicates whether the parent company divested the subsidiary in 2019-2022. COVID risk exposure is measured by borrowing from Hassan et al. (2020). Standard errors in parentheses are clustered by parent company and reported in parenthesis; significance levels are *** p<0.01, ** p<0.05, * p<0.1.

we find that at higher levels of COVID-19 risk, the probability of making a domestic divestment decreases significantly compared to foreign divestments, as shown in Figure 9[9]. The result suggests that when facing higher uncertainty induced by higher COVID-19 risk, MNEs tend to have a higher home bias related to divestment choices. In Column (3), we investigate whether there is a differential effect for affiliates producing intermediate inputs located in home countries or abroad. We find that while the probability of divesting decreases for intermediate suppli-

[9]Note that for highest values of COVID Risk the difference between foreign and domestic is not significant anymore. However, those values correspond to the maximum values of the distribution of COVID risk, and only a few countries record such extreme values.

ers, it does not change significantly when the intermediate is domestic. This result might suggest that firms operating in a supply chain are relatively more resilient.

In Column (4), we study whether there are differential effects of affiliates producing intermediate inputs depending on the distance. We find that there aren't signals of nearshoring. On the contrary, at higher distances, the probability of divesting from an affiliate producing intermediate inputs is significantly lower. This is clearly shown in Figure 10, where we report predicted margins at increasing (logs of) distance in the case of foreign subsidiaries: the higher the distance, the less the predicted propensity to divest. It may be the case that parent firms with established investments in distant foreign countries are less prone to divest because decoupling from global supply chains may have relevant fixed costs. Considering that the pandemic shock was expected to be temporary, they may have implemented a more cautious strategy on more distant investment projects when they were plunged into complex production networks[10].

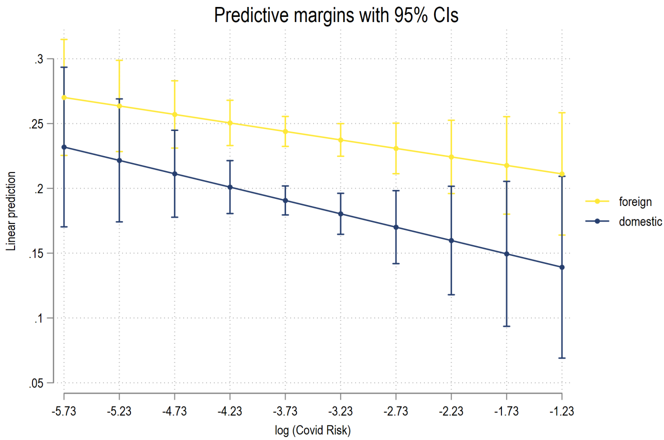
We can read this evidence in connection with the descriptive statistics we introduced in Section 2.2. At the end of the period, we find that MNEs present a higher geographic diversification of investment, i.e., a higher number of countries in which they located subsidiaries. Against this background, we can argue that the dominant strategy has been to add more destinations rather than simplify geographic exposure. Although distant, sourcing intermediate inputs from more countries may increase the resilience of the MNEs' supply chain.

Finally, please note that our data set of linkages between parents and affiliates also includes financial activities, which may follow a different logic than industrial productive networks. To avoid the financial industry confounding our results, we exclude affiliates operating in financial, insurance and real estate activities. We find consistent results reported in

[10] Interestingly, before the pandemic, Clò, Marvasi, and Ricchiuti (2023) notice that there was a difference between state-owned and privately owned enterprises. The first tended to concentrate their investments towards less risky countries that were geographically and culturally closer, with better institutional quality and a more central position in the trade network.

Appendix Table 33.

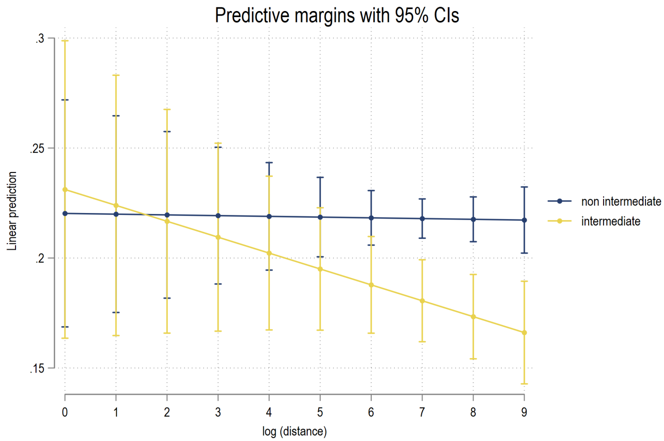
Figure 9: Predicted probability of divestment at changing COVID Risk



Predicted probability of divestment at changing COVID Risk over foreign vs. domestic affiliates taking overall averages of the other control variables. The x-axis takes values of the entire distribution of COVID-19 risk, where -5.73 corresponds to the lowest average, and -1.23 corresponds to the highest average value.

So far, the evidence suggests a higher revealed preference to domestic investments, especially when there is higher uncertainty related to COVID-19. To better understand whether that implies a proper reshoring process, we propose an augmentation of our baseline specification. We define a proxy variable called $reshoring$ that catches whether the probability of divesting abroad by a parent company in a specific industry in 2019-2022 is associated with the acquisition of control of a new subsidiary at home in the same industry of the divestment. We report results in Table 15. Interestingly, we find that there is indeed a positive and significant association, and this is valid both in the case of subsidiaries involved in the production of intermediate inputs (Column 3) and all the other activities (Column 4). Overall, coefficients suggest that, in our analysis period, parent companies are more likely to dismiss operations

Figure 10: Predicted probability of divestment on intermediates at changing distance



Predicted probability of divestment at changing distance over intermediates taking overall averages of the other control variables. The x-axis takes values of the entire distribution of (log) distance, where 0 corresponds to the minimum, and 9.89 corresponds to the highest average value.

abroad in a specific industry when they invest at home in the same industry.

2.4 Limitations of this study

In this Section, we highlight three main limitations of our study, which future studies could hopefully overcome. The first is a lack of firms' complete financial accounts on a global scale for the entire period of analysis. While ownership data are made available almost in real-time, mainly due to national regulations, financial accounts are registered only yearly and officially made public in the first quarter of the following year. Then, it takes some time to update them in electronic sources. Therefore, in this study, we managed to control for firm size, industry affiliation and loca-

Table 15: Firm-level divestment choices and reshoring

VARIABLES	(1) LPM All foreign	(2) LPM All foreign	(3) LPM Foreign interm	(4) LPM Foreign no interm
reshoring	0.028***	0.031***	0.045**	0.028**
	(0.010)	(0.011)	(0.021)	(0.012)
Observations	849,599	696,101	53,123	642,943
R-squared	0.036	0.040	0.055	0.041
Gravity controls	NO	YES	YES	YES
Size category affiliate FE	YES	YES	YES	YES
Country-origin FE	YES	YES	YES	YES
Country-destination FE	YES	YES	YES	YES

Note. We report estimates of a Linear Probability Model where the variable of interest (reshoring) is a dummy indicating whether the parent company made at least one domestic investment in the same 2-digit sector in which it made a foreign divestment. Columns (1) and (2) report results related to all divestments from foreign affilaites, while columns (3) and (4) report results related to divestments from foreign subsidiaries in intermediate industries and the remaining sectors, respectively. Standard errors in parentheses are clustered by parent company and reported in parenthesis; significance levels are *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

tion based on the basic information provided by companies to national registries. Yet, more detailed financial accounts could be helpful to have a clearer picture of how firm performance interacts with a geographic reorganization of subsidiaries coordinated by MNEs.

A second important limitation concerns the definition of reshoring that we adopted above. We assume that reshoring is detected when headquarters divest abroad (at least) a subsidiary that was active in a specific industry and invests in (at least) a new subsidiary in the origin country in the same industry. We are aware that there could be cases in which the activities that were performed by the divested affiliate abroad may still be different from the ones performed by the new affiliate in the origin country, regardless of the industrial affiliation. At the end of the day, the real reason for a divestment or an investment can only be revealed by the company's management. And yet, we may assume that companies do not always want to disclose their investment strategies fully. Against this background, we argue that our proxy may overestimate the actual phenomenon. Nonetheless, we believed it was important to high-

light that such an association between investment and divestment decisions by the parent companies was detected in our analysis period when a higher preference for domestic investment was detected without any doubt. Future studies could possibly go deeper into the investment motivations to understand how significant the bias is.
A third relevant limitation we want to discuss is the descriptive nature of this study. As far as we know, ours is the first study that reports stylized facts about a reorganization by MNEs with global coverage. However, it is beyond the scope of this work to investigate the economic channels that drive such a reorganization. We leave it to future studies, for example, to understand whether the pandemic or the changing geopolitical scenarios prevailed in the reshaping of investment strategies and under which conditions such changes are temporary or permanent.

2.5 Conclusion

Recent discussions among scholars and policymakers have raised important questions about the future of globalization. The COVID-19 pandemic, trade wars, and geopolitical conflicts triggered a series of shocks that have exposed the fragility of supply chains and raised concerns about the global economy's resilience. As a result, many firms are reassessing their investment strategies and exploring ways to build more flexible and reliable supply chains. This study addresses this critical topic by analyzing MNEs' investment and divestment decisions from 2019-2022. First, we provide a country-level picture of the role of COVID-19 in reshaping investment strategies. Our results suggest that firms have started investing relatively more in their country of origin, the higher the exposure to COVID-19 risk, possibly because they perceive a higher degree of economic uncertainty. Second, we investigate MNEs' divestment choices leveraging the richness and granularity of our data, with a specification at the parent-affiliate level, to estimate the probability of divesting conditional on firm-level characteristics. Our intuition is that reshoring can be defined as a statistical association between the decision of a parent to divest abroad in an industry and invest at home in the same industry. We find that such a statistical association is detected in our data, and we also discuss the limits of our approach, i.e., when the investment motivation is not made apparent by headquarters.

Most interestingly, we do not find signs of nearshoring. On the contrary, we find that, on average, the distance between the parent and its affiliates is higher in 2022 than in 2019, possibly because MNEs differentiate their portfolio of locations to avoid the level of disruption experienced after the outburst of the pandemic.

To conclude, our study confirms that recent events initiated a crucial reorganization of investment strategies by MNEs, whose preference for investments at home has increased dramatically. Future analyses could tell us whether this phenomenon can be reversed or whether it will have a long-lasting impact on the degree of global economic integration.

Chapter 3

Better Together: How Digital Connectivity and Regulation Reduce Trade Costs

[1]Improvements in digital connectivity can boost international trade by reducing many types of frictions. Using a new broad measure of trade costs, we estimate that, on average, a 10 percentage point increase in connectivity reduces trade costs by 2% and, consequently, increases trade flows by around 6%. We find evidence that this effect is channeled through reductions in language barriers and costs associated with customs procedures and regulatory differences. Importantly, we find that the positive effects are much larger in economies where digital regulation guarantees open access to communications infrastructures and freer cross-border data flows.

[1]This chapter is inspired by the working paper "Better together: How digital connectivity and regulation reduce trade costs" by Bellucci, Rubínová, and Piermartini (2023).

3.1 Introduction

Throughout recent decades, the fast improvement of information and communication technology (ICT) and advancements in digitalization have considerably affected international trade, enabling direct connections between producers and consumers from around the world, helping in spreading ideas and technologies, and easing the management of global value chains (GVCs). These technological advances thus reduced international trade costs and enhanced trade flows. At the same time, domestic and international regulatory frameworks are evolving to integrate digital policies into their governance structures. In doing so, policymakers face the challenge of balancing the economic benefits of digital trade with addressing public policy concerns, such as data privacy, consumer protection and cybersecurity. Several large economies have imposed restrictions on cross-border data flows and requirements to store data domestically. Notably, in many developing economies, the openness in data to transfer policies more often results from a lack of comprehensive regulation rather than a strategic policy decision (World Bank and World Trade Organization (WTO), 2023). And while international cooperation is needed to reach a balanced approach to global data governance, considerations for preserving policy flexibility within the international governance framework persist.[2] This chapter contributes to the debate by examining how digital technologies lower trade costs and the crucial role of regulatory frameworks in maximizing these benefits.

Access to modern ICT can reduce trade costs through multiple channels. First, digital transformation reduces the importance of physical proximity and face-to-face interaction for business relationships. ICT tools such as internet search, e-commerce platforms and services that allow real-time production monitoring lower the costs associated with searching for foreign products, information frictions, as well as GVC management costs. Moreover, the possibility of delivering some services digitally increases their cross-border tradability. As the costs of deliver-

[2] As highlighted by the United States retracting its proposal for rules to allow free cross-border data flows and prohibit national requirements for data localization in e-commerce discussions at the World Trade Organization (WTO) (Lawder, 2023).

ing a service over the internet are much lower than delivering it in person or through a foreign affiliate, digitalization can significantly reduce trade costs for these digitally deliverable services. This also applies to physical goods that can be digitized, allowing them to be traded at a reduced cost by eliminating transportation expenses.

