Essays on International Economics

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A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in Economics

August 2021

I would like to dedicate this thesis to my loving parents and sisters for their unconditional love and support . . .

献给我的父母和妹妹们, 感谢他们一直以来无条件的爱与支持. . .

Declaration

I hereby declare that except where specific reference is made to the work of others, the contents of this dissertation are original and have not been submitted in whole or in part for consideration for any other degree or qualification in this, or any other university. I confirm that chapter three was jointly co-authored with Dr Pavel Chakraborty.

Huan Yang

August 2021

Acknowledgements

This thesis has been completed with the help of so many amazing people. First and foremost, I would like to express the deepest appreciation to my supervisors, Dr. Kwok Tong Soo and Dr. Pavel Chakraborty, for their unwavering support, patience and positive attitude throughout. Without their guidance, comments and advice, this thesis would not have been possible. They have been such great mentors, who encouraged and inspired me throughout the whole journey. Thank you for always being approachable for me and providing guidance and advice in not only academic research but also in career wise. I have been incredibly lucky to have such friendly and supportive supervisors. It has been such a pleasure to work with them.

I am also grateful for all the support I got from the Department of Economics at Lancaster University. I would like to thank the faculty of our department, Caren Wareing, Professor Themis Pavlidis, Dr. Giorgio Motta and Dr. David Rietzke, for creating and fostering a vibrant and supportive community for PhD students. I would like to thank Professor Maurizio Zanardi, Dr. Aurelie Slechten and many others for their insightful comments and feedback.

I would also like to thank my friends I have made in this journey, Yi Luo, Charlotte Edney, Gerda Buchmueller, Dr. Yuting Bai, Alex Skouralis, Alex Farnell and Andrew McKendrick, who have provided both academic help and friendship over the course of this PhD. Special thanks to Dr. Hankui Peng and Yingying Zhang (瀚葵和英英) for all the great time we had during so many lovely home-made meals, pleasant walks and our casual chats every Saturday nights during the Pandemic. 非常庆幸在博士求学道路上有你们一路同行！

A special acknowledgement must goes to Chibuzor, for always being my cheer leader in life. Thank you for always being there for me to encourage and motivate me to achieve my goals. I am lucky to have you by my side and believe in me when I have doubts.

The last but certainly not least, I am deeply grateful to my family, for their endless love and support. 首先，我要感谢我的母亲，白建华女士。谢谢你一直在我身边支持我，鼓励我，顶住来自各方的压力支持我这个自私的决定。也感谢你在我成长的道路上不断地激发我自身的潜能，激励我努力提升成为更好的自己。其次，我要感谢我的父亲，杨玉虎先生的包容和理解。谢谢你对于家庭的付出，对我的鼓励和支持。希望我没有让你们失望。对于父母，真的很抱歉因为远在地球的另一边没有好好陪伴在你们的身边，让你们为我担心。另外，我要感谢我的两个妹妹，笑和梓畅。谢谢你们无条件的爱与支持。最后，我想以此毕业论文来纪念我的曾外祖父，白德明先生。

Abstract

This thesis has three essays corresponding to the three research projects I undertook in the area of foreign direct investment, international and labor economics.

In the first essay, I quantify the welfare and employment effect of international trade both at the aggregate and sector level. I build into a multi-country, multi-sector Ricardian model (Eaton and Kortum, 2002) the imperfect labor market with the search and matching framework (Pissarides, 2000). Welfare and equilibrium unemployment are both associated with production and labor market efficiency. Comparing with the trade gains literature, trade gains generated in our model is magnified by the inverse of labor market matching elasticity. The change in sectoral employment rate resulting from the trade policy change can be decomposed into two parts: the change in the share of domestic expenditure in that sector and the change in sectoral price index via the sectoral linkages. The counterfactual analysis of "The China Syndrome" after China joining the WTO in 2001 provides evidence that there are heterogeneous effect of trade openness on different sectors.

The second essay investigates the role of trade liberalization on business investments by manufacturing firms in India. In particular, we look at the drop in output tariffs, as a result of the Indian trade liberalization process in the 1990s and estimate the investments responses of firms. We find that higher degree of product market competition, or a 10% drop in output tariffs reduces business investments of a firm by around 2.5%. Our results show substantial heterogeneity when dividing firms by family-owned and others. The drop in investments is 55–98% less for family firms when compared to non-family firms, especially in R&D-intensive and industries that depend more on external finance. In addition, among family firms, the ones which are a part of a business group or "family-network" (Karaivanov

et al., 2019) do the opposite: they increase their investments. We explain this differential behaviour between family and non-family firms by their risk-taking behaviour and connection to the state-owned banks. Our results highlight two important points, both from theoretical and empirical perspective, how ownership of a firm influences its business decisions and how internal financial markets allocate resources while firms compete with external forces.

The third essay analyzes the causal effect of cross-border M&A on the productivity performance of acquiring firms. We compile a unique data set for the analysis using M&A data from UNCTAD cross-border M&A database and company data from OSIRIS and firm annual reports. The result indicates that acquiring firms would achieve an increase of around 1.4% of the productivity growth rate one year after the acquisition, but suggests no lasting effect at two years after the deal. The estimated Average Treatment Effect on Treated (ATT) are larger for acquirers from developing country than these from industrialized economies. Moreover, We find positive effect on acquiring firms productivity growth only if target firm is from developed countries, in the same industry with the acquirers, and 100% ownership acquired. Finally, the cross-border M&A will have significant effect on acquirers productivity performance only when target firm is slightly larger than industry average in respect of firm revenue and much more productive.

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Chapter 1

Introduction

1.1 The International Economic Environment

With the ongoing globalization, the world is more connected than ever with growing interdependence of the world's economies, cultures, and populations. The international economic environment has also experienced changes and new challenges. International economics is no longer simply just about the cross-border movement of goods and capital, but includes broader concepts, for instance the movement of services and technology, flows of people, and information across economies. The emergence of Global Value Chains with the deep input-output linkages across countries also makes the global economy incredibly complex. Countries have built economic partnerships to facilitate these movements over centuries, for example, bilateral and multilateral trade agreements, creation of an integrated single market, etc.

Driven by technology and transportation progress, and changes in international cooperation, the world have experienced different periods of globalization trend in various elements over the past few decades. **Figure 1.1** shows the world globalization trends in 1975-2019, which comprises of three major elements: cross-border flows of merchandise, service and investment. The plots of merchandise trade shows that starting from about 27% as a share of the world GDP in 1975, how yearly merchandise trade grow and reached to a historically high level at about 51% of the world GDP in 2008, but dropped dramatically during the

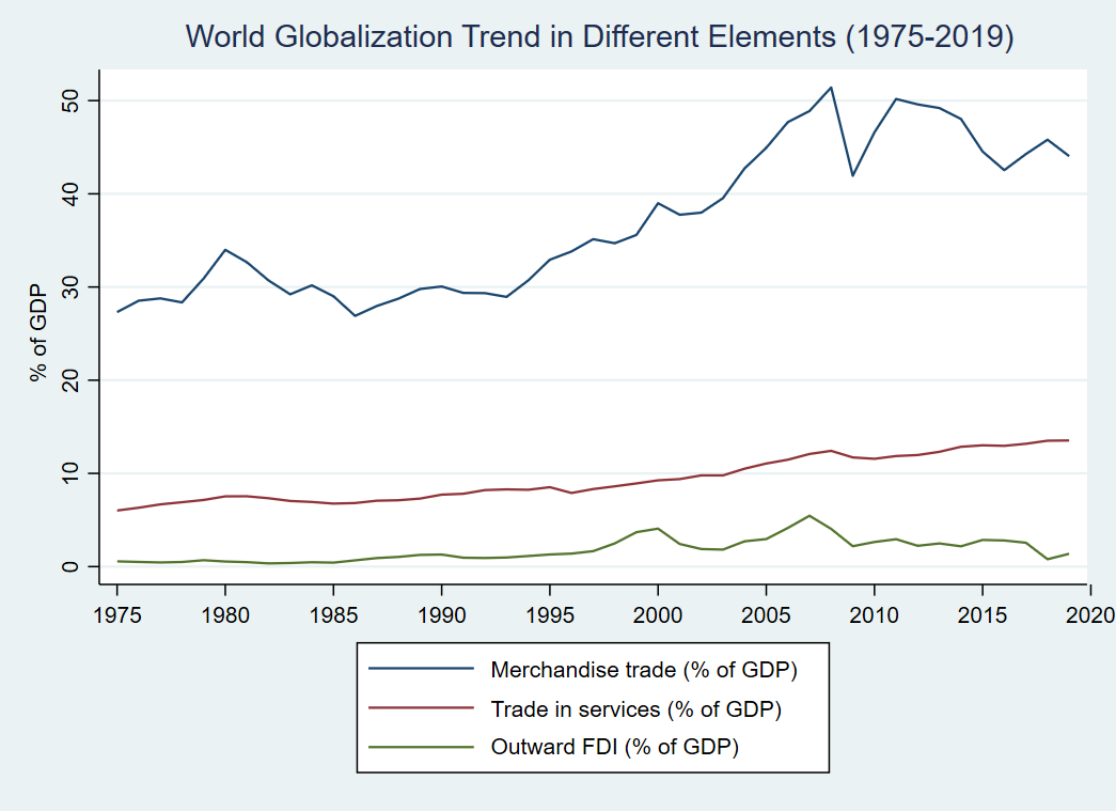


Fig. 1.1 World Globalization Trend in Different Elements (1975-2019)

Source: World Trade Organization and World Bank and OECD GDP estimates. International Monetary Fund, Balance of Payments database, supplemented by data from the United Nations Conference on Trade and Development and official national sources.

Note: Merchandise trade as a share of GDP is the sum of merchandise exports and imports divided by the value of GDP, all in current U.S. dollars. Trade in services is the sum of service exports and imports divided by the value of GDP, all in current U.S. dollars. Foreign direct investment refers to direct investment equity flows in an economy. It is the sum of equity capital, reinvestment of earnings, and other capital. Direct investment is a category of cross-border investment associated with a resident in one economy having control or a significant degree of influence on the management of an enterprise that is resident in another economy. This series shows net outflows of investment from the reporting economy to the rest of the world, and is divided by GDP.

global financial crisis of 2008–09. As the figure shows, although the world merchandise trade to GDP bounced back in 2010, but the trade growth has been weak ever since. Although the FDI as a share of GDP is relatively low comparing with trade in merchandises and services, it has grown steadily and peaked in 2007, but has been decreasing since. We are now in an era of World Trade Slowdown (Hoekman, 2015) or "Slowbalization" as discussed in an article published on *The Economist* on January 24, 2019.[1] However, in terms of the other element

[1] See https://www.economist.com/leaders/2019/01/24/the-steam-has-gone-out-of-globalisation, accessed on May 3, 2021.

of international economics, trade in services, there is no obvious sign of deglobalization. The share of trade in services has been growing slowly and steadily from about 6% in 1975 to about 13% in 2019. These plots show that the global economy has became more complex and more connected in various ways.

Alongside the changes in trade growth, recent incidents, for example, "Brexit", "Trade War" between the U.S. and China and the COVID-19 pandemic, etc., show that the world economy is currently at a critical inflection point in history in which fears about global economic integration are growing. In an environment where protectionism is encouraged, policymakers and business leaders are now questioning whether their economic interdependence have been stretched too far. All this has highlighted the importance of understanding the impact of global economic integration. This thesis provides findings that help to answer this question.

1.2 The Objectives of This Thesis

As mentioned earlier, it is important to understand the consequences of globalization which comprises different elements. This thesis considers global value added chain, trade liberalization in manufacturing sectors and cross-border merger and acquisition from both theoretical and empirical perspectives. This thesis also focuses on the effect of globalization in various aspects, for instance, welfare, employment, firm investment and productivity.

In particular, **Chapter 2** builds a multi-country, multi-sector Ricardian model (Eaton and Kortum, 2002) with imperfect labor market to quantify the welfare and employment effect of international trade with input-output linkage. **Chapter 3** is an empirical study which investigate the impact of trade liberalization on manufacturing firms' investment decisions. Last, **Chapter 4** focuses on the cross-border M&A and analyzes the effect on the productivity performance of the acquiring firms.

1.3 Overview of the Results

For each of the research questions that the following chapters attempt to address, there are previous studies in the literature that have provided evidence and answers to the question. Here in this section, we discuss how the results this thesis contribute to the previous literature.

In **Chapter 2**, the question is to quantify the welfare and employment effects of trade by a trade model with imperfect labour market framework. Existing studies in the literature often either assume labour is the only factor of production in a model with imperfect labour markets, or perfect labour markets in a model with input-output linkages. **Chapter 2** combines both labour market imperfections and input-output linkages (which take the form of tradable intermediate inputs in the production function). By doing this, the overall trade gains at general equilibrium is magnified compared with the traditional trade gains in the literature. The result shows that trade gain in terms of real wages is a function of: (a) sector-level trade openness; (b) sector-level trade elasticity; (c) value added share at the sector level; and (d) the elasticity of the labour market matching function. Using this framework, I was also able to get the changes in the sector and national level employment rate following changes in trade policy. It is evident that an increase in trade openness leads to an increase in employment rates, especially for sectors that use more intermediate inputs.

I calibrate the model and exploit China's accession in the WTO in 2001 as a counterfactual exercise. The result shows that following one country's trade liberalization, China in this case, there are heterogeneous effects on real wages and employment rates across countries and sectors. Countries who benefit from the tariff changes due to China joining the WTO are mostly developing economies or transition countries, while countries who lose are mostly advanced countries. Moreover, the size of the such effect—be it negative or positive—varies across different sectors, where larger effect on manufacturing sectors than service sectors is observed.

In **Chapter 3**, we wish to understand the how manufacturing firms adjust their investment decisions in response to unilateral trade liberalization. Different from the previous literature, we bring to bear unique data on a specific type of investment, which captures the activities directly related to secure or expand firm's businesses along the supply chain. In particular, any

investments made by a firm in any other establishment, which is connected with the investing firm in the corresponding downstream or upstream sector. This particular investment is defined as **"Business Investment"** in this thesis. To establish a causal link, we exploit India's Eight-Plan trade reform in the 1990s, a quasi-natural experiment, and utilize the drop in output tariffs as an indicator of product market or foreign competition. Overall, we find a remarkably persistent and economically meaningful negative effect: a 10% drop in output tariffs reduces business investments of a firm by around 2.5%.

Another contribution we have to the literature is that we show how different types of firms respond to changes in product market or foreign competition based on their ownership. In particular, when dividing our sample between family and non-family firms, the result shows that family firms, on average, drop investments about 50–98% less than non-family firms. We also find that this is mainly driven by the family firms which belong to a business group or are "family-networked" (Karaivanov et al., 2019) and above the median of the size distribution. Those groups of family firms, in fact, increase their business investments in response to drop in output tariffs. Investigating the cause for this differential effect for family firms, our results suggest that risk-taking behaviour and banking relationships play an important role.