Second, digital tools contribute to reductions in communication costs. Communication services via the Voice over Internet Protocol equalized the costs of international and domestic calls. Furthermore, the availability of automatic translations helps overcome language barriers and further lowers communication and search costs. Third, digital technologies facilitate trade in goods through enhanced logistics and customs efficiency. Tracking systems and automation of port and airport activities reduce the time spent in transit while digitalization of customs results in goods spending less time at borders and lower administrative costs.

Moreover, digitalization has ushered in the use of electronic payments and e-commerce platforms, thereby reducing transaction costs, particularly when purchasing products from foreign suppliers. The recent surge in the utilization of blockchain technologies enables the creation of a more secure contract environment by ensuring safe contracts and decreasing transaction costs. Finally, an easier access to foreign financial services through digital banking and e-commerce platforms' own credit services can alleviate the effects of a poor credit environment.

Policies at both national and international levels are key in providing the right environment for digital technologies to facilitate trade. Newly emerged digital markets need adequate regulation that preserves competitive environment and strengthens trust by ensuring that consumers' rights are protected and personal information is safe and private. Discussions at various international fora aim to reduce the heterogeneity in domestic regulations, including by establishment of new regulations where none previously existed, to facilitate cross-border digital trade and to ensure that access to digital infrastructure is open for all suppliers. At the WTO, the work programme on e-commerce aims to examine all trade-related aspects of e-commerce. Moreover, negotiations are under way among a group of 90 members to advance discussions on several topics related to e-commerce such as facilitating electronic transactions, access to internet and to government data, consumer protection and privacy, cross-border data flows, transparency and capacity building as well as additional regulatory disciplines relating to telecommunication services.

This work contributes to the existing literature by providing robust and theory consistent estimates of the impact of digital connectivity on trade costs by sector, level of development and region. Most importantly, we are the first to provide evidence of the magnifying effect of an open regulatory regime. Our results suggest that domestic policies that ensure smooth cross-border access to communications infrastructure and facilitate data flows, amplify the impact of digital connectivity, especially in low- and middle-income economies. This finding has important policy implications. While there have been significant improvements in digital infrastructure, the regulatory framework has been lagging behind in many cases and some governments have introduced polices that tighten the regulatory environment Organization for Economic Co-operation and Development (OECD), 2023.

Several recent studies have evaluated the impact of digitalization on trade costs, trade flows and economic development using various measures of digital connectivity and digital infrastructure. Using data for 37 economies in 2016, Rubínová and Sebti (2021) estimate that ICT connectivity, measured by the share of population using the internet and the share of population with mobile phone subscriptions, can explain on average 4 to 6 per cent of the variation in trade costs across trade partners. The seminal works of C. Freund and Weinhold (2002) and C. L. Freund and Weinhold (2004) show that the internet has had positive effects on export growth. Subsequent studies from Choi (2010), Liu and Nath (2013), Lin (2015), Anderson, Borchert, et al. (2018), López González, Sorescu, and Kaynak (2023), Chiappini and Gaglio (2024) and Herman and Oliver (2023) provide consistent evidence that digital infrastructure and the growing share of population using the internet boost trade in both goods and services. Using firm-level data, Akerman, Leuven, and Mogstad (2022) exploit the exogenous variation in broadband adoption resulting from the roll-out of a public program in Norway to establish broadband infrastructure between 2000 and 2008. Contrary to studies focusing on trade through e-commerce platforms (Hortaçsu, Martínez-Jerez, and Douglas, 2009; Lendle et al., 2016), they find that increased broadband adoption increases the sensitivity of exports to geographical distance and to the size of the destination market. The authors propose that these findings are consistent with a model where ICT adoption lowers information frictions and thus expands the choice set of exporters and importers, making demand more elastic with respect to trade costs and thus distance. Hjort and Poulsen (2019) show that better digital infrastructure increases employment and incomes in developing countries, including through boosting exports. The authors exploit the gradual arrival of submarine internet cables in Africa and show large positive effects on employment rates, primarily driven by higher-skill occupations. They find evidence that these employment effects are partly driven by an increase in direct exports, suggesting that internet availability makes it easier for firms to sell to customers abroad.

There is an emerging literature that studies the impact of regulation in the digital economy on trade. Van der Marel and Ferracane (2021) develop an index to assess the restrictiveness of countries' data policy concerning cross-border movements of data and domestic use of data, finding that more rigid policies negatively affect imports of data-intensive services. Focusing on preferential trade agreements, López González, Sorescu, and Kaynak (2023) find that agreements with e-commerce provisions have a stronger positive impact on trade of high-income economies than other agreements while Herman and Oliver (2023) find that data flows provisions increase trade in services for high-income economies. Suh and Roh (2023) study the effects of domestic vs. bilateral digital trade policies and find that digital trade flow increase when countries have a trade agreement containing digital trade-related provisions, while domestic regulations actually inhibit digital trade flows.

We build on previous work to estimate how digital connectivity, digital regulation and their interaction impact trade costs. Our empirical methodology follows two steps. We first estimate bilateral sector-level trade costs using a fixed effects gravity model following the methodology introduced in P. Egger et al. (2021). In a second step, we exploit the variation in trade costs within country-sector-year across partners and within sector-country-pair over time to estimate the impact of digital connectivity. Our preferred measure of digital connectivity is the number of active mobile broadband subscription per capita, which is a reliable proxy for internet use, particularly in developing countries where mobile internet is a more widespread technology compared to fixed broadband internet access. Considering that enabling legal and regulatory environment is an essential component of the ecosystem for digital trade, we then estimate how improvements in digital trade regulation can amplify the impact of digital connectivity on trade costs. To capture the impact of regulation, we employ a component of the OECD's Digital Services Trade Restrictiveness Index (DSTRI) that measures the extent to which regulation enables smooth cross-border access to communications infrastructure and facilitates data flows.

Our findings indicate that the expansion of digital connectivity has had a significant effect on reducing trade costs across all economic sectors. We estimate that a 10 percentage point higher connectivity is associated with around 2 per cent lower trade costs both in goods and services. Additionally, we find evidence that higher connectivity is associated with lower trade costs for countries that do not share a common language and that do not belong to a custom union.

When we look at the interplay between digital connectivity and digital regulation, we find that the trade-cost-reducing effect of improved connectivity is magnified by an open regulatory environment, especially for digitally deliverable services. To illustrate the magnitude of the estimated effects, we consider a scenario in which all economies improved their connectivity to at least the 75th percentile of the global distribution. We then show that the predicted decline in trade costs at the actual average level of digital trade regulation is much smaller than if all economies were at most at the 25th percentile of the global distribution or at the global best level. This impact is particularly pronounced for trade costs in digitally deliverable services which would register almost four times larger reduction in the most open regulatory environment.

The rest of the chapter is organized as follows: Section 2 provides descriptive statistics of trade costs, digital connectivity and digital trade regulation, Section 3 describes our empirical strategy, Section 4 discusses the estimated impact of digital connectivity and Section 5 focuses on the estimated interaction between connectivity and regulation. Section 4 concludes.

3.2 Data and descriptive statistics

In our analysis, we are mainly interested in understanding how improvements in digital infrastructure and digital regulation help in lowering trade costs. We document below the evolution over time of our variables of interests, as well as the differences that exist across country income groups and regions.

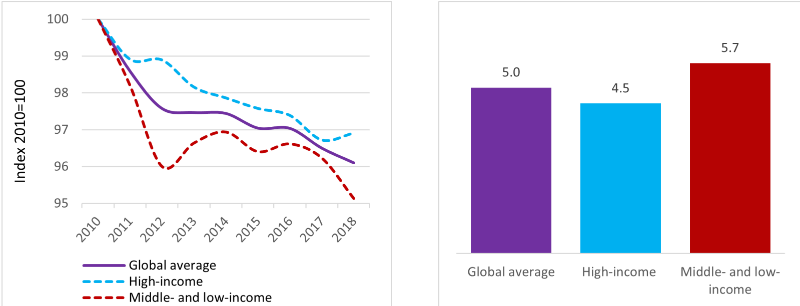
3.2.1 Trade costs

We estimate bilateral sector-specific trade costs following the methodology proposed by P. Egger et al. (2021) using data from the OECD Inter-Country Input-Output (ICIO) tables 2021 edition. The data cover 61 individual economies disaggregated into 34 sector groups including agriculture, industry and service sectors. The estimated Trade Cost Index captures all impediments that make international trade more difficult or costly than domestic trade.

Panel (a) of Figure 11 shows that global trade costs decreased by 4 per cent between 2010 and 2018. This was a combination of a 3 per cent decline in high-income economies and a faster, 5 per cent, decline in emerging and developing economies. Despite the narrowing gap, trade costs in emerging and developing economies were almost 30 per cent higher than in high-income economies in 2018, as shown in Panel (b) of Figure 11.

There is a considerable level of heterogeneity in trade costs across broad economic sectors. While trade costs are the lowest in the manufacturing sector, cross-border trade in services faces more than 30 per cent

Figure 11: Global Trade Cost Index by income groups



(a) time series 2010-2018 **(b)** levels 2018

Note: The Trade Cost Index captures the magnitude of global trade costs relative to domestic trade costs. It can also be interpreted as ad valorem equivalent: global trade costs in 2018 (5.0) correspond to an ad valorem equivalent of 400 per cent. Bilateral sector-specific trade costs are aggregated to the economy level using theory-consistent weights. Simple averages are used to aggregate trade costs to the global level. Income groups are based on the World Bank classification in 2018.

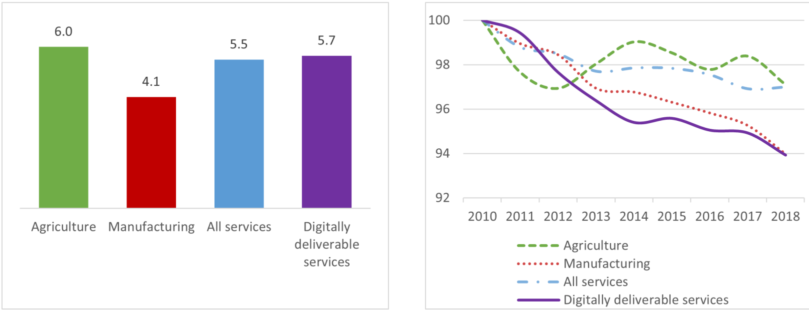
higher trade costs and trade costs in agriculture are almost 50 per cent higher (see Panel (a) of Figure 12). Cross-border trade in digitally deliverable services such as administrative, computer, professional and other business activities also faces higher costs than trade in manufacturing products.[3] While digital delivery avoids transportation costs associated with delivering goods, many other costs remain, including the costs of finding foreign business partners, establishing trust across different institutional systems, the need for face-to-face communication, as well as trade barriers and heterogeneity in regulation.

The cost of trading manufactured products dropped by 6 per cent between 2010 and 2018, as shown in Panel (b) of Figure 12, while trade

[3]Digitally deliverable services also include financial intermediation and other services such as audio-visual services. There are two main reasons why we focus on a narrower category of business and professional activities. First, the sector aggregation of trade costs is such that audio-visual and other cultural services are bundled together with other personal, social and community services that typically cannot be delivered digitally. Second, financial services are a highly regulated sector were cross-border trade likely interacts with commercial presence and as such might require a tailored empirical model (Oldenski, 2012).

costs in agriculture and services saw a more modest drop of 3 per cent. Notably, the subset of services that can be delivered digitally registered a similarly sharp decline as manufactured goods between 2010 and 2018 (6 per cent).

Figure 12: Global Trade Cost Index by economic sectors



(a) Levels in 2018

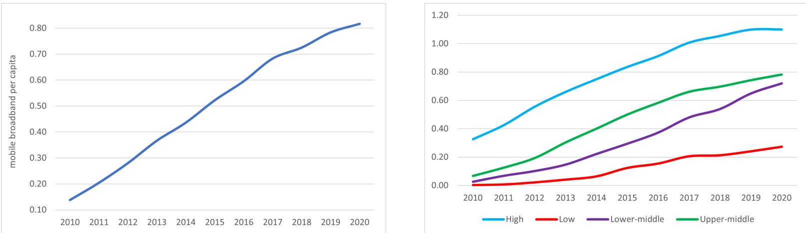
(b) Index 2010 = 100

Note: The Trade Cost Index captures the magnitude of international trade costs relative to domestic trade costs. Services exclude construction and public services. Digitally deliverable services comprise of business activities such as information, administrative, and professional services (sectors 71-74 of the International Standard Industrial Classification (ISIC) revision 3.1). Bilateral sector-specific trade costs are aggregated to the economy-broad-sector level using theory-consistent weights. Simple averages are used to aggregate trade costs to the global level.

3.2.2 Digital connectivity

We measure digital connectivity with the number of active mobile broadband subscriptions, provided by the International Telecommunication Union (ITU), relative to total population. Between 2014 and 2020, the global average connectivity almost doubled, reaching just above 0.8 subscriptions per capita in 2020, meaning that on average eight out of ten people had an active mobile broadband subscription (see Figure 13a). Figure 13b shows that the average connectivity increases with the income level of the economy. While high-income economies had on average more than one subscription per capita[4], in low-income economies only one in four people had a subscription in 2020. The figure also shows that lower-middle-income economies saw a particularly rapid increase in digital connectivity between 2014 and 2020.

Figure 13: Active mobile broadband subscriptions per capita



(a) world **(b)** income groups

Note: Data from ITU for 146 economies. One individual (or business) can have multiple subscriptions and therefore the number of subscriptions per capita can be higher than one. Income groups are based on World Bank classification in 2018.

3.2.3 Digital trade regulation

Regulations may act through several dimensions to restrict or foster trade. The Digital Services Trade Restrictiveness Index published by the OECD quantifies barriers to trade in digitally enabled services across 85 economies from 2014 onward. In our analysis we focus on the "infrastructure and connectivity" component of DSTRI that quantifies regulation related to the access to communications infrastructure, interconnectivity and cross-border data flows.[5] It captures best practice regulations on interconnec-

[4]One individual (or business) can have multiple subscriptions and therefore the number of subscriptions per capita can be higher than one.

[5]The overall DSTRI is a composite index that captures impediments affecting services traded digitally across five dimensions: (1) access to communications infrastructure and interconnectivity, (2) measures related to electronic transactions like standards on electronic contracts and (3) electronic payments, (4) intellectual property rights, as well as (5) other types of barriers to digital trade. Our focus on the first component is mainly driven by empirical considerations - it has the largest variation across economies while the second

tions among network operators as well as measures limiting or blocking the use of communications services. It comprises also a coverage of policies that affect cross-border data flows and data localisation. The restrictiveness of regulatory measures increases when there is a "lack of efficient regulation on interconnection as well as burdensome conditions on cross-border data flows beyond those imposed to ensure the protection and security of personal data" (Ferencz, 2019).

The regulatory index ranges between zero and one where zero indicates complete openness of regulation while one indicates the highest level of restrictiveness. On average, restrictive measures have been increasingly put in place starting from 2015, reaching their maximum in 2018, as shown in Figure 14a. There was a substantial decline in 2019 that was driven by low-income economies who reduced in a remarkable way the restrictiveness of their regulatory frameworks, down to a level comparable to high-income economies (Figure 14b).[6] Middle-income economies, on the other hand, still display high average regulatory restrictiveness.

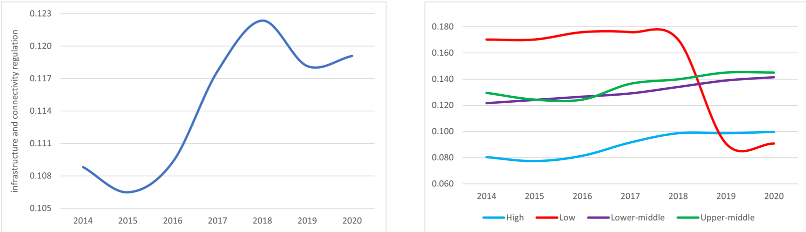
3.3 Empirical strategy

We run a regression analysis of bilateral trade costs disaggregated into 24 economic sectors (including agriculture, mining products, manufacturing and commercial services) in 58 economies over the period 2014-2018. Similar to the empirical strategy in Rubínová and Sebti (2021), we base

and third component vary very little. Accordingly, when we use the full composite DSTRI in our estimations, the results are qualitatively similar but less statistically significant.

[6] This drop was mainly driven by two African economies: Ethiopia and Uganda. In 2019, Ethiopia introduced a directive making it mandatory for the public disclosure of interconnection reference offers. This was a shift from the past, where there was no such obligation, despite the regulation of interconnection prices. Uganda implemented a regulation facilitating cross-border data transfer. This regulation ensures that recipient countries have robust data protection measures in place and that the transfer of personal data is only possible to countries with substantially similar privacy protection laws. Furthermore, in the same year, Uganda rolled out rules for both mobile and fixed connectivity sectors. These rules mandated public disclosure of interconnection reference offers, regulated interconnection prices and conditions, and enforced vertical accounting separation among operators.

Figure 14: Restrictiveness of digital regulation



(a) world **(b)** income groups

Note: The figure shows the evolution of the "infrastructure and connectivity" component of DSTRI. Data from OECD for 85 economies. Income groups are based on World Bank classification in 2018.

our analysis on explaining the variation in trade costs in a given sector, country and year across partners.

Our baseline regression specification is as follows:

$$ln(TC_{ijts}) = \alpha + \beta_1 connectivity_{ijt} + \beta_2 X_{ijt} + \theta_{its} + \delta_{jts} + \epsilon_{ijts} \quad (3.1)$$

Where TC are trade costs, i is the exporter, j is the importer, t is year and s is the sector. X_{ijt} includes standard variables at bilateral level which capture several determinants of trade costs. For transport and travel costs we include log of population-weighted bilateral distance, a binary variable indicating if the trading partners share a border, a binary variable indicating if either of the trading partners is landlocked, and we control for time zone differences. We account for information and transaction costs by including binary variables for colonial dependency, colonial sibling relationship and include binary variables indicating if the partners share a common official language and if they have common legal origins. We include also the log of the 1970 stock of migrants from the importing in the exporting country, and vice versa. As for trade costs deriving from trade policy and regulatory differences, we include being in a regional trade agreement and being in a customs union. We control for governance quality by including differences in corruption between the importer and the exporter. We also control for differences in GDP per capita and differences in human capital. Finally, we include exporter-year-sector θ_{its} and importer-year-sector δ_{jts} fixed effects.

Our variable of interest refers to digital connectivity, which we proxy with the number of active mobile broadband subscriptions per capita.[7] Our empirical model assumes that bilateral trade costs depend on the minimum of digital connectivity between the importer and the exporter. This means that good connectivity in one of the trade partners does not help reduce trade costs with a partner that is poorly connected. For instance, calls over the internet dramatically reduce communication costs but both partners need to be well connected and the quality of the call will be determined by the worse connection. Or, even if all producers in the exporting economy are connected and thus able to deliver a service digitally, they can do so only to the number of consumers in the importing economy that are connected as well. We also control for the the minimum of the number of mobile telephone subscriptions per capita between the importer and the exporter.

For a smaller sample of economies, we augment the model by allowing the impact of digital connectivity to depend on the level of digital trade restrictiveness. We measure the latter considering the maximum between the importer and the exporter. The effectiveness of digital connectivity in reducing trade costs thus depends on the trade partner with more restrictive digital regulation.

For robust inference, we cluster standard errors at the importer and at the exporter level (two-way clustering) as suggested in P. H. Egger and Tarlea (2015). Our empirical strategy also mitigates concerns related to endogeneity issues. First, our two-step procedure is a theory-consistent approach that permits identifying partial effects of observable variables on total trade costs which do not suffer from the unobserved-trade-cost bias (P. H. Egger and Nigai, 2015). Second, we include fixed effects that

[7] As a robustness, we run an estimation using the *log* of the number of active mobile broadband subscriptions per capita and an estimation where we include the share of individuals using the internet as a proxy for digital connectivity.

capture the unobservable characteristics at the country-year-sector level, as well as a rich set of controls at the bilateral level. Both potential reverse causality and omitted variable bias are further attenuated by the fact that we bilateralize digital connectivity and regulation variables by considering the country-pair minimum.

3.4 The impact of digital connectivity on trade costs

Table 16 shows results of our baseline regression analysis. We find consistent evidence that better ICT connectivity decreases trade costs for both goods and services. On average, a 10 percentage point increase in the number of active mobile broadband subscriptions per capita reduces trade costs by around 2 per cent.[8] These reductions in trade costs translate into increases in trade flows of 6-7 per cent on average.[9]

We extend the baseline empirical model to investigate whether better access to digital infrastructure has reduced trade costs through specific channels. First, we test whether better digital connectivity decreased trade costs for countries with higher language barriers. Despite the fact that we cannot establish a causal relationship, the intuition is that better connectivity can help reduce trade costs by lowering language barriers through a reduction in communication and information costs. We therefore augment our baseline specification by including an interaction between connectivity and the binary variable of common language. Columns (1) to (3) of Table 17 Panel A report the results. We find heterogeneous results across broad sectors. Reduction in language barriers appears to drive our results in goods sectors where we find a large and

[8]Results using alternative measures/functional forms of connectivity are reported in Table 36 of the Appendix. The table shows that a 10 percentage point increase in the share of individuals using the internet reduces trade costs by around 3.5 per cent and a 10 per cent increase in the number of active mobile broadband subscriptions per capita reduces trade costs by around 1 per cent.

[9]The results are reported in Table 37 in Appendix. They reflect the average sectoral elasticities of trade flows to trade costs which we estimate to be 3.90 for goods, 3.95 for services and 3.71 for digitally deliverable services.

statistically significant cost-reducing effect of connectivity only for countries that do not share a common spoken language. Therefore, for trade in goods, reductions in communication and information costs seem to be a major channel through which connectivity reduces overall trade costs. For trade in digitally deliverable services, on the other hand, we find similar effects of connectivity irrespective of whether the trade partners share a common language.

Table 16: The impact of digital connectivity on trade costs

VARIABLES	(1) Goods	(2) Services	(3) Digitally Deliverable Services
Connectivity	-0.171***	-0.157***	-0.194***
	(0.0448)	(0.0391)	(0.0456)
Distance	0.289***	0.226***	0.233***
	(0.0204)	(0.0170)	(0.0180)
Contiguity	-0.069**	-0.077***	-0.027
	(0.0294)	(0.0203)	(0.0222)
Landlocked	0.096**	0.156***	0.087
	(0.0369)	(0.0432)	(0.0563)
Colonial dependency	-0.089***	-0.127***	-0.140***
	(0.0232)	(0.0224)	(0.0223)
Colonial siblings	-0.169***	-0.142***	-0.130***
	(0.0313)	(0.0326)	(0.0379)
Common language	-0.046**	-0.018	-0.043*
	(0.0226)	(0.0214)	(0.0257)
Common legal origin	-0.005	-0.011	-0.019
	(0.0124)	(0.0115)	(0.0151)
Time zone difference	-0.018***	-0.015***	-0.016***
	(0.0057)	(0.0039)	(0.0046)
Migrants$_{od}$	-0.012***	-0.014***	-0.013***
	(0.0029)	(0.0023)	(0.0029)
Migrants$_{do}$	-0.011***	-0.010***	-0.012***
	(0.0032)	(0.0028)	(0.0032)
RTA	-0.070***	-0.048***	-0.030
	(0.0201)	(0.0147)	(0.0184)
Customs union	-0.058	-0.055	-0.070*
	(0.0477)	(0.0376)	(0.0409)
Differences in corruption	0.032	-0.031	-0.122
	(0.2952)	(0.2267)	(0.3062)
Differences in GDPpc	-0.155***	-0.148***	-0.184***
	(0.0518)	(0.0415)	(0.0538)
Differences in human capital	0.010	0.045	0.055
	(0.0684)	(0.0576)	(0.0597)
Mobile telephone	0.016	-0.036	-0.009
	(0.0313)	(0.0335)	(0.0553)
Constant	-0.194	0.397***	0.538***
	(0.1752)	(0.1433)	(0.1450)
Observations	221,328	143,260	15,924
R-squared	0.800	0.841	0.813
Within R-squared	0.420	0.496	0.471

Note: We include exporter-year-sector and importer-year-sector fixed effects. Cluster-robust standard errors in parentheses, two-way clustering at importer and exporter level. *** p<0.01, ** p<0.05, * p<0.1.

Second, we analyse whether digitalization helps in reducing trade costs for partner countries outside a custom union. For this purpose, we interact connectivity with a common membership in a customs union or an even deeper economic integration agreement, assuming that trade costs related to customs and regulatory differences are much lower or null between members of such agreements. We find strong evidence across all sectors that improvements in digital connectivity are associated with reduced trade costs for trading partners that are not part of a customs union, as shown in Panel B. In this regard, the dummy is a proxy for all factors associated with membership in a customs union. As an example, digital connectivity could lower trade costs by reducing the costs of customs procedures and regulatory differences. This result is further corroborated by results in Panel C, which show that the impact of connectivity on trade costs does not depend on whether the trade partners are part of a regional trade agreement (RTA), including shallow agreements, or not.

3.5 The interaction between technology and regulation

Policy design and regulatory frameworks may play an important role in determining the impact of digital connectivity on trade costs and trade flows. We therefore investigate whether the trade-cost-reducing effect of improved connectivity is magnified by an open regulatory environment. We include a measure of digital trade regulation restrictiveness (DSTRI) and its interaction with mobile broadband subscriptions in our empirical model. Furthermore, we control for the overall market access in services by including the OECD Services Trade Restrictiveness Index (STRI). Note that in this case we are using a sub-sample comprising 46 economies for which we have information about the (digital) services trade regulation.