Chapter 4 makes an empirical attempt to investigate whether acquiring firms would benefit from the cross-border M&A in terms of their productivity performance. What makes the research project distinct from the existing studies is that I compile a unique multiple country firm-level dataset that merges firm level data and M&A data with information on both the acquired and acquiring firms. Using the unique panel dataset, **Chapter 4** estimates the effect on acquirer performance with the recognition of the investor country origin effect, contributing to our understanding of the overall consequence of cross-border M&A. The result shows that cross-border acquisition do have a positive and significant effect on the growth of acquiring firms productivity for firms from developing and developed countries. The size of the treatment effect, however, is different by acquirer's country origin, with larger effect on developing acquirers than developed acquirers.

Moreover, different from the existing literature focusing on simple treatment effect, we estimate how varying features of a cross-border acquisition alters the effect of the treatment. The varying features of M&A we analyzed are 1) country origin of the target firms, 2) whether the deal is horizontal or vertical, 3) whether target firms is 100% acquired or not. We find positive effect on acquiring firms productivity growth only if target firm is from developed countries, in the same industry with the acquirers, and 100% ownership acquired. Finally, the cross-border M&A will have significant effect on acquirers productivity performance only when target firm is slightly larger than industry average in respect of firm revenue and much more productive.

1.4 Structure of the Thesis

This thesis is structured as follows. **Chapter 2** presents the first study: "Frictional Unemployment and Trade in Value Added", which quantify the welfare and employment effect of trade openness. **Chapter 3** presents the second essay: "Trade Liberalization, Business Investments and Family Firms", a joint work with Dr Pavel Chakraborty, which investigate the trade liberalization effect on firm's investment decisions. The last essay included in this thesis: "Cross-border M&A and the Performance of Acquirer", is presented in **Chapter 4**. It analyses the effect of Cross-border M&A on the productivity performance of the investing firms. Finally, in **Chapter 5**, we conclude.

Chapter 2

Frictional Unemployment and Trade in Value Added

2.1 Introduction

With the explosion of micro-theoretical foundations underlying gravity equations, quantifying the consequences or gains from globalization based on gravity equations has become a core issue in the literature. Existing frameworks focus on the welfare gains from globalization under the assumption of perfect labour markets, but few shed light on labour market outcomes in terms of unemployment rates and welfare gains with labour market frictions.

In contrast to the academic literature addressing the issue, the effect of trade openness on country's unemployment rate has caused lots of debates in the media. In fact, the unemployment rate issue, related to concerns of job reduction, has often been used as an excuse for trade protectionism. For example, the recent "Trade War" between the U.S. and China, which started due to the Trump administration's trade policy, reflects these protectionist arguments. The many Americans cheering President Trump's trade policies shows how people are convinced of trade protectionist's claim. On the other hand, on March 28, 2018, an article published on *The New York Times* written by Donald J. Boudreaux, argued that "Trade is not a job killer" and a "Trade War" cannot make America great again[1].

Quantifying the effects of globalization on welfare and the equilibrium unemployment rate with frictional labour markets, therefore, is of first-order importance.

I extend Eaton and Kortum (2002) by building a multi-country, multi-sector Ricardian model to include the imperfect labour market framework with search and matching (Pissarides, 2000) to quantify the welfare and employment effects of international trade. Different from the previous research assuming labour is the only factor of production, I add intermediate inputs allowing for input-output linkages in the model. This is my primary contribution. Under this framework, I link the goods market with the labour market and compute simple expressions for welfare predictions and the equilibrium unemployment rate in an open economy at the sector and aggregated level. The overall welfare effect consists of a component of trade effect and a component addressing the labour market imperfection. The overall welfare effect is magnified compared with the traditional trade gains measurement assuming full employment. The sector and aggregate equilibrium unemployment rates are related to the efficiency of both the production and labour markets. It is also evident that an increase in trade openness leads to larger increase of employment for sectors that use more intermediate inputs.

To calibrate the model, I estimate two key parameters: θ_s, the sector level trade elasticity, and μ, the elasticity of the labour market matching function. Consistent with the wide class of gravity-trade models, I adopt the method proposed in Caliendo and Parro (2015) to estimate θ_s. Here, I propose a new method to estimate the value of μ with observed data based on the setups of the model. To quantify the effect of trade policy changes, I calibrate the model with data on bilateral tariff from UNCTAD TRAINS database, bilateral trade flow from CEPII BACI and I-O tables from World Input-Output Database.

I exploit China's accession in the WTO as a counterfactual exercise and use the estimated key parameters from my model to identify the employment and welfare effects of a change in the tariff structure. In particular, I perform four different counterfactual exercises: (1) I introduce into the model the changes in the tariff structure due to China joining the WTO; (2) I hold the tariff rates involving China fixed to the level of 2000 and introduce only the

[1] See https://www.nytimes.com/2018/03/28/opinion/trump-tariffs-trade-war.html, accessed on September 30, 2019.

changes of tariffs between other countries; (3) I consider the change in the tariff structure imposed only by China and keep the other countries' tariff rates unchanged as in 2000; (4) I introduce only the tariff changes on Chinese products by other countries. I find that following China joining the WTO, countries who benefit from the tariff changes are mostly developing economies or transition countries. Most of the advanced countries experience negative impact on their employment rates and welfare. The gains from joining the WTO for China are driven by the decline in the Chinese tariffs rather than the changes to tariffs on Chinese exports. Furthermore, our counterfactual analysis at the sector level also highlight the heterogeneous effects of one country's trade liberalization on other countries' labour market across sectors.

This paper have several contributions to different strands of literature. My first contribution complements the literature on quantifying the consequences of trade liberalization. By introducing labour market frictions to the trade model, my paper shows that the gains from trade is magnified by elasticity of the labour market matching function. Studies in this literature can be classified into two major groups based on the micro-theoretical foundations they use, namely the Armington Eaton-Kortum perfect competition model (Eaton and Kortum, 2002) and the Melitz (2003) monopolistic competition model with firm-level heterogeneity. Starting with Eaton and Kortum (2002), the welfare predictions of moving to Autarky, an extreme counterfactual scenario with no trade, is a function of a change in the domestic expenditure share, λ_{ii}, and the trade elasticity θ. Later work, led by Arkolakis et al. (2012), derived a similar closed form of trade gains using the Melitz (2003) monopolistic competition model, showing that irrespective of the micro-structure, the domestic trade share and the trade elasticity are sufficient statistics to quantify the aggregate trade gains. The beauty of the similar clean expression of welfare prediction from these two models is that one can easily compute the consequence of globalization with observed macro-level data and an estimate of trade elasticity, which can be obtained from the large gravity literature.

As reviewed by Costinot and Rodriguez-Clare (2014), recent studies also extend the model by introducing many sectors, intermediate goods and multiple factors of production, and compute similar expressions for welfare gains but with a small number of additional

parameters apart from trade elasticity. Such extensions seem to increase significantly the magnitude of the gains from trade, while the fundamental idea still remains consistent with the simple model in early work. The formula for gains from trade generated in my paper is closely related to the one in Costinot and Rodriguez-Clare (2014) with the existence of multiple sectors and tradable intermediate goods following the Eaton and Kortum (2002) setting. The main difference between my model and Costinot and Rodriguez-Clare (2014) is that I introduce labour market frictions, and as a result my welfare prediction formula identifies two channels of the trade effect on welfare: the employment effect and the income effect. The employment effect assembles the employment rates across all sectors, while the income effect aggregate the real wages across all sectors.

Secondly, I contribute to the literature on how trade liberalization affects (un)employment. The primary contribution to this literature is that I introduce the input-output linkage to the theoretical framework by adding the intermediate inputs in the model. The counterfactual exercise in my paper also complements the literature by showing how one country's trade liberalization affects both home and foreign countries' labour market outcomes. The employment rate in the model after solving the equilibrium in the labour and goods market is shown to be increasing in the home country's trade openness. However, the effect of one country's trade liberalization on foreign countries is plausible. In the literature, a widely held view is that international trade increases unemployment, which finds supportive evidence in the "China Syndrome" by Autor et al. (2013). Their paper provides evidence that local labor markets that are exposed to rising low-income-country imports experience increased unemployment and decreased labor-force participation. Although Autor et al. (2013) shed light on the job losses due to the Chinese import competition shocks, their work is primarily an empirical paper and their model did not include input-output linkages.

In terms of the theoretical framework, there is a growing literature on the relationship between the equilibrium unemployment rate and trade openness with imperfect labour markets. The strand of the theoretical trade literature which my paper is closely related to introduces search frictions as the labour market imperfection into the trade model. In all these studies, the labour market setups are similar, with some using the Diamond-Mortensen-

Pissarides search and matching frictions model (Helpman and Itskhoki (2010); Helpman et al. (2010); Carrère et al. (2015)) while others use the one-shot search and matching version of the Pissarides (2000) model (Felbermayr et al. (2013); Heid and Larch (2016)). Under the search and matching framework, workers search for jobs and firms search for workers, and they bargain over the match surplus. The equilibrium employment or unemployment rate, hence, is derived by interacting the wage curve and job creation curve from the bargaining process.

The trade model used in this field are based around either the Eaton and Kortum (2002) model, or the Melitz (2003) model. Papers which introduce search frictions into trade models with increasing returns to scale of the Melitz (2003) type provide mixed results of the relationship between globalization and unemployment (Felbermayr et al. (2011b); Helpman and Itskhoki (2010); Helpman et al. (2010)). Despite the clear theoretical framework, these studies find it difficult to carry out empirical investigations because of the lack of analytical tractability. In deriving empirically testable predictions on observable market characteristics, this paper lies in the other small but growing strand of the literature following the Eaton and Kortum (2002) model (Felbermayr et al. (2013); Heid and Larch (2016); Felbermayr et al. (2013); and Carrère et al. (2015)).[2] It is worth noting that different from the mixed result shown in papers following the Melitz (2003) trade model, all the existing research using the Eaton and Kortum (2002) trade model show that the unemployment rate is decreasing in the degree of openness and provide supporting empirical evidence.

My third contribution is that I proposed a new method to estimate the elasticity of search and matching function. The matching function in the labour market is assumed to be a Cobb-Douglas constant returns to scale function, where there is widespread empirical evidence for such matching function in the literature. In this strand of labour literature, the elasticity of search and matching function is often estimated by regressing the job-finding rate on

[2]In particular, Carrère et al. (2015) builds a multi-country, multi-sector trade model with search frictional unemployment. They estimate the sector-specific labor market frictions and run counterfactual exercises for TTIP(The Transatlantic Trade and Investment Partnership), TPP(The Trans-Pacific Partnership) and the removal of trade imbalances. The results show that international trade leads to a reduction of unemployment through the increased real wage and reallocation effects. The set-up of the labour market in my paper is different from theirs, and we are able to derive the sector level labour market outcomes.

the market tightness, which refer to the vacancy to unemployment ratio (see Petrongolo and Pissarides (2001) for an early survey, Barnichon (2012), Kohlbrecher et al. (2016) and Lange and Papageorgiou (2020) for recent empirical approaches). Here, the new method I propose follows the relationship of the changes in nationwide employment rates and the changes in real wages derived from the model. [3] I got the estimate of the elasticity of the matching function with respect to vacancies by regressing the changes of employment rates on changes in real wages with data for 206 countries from 1996 to 2018. Although the proposed approach for estimating the elasticity depends on the underlying microstructure assumed in the model, the magnitude of my estimate is in the plausible range of the matching elasticity in the labour literature.

This paper also complements the literature on estimating the trade elasticity in the wide class of gravity-trade models. Most of the previous studies focus on either small sample periods or limited countries or regions (Eaton and Kortum (2002), Hillberry et al. (2005), Broda and Weinstein (2006) and Caliendo and Parro (2015)). I adopt the method proposed in Caliendo and Parro (2015) to estimate the sector level trade elasticity with a relatively larger countries and years observations. The method exploit the cross-sectional variation in trade shares induced by the cross-sectional variation in tariffs. The magnitude of our estimates with country and year FE are smaller comparing to the existing literature, which might be due to the different(larger) sample period and countries I use.

Lastly, the counterfactual analysis result also contribute to the small empirical literature on the role of trade openness in cross-country unemployment regression. Although previous studies like Felbermayr et al. (2011a) [4] provide evidence on the employment effect of trade openness, little is known about how one country's trade liberalization affect the labour market in the other countries via the input-output linkage. This paper shed light on this area by applying the model to quantify the changes of employment across countries and sectors from

[3]The method proposed in the paper is based on the fundamental microstructure assumed in the model. Therefore, the elasticity of the search and matching function estimated using the proposed method suits the model better.

[4]Building on the tradition of rich empirical labor market studies but including trade liberalization, Felbermayr et al. (2011a) find that more trade openness reduces unemployment for both a high-quality panel data set of 20 rich OECD countries and a lower-quality cross-section data set of 62 countries.

Chinese trade liberalization after joining the WTO. The result shows the effect varies in different countries groups and sectors.

The paper is structured as follows. Section 2.2 set up the theoretical model and derive the sector and aggregate level employment rate and real wage in general equilibrium. In section 2.3, we present the model in Autarky and open economy to evaluate the changes in employment and welfare due to trade policy changes. Section 2.4 take the model to the data and show the result of the estimations of the key parameters to calibrate the model. Using China Joining WTO as a counterfactual scenario, we discuss employment and welfare effect of one country's trade liberalization across countries and sectors in Section 2.5. In Section 2.6 we conclude.

2.2 Model Setup

2.2.1 Goods market

We build on the Eaton and Kortum (2002) Ricardian model with multiple sectors, $s = 1, \ldots, S$, by using a two-tier utility function with a upper-level Cobb-Douglas function and a lower-level CES function. A representative consumer in each country faces a upper level utility function

$$U_n = \prod_{s=1}^{S} U_{n,s}^{\beta_{n,s}} \tag{2.1}$$

where $\beta_{n,s} \geq 0$ are exogenous preference parameters with $\sum_{s=1}^{S} \beta_{n,s} = 1$. We use the expenditure share of goods from sector s in total expenditure as proxy for $\beta_{n,s}$ in that country. $U_{n,s}$ is the utility the representative agent gets from the consumption of goods in sector s, in country n.

For the lower-level CES function, the representative agent purchases a continuum of goods or varieties $j \in [0,1]$ to maximize

$$U_{n,s} = \left(\int_0^1 Q_{n,s}(j)^{(\sigma_s - 1)/\sigma_s} dj\right)^{\sigma_s/(\sigma_s - 1)} \tag{2.2}$$

where $\sigma_s > 1$ is the elasticity of substitution between different varieties within sector s and is assumed to vary across sectors.

In line with Eaton and Kortum (2002) , country i's efficiency in producing a good variety j in sector s is $z_{i,s}(j)$. Assuming the input cost of good in sector s, in country i is $c_{i,s}$, with constant returns to scale, the cost of producing a unit of good in sector s, in country n is $c_{i,s}/z_{i,s}(j)$. Considering trade with geographic barriers, delivering a unit of good j in sector s from country i to country n requires a trade cost $d_{ni,s} > 1$, which are composed of import tariffs and "iceberg" trade costs. Note that the geographic barriers vary by sector, but not by variety. Therefore, the total cost is the unit production cost multiplied by the trade cost.

$$p_{ni,s}(j) = \frac{c_{i,s}d_{ni,s}}{z_{i,s}(j)} \tag{2.3}$$

Under the perfect competition assumption, consumers compare goods from all around the world in terms of price and choose the cheapest one to buy. Therefore, the actual price that consumers in country n pay for the good j in sector s is

$$p_{n,s}(j) = min\{p_{ni,s}(j); i = 1, ..., N\} \tag{2.4}$$

Together with the two-tier utility functions, the expenditure in any country n on variety j in sector s is given by $E_{n,s}(j) = [\frac{p_{n,s}(j)}{P_{n,s}}]^{1-\sigma_s}\beta_{n,s}E_n$, where E_n is the aggregate expenditure in country n. Consistent with the upper-level utility function, the associated consumer price index is $P_n = \prod_{s=1}^{S} P_{n,s}^{\beta_{n,s}}$, with the sector-specific price indices $P_{n,s}$. To derive the distribution of prices, we assume that country i's efficiency in producing a good in sector s, $z_{i,s}(j)$, follows a Frechet probability distribution

$$F_{i,s}(z) = Pr[Z_{i,s} \leq z] = exp(-T_i z^{-\theta_s}) \tag{2.5}$$

where $T_i > 0$ is a country-specific parameter that governs the level of the distribution: the bigger T_i is, the more likely a high efficiency is drawn for producing any good j. θ_s, however,

is a sector-specific parameter, determining the variation within the distribution, with larger θ_s representing less variability.

Similar with Eaton and Kortum (2002) and assuming $1+\theta_s > \sigma_s$ for all $s = 1,\ldots,S$, the distribution of prices derived from the distribution of technologies together with the lower-level utility function yields a expenditure share function. The fraction of expenditure on goods from sector s, country i in country n is

$$\lambda_{ni,s} = \frac{X_{ni,s}}{X_{n,s}} = \frac{T_i(c_{i,s}d_{ni,s})^{-\theta_s}}{\Phi_{n,s}} \tag{2.6}$$

with a sector-level price parameter $\Phi_{n,s}$ determined by the technologies, input costs around the world and trade barriers between country n with all the other countries around the world.

$$\Phi_{n,s} = \sum_{i=1}^{N} T_i(c_{i,s}d_{ni,s})^{-\theta_s} \tag{2.7}$$

The sector-specific associated consumer price index, hence, is

$$P_{n,s} = \gamma_s \Phi_{n,s}^{-1/\theta_s} \tag{2.8}$$

with $\gamma_s = [\Gamma(\frac{\theta_s+1-\sigma_s}{\theta_s})]^{1/(1-\sigma_s)}$ and Γ is the Gamma function.

2.2.2 Labour Market

Different from most of the trade frameworks with full employment, we allow unemployment in the labour market. Building upon Heid and Larch (2016) and Felbermayr et al. (2013), we develop a labour market model using a one-shot version of the Pissarides (2000) search and matching framework. Different from their models, we construct a sector level labour market model with input-output linkage to be consistent with the goods market.

Assume the potential workers in country i is L_i, the allocation of the potential workers for each sector is $L_{i,s} = s_{i,s}L_i$ for $s = 1,\ldots,S$, where $s_{i,s}$ is the sector output share in country i. Hence, the potential workers in sector s, in country i, $L_{i,s}$, have to search for a job. On the other hand, firms in sector s, in country i, post vacancies $V_{i,s}$ to find workers. The number of

successful matches is a Cobb-Douglas constant returns to scale function:

$$M_{i,s} = m_i L_{i,s}^{\mu} V_{i,s}^{1-\mu}$$

where $\mu \in (0,1)$ is the elasticity of the matching function. m_i denotes the efficiency of the matching process in country i, which is allowed to vary across countries. We use $\delta_{i,s} \equiv V_{i,s}/L_{i,s}$, as the degree of labour market tightness in sector s, in country i, the fraction of all the vacancies that will be filled is $M_{i,s}/V_{i,s} = m_i(L_{i,s}/V_{i,s})^{\mu} = m_i \delta_{i,s}^{-\mu}$. Similarly, the employed worker share of all the potential workers is $M_{i,s}/L_{i,s} = m_i(V_{i,s}/L_{i,s})^{1-\mu} = m_i \delta_{i,s}^{1-\mu}$. Therefore, we get the sector level unemployment rate in the labour market

$$u_{i,s} = 1 - m_i \delta_{i,s}^{1-\mu} \tag{2.9}$$

The aggregate unemployment rate in country i is equal to 1 minus the share of all sectors' total employment in country i's total potential workers.

$$u_i = 1 - m_i \sum_{s=1}^{S} s_{i,s} \delta_{i,s}^{1-\mu} \tag{2.10}$$

Note that the unemployment rate is decreasing in the country's labour market efficiency m_i and the country-sector level labour market tightness $\delta_{i,s}$. Moreover, the larger the elasticity of the matching function, μ, the smaller the effect of labour market tightness on employment.

Different from the existing labour market search and matching models that assume labour to be the only factor of production, we assume that production combines labour and intermediate inputs with labour having a constant share $\alpha_{i,s} \in (0,1)$. This allows us to add input-output linkages into the model. The intermediate inputs used in sector s from sector k also have a constant share $\alpha_{i,ks} \in (0, 1-\alpha_{i,s})$. Here, we assume this constant input share to be equal to $\alpha_{i,ks} = (1-\alpha_{i,s})\beta_{i,k}$ and $\sum_{k=1}^{S} \alpha_{i,ks} = 1 - \alpha_{i,s}$. In other words, the share of intermediate input from sector k, is proportional to the consumer preference for final good from sector k. This means that the preference for intermediate good is consistent with the consumer preference for final goods. This assumption simplifies the calculation and allow us

to get a clean form for the equilibrium labour market tightness later. The production function takes a Cobb-Douglas form as follows:

$$Y_{i,s} = Z_{i,s} L_{i,s}^{\alpha_{i,s}} \prod_{k=1}^{S} X_{i,ks}^{\alpha_{i,ks}} \tag{2.11}$$

Firms maximize their profits by choosing inputs $L_{i,s}$ and $X_{i,ks}$, taking intermediate factor price $P_{i,k}$, wage $w_{i,s}$, and good price $c_{i,s}/Z_{i,s}$ [5] as given. Solving the profit maximization problem yields the relative labour input to intermediate input as a function of the price of intermediate inputs and labour:

$$\frac{L_{i,s}}{X_{i,ks}} = \frac{\alpha_{i,s}}{\alpha_{i,ks}} \frac{P_{i,k}}{w_{i,s}}$$

As is standard in the search and matching model, we assume that every firm employs one worker. Similar with Helpman and Itskhoki (2010), Felbermayr et al. (2013), and Heid and Larch (2016), under the perfectly competitive market setting, this assumption does not cause any loss of generality as long as the firms are price takers. With one unit of labour and the relative input of intermediate goods, we can get the quantity of output. Furthermore, the revenue from sales of output produced by one labour and the corresponding intermediate inputs is $c_{i,s} \prod_{k=1}^{S} (\frac{\alpha_{i,ks} w_{i,s}}{\alpha_{i,s} P_{i,k}})^{\alpha_{i,ks}}$.[6] In the bargaining case, firm and worker bargain over their surplus when they match. The matching gain for the firm is the revenue minus the wage costs and intermediate input costs

$$c_{i,s} \prod_{k=1}^{S} (\frac{\alpha_{i,ks} w_{i,s}}{\alpha_{i,s} P_{i,k}})^{\alpha_{i,ks}} - w_{i,s} - \sum_{k=1}^{S} \frac{\alpha_{i,ks} w_{i,s}}{\alpha_{i,s}} = c_{i,s} \prod_{k=1}^{S} (\frac{\alpha_{i,ks} w_{i,s}}{\alpha_{i,s} P_{i,k}})^{\alpha_{i,ks}} - \frac{w_{i,s}}{\alpha_{i,s}}$$

As for the worker, the outside option is being unemployed with unemployment benefits. Let $b_{i,s} = \vartheta_i w_{i,s}$ be the unemployment benefit in country i with $\vartheta_i \in (0,1)$, which is exogenous to both the worker and firm. For a worker, the matching gain is the wage

[5] The expression of good price is derived from the good market setup in the previous section.

[6] Corresponding to one unit of labour input, $L_{i,s} = 1$, the firm should use $X_{i,ks} = \frac{\alpha_{i,ks}}{\alpha_{i,s}} \frac{w_{i,s}}{P_{i,k}}$ units of intermediate inputs from sector k ($k = 1, ..., S$). With all the inputs, the output that a firm can produce is $Z_{i,s} \prod_{k=1}^{S} (\frac{\alpha_{i,ks} w_{i,s}}{\alpha_{i,s} P_{i,k}})^{\alpha_{i,ks}}$. We also know that the goods price is $c_{i,s}/Z_{i,s}$, hence, the revenue from sales of these output is $c_{i,s} \prod_{k=1}^{S} (\frac{\alpha_{i,ks} w_{i,s}}{\alpha_{i,s} P_{i,k}})^{\alpha_{i,ks}}$.

minus the unemployment benefit, $w_{i,s} - b_{i,s}$. In line with the literature, wage is determined by a generalized Nash bargaining solution. In particular, the total surplus from the match is equal to the sum of the matching gain of the firm and of the worker, which will be $c_{i,s}\prod_{k=1}^{S}(\frac{\alpha_{i,ks}w_{i,s}}{\alpha_{i,s}P_{i,k}})^{\alpha_{i,ks}} - \frac{(1-\alpha_{i,s})w_{i,s}}{\alpha_{i,s}} - b_{i,s}$. Assume that the bargaining power of the worker is $\xi_i \in (0,1)$. The Nash bargaining process yields that a fraction ξ_i of the total surplus should be equal to the matching gain of the worker.

$$\xi_i(c_{i,s}\prod_{k=1}^{S}(\frac{\alpha_{i,ks}w_{i,s}}{\alpha_{i,s}P_{i,k}})^{\alpha_{i,ks}} - \frac{(1-\alpha_{i,s})w_{i,s}}{\alpha_{i,s}} - b_{i,s}) = w_{i,s} - b_{i,s}$$

Together with $b_{i,s} = \vartheta_i w_{i,s}$, we can compute the **wage curve** as

$$w_{i,s} = \Big(\frac{\xi_i}{\alpha_{i,s}(1-\xi_i)(1-\vartheta_i)+\xi_i}\Big)^{1/\alpha_{i,s}}\alpha_{i,s}(c_{i,s})^{1/\alpha_{i,s}}\prod_{k=1}^{S}(\frac{\alpha_{i,ks}}{P_{i,k}})^{\alpha_{i,ks}/\alpha_{i,s}} \tag{2.12}$$

One can see that the wage curve does not depend on the degree of labor market tightness $\delta_{i,s}$ but increases in the worker's bargaining power, ξ_i, in the factory gate value of the output, $c_{i,s}$, and in the unemployment benefit replacement rate, ϑ_i. Although effects of the labour and intermediate input shares on the wage curve are unclear, the effects of worker's bargaining power and output value on wage are stronger under the intermediate input model comparing with the pure labour input model since $\alpha_{i,s} \in (0,1)$. This is because using labour as the only factor for production, $\alpha_{i,s} = 1$, the wage curve is $w_{i,s} = \frac{\xi_i}{(1-\xi_i)(1-\vartheta_i)+\xi_i}c_{i,s}$. However, in our model with intermediate inputs, $0 < \alpha_{i,s} < 1$, the effect of worker's bargaining power and output value on wage is magnified by $1/\alpha_{i,s}$.

Note that in our competitive labour marker model workers are homogeneous and risk neutral, while the wage curve is sector specific. Therefore, in line with Carrère et al. (2015), we assume that workers freely choose the sector in which they search for a job based on the expected wage in that sector. Additionally, the choice of sector is irreversible as they acquire the skills specific to their choice. In equilibrium, the expected wage, which is defined as the sector specific wage $w_{i,s}$ times the probability of being employed in that sector $m_i\delta_{i,s}^{1-\mu}$ or

$1-u_{i,s}$, must be the same across sectors. The expected wage for all sectors $s=1,...,S$ is,

$$w_i = m_i \delta_{i,s}^{1-\mu} w_{i,s} = (1-u_{i,s}) w_{i,s}$$

We assume that firms posting a vacancy need to pay an upfront fee measured by the final good as $\rho_i P_i$ and firms create vacancies until all rents are exhausted. As illustrated in the matching function, the probability that the firm will find the worker to fill in the vacancy is $m_i \delta_{i,s}^{-\mu}$. The expected bargaining gain of the firm, $m_i \delta_{i,s}^{-\mu} [c_{i,s} \prod_{k=1}^{S} (\frac{\alpha_{i,ks} w_{i,s}}{\alpha_{i,s} P_{i,k}})^{\alpha_{i,ks}} - \frac{w_{i,s}}{\alpha_{i,s}}]$, therefore, should be equal to the posting cost $\rho_i P_i$. From this condition, we can get the **job creation curve**

$$m_i \delta_{i,s}^{-\mu} [c_{i,s} \prod_{k=1}^{S} (\frac{\alpha_{i,ks} w_{i,s}}{\alpha_{i,s} P_{i,k}})^{\alpha_{i,ks}} - \frac{w_{i,s}}{\alpha_{i,s}}] = \rho_i P_i \tag{2.13}$$

Combining the wage curve (2.12) and job creation curve (2.13), and together with $\alpha_{i,ks} = (1-\alpha_{i,s})\beta_{i,k}$ and $P_i = \prod_{s=1}^{S} P_{i,s}^{\beta_{i,s}}$, the equilibrium labour market tightness is

$$\delta_{i,s} = (\frac{c_{i,s}}{P_i})^{\frac{1}{\alpha_{i,s}\mu}} (\frac{\rho_i}{m_i} \Omega_{i,s})^{-\frac{1}{\mu}} \tag{2.14}$$

where $\Omega_{i,s} = \frac{\xi_i}{\alpha_{i,s}(1-\xi_i)(1-\vartheta_i)} (\frac{\alpha_{i,s}(1-\xi_i)(1-\vartheta_i)+\xi_i}{\xi_i \prod_{k=1}^{S} (\alpha_{i,ks})^{\alpha_{i,ks}}})^{1/\alpha_{i,s}} \geq 1$ [7] summarizes the effective bargaining power of workers. Assuming the labour input share in production is constant, the more diverse the intermediate inputs in sector s, the smaller $\prod_{k=1}^{S} (\alpha_{i,ks})^{\alpha_{i,ks}}$, hence, the larger the effective bargaining power of workers $\Omega_{i,s}$. Equation (2.14) illustrates that labour market tightness is increasing in the price of the sector input cost relative to the customer price indices, and decreasing in the effective bargaining power of workers and the vacancy posting fee. Moreover, we can get the sector level and aggregate unemployment rate

$$u_{i,s} = 1 - (\frac{c_{i,s}}{P_i})^{\frac{(1-\mu)}{\alpha_{i,s}\mu}} m_i^{\frac{1}{\mu}} (\rho_i \Omega_{i,s})^{-\frac{(1-\mu)}{\mu}} \tag{2.15}$$

[7] $\Omega_{i,s}$ can be rewritten as $\frac{(\alpha_{i,s}(1-\xi_i)(1-\vartheta_i)+\xi_i)^{1/\alpha_{i,s}}}{\alpha_{i,s}(1-\xi_i)(1-\vartheta_i)} \frac{1}{\xi_i^{1/\alpha_{i,s}-1} \prod_{k=1}^{S} (\alpha_{i,ks})^{\alpha_{i,ks}/\alpha_{i,s}}}$. One can see that $\frac{(\alpha_{i,s}(1-\xi_i)(1-\vartheta_i)+\xi_i)^{1/\alpha_{i,s}}}{\alpha_{i,s}(1-\xi_i)(1-\vartheta_i)} \geq 1$, $\frac{1}{\xi_i^{1/\alpha_{i,s}-1} \prod_{k=1}^{S} (\alpha_{i,ks})^{\alpha_{i,ks}/\alpha_{i,s}}} \geq 1$. Therefore, $\Omega_{i,s} \geq 1$.

$$u_i = 1 - \sum_{s=1}^{S} s_{i,s} \left(\frac{c_{i,s}}{P_i}\right)^{\frac{(1-\mu)}{\alpha_{i,s}\mu}} m_i^{\frac{1}{\mu}} \left(\rho_i \Omega_{i,s}\right)^{-\frac{(1-\mu)}{\mu}} \tag{2.16}$$

Equations (2.15) and (2.16) illustrate that the unemployment rate in a country is determined by two components, the relative price $\frac{c_{i,s}}{P_i}$ and the labour market efficiency effect. The first component, the relative price of the input price bundle and consumer price index provide the link between the labour and goods markets. Moreover, from the goods market setup, the consumer price index is shown to be dependent on international trade. Therefore, the first component of the unemployment rate also shows the link between unemployment rate and globalization. To simplify the analysis, we introduce $\Psi_{i,s} = m_i^{\frac{1}{\mu}} \left(\rho_i \Omega_{i,s}\right)^{-\frac{(1-\mu)}{\mu}}$ representing the ***Sectoral Effective Labour Market Matching Efficiency***. In particular, $\Psi_{i,s}$ is increasing in the matching efficiency m_i, decreasing in the vacancy posting cost ρ_i and sectoral effective bargaining power of workers $\Omega_{i,s}$. It is worth noting that the variation in the labour market efficiency between each sector is due to the variations in the production function for each sector in terms of labour and intermediate input shares. Sectors with larger labour value added share are associated with greater bargaining power for workers, therefore, lower sectoral effective labour market matching efficiency.