We provide results in Table 18. Columns (1) to (3) report results for goods, services and digitally deliverable services. We find that having an open regulatory environment (low DSTRI) amplifies the effect of connectivity in reducing trade costs for services. For economies with the best

Table 17: The channels through which digital connectivity reduces trade costs

VARIABLES	(1) Goods	(2) Services	(3) Digitally Deliverable Services
Panel A: common language			
Different language	-0.175***	-0.159***	-0.194***
	(0.0446)	(0.0386)	(0.0452)
Same language	-0.105	-0.128*	-0.188**
	(0.0916)	(0.0728)	(0.0835)
Panel B: customs union			
Not in customs union	-0.194***	-0.171***	-0.220***
	(0.0482)	(0.0419)	(0.0494)
Within customs union	-0.078	-0.098	-0.081
	(0.0849)	(0.0649)	(0.0738)
Panel C: RTA			
Not in RTA	-0.153**	-0.153***	-0.186***
	(0.0585)	(0.0486)	(0.0554)
Within RTA	-0.183***	-0.160***	-0.199***
	(0.0446)	(0.0397)	(0.0495)
Observations	221,328	143,260	15,924

Note: We include exporter-year-sector and importer-year-sector fixed effects. Cluster-robust standard errors in parentheses, two-way clustering at importer and exporter level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The model also includes the set variables reported in Table 1, coefficients not reported.

digital trade regulation, the reduction in trade costs from improved digital connectivity is more than 60 per cent larger than for economies with the median regulation. The effect is even more pronounced for trade in digitally deliverable services where the marginal effect of connectivity at the best regulation is 80 per cent larger than at the median regulation [10]. Moreover, for the quarter of economies with the most restrictive digital trade regulation, digital connectivity does not have a statistically signifi-

[10] The median value of the DSTRI is 0.12 while the average value is 0.15.

cant effect on trade costs.[11]

Table 18: The impact of digital connectivity depends on digital trade regulation

VARIABLES	(1) Goods	(2) Services	(3) Digitally Deliverable Services
Connectivity	-0.236***	-0.227***	-0.269***
	(0.0489)	(0.0452)	(0.0638)
Connectivity x DSTRI	0.598	0.725***	1.002***
	(0.3882)	(0.2634)	(0.3432)
DSTRI	-0.472	-0.708***	-1.142***
	(0.3309)	(0.2617)	(0.2853)
Importer STRI		0.619***	0.545***
		(0.1334)	(0.1283)
Observations	142,857	90,798	10,229
R-squared	0.813	0.857	0.824
Within R-squared	0.473	0.535	0.504
DSTRI at best connectivity	0.555	0.536*	0.576
	(0.4179)	(0.2877)	(0.4007)

Note: We include exporter-year-sector and importer-year-sector fixed effects. Cluster-robust standard errors in parentheses, two-way clustering at importer and exporter level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The model includes also the set of variables reported in Table 1, coefficients not reported. The last row presents the marginal effect of DSTRI at the best level of connectivity.

Based on these results, we gauge the potential for digital connectivity and regulation to reduce global trade costs. Using data on 79 economies, we perform out-of-sample predictions considering a scenario in which all economies improve their mobile broadband access at least to the 75th percentile of the global distribution.[12] We predict the change in trade costs at three different levels of digital trade regulation: at the current

[11] The coefficient on regulation alone does not have a sensible interpretation because it represents the estimated marginal effect of digital trade regulation at zero digital connectivity. The last row of Table 18 therefore reports the marginal effect of regulation at the best level of connectivity in the sample.

[12] We use data for 2020, which is the most recent year that maximizes the sample size for which information is available both on mobile broadband subscriptions and digital trade

average regulation, at a less restrictive level where all economies are at most at the 25th percentile of the global distribution, and at the least restrictive level.

The results suggest that the counterfactual improvement in digital connectivity would reduce average trade costs by 3 per cent to 5 per cent across different sectors (Figure 15). The Figure also reveals the extent to which restrictive digital trade regulation impedes the impact of technology adoption on trade costs. For this purpose, we compare the reductions at current levels of regulation with reductions in the scenario with less restrictive regulation. If all economies were at most at the 25th percentile of the global distribution [global best], the reduction in trade costs resulting from better connectivity would be more than twice [three times] more pronounced in the service sector and three [almost four] times more pronounced in digitally deliverable services.[13]

Figure 16 shows results of the same counterfactual scenarios for average trade costs across all economic sectors but differentiated by income groups.[14] While low-income economies would register the steepest decline in trade costs, a comparison between the different columns within each income group suggests that digital trade regulation constrains the effect of digital connectivity the most in the group of upper-middle-income economies. In the scenario with the least restrictive regulation, reductions in average trade costs would be 2.4 times larger in low-income economies, three times larger in lower-middle-income economies and 3.5 times larger in upper-middle-income economies.[15]

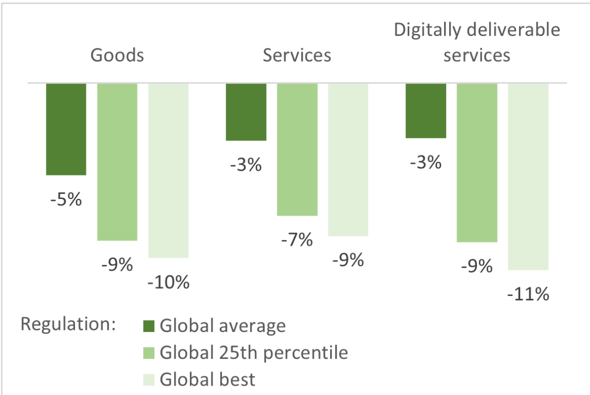
regulation. The 75th percentile is representative of countries such as Austria, Indonesia, Uruguay or South Africa.

[13]Note that for goods the difference between the estimated trade costs reductions at the two levels of regulation is not statistically significant.

[14]For this set of predictions we use estimations where we allow the impact of connectivity and regulation to vary between high-income and lower-income economies (regression results are reported in Table 38 of the Appendix).

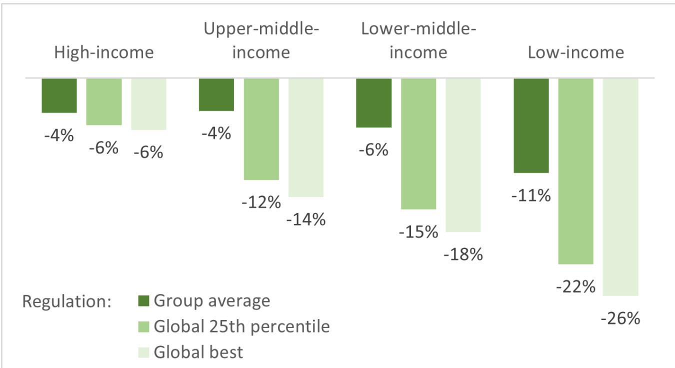
[15]Figure 24 of the Appendix presents additional charts by income group for each economic sector. Figure 25, 26 and 27 present additional charts by regions, showing that Africa has the largest potential to benefit from improved digital infrastructure and regulation.

Figure 15: Counterfactual reductions in trade costs by sector group and restrictiveness of regulation



Note: The figure shows the estimated average reduction in trade costs in a scenario where all economies improve their mobile broadband access at least to the level of the economy at the 75th percentile of the global distribution in 2020. The estimates for goods are not statistically significantly different from each other.

Figure 16: Counterfactual reductions in trade costs by income group and restrictiveness of regulation



Note: The figure shows the estimated average reduction in trade costs across all economic sectors in a scenario where all economies improve their mobile broadband access at least to the level of the economy at the 75th percentile of the global distribution in 2020. The estimates for high-income economies are not statistically significantly different from each other.

3.6 Conclusion

Digital connectivity is fundamental for trade. Advancements in ICT and the roll out of fast internet reduced communication, information and transaction costs associated with international business. Moreover, digitalization has dramatically reduced trade costs for services that can be delivered over the internet: the costs of delivering a service digitally are much lower than delivering it in person or through a foreign affiliate.

We estimate that a 10 percentage point increase in digital connectivity is associated with around 2 per cent lower trade costs in goods and services. We also find empirical support for two channels through which digital connectivity reduces trade cost. Our results suggest that reductions in communication and information costs are an important channel for trade in goods while reductions in the costs associated with customs procedures and regulatory differences are important for all types of trade.

The main contribution of this work is to show that the impact of digital connectivity depends on digital trade regulation. Regulation that does not guarantee interconnection and restricts cross-border data flows reduces the potential for cross-border services trade created by digitalization. Our findings show that this is especially true for trade in digitally deliverable services such as business and professional services. For economies with the best digital trade regulation, the reduction in trade costs resulting from improved digital connectivity is around 80 per cent larger than for economies with the median regulation. For the quarter of economies with the worst regulation, digital connectivity has no significant effect on trade costs in digitally deliverable services.

Our findings bear important policy implications. Investing in digital infrastructure and digital technology adoption is a necessary step towards reaping the benefits of the digital economy for international trade. However, these investments need to be supported by a robust regulatory framework that facilitates cross-border digital trade and avoids fragmentation of the digital economy due to regulatory heterogeneity.

Conclusions and policy remarks

This thesis delves into various aspects of globalization and its unforeseen repercussions on global economies. Each chapter examines different dimensions: the effects of takeovers on market power, multinational enterprises (MNEs) investment decisions amidst uncertainty, and the role of digital connectivity and its related policies in reducing trade costs.

The first chapter investigates the effects of takeovers as a driver of changes in market power and other firm performances. Considering the robust evidence of rising market power and concentration in the US and Europe, the work contributes to the literature by assessing the effect of one of the channels through which firms can achieve dominant positions in the market and undermine competition. The work employs robust empirical methodologies to determine the effects of horizontal and vertical integrations on firms' markups, profitability, productivity, and scale of operations. Findings suggest that while horizontal integration does not significantly change markup levels, vertical integration tends to decrease them, suggesting the presence of cost-saving strategies employed by the parent firm by eliminating double marginalization between the parent and affiliate, located at different stages of the production chain. Future research could delve deeper into firm-to-firm linkages and incorporate quantity-related data to understand better whether prices and marginal costs drive markup changes. Additionally, it would be interesting to further disentangle heterogeneous effects depending on whether vertical acquisitions are made upstream or downstream of the supply chain, considering that there could be different mechanisms at play depending on the position of the parent company. Moreover, general equilibrium models can better explain whether the efficiency gains potentially created by vertical integration through the reduction of double margins are followed by a pass-through to consumers that can increase their welfare. This work is valuable also from a policy perspective since it aligns with what is prescribed by the 2020 Vertical Merger Guidelines issued by the US Department of Justice and the Federal Trade Commission. In this context, while competition authorities in both the US and Europe typically focus on the adverse effects of horizontal mergers, which often result in more concentrated markets by eliminating competitors, there is a call for greater attention to be paid to the potential positive outcomes of vertical M&A deals. Instead of solely concentrating on potential threats to competition, it is crucial to consider the potential benefits, such as fostering innovation, bolstering R&D efforts, enhancing productivity, and achieving economies of scale. Regulators should adopt a broader approach that encompasses the wider impacts of acquisitions on innovation, dynamic competition, and international competitiveness. Without this comprehensive perspective, antitrust analyses run the risk of inconsistency. Indeed, a holistic approach to antitrust regulation is crucial: by considering not only immediate market effects but also broader implications, regulators can create a more stable and predictable business environment. Furthermore, as global economies become increasingly interconnected, alignment in merger evaluations, particularly between major geopolitical blocs such as the US and EU, becomes crucial.

The second chapter delves into MNEs' investment and divestment decisions during heightened uncertainty, particularly between 2019 and 2022. A novel dataset built with parent-affiliate linkages reveals substantial turnovers in investment choices by MNEs at the global level, with divestments outnumbering investments. Results from a basic empirical strategy show that a higher COVID-19 risk exposure by firms is associated with a higher number of domestic investment decisions. Estimations of a parent-level specification show that parent firms are more likely to divest from a foreign affiliate when they make a domestic investment in the same industry. Therefore, results point towards the reshoring decision of parent firms. Also, the work shows evidence that parent firms are less likely to divest from foreign subsidiary firms producing intermediate inputs and located at a higher distance from the parent. In this regard, there are no signs of nearshoring but rather evidence that inputs sourced from particular countries that have a comparative advantage are not easy to substitute. Despite shedding light on reshoring and nearshoring tendencies, the study suggests avenues for future lines of research. First, future work should account for complete financial accounts of firms, given that at the time of the study, only partial information could be recovered, considering that usually, complete balance sheet data are available with a lag of one year. In this way, it would be possible to picture better how firms' characteristics interact with the investments/divestment decisions and domestic/foreign affiliates' locations. In this regard, future studies should develop a structural approach to understand the determinants that lead MNEs to reshore or nearshore part of their activities and under what circumstances. Future extensions of the work should also develop a causality framework to understand whether higher uncertainty impacts MNEs' location decisions and if the effect is temporary or permanent. Firms can have different investment strategies depending on whether the shocks they face are perceived as temporary or will have long-term effects on the region or sector in which the MNE is operating. Evaluating the main drivers that lead MNEs to invest or divest is also crucial for governments. Indeed, the choice of MNEs to make investments is highly relevant from a policy perspective. MNEs are not only big producers of goods and services but are usually leaders in innovation thanks to the massive investments in R&D and human capital. This usually makes them the critical nodes of the global value chain in which they operate and a hub from which local firms obtain technological spillovers. For these reasons, the decision by an MNE to divest from a region can profoundly impact all the domestic firms relying on it. Governments should, therefore, support MNEs by providing clear guidelines and flexible policies that allow for adaptation, especially during crises. Policymakers can undertake many actions to create incentives for MNEs to invest or to avoid divestments from the country. They can offer targeted incentives to encourage MNEs to invest in critical sectors during uncertain times or provide support mechanisms, such as tax breaks or grants, to help MNEs maintain or expand operations. Indeed, the benefits of FDI flow from a conducive policy and legal and institutional environment. In a global landscape deeply impacted by the long-lasting effects of the COVID-19 pandemic and of the recent conflicts that contribute to uncertainty and instability, and yet still subject to rapid technological change, countries must refine their value propositions as investment locations, by establishing transparent rules and clear regulatory frameworks.