2.2.3 Equilibrium Unemployment and welfare

To get relative prices in the goods market, we combine equations (2.6) and (2.8), and derive an expression for domestic expenditure share as a function of relative prices.

$$\lambda_{ii,s} = \frac{T_i}{\gamma_s^{\theta_s}} \left(\frac{c_{i,s}}{P_{i,s}}\right)^{-\theta_s} = \frac{T_i}{\gamma_s^{\theta_s}} \left(\frac{c_{i,s}/P_i}{P_{i,s}/P_i}\right)^{-\theta_s} \tag{2.17}$$

Rearrange equation (2.17), we get the relative price as

$$\frac{c_{i,s}}{P_i} = \frac{1}{\gamma_s} \left(\frac{\lambda_{ii,s}}{T_i}\right)^{-\frac{1}{\theta_s}} \frac{P_{i,s}}{P_i} \tag{2.18}$$

Substituting the relative price in equation (2.15) and (2.16) and using the expression in (2.18), we can compute the unemployment rate as

$$u_{i,s} = 1 - \gamma_s^{-\frac{(1-\mu)}{\mu\alpha_{i,s}}} \left(\frac{\lambda_{ii,s}}{T_i}\right)^{-\frac{(1-\mu)}{\mu\alpha_{i,s}\theta_s}} \left(\frac{P_{i,s}}{P_i}\right)^{\frac{(1-\mu)}{\mu\alpha_{i,s}}} \Psi_{i,s} \tag{2.19}$$

$$u_i = 1 - \sum_{s=1}^{S} s_{i,s}(1 - u_{i,s}) \tag{2.20}$$

The above equilibrium unemployment shows the linkage between the goods market and the labour market outcomes. Equation (2.19) indicates that the sector unemployment rate is decreasing in the sectoral openness of trade.

Recall that in our competitive market with risk neutral workers, there is a wage condition which holds for all sectors, $w_i = m_i \delta_{i,s}^{1-\mu} w_{i,s} = (1 - u_{i,s}) w_{i,s}$. This is to ensure that the expected return from working in the chosen sector is the same for all sectors. Dividing both sides by the consumer price index P_i, we get the expected real wage for each sector as

$$\frac{w_i}{P_i} = \frac{(1 - u_{i,s}) w_{i,s}}{P_i} \tag{2.21}$$

which is the sector-specific real wage times the probability of being employed in that sector. To link the welfare with our equilibrium unemployment expression (2.19), we need to derive an expression for the sector real wage $\frac{w_{i,s}}{P_i}$.

As mentioned before in equation (2.11), we assume that production combines labor and intermediate inputs, and labor has a constant share $\alpha_{i,s}$. The cost of an input bundle in country i is thus $c_{i,s} = w_{i,s}^{\alpha_{i,s}} P_i^{1-\alpha_{i,s}}$. We now substitute this input cost bundle in equation (2.17), hence get the expression for the sector-specific real wage:

$$\frac{w_{i,s}}{P_i} = \gamma_s^{-\frac{1}{\alpha_{i,s}}} \left(\frac{\lambda_{ii,s}}{T_i}\right)^{-\frac{1}{\theta_s \alpha_{i,s}}} \left(\frac{p_{i,s}}{P_i}\right)^{\frac{1}{\alpha_{i,s}}} \tag{2.22}$$

Let $W_i = \frac{w_i}{P_i}$, as in our competitive market with risk neutral workers, the wage condition suggests that the expected real wage from the chosen sector should also be equal for all

sectors. Therefore, the aggregate real wage, $W_i = \frac{w_i}{P_i} = \prod_{s=1}^{S} (\frac{w_i}{P_i})^{\beta_{i,s}}$, is:

$$W_i = \prod_{s=1}^{S} \underbrace{(1-u_{i,s})^{\beta_{i,s}}}_{\text{Employment effect}} \underbrace{\gamma_s^{-\frac{\beta_{i,s}}{\alpha_{i,s}}} (\frac{\lambda_{ii,s}}{T_i})^{-\frac{\beta_{i,s}}{\theta_s \alpha_{i,s}}}}_{\text{Income effect}} \tag{2.23}$$

Combining the expressions for our expected sector real wage (2.21), sector real wage (2.22) and equilibrium unemployment rate (2.19), one can also get

$$W_i = \prod_{s=1}^{S} \gamma_s^{-\frac{\beta_{i,s}}{\alpha_{i,s}\mu}} (\frac{\lambda_{ii,s}}{T_i})^{-\frac{\beta_{i,s}}{\theta_s \alpha_{i,s}\mu}} \Psi_{i,s}^{\beta_{i,s}} \tag{2.24}$$

The final form of the equilibrium welfare indicates that the effect of trade openness on real wages is generated from two channels: the employment effect and income effect. The first component denoting the employment effect, circled in blue, assembles the employment rates at the sector level. The second component indicating the income effect, which is circled in red, aggregate the sector real wages.

Last, the aggregate real wage, $W_i = \frac{w_i}{P_i} = \prod_{s=1}^{S} (\frac{w_i}{P_i})^{\beta_{i,s}}$, the relationship between national welfare and the sector level unemployment shown in equation (2.23), together with country unemployment rate (2.20), provide the relationship between the equilibrium welfare and the unemployment rate at the nationwide level as follows:

$$u_i = 1 - W_i^{1-\mu} \sum_{s=1}^{S} s_{i,s} \Psi_{i,s}^{\mu}$$

This shows that in general equilibrium, the nationwide unemployment rate is negatively related with the nationwide real wage and the sector matching efficiency.

In summary, under this framework, I link the goods market with the labour market and compute simple expressions for welfare predictions and the equilibrium unemployment rate in an open economy at the sector and aggregated level. The overall welfare effect consists of a component of trade effect and a component addressing the labour market imperfection. The

overall welfare effect is magnified compared with the traditional trade gains measurement assuming full employment. The sector and aggregate equilibrium unemployment rates are related to the efficiency of both the production and labour markets. It is also evident that an increase in trade openness leads to larger increase of employment for sectors that use more intermediate inputs.

2.3 Counterfactual Analysis

2.3.1 Autarky

Before we turn to the welfare and employment consequences with respect to the change of trade policy, it is worthwhile to investigate the goods and labour market factors that affect the equilibrium real wage and employment rate and the relation between welfare and (un)employment in Autarky, where the geographic barriers are prohibitive, $d_{ni,s} = +\infty$ for any pair of countries $n \neq i$. We use the superscript "**A**" represent the Autarky equilibrium values.

From equations (2.7) and (2.8), the sector-specific and aggregate consumer price indices are $P_{i,s}^A = \gamma_s c_{i,s} T_i^{-1/\theta_s}$, $P_i^A = \prod_{s=1}^S (\gamma_s c_{i,s} T_i^{-1/\theta_s})^{\beta_{i,s}}$. In this case, the domestic expenditure share in the closed market must be equal to 1, $\lambda_{ii,s} = 1$ for all sectors. Moreover, in the closed economy, the sector production share should also equal to the sector expenditure share in the equilibrium, $s_{i,s} = \beta_{i,s}$, since all intermediate inputs must be produced domestically. Using (2.19) and (2.20) yields the unemployment in this special case

$$u_{i,s}^A = 1 - (\gamma_s^{-1} T_i^{1/\theta_s} \frac{P_{i,s}^A}{P_i^A})^{\frac{(1-\mu)}{\mu \alpha_{i,s}}} \Psi_{i,s}$$

$$u_i^A = 1 - \sum_{s=1}^S \beta_{i,s} (1 - u_{i,s}^A)$$

Consider next the equilibrium nationwide real wage under autarky and the relationship between real wage and labour market outcomes, using equation (2.24),

$$W_i^A = \prod_{s=1}^{S}(1-u_{i,s}^A)^{\beta_{i,s}}(\gamma_s^{-1}T_i^{1/\theta_s})^{\frac{\beta_{i,s}}{\alpha_{i,s}}} = \prod_{s=1}^{S}(\gamma_s^{-1}T_i^{1/\theta_s})^{\frac{\beta_{i,s}}{\alpha_{i,s}\mu}}\Psi_{i,s}^{\beta_{i,s}}$$

To summarize, we establish the result in Proposition 1:

Proposition 1 In Autarky, (i) the real wage and unemployment rate are negatively related, and welfare and the employment rate are both increasing in the product and labour market efficiencies, T_i^{1/θ_s} and $\Psi_{i,s}$, respectively. (ii) The effect of product market efficiencies on the unemployment rate ($\frac{(1-\mu)}{\mu\alpha_{i,s}}$) and welfare ($\frac{\beta_{i,s}}{\alpha_{i,s}\mu}$) is associated with the share of intermediate inputs in the production function. Thus, a higher share of intermediate goods in the sector, $1-\alpha_{i,s}$, leads to a lower sectoral unemployment rate and higher welfare, holding the efficiencies constant.

2.3.2 Open Economy

In order to quantify the consequences of globalization, we evaluate the relative changes in welfare and (un)employment rate under some counterfactual scenarios of trade policy changes. We assume that the factors affecting welfare and employment in Autarky, namely the productivity distribution and labour market efficiency, remain the same following the trade policy changes. To start with, we define $\hat{\nu} \equiv \nu'/\nu$ as the proportional change in any variable ν between the initial and counterfactual equilibria.

To get a simple expression of the relationship between trade policy change and labour market outcome change, we introduce the employment rate, which is one minus the unemployment rate, $e_{i,s} = 1-u_{i,s}$. It can be shown that as a result of the trade policy change, the change in the cost of input bundles and in the Price index in the open economy are $\hat{c}_{i,s} = \hat{w}_{i,s}^{\alpha_{i,s}}\prod_{k=1}^{S}\hat{P}_{i,k}^{\alpha_{i,ks}}$, $\hat{P}_{i,s} = \left(\sum_{n=1}^{N}\lambda_{in,s}(\hat{c}_{n,s}\hat{d}_{in,s})^{-\theta_s}\right)^{-1/\theta_s}$, respectively. Using equations (2.19) and (2.20), the change in employment at the sector level in response to the trade policy change is

$$\hat{e}_{i,s} = \hat{\lambda}_{ii,s}^{-\frac{(1-\mu)}{\mu\alpha_{i,s}\theta_s}}\left(\frac{\hat{P}_{i,s}}{\hat{P}_i}\right)^{\frac{1-\mu}{\mu\alpha_{i,s}}} \tag{2.25}$$

where $\hat{\lambda}_{ii,s}$ is the change in domestic expenditure share under the trade policy change. One can see that the change in employment rate can be decomposed into two parts: the change in the share of domestic expenditure in that sector and the change in the sectoral price index via the sectoral linkages. Moreover, the exponent of $\hat{\lambda}_{ii,s}$, $-\frac{(1-\mu)}{\mu\alpha_{i,s}\theta_s}$ implies that the sectoral heterogeneity in trade elasticities θ_s and value added shares $\alpha_{i,s}$ have important roles in the effect of trade on labour market outcomes. The larger the intermediate input share is, the more sensitive is the employment rate to small changes in the domestic expenditure share.

Using (2.24), we obtain a similar expression of the relative changes in real wage as Costinot and Rodriguez-Clare (2014),

$$\hat{W}_i = \prod_{s=1}^{S} (\hat{\lambda}_{ii,s})^{-\frac{\beta_{i,s}}{\theta_s \alpha_{i,s} \mu}} \tag{2.26}$$

From this expression it is evident that consistent with the literature, the welfare predictions of trade policy changes is a function of the change in the domestic expenditure share $\hat{\lambda}_{ii,s}$, and the trade elasticity θ_s. However, by adding intermediate inputs and frictional unemployment, we have two more parameters in the welfare function: 1) the value added share $\alpha_{i,s}$; and 2) the elasticity of the labour market matching function μ.

To show the change in the aggregate employment rate, we make use of the relationship between the nationwide unemployment rate and real wages in Equation 2.24 together with the feature of Autarky that $s_{i,s} = \beta_{i,s}$ to give

$$u_i = 1 - W_i^{1-\mu} \sum_{s=1}^{S} s_{i,s} \Psi_{i,s}^{\mu}$$

$$u_i^A = 1 - (W_i^A)^{1-\mu} \sum_{s=1}^{S} \beta_{i,s} \Psi_{i,s}^{\mu}$$

$$\hat{e}_i = (\hat{W}_i)^{1-\mu} = \prod_{s=1}^{S} (\hat{\lambda}_{ii,s})^{-\frac{(1-\mu)\beta_{i,s}}{\theta_s \alpha_{i,s} \mu}} \tag{2.27}$$

Summarizing, we establish the following:

Proposition 2 (i) The decrease in the domestic expenditure share for each sector corresponding to the trade policy change leads to an increase in the employment rate at both the sector and aggregate levels, and an increase in real income. (ii) Adding intermediate inputs in the model generates larger employment and welfare effects. Sectors with larger intermediate input shares benefit more from trade openness. (iii) Introducing labour market imperfections magnifies the trade gains in terms of real wages by $1/\mu$.

2.4 Taking the Model to the Data

Solving the relative changes of welfare and (un)employment rate under counterfactual scenarios in the previous section helps us to calibrate the model with minimal data requirements. In particular, to quantify the effect of trade policy changes, we need to get: (a) bilateral tariffs at the sector level $d_{ni,s}$; (b) bilateral trade flows at the sector level $X_{ni,s}$; (c) Value added share in production at the sector level $\alpha_{i,s}$; (d) total output of each country in each sector $Y_{i,s}$; and (e) the input-output coefficient in production $\alpha_{i,ks}$.

The bilateral tariffs at 2-digit ISIC Rev.3 industries in 1996-2018 are sourced from the UNCTAD TRAINS database and downloaded from the World Integrated Trade Solution (WITS). We obtain the bilateral trade flows data at Harmonized System(HS) 6-digit level in 1996-2018 from CEPII BACI. Value added share, total output and the I-O coefficient are calculated from the World Input-Output Database (WIOD) Release 2013. The database covers 27 EU countries and 13 other major countries in the world from 1995 to 2011.[8] Moreover, to match the sector code in these three data sources, the 6-digit HS (1996 revision) trade flow data were converted to 2-digit ISIC Rev.3 level using the United Nations concordance table. Then we mapped the bilateral trade flow and tariff data using the World Input-Output Tables

[8]The WIOD Release 2013 only provides input output tables until 2011, but we sourced tariffs and trade data from 1996 until 2018. There are two reasons for this. First, the more recent data (between 2012 to 2018) is used for some parts of the analysis (e.g. elasticity estimation), while the WIOD data is used in other parts of the analysis (e.g. counterfactuals). Second, for the counterfactual exercises, we compute the changes in welfare and employment rate due to the tariff changes from 2000 to 2010. Although the data used are mainly used for these two years, where missing data are detected, I use the latest known value for that variable. For example if the tariff rate in 2000 is missing, the corresponding value from 1999, 1998, 1997 or 1996 is employed depending on the availability. Similarly, if the tariff rate in 2010 is mission, the corresponding value from 2011, 2012, 2013 or 2014 is employed depending on the availability.

(WIOT) industry classifications which include 35 industries mostly at the two-digit ISIC Rev.3 level or groups thereof (Timmer et al., 2015). The description of the 35 WIOT sectors and the corresponding ISIC Rev.3 code is shown in **Table A1**.

Therefore, we can get the fraction of expenditure on goods from sector s, country i in country n using $\lambda_{ni,s} = \frac{X_{ni,s}}{X_{n,s}}$. Following Caliendo and Parro (2015), the final consumption shares for each country at sector level $\beta_{i,s}$, are generated using the final goods expenditure (the total expenditure minus total intermediate goods expenditure) divided by total income (the sum of labour income, tariff revenue and trade deficit). Hence, there are only two key parameters needed to calibrate the model: (a) the sectoral dispersion of productivity θ_s which is also the same as the trade elasticity (Eaton and Kortum (2002), Caliendo and Parro (2015)); and (b) the elasticity of the matching function μ. I will present the method of estimating these parameters in the following subsections.

2.4.1 Estimate Trade Elasticity

The first key parameter needed to calibrate the model is θ_s, which appears in a country's efficiency distribution in producing goods. The standard deviation of a country's technology distribution in a certain sector depends on the sector specific parameter θ_s. In particular, a larger (smaller) θ_s implies a relatively less (more) heterogeneity. This key parameter in the efficiency distribution, later translates into the effect of changes in trade costs with a country on the expenditure share from that country (Eaton and Kortum (2002), Caliendo and Parro (2015)), as shown in **Equation** (2.6). This is also known as the trade elasticity in the literature on gravity models.

Here, we adopt the method proposed in Caliendo and Parro (2015) to estimate θ_s using the following equation:

$$\frac{X_{ni,s}X_{ih,s}X_{hn,s}}{X_{nh,s}X_{hi,s}X_{in,s}} = \left(\frac{\tau_{ni,s}\tau_{ih,s}\tau_{hn,s}}{\tau_{nh,s}\tau_{hi,s}\tau_{in,s}}\right)^{-\theta_s} \tag{2.28}$$

where $X_{ni,s}$, $X_{ih,s}$ and $X_{hn,s}$ are trade flows between three countries indexed by n, h, i. $\tau_{ni,s}$, $\tau_{ih,s}$ and $\tau_{hn,s}$ are one plus the ad-valorem flat-rate tariffs of the involved country pairs. Note that

this equation is derived from **Equations** (2.6) and (2.7), where the countries' productivity level, T_n, T_h, T_i, input costs $c_{n,s}, c_{h,s}, c_{i,s}$, and sector-level price parameter $\Phi_{n,s}, \Phi_{h,s}, \Phi_{i,s}$ are all cancelled out in the ratio term. We only have the tariffs costs left. The reason is that trade cost $d_{ni,s} > 1$ is composed of tariff and "iceberg" trade costs, and the "iceberg" trade costs were canceled out in the ratio term.[9] Taking the logarithm, we get:

$$ln(\frac{X_{ni,s}X_{ih,s}X_{hn,s}}{X_{nh,s}X_{hi,s}X_{in,s}}) = -\theta_s ln(\frac{\tau_{ni,s}\tau_{ih,s}\tau_{hn,s}}{\tau_{nh,s}\tau_{hi,s}\tau_{in,s}}) + \varepsilon_s \tag{2.29}$$

where $\varepsilon_s = \varepsilon_{ni,s} - \varepsilon_{in,s} + \varepsilon_{ih,s} - \varepsilon_{hi,s} + \varepsilon_{hn,s} - \varepsilon_{nh,s}$. Here, ε_s is assumed to be orthogonal to tariffs.

We estimate **Equation** (2.29) using bilateral trade flows and tariffs data from 1996-2018 with 179 countries. **Table** 2.1 presents the estimates of trade elasticity θ_s by sectors consistent with the WIOT sector classifications, which include Agriculture, Mining and 14 manufacturing sectors. We first show the estimation result of **Equation** (2.29) with year fixed effects, then we re-estimated the parameters including importer and exporter fixed effects. As shown in **Table** 2.1, overall the sign and magnitude of the coefficient in most sectors are consistent with the literature with just one exception: Machinery, n.e.c.[10] Excluding Machinery, n.e.c., the estimates of trade elasticity θ_s from 0.111 to 10.635 with Year FE, and range from 0.108 to 10.499 with Country & Year FE. [11] In addition, the last row of **Table** 2.1 shows the estimate of the aggregate elasticity with Year FE, and Country & Year FE.

In the later section 2.5 when solving the model, we use the estimates of θ_s with Country & Year FE, as this specification controls for all the Year, importer and exporter fixed effects.

[9] See the detailed explanation in Caliendo and Parro (2015) Section 4.

[10] The regressions for the estimation of the trade elasticity are estimated for each sector. The puzzling sign for the estimate of Machinery, n.e.c. was also found in Caliendo and Parro (2015). We conduct several robustness checks including using different samples, and different indicators of tariffs, but the sign of θ_s for Machinery, n.e.c. is still negative. Due to the input-output linkage between sectors, we could not simply exclude the whole industry in the counterfactual analysis. However, the change in the aggregate elasticity when include and exclude Machinery is really small.

[11] The magnitude of our estimates are smaller than the existing literature. For example, in Eaton and Kortum (2002), the estimates of the aggregate trade elasticity for the manufacturing sector range from 3.60 to 12.86. Caliendo and Parro (2015) present estimates ranging between 0.39 and 64.85. However, the smaller magnitude of our estimates might be due to the different(larger) sample period and countries we use. Most of the previous studies focus on either small sample periods or limited countries/regions (Eaton and Kortum (2002), Hillberry et al. (2005), Broda and Weinstein (2006) and Caliendo and Parro (2015)).

Table 2.1 Estimates of trade elasticity θ_s

	Year FE		Country & Year FE		
Sector Description	θ_s	s.e.	θ_s	s.e.	N
Agriculture, Hunting, Forestry and Fishing	0.111	(0.025)	0.108	(0.025)	591,495
Mining and Quarrying	10.635	(0.225)	10.499	(0.225)	243,721
Manufacturing Sectors					
Food, Beverages and Tobacco	0.835	(0.017)	0.850	(0.017)	874,555
Textiles and Textile Products	4.364	(0.041)	4.377	(0.041)	835,320
Leather, Leather and Footwear	3.450	(0.067)	3.481	(0.067)	399,913
Wood and Products of Wood and Cork	6.170	(0.107)	6.212	(0.107)	311,655
Pulp, Paper, Paper , Printing and Publishing	2.417	(0.077)	2.360	(0.077)	534,146
Coke, Refined Petroleum and Nuclear Fuel	4.901	(0.451)	5.061	(0.453)	140,032
Chemicals and Chemical Products	3.503	(0.074)	3.505	(0.074)	852,956
Rubber and Plastics	1.079	(0.068)	1.066	(0.068)	597,913
Other Non-Metallic Mineral	2.075	(0.085)	2.115	(0.084)	444,381
Basic Metals and Fabricated Metal	5.686	(0.066)	5.658	(0.066)	759,572
Machinery, nec	-0.869	(0.067)	-0.849	(0.067)	787,007
Electrical and Optical Equipment	1.214	(0.060)	1.203	(0.060)	1,021,563
Transport Equipment	0.192	(0.051)	0.175	(0.051)	536,137
Manufacturing, nec; Recycling	0.828	(0.051)	0.866	(0.052)	616,010
Aggregate elasticity	1.390	(0.011)	1.389	(0.012)	9,546,376

Notes: Numbers in the parentheses are robust standard errors. Numbers in Column (N) are the number of observations in each estimation regression. All the estimates of trad elasticity are statistically significant at 1%.

To tackle the puzzling estimate of Machinery, n.e.c., similar with Caliendo and Parro (2015), we replace that by the mean estimate for the manufacturing sector.

2.4.2 Estimating the Matching Elasticity

Having estimated the dispersion of productivity parameter, the only key parameter needed to solve the model is the elasticity of the labour market matching function, μ. Here, we propose a new model-based method to estimate the value of μ with observable data based. Recall that in the previous section, we derived the relative changes in aggregate employment rate in

Equation (2.27). The change in the nationwide employment rate is related to the change in real wage with the parameter of interest, $1-\mu$.

$$\hat{e}_i = (\hat{W}_i)^{1-\mu} = \prod_{s=1}^{S} (\hat{\lambda}_{ii,s})^{-\frac{(1-\mu)\beta_{i,s}}{\theta_s \alpha_{i,s} \mu}}$$

To get an estimate of the elasticity of the matching function, the empirical specification is derived from taking the logarithmic form of the above equation with controls for time and country fixed effects as follows:

$$ln(\frac{e_{i,t}}{e_{i,t-1}}) = (1-\mu) ln(\frac{\text{GDP per Capita}_{i,t}}{\text{GDP per Capita}_{i,t-1}}) + \nu_i + \delta_t + \varepsilon \tag{2.30}$$

Where $e_{i,t}$ denotes the employment rate of country i in year t, while $\text{GDP per Capita}_{i,t}$ indicates the real wage of country i in year t.[12] The parameter ν_i and δ_t capture the country and year fixed effects, respectively. Therefore, the estimate of the coefficient of the relative real wage term would be our estimate for $(1-\mu)$.

Annual GDP per Capita and the unemployment rates are sourced from the World Bank's World Development Indicators (WDI)[13], where the sample covers 206 countries from 1996 to 2018. The results of the proposed specification **Equation** (2.30) are shown in **Table** (2.2). As a robustness check, the observations where the employment rate and GDP per capita were less than 1.25% or 2.5% percentile and more than the 98.75% or 97.5% percentile were dropped from the sample. Columns (2) and (3) in **Table** (2.2) show the estimates for 97.5% and 95% of the sample, respectively. One can see that the significance and magnitude of the coefficient are robust across the samples. This, therefore, gives us an estimate of the elasticity of the matching function with respect to workers searching for jobs, μ, ranging from 0.831 to 0.835.

[12] I use GDP per capita because it has been used as a good indicator for real income in the literature. Moreover, the data coverage of wages or labour compensation is much lower comparing with GDP per capita. An alternative wage of measuring real wage is to use wages or labour compensation directly. However, the number of observations for the regression using wages has gone down to only 427.

[13] GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2010 U.S. dollars.

Table 2.2 Estimates of Elasticity of Matching Function μ

Dependent variable:	Changes of employment rate		
	Full sample	97.5% sample	95% sample
	(1)	(2)	(3)
$ln(\frac{\text{GDP per Capita}_{i,t}}{\text{GDP per Capita}_{i,t-1}})$	0.166***	0.169***	0.165***
	(0.027)	(0.028)	(0.027)
R-Square	0.202	0.220	0.222
N	2,330	2,251	2,146
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

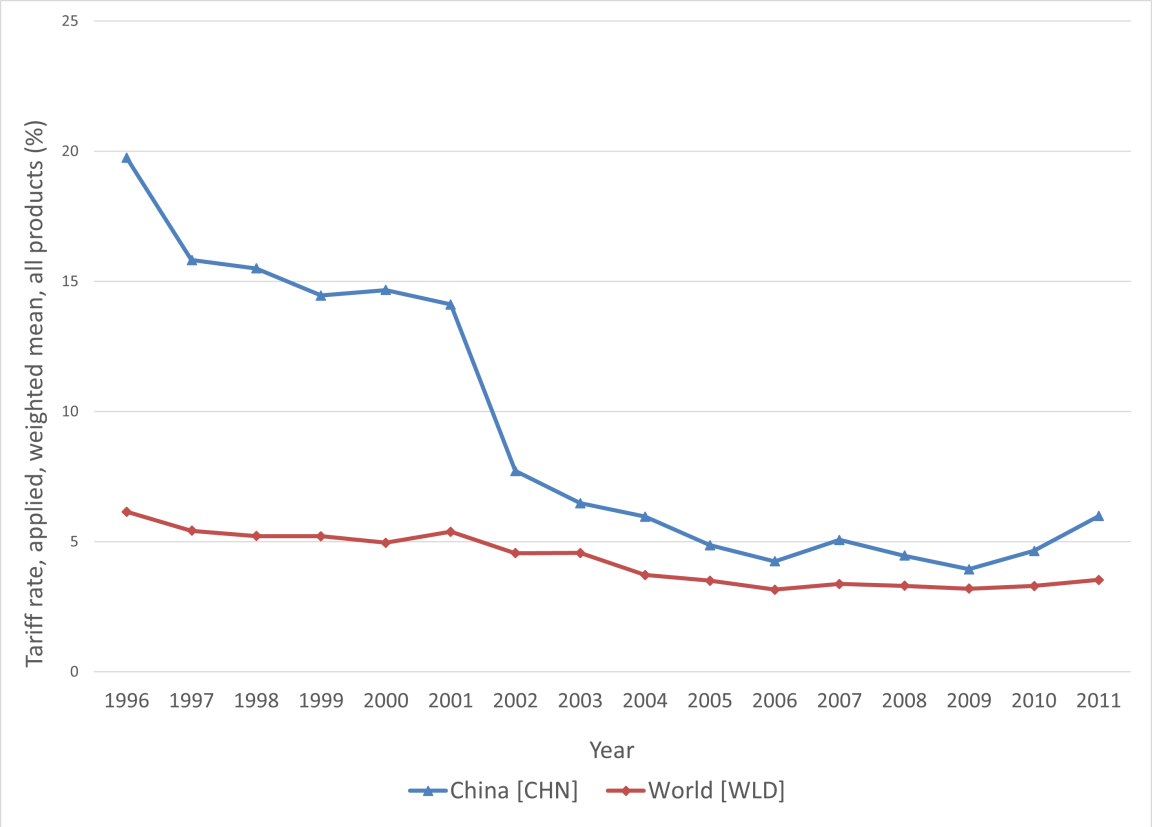
Notes: Columns (1), (2) and (3) presents the result using the full sample, 97.5% sample and 95% sample, respectively. Numbers in the parentheses are robust standard errors clustered at the country level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Note that although our proposed approach of estimating the elasticity of the matching function depends on the underlying microstructure assumed in the model, the magnitude of our estimate is in the plausible range of the matching elasticity in the labour literature with Constant Returns to Scale (CRS). An early survey of matching function estimation by Petrongolo and Pissarides (2001) shows that the estimated elasticity on unemployment is about 0.7 and the elasticity on vacancies is about 0.3. Later studies (Barnichon (2012), Kohlbrecher et al. (2016) and Lange and Papageorgiou (2020)) using different empirical approaches find elasticity with respect to vacancies ranging from 0.15 to 0.43, which indicates the range of μ in our labour model from 0.57 to 0.85. The estimate of μ we use in the later model calibration is 0.834, as this is in line with the underlying model setting in the paper. However, we also used other estimates of μ from the existing literature for robustness checks.