The third chapter explores digital trade and its nexus with regulatory frameworks. It underscores the crucial role of digital technologies in expanding trade flows and reducing trade costs but highlights that regulatory frameworks still need to catch up. This work is the first to provide evidence about digital infrastructure's combined effect and related regulatory rules on trade costs. Results indicate that domestic policies that ensure smooth cross-border access to communications infrastructure and facilitate data flows amplify the impact of digital connectivity, especially in low- and middle-income economies. Future research on this topic should provide a theoretical framework to account for the role of regulation in driving changes in trade costs and trade flows. More work is needed also on the definition of digital trade and the differences between trade in digital services vs. trade in goods enabled by digital platforms. This study, despite providing preliminary results on the importance of digital regulation on trade flows, sheds light on the relevance of the subject for policy-making. Indeed, digital trade encompasses many aspects that require different actions and coordination at the domestic and international levels. Firstly, regarding cross-border data flows, policymakers face a delicate balancing task between facilitating seamless transactions and ensuring privacy and security. Developing international data protection and transfer mechanisms standards emerges as essential to foster trust and confidence in digital transactions. Secondly, robust data privacy and security measures are paramount for protecting personal data and maintaining consumer trust in digital services. This necessitates the establishment of comprehensive legal frameworks aligned with global standards, along with the encouragement of adherence to cross-border privacy rules. Thirdly, investment in reliable digital infrastructure emerges as a cornerstone for fostering digital trade. Governments must prioritize equitable access to digital services and harmonize technical standards to facilitate seamless connectivity across regions and countries. Moreover, ensuring consumer protection in e-commerce transactions requires enforcing relevant laws and dispute resolution mechanisms. Transparency in product details, pricing, and terms is critical for maintaining consumer confidence in online transactions. Addressing the contentious issue of digital taxation calls for developing international norms to ensure fair taxation and prevent double taxation through coordinated policies. Lastly, fostering international cooperation through multilateral agreements and bilateral partnerships is imperative for advancing global governance in digital trade. Engagement in multilateral negotiations and strengthening digital ties with like-minded partners can pave the way for effective collaboration in this domain. Overall, policymakers must navigate the complexities of digital connectivity, data privacy, and infrastructure to foster sustainable and inclusive digital trade. By addressing these policy challenges, countries can effectively harness the benefits of globalization while mitigating its difficulties, thereby promoting economic growth and prosperity in an interconnected world.

In conclusion, this thesis sheds light on the critical consequences of a globalized economy and the challenges countries face due to having interconnected economic systems. While it is essential to build resilient production networks to minimize the adverse effects when shocks hit some economies, on the policy side, policymakers at the national and supranational levels should be more reactive to support the economy with timely policy actions when needed. Also, having a globalized world requires a higher level of cooperation to have a governance structure that can effectively deal with a profoundly globalized economic system and to contrast the return to a polarized world as we already witnessed in history.

Appendix A

Appendix Chapter 1

Appendix: Markup Estimation

[1]Firm level markup estimation relies on the method proposed by De Loecker and Warzynski (2012), which recovers the markup as the ratio of price over marginal cost. Indeed, the crucial assumption is that output elasticity of a variable factor of production is only equal to its expenditure share in total revenue when prices equals marginal cost of production. Hence, the presence of markups drives a wedge between input's revenue share and its output elasticity. The empirical approach used to recover firm level markups relies on standard cost minimization conditions for variable inputs free of adjustment costs and on the estimation of output elasticity.

In particular, given a production technology $Q_{it} = Q_{it}(X_{it}^1, ..., X_{it}^V, K_{it}, \omega_{it})$ with V variable inputs such as labor or intermediate inputs and assuming that producers are cost minimizers, the FOCs for any variable inputs

[1]The Appendix is sourced from the working paper "Supply Chains, Takeovers, and Market Power" by Bellucci and Rungi (2022).

associated with the Lagrangian function are such that:

$$\frac{\partial L_{it}}{\partial X_{it}^{v}} = P_{it}^{X^{v}} - \lambda_{it}\frac{\partial Q_{it}(\cdot)}{\partial X_{it}^{v}} = 0$$

where λ_{it} is the marginal cost of production at a given level of output. Rearranging terms, multiplying both sides by $\frac{X_{it}}{Q_{it}}$ and definying $\mu_{it} \equiv \frac{P_{it}}{\lambda_{it}}$ the following expression for markups can be derived:

$$\mu_{it} = \theta_{it}^{X}(\alpha_{it}^{X})^{-1}$$

where θ_{it}^{X} is the output elasticity on an in input X and α_{it}^{X} is the share of expenditures on input X_{it} in total sales $(P_{it}Q_{it})$. We estimate the output elasticity associated to a Cobb-Douglas production function with an OLS regression in which we use materials as a proxy for variable costs. To get estimates of the output elasticity, consider a production function with Hicks-neutral productivity term and common technology parameters across the set of producers:

$$Q_{it} = F(X_{it}^{1}, ..., X_{it}^{V}, K_{it}; \beta)exp(\omega_{it})$$

This form allows to rely on proxy method suggested by Ackerberg, Caves, and Frazer (2015) to obtain consistent estimates of the technology parameters β. The estimation procedure rely on the use of materials to proxy for productivity to solve the simultaneity problem deriving from unobserved productivity shocks potentially correlated with input choices. In particular, in the first stage we run the following regression to obtain estimates of expected output $(\hat{\phi}_{it})$ and an estimate for ϵ_{it}: $y_{it} = \phi_t(\ell_{it}, k_{it}, m_{it}, \mathbf{z}_{it}) + \epsilon_{it}$, while in the second stage we rely on the law of motion of productivity $\omega_{it} = g_t(\omega_{it-1}) + \xi_{it}$ to get estimates for all production function coefficients.

Appendix: Additional descriptive evidence

Table 19: Time coverage of takeovers

Year of acquisition	N. of acquisitions
2009	331
2011	632
2013	917
2015	1,077
2017	1,090
Total	4,047

Note. The table shows the number of acquisitions per year. We observe acquisitions on a 2-year basis depending on the time of release of ownership data.

Table 20: Industry coverage of firms' acquisitions

NACE	Industry description	N. of acquisitions
10	Manufacture of food products	654
11	Manufacture of beverages	160
12	Manufacture of tobacco products	3
13	Manufacture of textiles	192
14	Manufacture of wearing apparel	107
15	Manufacture of leather and related products	64
16	Manufacture of wood and of products of wood and cork	166
17	Manufacture of paper and paper products	151
18	Printing and reproduction of recorded media	132
19	Manufacture of coke and refined petroleum products	6
20	Manufacture of chemicals and chemical products	420
21	Manufacture of basic pharmaceutical products	98
22	Manufacture of rubber and plastic products	405
23	Manufacture of other non-metallic mineral products	291
24	Manufacture of basic metals	136
25	Manufacture of fabricated metal products	958
26	Manufacture of computer, electronic and optical products	233
27	Manufacture of electrical equipment	283
28	Manufacture of machinery and equipment n.e.c.	811
29	Manufacture of motor vehicles, trailers and semi-trailers	204
30	Manufacture of other transport equipment	63
31	Manufacture of furniture	124
32	Other manufacturing	127

Note. The table shows the number of acquisitions per 2-digit industry based on NACE Rev. 2 classification.

Table 21: Correlation matrix

	markup	sales	ROI	capital intensity	TFP	fixed assets	value added	num. of employees	market shares	variable costs
markup	1									
sales	-0.0275*	1								
ROI	-0.0012	-0.0001	1							
capital intensity	-0.0512*	0.0472*	-0.0013	1						
TFP	0.1173*	-0.0139*	0.0024*	-0.0781*	1					
fixed assets	-0.0064*	0.8514*	-0.0001	0.0746*	-0.0082*	1				
value added	-0.0154*	0.9137*	-0.0001	0.0460*	-0.0101*	0.8479*	1			
num. of employees	-0.0198*	0.8635*	-0.0001	0.0274*	-0.0119*	0.7317*	0.8713*	1		
market share	-0.0331*	0.2267*	-0.0003	0.0538*	-0.0111*	0.1516*	0.2310*	0.2565*	1	
var. cost	-0.0275*	0.9942*	-0.0001	0.0429*	-0.0139*	0.8435*	0.8971*	0.8491*	0.2189*	1

Note. The table shows pairwise correlations of variables for treated and untreated firms included in the sample.

Table 22: Sample coverage by technology intensity

Technological Intensity	Frequency	%
Low tech	131,491	44%
Medium-low tech	103,197	35%
Medium-high tech	53,837	18%
High tech	8,410	3%

Note. The table represents sample coverage by technology intensity based on firms' industrial affiliations, as from Eurostat classification.

Appendix: Additional results

Table 23: Average treatment effect (ATE) of takeovers on parent companies

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Markup	Market share	Sales	Variable cost	Variable cost ratio
Post Treatment	0.007	-0.041	0.015	0.021	0.004
	(0.010)	(0.062)	(0.024)	(0.027)	(0.010)
Observations	51,125	51,975	51,975	51,975	51,776
Controls	YES	YES	YES	YES	YES
	(6)	(7)	(8)	(9)	(10)
VARIABLES	TFP	ROI	Capital Intensity	Liquidity Ratio	Solvency Ratio
Post Treatment	-0.007	-0.043*	0.014	-0.044	0.006
	(0.014)	(0.025)	(0.042)	(0.027)	(0.026)
Observations	51,975	45,801	51,975	51,691	50,996
Controls	YES	YES	YES	YES	YES

The table reports aggregate results obtained following the methodological approach proposed by Callaway and Sant'Anna (2021) to account for heterogeneity in treatment timing. Single coefficients of the ATE are obtained with a weighted average that considers the importance of each cohort of firms in different times. Estimations are obtained through a doubly robust estimator and include firms' characteristics as control variables. The control group is composed by never treated units and not-yet-treated units. Variables are in logs. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** $p<0.01$ ** $p<0.05$ * $p<0.1$

Table 24: Average treatment effect (ATE) of vertical takeovers on parent companies

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Markup	Market share	Sales	Variable cost	Variable cost ratio
Post Treatment	0.013	0.558***	0.136	0.115	-0.019
	(0.029)	(0.176)	(0.087)	(0.101)	(0.028)
Observations	41,172	41,851	41,851	41,851	41,672
Controls	YES	YES	YES	YES	YES
	(6)	(7)	(8)	(9)	(10)
VARIABLES	TFP	ROI	Capital Intensity	Liquidity Ratio	Solvency Ratio
Post Treatment	-0.077	55.917*	-0.062	0.043	0.010
	(0.049)	(29.925)	(0.131)	(0.139)	(0.098)
Observations	41,851	36,834	41,851	41,638	41,034
Controls	YES	YES	YES	YES	YES

The table reports aggregate results obtained following the methodological approach proposed by Callaway and Sant'Anna (2021) to account for heterogeneity in treatment timing. Single coefficients of the ATE are obtained with a weighted average that considers the importance of each cohort of firms in different times. Estimations are obtained through a doubly robust estimator and include firms' characteristics as control variables. The control group is composed by never treated units and not-yet-treated units. Variables are in logs. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** $p<0.01$ ** $p<0.05$ * $p<0.1$

Table 25: Average treatment effect (ATE) of vertical takeovers on markups by industry

	(1) Wood products	(2) Chemicals	(3) Pharmaceuticals	(4) Electronics	(5) Machinery and equipment	(6) Motor vehicles
Post Treatment	0.023**	-0.028***	0.052**	-0.035*	-0.009*	-0.018*
	(0.012)	(0.011)	(0.026)	(0.020)	(0.005)	(0.009)
Observations	215,689	111,250	16,479	90,417	316,554	64,235

Note. The table shows results after the doubly robust estimator proposed by Callaway and Sant'Anna (2021), using never-treated and not-yet-treated units in the control group. We test the sensitivity of the results on markups by estimating the ATE by industry. We do not show estimates where results are not significant. Variables are in logs. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** $p<0.01$ ** $p<0.05$ * $p<0.1$.