2.5 Employment and Welfare Effects of "The China Syndrome"

In this section, we quantify the employment and welfare effects of China joining the WTO across countries and sectors. China became the 143rd member of the World Trade Organiza-

Fig. 2.1 Applied Weighted Average Tariff Rate During 1996 - 2011



Note: Data from World Development Indicators (https://datacatalog.worldbank.org/public-licensescc-by). Weighted mean applied tariff is the average of effectively applied rates weighted by the product import shares corresponding to each partner country.

tion (WTO) on 11 December 2001. Following China's accession, China experienced major trade liberalization with significant tariff reductions. **Figure** 2.1 plots the applied weighted average tariff rate of all products in China comparing with the World average. In 1996, China's average weighted tariff rate was about 19.75%, which was much higher than the global average of 6.15%. However, since WTO Accession in 2001, the tariff rates have fallen considerably to below 5% in 2010. Apart from the considerable changes in the openness of Chinese economy, Chinese exports to other countries also benefit from the reduced tariff rate applied to Chinese products. In addition, China's ongoing trade and structural reform have opened the economy to international trade and investment and have made it one of the fastest growing countries in the world.

Following China joining the WTO and the increase in Chinese exports to the rest the world, previous studies link the rising Chinese import competition with changes in employment in local labour markets, such as in the US (Autor et al. (2013); Autor and Dorn (2013); Pierce and Schott (2016) and Autor et al. (2016)) and European countries (Auer et al. (2013); Ashournia et al. (2014);Dauth et al. (2014) and Balsvik et al. (2015)). The "China Syndrome", as named in Autor et al. (2013), provides a good counterfactual exercise for us to estimate the effect of one country's trade liberalization and expansion on other countries' welfare and labour outcomes.

Here, our base year is 2000, a year before China officially joined the WTO. As mentioned earlier, we use data from different sources to calibrate the model to the base year, including bilateral trade flows from CEPII BACI, bilateral tariffs data from the UNCTAD TRAINS database, and I-O tables from WIOD. The final sample we have after matching the data from those different sources comprises 38 countries and 35 sectors (16 tradable and 19 non-tradable). We calibrate the model following the strategy as described in Caliendo and Parro (2015) with adjustment for the differences in our model.[14] The key parameters used are sourced from estimates presented in the previous section. We first get the initial data in the base year and solve the model at general equilibrium. Then, we perform the counterfactual exercises with changes in trade policy and the the changes in the employment rates and welfare at the equilibrium.

To investigate the effect of one country's trade policy change on all countries, we perform different counterfactual exercises using the case of China joining the WTO. In the first exercise, we introduce into the model the changes in the tariff structure due to China joining the WTO only from 2000 to 2010, conditional on no other tariff changing in the world (the same tariff rates as in 2000). In contrast, in the second exercise, we hold the tariff rate involving China fixed to the level of 2000 and introduce only the changes of tariffs between other countries. Comparing these two counterfactual exercises, we can compare the overall welfare and employment changes with and without China joining the WTO.

[14]We thank the authors for making the code publicly available.

Note that the effect of China joining the WTO on Chinese and other countries' welfare and labour market outcomes could come from two different channels corresponding to the source of tariff reductions: (a) the reduction of Chinese tariffs on products from other countries or China's openness; and (b) the reduction in tariffs on Chinese products in the other countries. Hence, in the third exercise, we introduce into the model the change in the tariff structure from 2000 to 2010 imposed only by China and keep the other countries' tariff rates unchanged as in 2000. This will show how the openness of the Chinese economy affects itself and other countries conditional on no other tariff changing. The last counterfactual exercise introduces only the tariff changes on Chinese products by other countries from 2000 to 2010, which will estimate the effect of Chinese import competition on the welfare and employment in all the countries. Comparing the results from these two scenarios, we decompose the effect of the "China Syndrome" into two channels. In particular, exercise 2 is the complement of exercise 1, while exercise 3 and 4 decompose exercise 1. In the next subsection, we first present the aggregate welfare and employment effects in these four counterfactual scenarios. Then we present the results at the sector level for some key countries in our sample.

2.5.1 Country Level Welfare and Employment Effect of China Joining the WTO

Here, we quantify the country level employment and welfare effects of China joining the WTO on the sample countries by showing the results of the various counterfactual scenarios mentioned earlier. The changes in the employment rate and welfare for some major countries from 2000 to 2010 in the four scenarios are listed in **Table 2.3**.[15] Panel A presents the employment rate changes while Panel B shows the welfare changes. The employment rate changes and welfare changes are estimated using **Equations** 2.25 and 2.26, respectively.[16] As we can see, overall, the signs of the changes in the welfare and employment rate are in

[15] See the employment rate and welfare changes for all the countries included in the sample in **Table A2** and **Table A3**.

[16] After using the equation to estimate the sector level employment rate change, we aggregated to the country level to obtain the values listed in **Table** 2.3

the same direction, where the net welfare effect is larger than the employment effect. This is consistent with implication of **Equation** 2.24 that the effect of trade openness on real wages can be generated from two channels: the employment effect and income effect. Moreover, the absolute changes in real wages is also larger than the changes in employment rates, which is consistent with the implication of **Equation** 2.27.

To start with, we compare the results of employment rate and welfare changes from 2000 to 2010 with China Joining the WTO only and without China joining the WTO in columns (1) and (2), respectively. Interestingly, in most of the major developed economies, there are negative effects on the employment rate and real wages from both the tariff rate changes following China joining the WTO and other tariff rate changes in the world, with the exception of Canada. The magnitude of the effect is also similar from those two counterfactual exercises in those countries, with falls in employment rates ranging from 0.16% to 0.34% and losses in real wages from 0.94% to 2.05%. In the case of Canada, the employment rate falls by 0.32% with China joining the WTO while it increases by 0.56% without China joining the WTO. Similarly, in terms of welfare, it loses 1.95% from China joining the WTO and gains by 3.41% from other tariffs changes in the world.

In contrast, for the major transition economies and developing economies, their employment rates increase and they gain from China joining the WTO except for Russia. For the case of Russia, the effect on employment and welfare from Chinese trade reform are negative but relatively small, with employment rate decreasing by 0.02% and welfare by 0.10%. Among the other countries, China is the largest winner, with an increase of employment rate of 5% and a welfare gain of 36.01%. However, considering the scenario that China didn't join the WTO, China's employment decreased by 0.33% and real wages by 1.97%. For the rest of the developing economies listed in **Table 2.3**, they gain from both scenarios with and without China joining the WTO, while the gains are relatively larger from the tariff changes in the rest of the world comparing with the case with tariff changes only involving China.

Overall, to show clearly who are the countries gains from China joining the WTO in terms of employment and welfare outcomes, we mapped all the countries in our sample against their "winning" or "losing" status in **Figure** 2.2. The map shows the results from

Table 2.3 Employment and Welfare Effects of Tariff Reductions from 2000 to 2010

Country	Joining WTO	Without Joining WTO	Chinese Tariffs Reduction	Tariffs Reduction of Chinese Products
	(1)	(2)	(3)	(4)
Panel A: Changes of Employment Rate				
Major Developed Economies				
Canada	-0.32%	0.56%	-0.33%	-0.32%
Japan	-0.31%	-0.23%	-0.29%	0.27%
France	-0.19%	-0.20%	-0.17%	-0.17%
Germany	-0.26%	-0.25%	-0.24%	-0.22%
Italy	-0.34%	-0.34%	-0.31%	-0.29%
UK	-0.25%	-0.25%	-0.24%	-0.24%
USA	-0.16%	-0.18%	-0.16%	-0.17%
Economies in Transition and Major Developing Economies				
Brazil	0.20%	0.88%	0.09%	-0.16%
China	5.26%	-0.33%	4.93%	0.30%
India	2.12%	3.31%	-0.002%	1.88%
Indonesia	0.63%	3.28%	0.04%	0.26%
Mexico	0.93%	2.07%	-0.15%	0.75%
Russia	-0.02%	0.63%	-0.23%	-0.11%
Turkey	0.19%	1.89%	-0.24%	0.05%
Panel B: Changes of Welfare				
Major Developed Economies				
Canada	-1.95%	3.41%	-1.95%	-1.92%
Japan	-1.86%	-1.38%	-1.71%	-1.62%
France	-1.17%	-1.21%	-1.05%	-1.00%
Germany	-1.53%	-1.50%	-1.42%	-1.34%
Italy	-2.05%	-2.06%	-1.84%	-1.73 %
UK	-1.53%	-1.49%	-1.45%	-1.43%
USA	-0.94%	-1.10%	-0.98%	-1.03%
Economies in Transition and Major Developing Economies				
Brazil	1.18%	5.40%	0.54%	-0.94%
China	36.01%	-1.97%	33.48%	1.83%
India	13.22%	21.30%	-0.04%	11.70%
Indonesia	3.79%	21.39%	0.22%	1.59%
Mexico	5.69%	13.07%	-0.93%	4.56%
Russia	-0.10%	3.86%	-1.39%	-0.64%
Turkey	1.14%	11.92%	-1.43%	0.28%

Note: The classification of countries is based on IMF's World Economic Outlook in April 2000. Column (1) shows the result from exercise 1, where there is only changes in tariffs involving China from 2000 to 2010. Column (2) present the result from exercise 2, a complement of exercise 1, where we hold the tariff rates involving China fixed to the level of 2000 and introduce only the changes in tariffs between other countries. Columns (3) and (4) show the result of exercises 3 and 4, respectively, which decompose exercise 1. In particular, exercise 3 only introduce the reduction of Chinese tariffs on products from other countries. In exercise 4, we only consider the reduction in tariffs on Chinese products in the other countries.

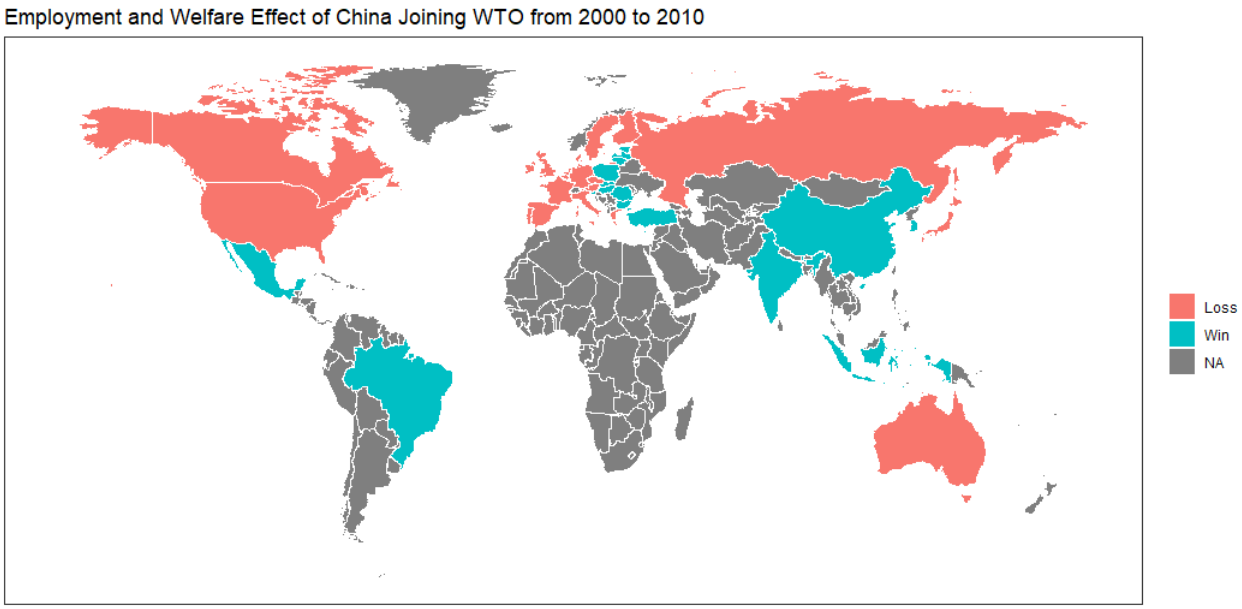


Fig. 2.2 Employment and Welfare Effect of China's Accession in WTO for all Countries

the first exercise, where there is only tariff changes involving China. Countries that have negative changes of employment rate and welfare are marked in red while countries who gain are marked in blue. The countries with NA in grey are not included in our sample. As we can see, the winning countries are most likely to be developing economies or countries in transition, in Asia, the Middle East and Europe, and the Western Hemisphere. Most of the advanced countries in our sample lose from China joining the WTO, experiencing decreases in both the employment rate and real wages.

Having estimated the overall employment and welfare effects from the counterfactual exercise of China joining the WTO, we are interested in the kind of tariff changes that drive the result for those countries. Recall that we also perform two other counterfactual exercises: (a) A scenario with only the reduction of Chinese tariffs on products from other countries; and (b) A scenario with only changes of tariffs on Chinese products imposed by other countries. Columns (3) and (4) in **Table 2.3** present the employment and welfare effects from these two exercises.[17] First of all, for the major advanced economies listed here, we fail to find

[17]Note that although these two exercise decompose exercise 1. The results in columns (3) and (4) do not sum up to the values in column (1). The reason is that the counterfactual exercises are done separately with loop control statements to get the general equilibrium.

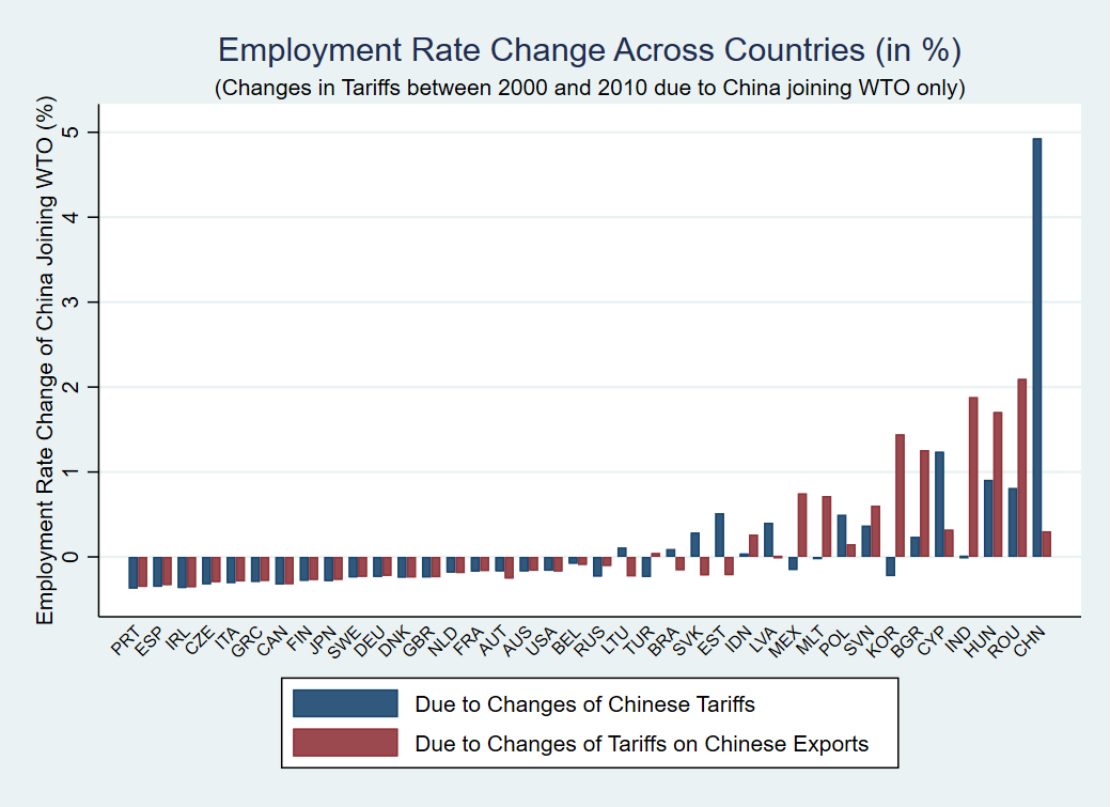


Fig. 2.3 Breakdown of Employment Effect from China's Accession in WTO for all Countries

any differential effect from these two scenarios. The employment and welfare effects on the advanced economies are negative and similar in both exercises, which are almost identical to the ones we find in the overall effect from China joining the WTO in Column (1).

However, for the case of the transition economies and developing economies, there are differential effects from the reduction in Chinese tariffs and tariff reduction on Chinese products. Interestingly, although China gains from both tariff reductions from 2000 to 2010, the most important source of these gains for China are from the tariff changes of opening the economy. In particular, the employment rate and welfare in China increased by 4.93% and 33.48%, respectively, from reducing its tariffs on imports from other countries. The benefits from the tariff reduction on Chinese products in other countries, are just a 0.30% increase in the employment rate and 1.83% of welfare gains. As for Brazil, the gains we find in Column (1) are driven by China opening the economy and it loses from the tariff reduction on Chinese products in the rest of the world, with a 0.16% decrease in the employment rate and

a 0.94% decrease in welfare. This could be due to the increased competition Brazil faces with the emergence of Chinese products in the global market. When it comes to India, Mexico and Turkey, they gain from the tariff reduction on Chinese products, but lose slightly from Chinese openness. India, among the others, is the biggest winner from the tariff reduction on Chinese products with an increase in the employment rate of 1.88% and welfare of 11.70%.

Furthermore, **Figure** 2.3 shows the breakdown of the employment effect from China joining the WTO into the two types of tariff structure change for all the countries in the sample. Overall, for countries that lose following China's accession, the changes in the employment rate are similar in the two counterfactual exercises. The "winning" economies, however, experience differential effects from the opening of the Chinese economy and easier access to Chinese products in the global market. One potential explanation for such heterogeneous effects on those countries might be the extent of their input-output links with China in the global value chain.

2.5.2 Sector Level Employment Effect of China Joining the WTO

One of the key contributions of this paper is that by introducing the sector level search and matching framework into the trade model, we are able to uncover the differential effect of trade liberalization on countries' labour markets across sectors. Having investigated the country level outcomes of China joining the WTO in the previous subsection, we now turn to the analysis of the sector level employment effect. Specifically, we estimate the changes in the employment rate by sector using **Equation 2.25**. Here we only present the employment outcomes from China joining the WTO in a few key economies in our sample.[18] Moreover, our analysis at the country level indicates heterogeneous effects in terms of the country classification groups. Therefore, we present the sector level employment effect of China joining the WTO in three economies, namely China, the US (as a representative of the advanced economies) and India (as a representative of the emerging economies). Consistent with the analysis before, we analyse the results by performing the same four different counterfactual exercises.

[18] Full results are in Appendix.

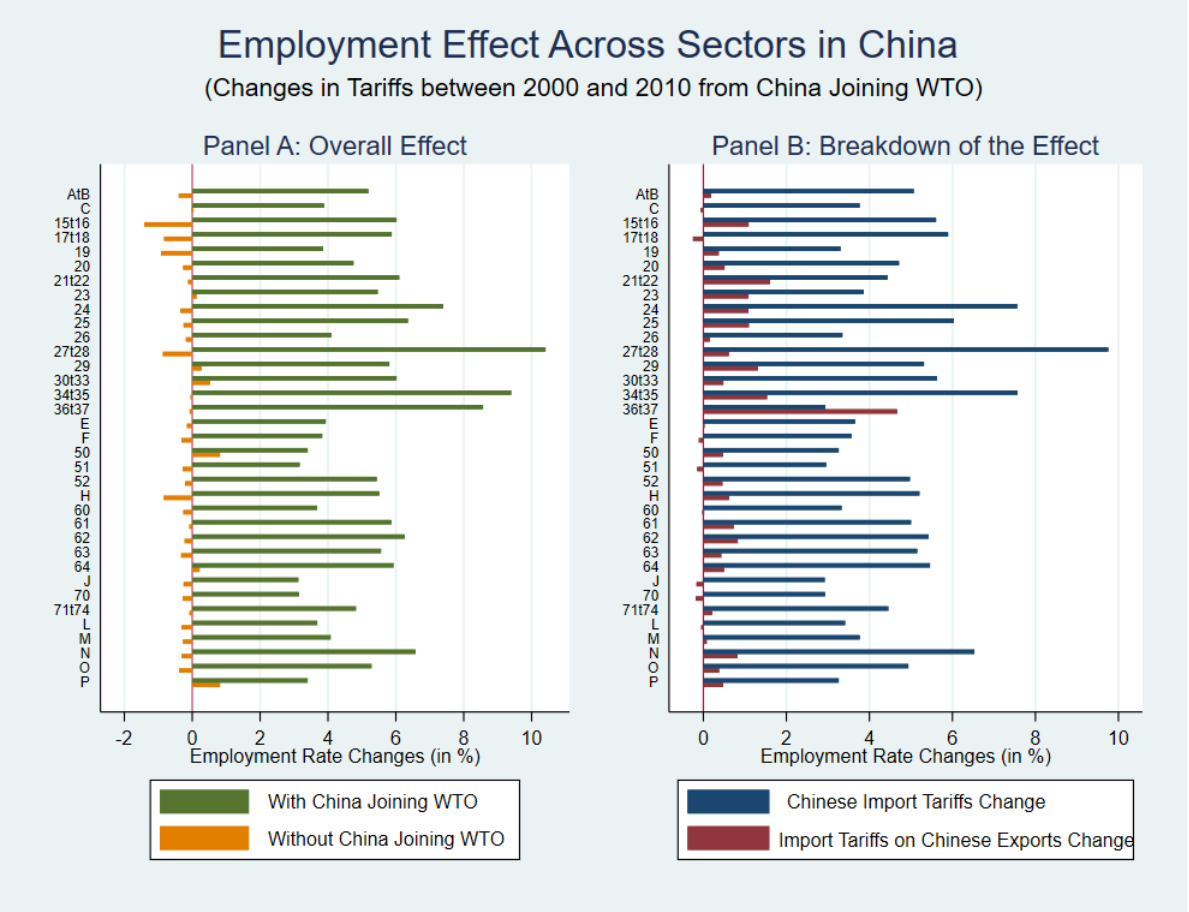


Fig. 2.4 Employment Effect by Sectors in China from China's Accession in WTO

Note: The tradable sectors are from sector AtB to sector 36t37, while the non-tradable sectors are from sector E to sector P.

To start with, **Figure 2.4** plots the changes in employment rate by sectors in China due to tariff structure changes in the four counterfactual scenarios.[19] Panel A compares the scenarios with and without China joining the WTO, while Panel B shows the breakdown of employment effects from changes in Chinese tariffs, and changes in tariffs on Chinese exports. The overall effect shown in Panel A indicates that China would have experienced a decline of employment rates across most sectors if China had not joined the WTO. With the trade reform after joining the WTO, we find a positive change in employment rates across all sectors in China, but the magnitude of the effect varies across sectors, from 3.13% to 10.41%. Comparing the tradable and non-tradable sectors[20], the gains in tradable sectors are

[19]The description of the sector code is listed in Appendix **Table A1**.

[20]Following the order in Appendix **Table A1**, the tradable sectors are from sector AtB to sector 36t37, while the non-tradable sectors are from sector E to sector P.

slightly larger averaging 6.20% compared to 4.56% in the non-tradable sectors. Sector 27t28 (Basic Metals and Fabricated Metal), is the biggest winner among all the sectors in China, followed by sector 34t35 (Transport Equipment), 36t37 (Manufacturing, nec; Recycling), and 24 (Chemicals and Chemical Products). Such heterogeneous gains across sectors could stem from the extent to which the sector is involved in the input-output network. For example, the top 4 winning sectors from China joining the WTO (27t28, 34t35, 36t27 and 24) are the sectors that have relatively larger shares of intermediate inputs in the base year 2000 (with 76.6%, 73.4%, 61.3% and 71.9%, respectively).

Looking at the outcomes across sectors in Panel B of **Figure 2.4**, we decompose the effect of China joining the WTO by investigating the effect from a reduction in Chinese import tariffs, and a reduction in import tariffs on Chinese exports. Consistent with earlier findings at the country level, the gains in China across sectors are driven by the decline in the Chinese tariffs rather than other countries' tariffs. The plot of changes in the employment rate by sector from changes in Chinese tariffs in Panel B range from 2.92% to 9.76%, looks almost identical to the plot in Panel A for the overall effect from China joining the WTO. Moreover, in the counterfactual scenario with only changes to tariffs on Chinese exports, most of the sectors experience a small increase in the employment rate. However, we find slight declines of employment in one manufacturing sector (17t18, Textiles and Textile Products) and some non-tradable sectors (F, Construction; 51, Wholesale Trade and Commission Trade; J, Financial Intermediation; 70, Real Estate Activities).

For the case of the US, which we use as an example of an advanced economy, we show the sector level employment effect of China joining the WTO across all sectors in **Figure 2.5**. Note that to present the plots clearly, we reverse the scale of x-axis (Employment rate changes). Comparing the employment outcomes in the scenarios with and without China joining the WTO, we can see that the US experiences a decline in the employment rate across all sectors in both cases. Furthermore, the decline in the employment rate in sectors, especially in the manufacturing sectors, are significantly larger than that in the service sectors. This finding is consistent with the previous empirical evidence of the negative effect of Chinese import competition on the manufacturing labour market in the US (Autor et al.

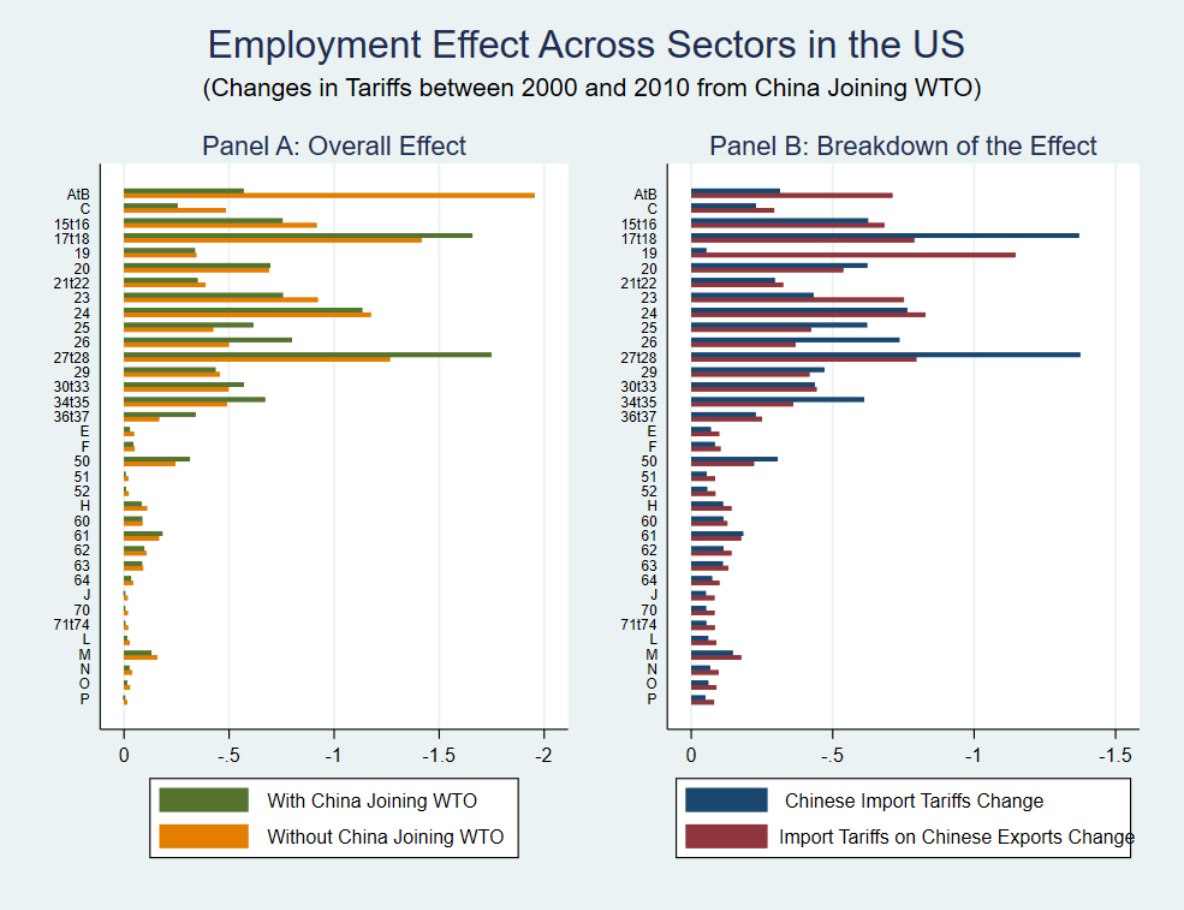


Fig. 2.5 Employment Effect by Sectors in the US from China Joining WTO

Note: The tradable sectors are from sector AtB to sector 36t37, while the non-tradable sectors are from sector E to sector P.