Table 26: Average treatment effect (ATE): classification by technology intensity after takeovers

(a) Low Tech

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Markup	Market share	Sales	Variable cost	Variable cost ratio
Post Treatment	0.005	-0.026*	-0.018	-0.016	-0.000
	(0.003)	(0.015)	(0.012)	(0.013)	(0.005)
Observations	1,559,733	1,559,733	1,559,733	1,559,733	1,551,886
	(6)	(7)	(8)	(9)	(10)
VARIABLES	TFP	ROI	Capital Intensity	Liquidity Ratio	Solvency Ratio
Post Treatment	0.005	-0.016	-0.069***	-0.060***	-0.244***
	(0.006)	(0.015)	(0.022)	(0.020)	(0.026)
Observations	1,559,733	1,384,531	1,559,733	1,159,657	1,052,996

(b) Medium-low Tech

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Markup	Market share	Sales	Variable cost	Variable cost ratio
Post Treatment	-0.002	0.022	0.020**	0.032***	0.010**
	(0.003)	(0.014)	(0.010)	(0.011)	(0.005)
Observations	1,295,690	1,295,690	1,295,690	1,295,690	1,289,563
	(6)	(7)	(8)	(9)	(10)
VARIABLES	TFP	ROI	Capital Intensity	Liquidity Ratio	Solvency Ratio
Post Treatment	-0.011*	0.026*	-0.029	-0.023	-0.167***
	(0.006)	(0.015)	(0.021)	(0.070)	(0.035)
Observations	1,295,690	1,159,778	1,295,690	951,658	892,519

Note. The table shows results after the doubly robust estimator proposed by Callaway and Sant'Anna (2021), using never-treated and not-yet-treated units in the control group. Variables are in logs. Control variables are included but not reported. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** $p<0.01$ ** $p<0.05$ * $p<0.1$

Table 27: Average treatment effect (ATE): classification by technology intensity after takeovers

(a) Medium-high Tech

VARIABLES	(1) Markup	(2) Market share	(3) Sales	(4) Variable cost	(5) Variable cost ratio
Post Treatment	-0.009***	0.005	0.034***	0.043***	0.009*
	(0.003)	(0.015)	(0.011)	(0.012)	(0.004)
Observations	671,205	671,205	671,205	671,205	668,841
VARIABLES	(6) TFP	(7) ROI	(8) Capital Intensity	(9) Liquidity Ratio	(10) Solvency Ratio
Post Treatment	-0.002	0.046**	-0.098***	-0.437***	0.083*
	(0.005)	(0.020)	(0.023)	(0.036)	(0.044)
Observations	671,205	603,615	671,205	485,142	465,150

(b) High Tech

VARIABLES	(1) Markup	(2) Market share	(3) Sales	(4) Variable cost	(5) Variable cost ratio
Post Treatment	-0.016	0.016	0.049*	0.057*	-0.005
	(0.011)	(0.041)	(0.028)	(0.029)	(0.019)
Observations	113,580	113,580	113,580	113,580	113,140
VARIABLES	(6) TFP	(7) ROI	(8) Capital Intensity	(9) Liquidity Ratio	(10) Solvency Ratio
Post Treatment	0.020	0.020	-0.009	-0.069*	-0.044
	(0.016)	(0.046)	(0.053)	(0.042)	(0.051)
Observations	113,580	102,375	113,580	83,246	79,922

Note. The table shows results after the doubly robust estimator proposed by Callaway and Sant'Anna (2021), using never-treated and not-yet-treated units in the control group. Variables are in logs. Control variables are included but not reported. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** p<0.01 ** p<0.05 * p<0.1

Table 28: Average treatment effect (ATE) on takeovers: Former vs. New EU Member States

(a) Old EU Member States

VARIABLES	(1) Markup	(2) Market share	(3) Sales	(4) Variable cost	(5) Variable cost ratio
Post Treatment	-0.001	-0.006	0.015**	0.020***	0.004
	(0.002)	(0.008)	(0.006)	(0.007)	(0.003)
Observations	2,786,493	2,786,493	2,786,493	2,786,493	2,785,490
	(6)	(7)	(8)	(9)	(10)
VARIABLES	TFP	ROI	Capital Intensity	Liquidity Ratio	Solvency Ratio
Post Treatment	0.000	0.020*	-0.071***	0.008	-0.032
	(0.003)	(0.011)	(0.013)	(0.031)	(0.036)
Observations	2,786,493	2,490,209	2,786,493	2,050,567	1,920,339

(b) New EU Member States

VARIABLES	(1) Markup	(2) Market share	(3) Sales	(4) Variable cost	(5) Variable cost ratio
Post Treatment	-0.002	-0.015	-0.008	0.003	0.001
	(0.007)	(0.023)	(0.025)	(0.026)	(0.009)
Observations	825,093	825,093	825,093	825,093	809,324
	(6)	(7)	(8)	(9)	(10)
VARIABLES	TFP	ROI	Capital Intensity	Liquidity Ratio	Solvency Ratio
Post Treatment	0.011	0.004	-0.016	-0.013	0.051
	(0.015)	(0.025)	(0.037)	(0.042)	(0.038)
Observations	825,093	733,989	825,093	608,041	549,341

Note. The table shows results after the doubly robust estimator proposed by Callaway and Sant'Anna (2021), using never-treated and not-yet-treated units in the control group. Variables are in logs. Control variables are included but not reported. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** p<0.01 ** p<0.05 * p<0.1

Table 29: Average treatment effect (ATE) after vertical integrations: Former vs. New EU Member States

(a) Old EU Member States

VARIABLES	(1) Markup	(2) Market share	(3) Sales	(4) Variable cost	(5) Variable cost ratio
Post Treatment	-0.002	-0.007	0.017**	0.023***	0.003
	(0.002)	(0.010)	(0.008)	(0.008)	(0.004)
Observations	2,765,556	2,765,556	2,765,556	2,765,556	2,764,557
VARIABLES	(6) TFP	(7) ROI	(8) Capital Intensity	(9) Liquidity Ratio	(10) Solvency Ratio
Post Treatment	-0.003	0.023*	-0.087***	-0.099***	-0.041
	(0.004)	(0.013)	(0.017)	(0.022)	(0.027)
Observations	2,765,556	2,470,870	2,765,556	2,036,221	1,906,294

(b) New EU Member States

VARIABLES	(1) Markup	(2) Market share	(3) Sales	(4) Variable cost	(5) Variable cost ratio
Post Treatment	-0.000	-0.009	-0.015	-0.012	-0.006
	(0.012)	(0.040)	(0.040)	(0.041)	(0.014)
Observations	821,815	821,815	821,815	821,815	806,046
VARIABLES	(6) TFP	(7) ROI	(8) Capital Intensity	(9) Liquidity Ratio	(10) Solvency Ratio
Post Treatment	0.021	0.003	-0.004	-0.039	-0.005
	(0.023)	(0.035)	(0.058)	(0.060)	(0.053)
Observations	821,815	730,941	821,815	603,914	545,527

Note. The table shows results after the doubly robust estimator proposed by Callaway and Sant'Anna (2021), using never-treated and not-yet-treated units in the control group. Variables are in logs. Control variables are included but not reported. Standard errors clustered at the firm level are reported in parentheses and significance levels are *** $p<0.01$ ** $p<0.05$ * $p<0.1$

Appendix B

Appendix Chapter 2

The Appendix is sourced from the paper ”Navigating Uncertainty: Multinationals’ Investment Strategies after the Pandemic Shock” by Bellucci and Rungi (2023).

Appendix A: Tables and Graphs

Table 30: Number of investment and divestment operations, 2019-2022

Industry	Divestments	Investments
Primary	4,025	53
Mining and Quarrying	5,372	103
Manufacturing	61,980	31,550
Utilities	16,994	5,618
Construction	19,822	5,739
Information and Communication	29,938	11,290
Financial and Insurance Activities	71,181	24,489
Other Services	224,224	76,234
N.A.	251,570	125,985

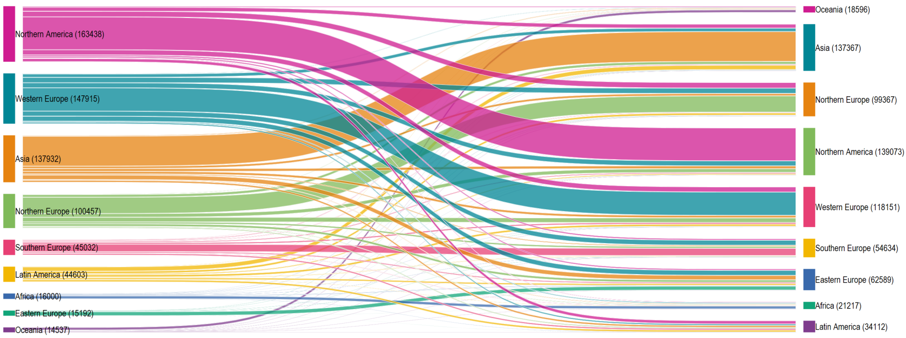
Note. The table shows the distribution of divestments and investments across main sectoral aggregates.

Table 31: Variables description

Variables	**Description**	**Source**
Distance	Simple distance between most populated cities, measured in km	CEPII -Geo Dist
GDP	GDP of origin and destination country	CEPII -Geo Dist
GDP per capita	GDP per capita of origin and destination country	CEPII -Geo Dist
Common language	1 for common official of primary language, 0 otherwise	CEPII -Geo Dist
Colony	1 for pairs ever in colonial relationship, 0 otherwise	CEPII -Geo Dist
Common legal origins	1 if countries share common legal origins after 1991, 0 otherwise	CEPII -Geo Dist
Colonial siblings	1 if countries share common colonizer, 0 otherwise	CEPII -Geo Dist
WTO	1 if country currently is a WTO member, 0 otherwise	CEPII -Geo Dist
EU	1 if country currently is a EU member, 0 otherwise	CEPII -Geo Dist
FTA (WTO)	1 if the country pair is engaged in a RTA, 0 otherwise	WTO supplemented by Thierry Mayer
COVID-19 Risk	Average of country-level COVID-19 Risk	Hassan et al. (2020)

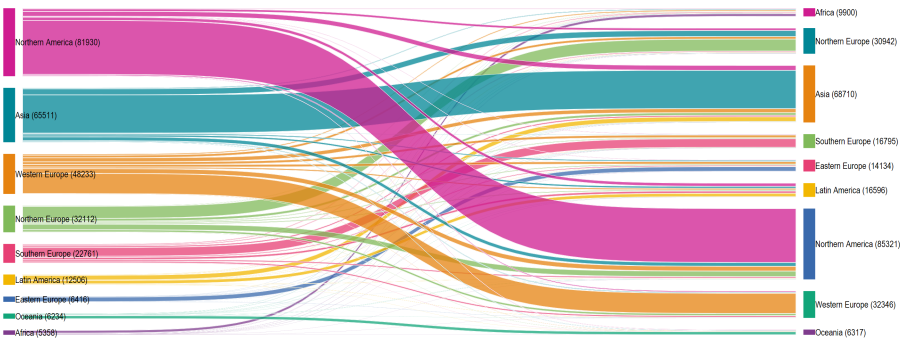
Note. Table describes the variables used in the empirical analysis. We source gravity variables from the most updated version of BACI-CEPII data set (2022).

Figure 17: Divestments flows 2019-2022



Note: The figure displays the number of divestment operations from the destination country/areas (on the right) by MNEs' countries/areas of origin (on the left) between 2019 and 2022.

Figure 18: Investments flows 2019-2022



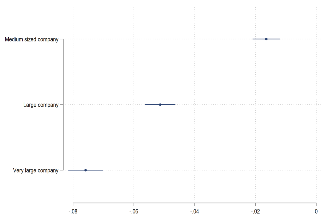
Note: The figure displays the number of investment operations in the destination country/areas (on the right) by MNEs' countries/areas of origin (on the left) between 2019 and 2022.

Table 32: Investment, divestment and affiliates' size

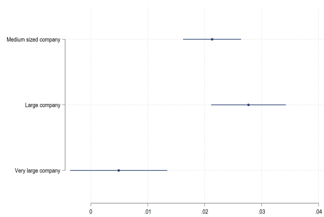
VARIABLES	inv. LPM	div. LPM
Medium company	-0.016***	0.021***
	(0.002)	(0.003)
Large company	-0.051***	0.028***
	(0.003)	(0.003)
Very large company	-0.076***	0.005
	(0.003)	(0.004)
Observations	1,136,606	1,294,172
R-squared	0.276	0.043
Country-origin FE	YES	YES
Country-destination FE	YES	YES
Sector affiliate	YES	YES

The table shows the correlations between an investment (left column) and divestment (right column) and main subsidiary size categories. The baseline is a small-sized representative firm.

Figure 19: Size and probability of investment and divestment



(a) Probability of investment



(b) Probability of divestment

The figure shows coefficients and confidence intervals, as from Table 32, for the predicted probability of investment/divestment conditional on subsidiary size.

Table 33: Firm-level divestment choices, excluding the financial industry

VARIABLES	(1) LPM div. choice	(2) LPM div. choice	(3) LPM div. choice	(4) LPM div. choice
domestic	-0.025**	-0.051	-0.026**	-0.026**
	(0.012)	(0.034)	(0.012)	(0.012)
intermediate	-0.039***	-0.039***	-0.043***	0.006
	(0.009)	(0.009)	(0.008)	(0.023)
log (COVID)	-0.011	-0.015	-0.011	-0.011
	(0.011)	(0.011)	(0.011)	(0.011)
domestic*log (COVID)		-0.007		
		(0.009)		
intermediate*domestic			0.009	
			(0.015)	
intermediate*log(distance)				-0.006**
				(0.003)
Observations	1,281,489	1,281,489	1,281,489	1,281,489
R-squared	0.028	0.028	0.028	0.028
Gravity controls	YES	YES	YES	YES
Size category affiliate FE	YES	YES	YES	YES
Country-origin FE	YES	YES	YES	YES
Country-destination FE	YES	YES	YES	YES

We estimate a Linear Probability Model (LPM) comparable with the one presented in Table 6 of Section 3.2. We exclude affiliates operating in financial, insurance and real estate activities. Standard errors in parentheses are clustered at the origin and destination level and reported in parenthesis; significance levels are *** p<0.01, ** p<0.05, * p<0.1.

Figure 20: Heterogeneity of COVID-19 exposure across countries in 2020

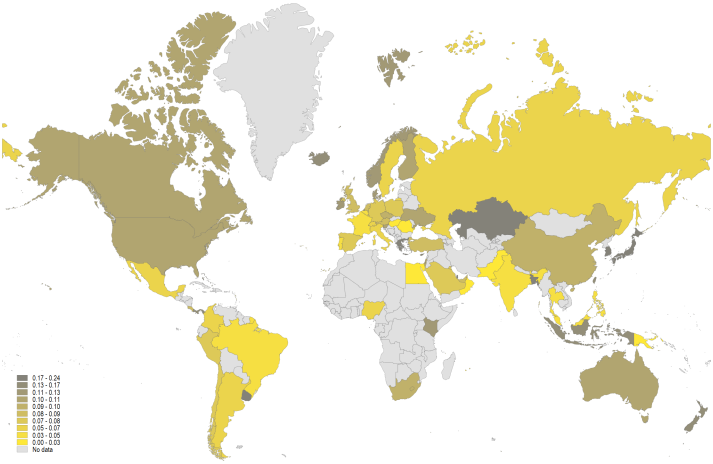
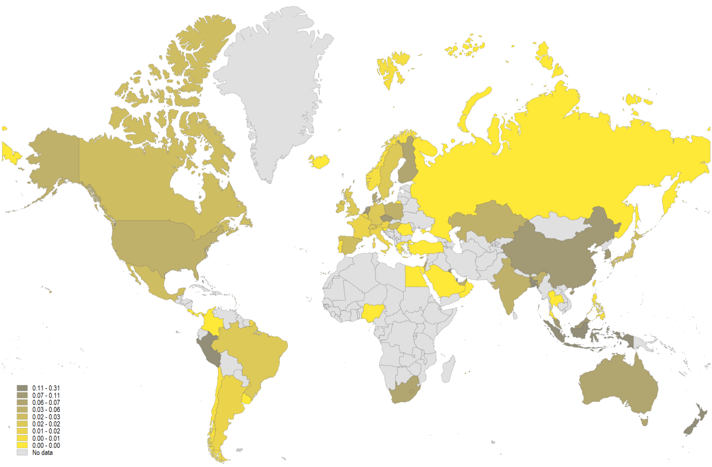
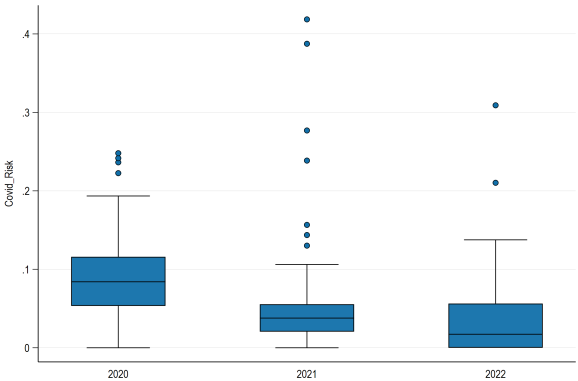


Figure 21: Heterogeneity of COVID-19 exposure across countries in 2022



Note. Figures A4 and A5 show the level of COVID-19 Risk measure across countries for 2020 and 2022. Comparison between the map shows that there is a higher degree of heterogeneity across countries than during time. For our analysis, we exploit country variation and use the level of 2022.

Figure 22: Average COVID-19 risk across years



Note. The figure shows the distribution of COVID-19 risk measure for the last three years available. We note over time a progressive reduction in the perceived risk by looking at median value, despite there are still countries with high values, as shown by the right skewed distribution.

Appendix B: Changing countries' attractiveness

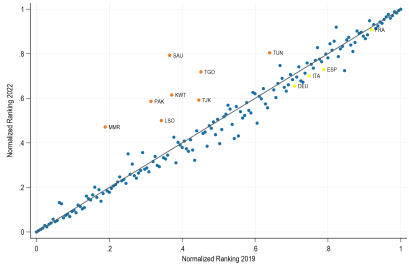
To evaluate the attractiveness of countries as destinations for foreign direct investment (FDI), we employ a gravity model following (Head and Ries, 2008) and, thus, we record fixed effects after controlling for bilateral and country-structural characteristics. Gravity models for FDIs are a natural extension of the widely used gravity models for trade, as they recognize that bilateral investment stocks are positively associated with the product of origin and destination size variables and negatively associated with the measure of bilateral distance, just like in trade models. Our preferred specification includes standard frictions to bilateral exchanges (distance, common language, common legal origins, colonial relationship, affiliation to the European Union, WTO membership, and Regional Trade Agreement). Additionally, we augment the standard structural model with two indexes from the World Bank's Doing Business Indicators, which we bilateralize by taking the average between the two countries in an investment relationship. The intuition is that they should catch additional investment-specific frictions among countries. Origin and destination country fixed effects are added for country-specific idiosyncrasies. In particular, destination fixed effects are of interest to us because they allow us to capture the residual unobservable factors that determine the attractiveness of a country not explained by structural characteristics.

We separately estimate the model for cross-sectional data on investment operations in 2019 and 2022, yielding distinct destination fixed effects for each year. By ordering these fixed effects, we rank countries based on their attractiveness. Comparing these rankings, we observe whether shifts occurred before and after the shocks between 2019 and 2022. Usefully, we calculate the fixed effects at an aggregate level; then we generate separate rankings for investment operations in services industries and intermediate inputs. We classify intermediate goods according to Eurostat's Main Industrial Grouping (MIG) classification. Figure 23 draws a visual comparative analysis of destination countries' fixed effects for 2019 and 2022. The graph displays changes in FDI attractiveness between 2019 (x-axis) and 2022 (y-axis) for the pooled sample in Panel A, the intermediate sector in Panel B, and the service sector in Panel C. The two rankings exhibit a ranking correlation of 0.97 according to Pearson's tests and 0.89 according to Kendall's test when measured on the total industries. A strong rank correlation persists when considering the intermediate and service sectors separately. Each dot indicates a destination country. Dots aligned with the bisector imply unchanged attractiveness between the two years; dots above the bisector indicate improved attractiveness in 2022 compared to 2019, while those below the bisector denote a lower investment appeal at the end of the period. We highlight selected countries: yellow dots represent France, Germany, Italy, and Spain, whereas orange dots denote countries with fixed effect differences exceeding two standard deviations between 2019 and 2022.

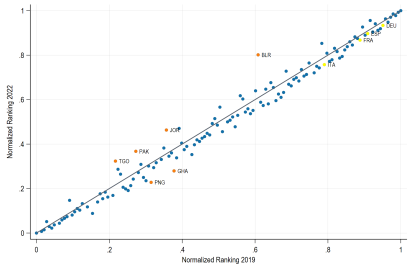
We observe that developed countries slightly decreased their level of attractiveness in the observed period while developing countries showed sharp increases. In particular, countries like Saudi Arabia and Pakistan significantly improved their attractiveness, especially in services industries. This might signal a longer-term trend of growth in developing countries that goes well beyond the short period we consider. Looking at intermediate inputs, we can detect which are the countries where MNEs decide to locate part of their supply chains between 2019 and 2022. Interestingly enough, Belarus seems to have gained significant attractiveness in 2022 as a destination for investments in producing intermediate inputs. This could be partly the reflection of the ongoing war in Ukraine. A few investors can consider Belarus as an alternative location for both the Russian Federation and Ukraine, given its geographical proximity.

Figure 23: Changing attractiveness of FDI destinations

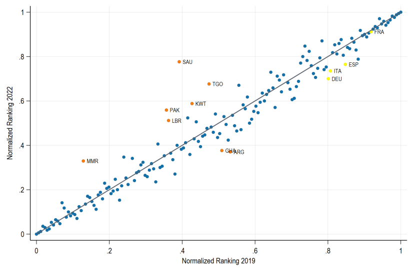
Panel A: Total



Panel B: Intermediates



Panel C: Services



Note. The figure plots changing countries' attractiveness, estimated as the residual after a gravity model, from 2019 to 2022. Dots above the bisector indicates increased attractiveness, while dots below indicate a decrease. Yellow dots represent France, Germany, Italy, and Spain, whereas orange dots denote countries with fixed effect differences exceeding two standard deviations between 2019 and 2022.

Appendix C

Appendix Chapter 3

The Appendix is sourced from the working paper "Better together: How digital connectivity and regulation reduce trade costs" by Bellucci, Rubínová, and Piermartini (2023).

Table 34: Economies included in the econometric analysis

Economy	Income Group	Economy	Income Group
Argentina	Upper-middle	Lao People's Democratic Republic	Lower-middle
Australia	High	Latvia	High
Austria	High	Lithuania	High
Belgium	High	Malaysia	Upper-middle
Brazil	Upper-middle	Mexico	Upper-middle
Bulgaria	Upper-middle	Morocco	Lower-middle
Cambodia	Lower-middle	Netherlands	High
Canada	High	New Zealand	High
Chile	High	Norway	High
China	Upper-middle	Peru	Upper-middle
Colombia	Upper-middle	Philippines	Lower-middle
Costa Rica	Upper-middle	Poland	High
Croatia	High	Portugal	High
Czech Republic	High	Romania	Upper-middle
Denmark	High	Russian Federation	Upper-middle
Estonia	High	Saudi Arabia, Kingdom of	High
Finland	High	Slovak Republic	High
France	High	Slovenia	High
Germany	High	South Africa	Upper-middle
Greece	High	Spain	High
Hungary	High	Sweden	High
Iceland	High	Switzerland	High
India	Lower-middle	Chinese Taipei	High
Indonesia	Lower-middle	Thailand	Upper-middle
Israel	High	Tunisia	Lower-middle
Italy	High	Türkiye	Upper-middle
Japan	High	United Kingdom	High
Kazakhstan	Upper-middle	United States of America	High
Korea, Republic of	High	Viet Nam	Lower-middle

Note: Income groups based on World Bank classification in 2018.

Table 35: List of sectors included in the econometric analysis

Sector	ISIC code
Primary	01T05
Mining	10T14
Food	15T16
Textiles & Leather	17T19
Wood	20
Paper	21T22
Chemicals	24
Plastics	25
Mineral	26
Metal	27T28
Other machinery	29
Electronics	30T33
Transport	34T35
Other manuf	36T37
Wholesale & Retail	50T52
Inland transport	60
Maritime transport	61
Air transport	62
Logistics	63
Post & Telecom	64
Financial intermediation	65T67
Business & Professional	71T74
Other Services	90T93

Note: Based on ISIC Revision 3.1 classification.

Table 36: The impact of digital connectivity on trade costs: alternative measures of connectivity

	Individuals using the internet			Log(mobile broadband subscriptions)		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Goods	Services	Digitally deliverable services	Goods	Services	Digitally deliverable services
Connectivity	-0.352**	-0.348***	-0.367***	-0.109***	-0.102***	-0.140***
	(0.1566)	(0.1008)	(0.1228)	(0.0357)	(0.0305)	(0.0364)
Distance	0.287***	0.224***	0.232***	0.289***	0.227***	0.234***
	(0.0199)	(0.0167)	(0.0178)	(0.0205)	(0.0171)	(0.0180)
Contiguity	-0.071**	-0.079***	-0.027	-0.069**	-0.077***	-0.027
	(0.0297)	(0.0207)	(0.0220)	(0.0296)	(0.0204)	(0.0224)
Landlocked	0.094**	0.156***	0.088	0.097**	0.157***	0.089
	(0.0368)	(0.0443)	(0.0558)	(0.0370)	(0.0433)	(0.0563)
Colonial dependency	-0.090***	-0.127***	-0.140***	-0.089***	-0.128***	-0.140***
	(0.0238)	(0.0234)	(0.0236)	(0.0235)	(0.0225)	(0.0225)
Colonial siblings	-0.172***	-0.145***	-0.132***	-0.169***	-0.142***	-0.130***
	(0.0318)	(0.0327)	(0.0380)	(0.0313)	(0.0326)	(0.0378)
Common language	-0.043*	-0.016	-0.042	-0.045*	-0.018	-0.044*
	(0.0228)	(0.0212)	(0.0257)	(0.0227)	(0.0215)	(0.0258)
Common legal origin	-0.006	-0.012	-0.020	-0.006	-0.012	-0.020
	(0.0125)	(0.0113)	(0.0151)	(0.0124)	(0.0114)	(0.0151)
Time zone difference	-0.018***	-0.015***	-0.016***	-0.018***	-0.015***	-0.016***
	(0.0056)	(0.0039)	(0.0046)	(0.0057)	(0.0039)	(0.0046)
Migrants_{od}	-0.012***	-0.014***	-0.014***	-0.012***	-0.014***	-0.013***
	(0.0029)	(0.0023)	(0.0029)	(0.0029)	(0.0023)	(0.0029)
Migrants_{do}	-0.012***	-0.010***	-0.011***	-0.011***	-0.010***	-0.012***
	(0.0032)	(0.0027)	(0.0031)	(0.0032)	(0.0028)	(0.0032)
RTA	-0.069***	-0.047***	-0.028	-0.069***	-0.047***	-0.029
	(0.0199)	(0.0146)	(0.0182)	(0.0202)	(0.0148)	(0.0185)
Customs	-0.060	-0.057	-0.071*	-0.057	-0.055	-0.070*
	(0.0473)	(0.0369)	(0.0403)	(0.0478)	(0.0376)	(0.0409)
Differences in corruption	0.028	-0.055	-0.154	0.063	-0.004	-0.094
	(0.2892)	(0.2156)	(0.3051)	(0.2937)	(0.2246)	(0.3030)
Differences in GDPpc	-0.206***	-0.199***	-0.235***	-0.158***	-0.151***	-0.190***
	(0.0581)	(0.0458)	(0.0604)	(0.0518)	(0.0419)	(0.0542)
Differences in human capital	0.003	0.037	0.050	0.015	0.050	0.058
	(0.0673)	(0.0554)	(0.0576)	(0.0681)	(0.0571)	(0.0593)
Mobile telephone	0.009	-0.042	-0.017	0.017	-0.034	-0.004
	(0.0324)	(0.0346)	(0.0570)	(0.0315)	(0.0338)	(0.0556)
Constant	-0.056	0.539***	0.667***	0.209	0.779***	1.074***
	(0.1830)	(0.1453)	(0.1697)	(0.2340)	(0.2026)	(0.1948)
Observations	219,855	142,254	15,810	221,328	143,260	15,924
R-squared	0.800	0.842	0.813	0.800	0.841	0.813
Within R-squared	0.423	0.498	0.472	0.420	0.496	0.470

Note: We include exporter-year-sector and importer-year-sector fixed effects. Columns (1) to (3) show the impact of digital connectivity using as a proxy the share of population using the internet, columns (4) to (6) use as a proxy the log of active mobile broadband subscriptions per capita. Cluster-robust standard errors in parentheses, two-way clustering at importer and exporter level. *** p¡0.01, ** p¡0.05, * p¡0.1.

Table 37: Impact of digital connectivity on trade flows

VARIABLES	(1) All	(2) Goods	(3) Services	(4) Digitally deliverable services
Mobile broadband subscriptions	0.647***	0.664***	0.618***	0.719***
	(0.1587)	(0.1744)	(0.1527)	(0.1693)
Observations	364,588	221,328	143,260	15,924
Individuals using the internet	1.367***	1.367**	1.369***	1.364***
	(0.5069)	(0.6091)	(0.3964)	(0.4559)
Observations	362,109	219,855	142,254	15,810
Log(mobile broadband subscriptions)	0.415***	0.422***	0.403***	0.520***
	(0.1254)	(0.1391)	(0.1194)	(0.1351)
Observations	364,588	221,328	143,260	15,924

Note: We include exporter-year-sector and importer-year-sector fixed effects. Results show the impact of digital connectivity on trade flows using as a proxy (i) active mobile broadband subscriptions per capita, (ii) the share of population using the internet and (iii) the log of active mobile broadband subscriptions per capita. Each model includes also the set of variables reported in Table 1, coefficients not reported. Cluster-robust standard errors in parentheses, two-way clustering at importer and exporter level. *** p¡0.01, ** p¡0.05, * p¡0.1.

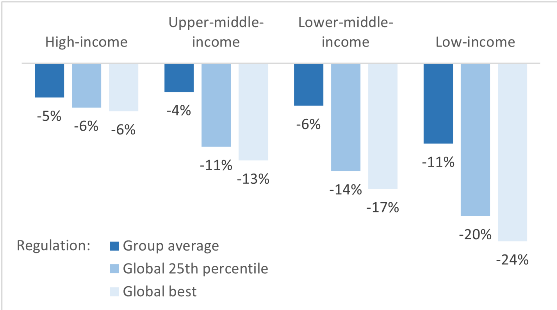
Table 38: Impact of digital connectivity depending on digital trade regulation across income groups

	Low/Middle income				High income			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	All sectors	Goods	Services	Digitally deliverable services	All sectors	Goods	Services	Digitally deliverable services
Connectivity	-0.337***	-0.310***	-0.365***	-0.386***	-0.207***	-0.216***	-0.194***	-0.230***
	(0.0582)	(0.0746)	(0.0521)	(0.0942)	(0.0458)	(0.0510)	(0.0460)	(0.0632)
Connectivity x DSTRI	1.237***	1.107**	1.351***	1.462***	0.447	0.406	0.485	0.740**
	(0.4225)	(0.5240)	(0.3214)	(0.4675)	(0.3961)	(0.4709)	(0.3073)	(0.3666)
DSTRI	-0.930***	-0.765**	-1.099***	-1.468***	-0.419	-0.333	-0.547*	-0.963***
	(0.2930)	(0.3325)	(0.2476)	(0.3059)	(0.3335)	(0.3795)	(0.2754)	(0.2836)
Importer STRI	0.064		0.611***	0.557***	0.066		0.616***	0.565***
	(0.1526)		(0.1286)	(0.1255)	(0.1519)		(0.1288)	(0.1245)
Observations	233,655	142,857	90,798	10,229	233,655	142,857	90,798	10,229
R-squared	0.826	0.813	0.857	0.825	0.827	0.813	0.857	0.825
Within R-squared	0.486	0.474	0.536	0.505	0.488	0.475	0.538	0.507
DSTRI at best connectivity	2.12***	1.898***	2.316***	2.507***	0.348	0.363	0.284	0.307
	(0.5066)	(0.6423)	(0.3941)	(0.5958)	(0.4100)	(0.493)	(0.3357)	(0.4404)

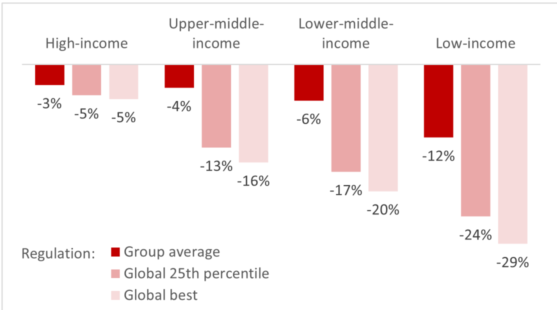
Note: We include exporter-year-sector and importer-year-sector fixed effects. Cluster-robust standard errors in parentheses, two-way clustering at importer and exporter level. *** p¡0.01, ** p¡0.05, * p¡0.1. The model includes also the set of variables reported in Table 1, coefficients not reported. The last row presents the marginal effect of DSTRI at the best level connectivity in the sample.

Figure 24: Counterfactual reductions in trade costs by income group

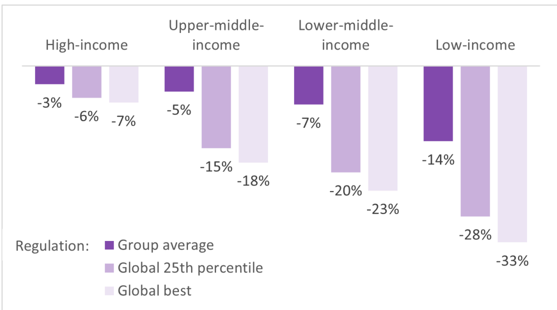
Goods



Services

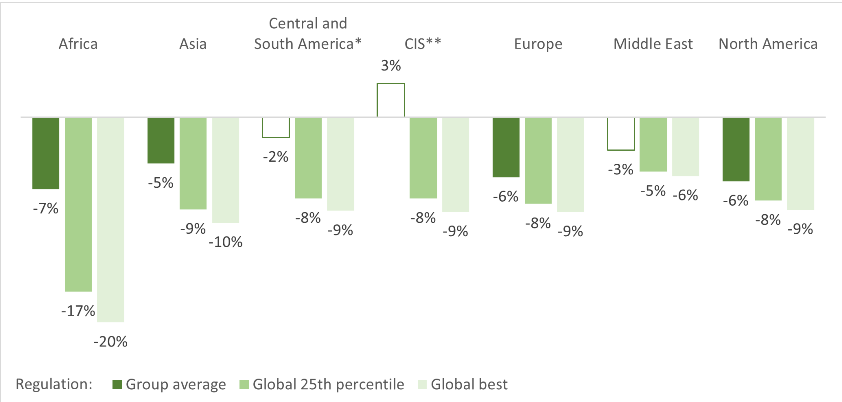


Digitally deliverable services



Note: The figures show the estimated average reductions in trade costs in a scenario where all economies improve their mobile broadband access at least to the level of the economy at the 75th percentile of the global distribution in 2020. In goods and in services, the estimates at different levels of regulation for high-income economies are not statistically significantly different from each other.

Figure 25: Counterfactual reductions in trade costs in goods by region

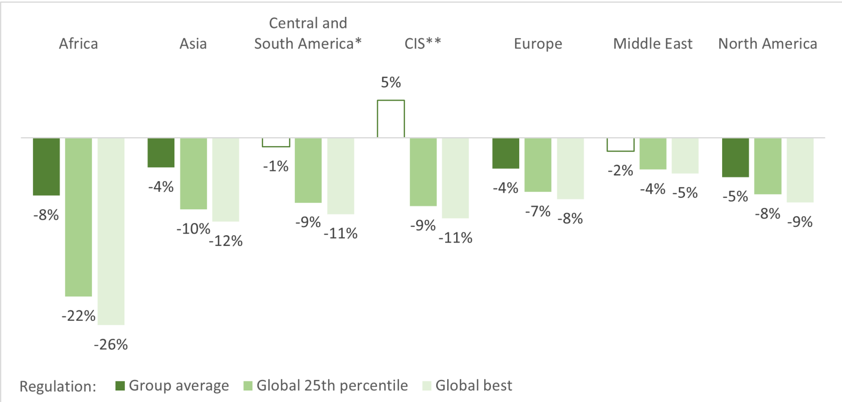


* Includes the Caribbean

** Commonwealth of Independent States, including certain associate and former member States

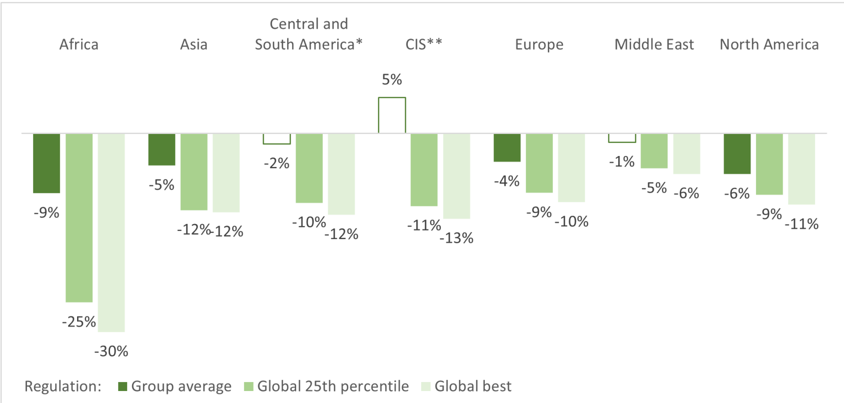
Note: The figures show the estimated average reductions in trade costs in a scenario where all economies improve their mobile broadband access at least to the level of the economy at the 75th percentile of the global distribution in 2020. White fill indicates that the estimate is not statistically significantly different from zero.

Figure 26: Counterfactual reductions in trade costs in services by region



* Includes the Caribbean
** Commonwealth of Independent States, including certain associate and former member States
Note: The figures show the estimated average reduction in trade costs in a scenario where all economies improve their mobile broadband access at least to the level of the economy at the 75th percentile of the global distribution in 2020. White fill indicates that the estimate is not statistically significantly different from zero.

Figure 27: Counterfactual reductions in trade costs in digitally deliverable services by region



* Includes the Caribbean
** Commonwealth of Independent States, including certain associate and former member States
Note: The figures show the estimated average reduction in trade costs in a scenario where all economies improve their mobile broadband access at least to the level of the economy at the 75th percentile of the global distribution in 2020. White fill indicates that the estimate is not statistically significantly different from zero.

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