(2013); Autor and Dorn (2013); Pierce and Schott (2016) and Autor et al. (2016)). However, the similarity found in the two counterfactual cases suggests that even without Chinese import competition, US manufacturing sectors would have still experienced declines in employment. One possible explanation is that there are several trade liberalization episodes in the 1990s among emerging countries, for example India, Vietnam, and Uganda. With the emergence of developing economies in the global market, most of the advanced economies experienced structural change with declines of employment in their manufacturing sectors.

The further breakdown of the employment effect from China joining WTO in Panel B, **Figure 2.5**, also generates a heterogeneous effect across sectors from the two types of tariff reductions. In particular, among the tradable sectors, sector 27t28 (Basic Metals and Fabricated Metal) is the most affected with the employment rate decreasing by 1.38% from

China's opening of its economy, followed by sector 17t18 (Textiles and Textiles Products) with -1.37%. However, in the case of changes only in tariffs on Chinese exports, the most affected sectors are sector 19 (Leather, Leather and Footwear) and Sector 24 (Chemicals and Chemical Products) with a decline of employment rate of 1.15% and 0.83%, respectively. On the other hand, the changes in the employment rate in the non-tradable or service sectors are relatively small with declines of less than 0.35%. The magnitude of the employment effects are also similar from reductions in both Chinese and partner country tariffs across the service sectors.

Recall that earlier findings showed differential effects of China joining the WTO on emerging economies compared to advanced economies. Having investigated the sector level effect on one typical advanced economy, we now turn to a case of a developing country, India. **Figure 2.6** presents the sector level employment effect in India from China joining the WTO, in which Panel A shows the overall effect by comparing with and without China in the WTO, and Panel B shows the breakdown of the effect by separating the effect from reductions in Chinese and partner country tariffs. The histograms in Panel A indicate the India gains in both counterfactual cases across most sectors except for sector 15t16 (Food, Beverages and Tobacco) and Sector 34t35 (Transport Equipment), where the employment rate decreased by 0.71% and 0.26%, respectively. Particularly, the magnitude of the gains from China joining the WTO only is slightly lower compared with the case where China had not joined the WTO, with sector 26 (Other Non-Metallic Mineral) as an exception. This is not a surprising result given that tariff reductions involving multiple countries are more beneficial compared with just one country reducing tariffs. Moreover, similar with the effect on Chinese sectors, the increase in the employment rate in tradable sectors, especially manufacturing sectors are larger than in the non-tradable sectors. The average gains are 3.10% in tradable sectors and 1.68% in non-tradable sectors. Sector 27t28 (Basic Metals and Fabricated Metal) and Sector 24 (Chemicals and Chemical Products) are the top two sectors in India that benefit the most from China joining the WTO, with employment rate increases of 12.50% and 9.50%, respectively.

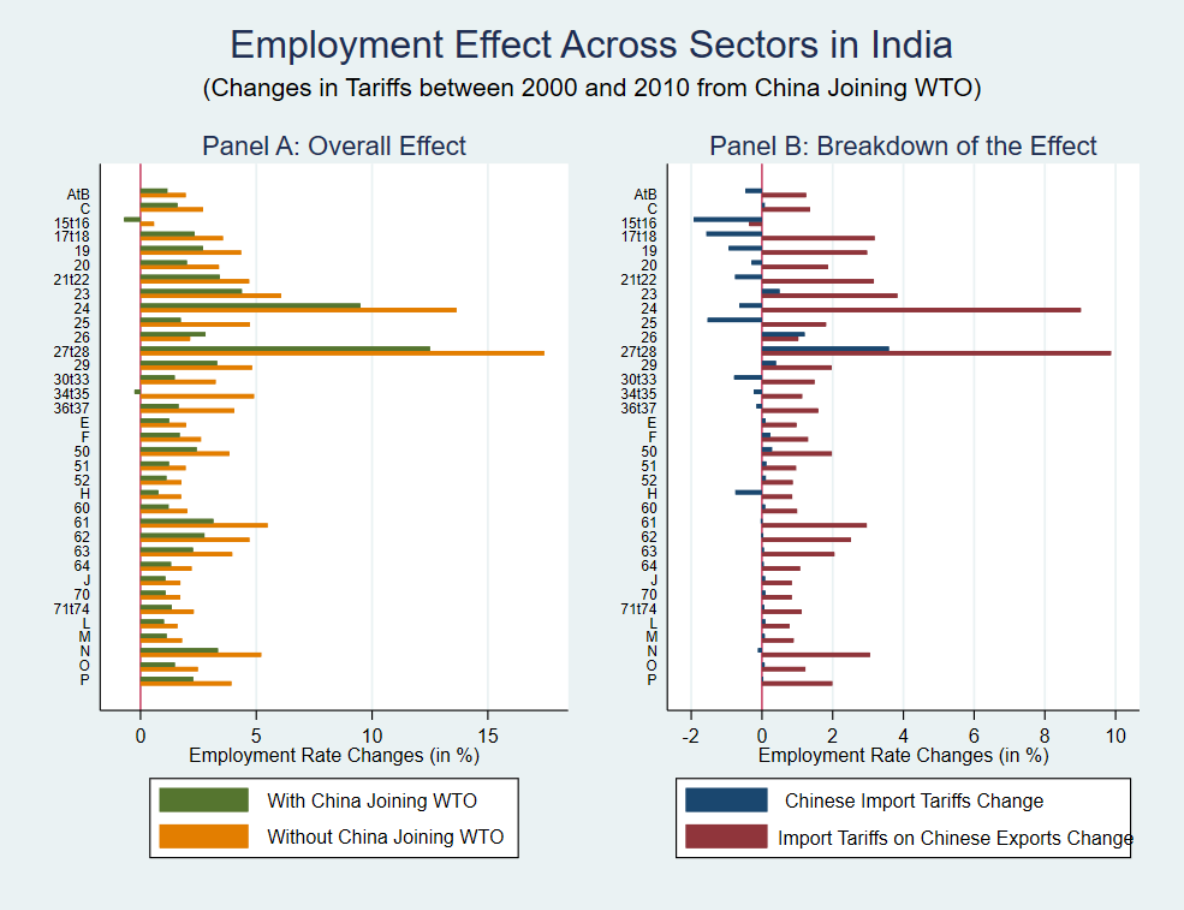


Fig. 2.6 Employment Effect by Sectors in India from China Joining the WTO

Note: The tradable sectors are from sector AtB to sector 36t37, while the non-tradable sectors are from sector E to sector P.

In Panel B of **Figure 2.6**, we distinguish the gains in Indian sectors from China joining the WTO by the two types of tariffs reductions. Overall, the gains we find in Panel A across Indian sectors are driven by reduction in tariffs on Chinese exports rather than Chinese import tariff reductions. In fact, the two counterfactual scenarios generate contrary effects on the sector employment in some sectors, for instance, sectors AtB, 17t18, 19, 20, 21t22, 24, 25 and 30t37. Specifically, those sectors benefit from the reduction in tariffs on Chinese exports, but experience a decrease in the employment rate from changes in the Chinese import tariffs. The average changes in the employment rate due to the changes of Chinese tariffs on imports from other countries is -0.08%, while the average change due to reductions in tariffs on exports from China is 2.07%, which is consistent with our findings at the country level. As for the sector heterogeneity, for both scenarios, the effect is significantly stronger in tradable

sectors than in non-tradable sectors. Similar with what we find in the overall effect, the top two sectors that experience an increase in the employment rate from the reduction in tariffs on Chinese exports are Sector 27t28 and 24. The sectors that lost the most, on the other hand, are sectors 15t16 (Food, Beverages and Tobacco), 17t18 (Textiles and Textile Products), with falls in employment of 1.93% and 1.57%, respectively, due to the changes in Chinese import tariffs.

Overall, the sector employment effect in China, the US and India shows the heterogeneous effects of one country's trade liberalization on its own economy and other economies in the world. Specifically, we find the following: (a) For the country experiencing trade reform, China in our case, we find an increase in the employment rate across all sectors, which are the result of the opening of the economy. The tradable sectors are found to benefit more from the reform than non-tradable sectors. (b) The trade liberalization in China, together with other trade reform episodes among emerging countries, is associated with the declines in employment in the manufacturing sector in the advanced economies, which might have sped up the structural changes in those countries. However, the result here does not imply that politicians are right in trying to protect their economy and implement protectionist measures. Actually, for the policy makers in those advanced countries, an open economy would be better for the economy to benefit the most from the globalization and structural changes trend. (c) Emerging countries, for instance India, experience an increase in the employment rate in most sectors from China joining the WTO. The effect on the manufacturing sector are larger compared with the service sectors. The main source of the gains for Indian sectors are likely to be reductions in tariffs on exports from China.[21]

2.5.3 Welfare Effect of China Joining the WTO in Different Models

One of my key contributions to the literature is adding labour market friction to a multi-sector, multi-country trade model. Solving the general equilibrium, comparing to the models in previous studies, the welfare effect of trade openness in my model is magnified by the

[21] Note that the main source of the gains from China joining the WTO may be different for other developing countries.

inverse of the elasticity of the search and matching function in the labour market, $1/\mu$. Here using China joining the WTO as a counterfactual exercise, I compare the results from my model (with frictional labour market) to a multi-sector model without labour market friction. I calibrate the trade model without labour market friction to the year 2000 and compute the welfare effect from China joining the WTO. **Table 2.4** presents the simulated welfare effects implied by both models for some major countries. Columns (1) and (2) show the welfare effect of tariff reductions from 2000 to 2010 from my model (Benchmark case), while columns (3) and (4) present the welfare effect from the trade model without frictional labour market. In each model, I perform two counterfactual exercises to comparing the overall welfare changes with and without China Joining the WTO.

As shown in **Table 2.4**, overall countries' "winning" and "losing" status from China joining the WTO are consistent in both models. However, for the model without frictional labour market, the welfare effects from tariff reductions are smaller compared to the Benchmark case. This is consistent with the conclusion in **Section 2.3** that introducing labour market imperfection magnifies the trade effects on real wages. For the major developed economies who lose from China joining the WTO, the changes of the real wages are higher in the benchmark model. For example, the welfare in the UK deteriorates more from -1.30% to -1.53% with labour market frictions. On the other hand, for the major developing economies who win, the gains are larger in the benchmark model. China's welfare, for instance, increases more from 30.66% to 36.01% with labour market friction. The results reflect the importance of accounting for the labour market friction.

2.6 Conclusion

This paper builds a computable general equilibrium model to quantify the welfare and employment effects of trade policy changes. With the input-output linkage and the frictional labour market, this model is able to investigate the changes in real wages and employment rates at the sector and national level as a consequence of changes in the trade openness. Adding the labour market friction to a multi-country, multi-sector Ricardian model, we show

Table 2.4 Welfare Effects of Tariff Reductions from 2000 to 2010 in Different Models

	Benchmark Case		No Labour Market Friction	
Country	Joining WTO	Without Joining WTO	Joining WTO	Without Joining WTO
	(1)	(2)	(3)	(4)
Major Developed Economies				
Canada	-1.95%	3.41%	-1.61%	2.50%
Japan	-1.86%	-1.38%	-1.56%	-1.29%
France	-1.17%	-1.21%	-0.97%	-0.99%
Germany	-1.53%	-1.50%	-1.28%	-1.25%
Italy	-2.05%	-2.06%	-1.70%	-1.71%
UK	-1.53%	-1.49%	-1.30%	-1.27%
USA	-0.94%	-1.10%	-0.80%	-0.83%
Economies in Transition and Major Developing Economies				
Brazil	1.18%	5.40%	1.39%	4.25%
China	36.01%	-1.97%	30.66%	-1.80%
India	13.22%	21.30%	10.84%	17.37%
Indonesia	3.79%	21.39%	3.18%	16.18%
Mexico	5.69%	13.07%	4.66%	11.27%
Russia	-0.10%	3.86%	3.91%	5.45%
Turkey	1.14%	11.92%	0.83%	9.12%

Note: The classification of countries is based on IMF's World Economic Outlook in April 2000. Columns (1) and (2) show the benchmark result from the model in this paper with labour market friction, While Columns (3) and (4) show the result using the trade model without friction. Columns (1) and (3) show the result from exercise 1, where there is only changes in tariffs involving China from 2000 to 2010. Columns (2) and (4) present the result from exercise 2, a complement of exercise 1, where we hold the tariff rates involving China fixed to the level of 2000 and introduce only the changes in tariffs between other countries.

that the gains from trade is magnified by the elasticity of the labour market matching function. With the model, one can perform evaluation on complex trade policy in a particular sector and country, and quantify the impact on the employment in that sector and in the rest of the economy, the impact on the general equilibrium price effect and real wage effect at home and the rest of the world.

To calibrate the model, this paper also estimates the sector level trade elasticity using the method proposed in Caliendo and Parro (2015), and proposes a new method to estimate the elasticity of the labour market matching function. I use the model and estimated key parameters to perform counterfactual exercise and identify the employment and welfare effects of China joining the WTO. The counterfactual analysis highlights the heterogeneous

effects across sectors and countries of one country's trade liberalization. Here, one can perform similar counterfactual exercises and use the model to investigate the employment and welfare effect of changes in tariffs following particular trade policies. Nevertheless, trade policies have more provisions than only changing the tariffs between involving countries. For example, changes in trade policies often induce changes in other unobserved and non-tariff trade costs. For future studies, it might be interesting to measure the changes in non-tariff trade barriers and add it to the model. Moreover, the model assumes that for the workers the choice of sector is irreversible, it might also be interesting to relax the assumption in the future study.

Chapter 3

Trade Liberalization, Business Investments and Family Firms

Joint with Pavel Chakraborty

3.1 Introduction

Understanding the effects of globalization on domestic investments is crucial for both academic literature and policy. However, little is known about the consequences of it. For example, how does manufacturing firms adjust their investment, in our case business investments, decisions in response to an unilateral trade liberalization process? Theoretically, drop in tariffs can affect investments of a firm from two different channels: first, access to cheaper and high-quality inputs can induce firms to invest more, for example towards long-term categories (Fromenteau et al., 2019). On the other hand, drop in output tariffs or rise in product market or foreign competition can invoke a higher degree of uncertainty in the economy and this can have a dampening effect on the long-term investment decisions of

a firm (Bloom et al., 2007). [1] However, the overall effect depends on the strength of each of these channels.

While a large strand of firm level literature focuses on the effects of trade liberalization on firm productivity (Pavcnik (2002); De Loecker (2007); Amiti and Konings (2007); Khandelwal and Topalova (2011)) and labour market adjustments (Revenga (1992); Artuç et al. (2010); Autor et al. (2013); Dix-Carneiro (2014); Chakraborty and Raveh (2018)), there is a dearth of empirical literature on the effects of investment responses despite the fact that investment is one of the key drivers of firm productivity, performance, and overall growth. The exiting small and growing empirical literature mainly focus on the US manufacturing firms and with a particular interest on the Chinese import competition effect. (Gutiérrez and Philippon (2017); Pierce and Schott (2018); Fromenteau et al. (2019); Amiti et al. (2020)).[2]

In contrast, exploiting rich and detailed information on different kinds of investments for Indian manufacturers (from PROWESS), we assess the potential impact of India's trade reform in the 1990s on a particular long-term financial investment undertaken by a manufacturing firm to secure and expand its businesses along its supply chain. In particular, any investments made by a firm in any other establishment, which is connected with the investing firm in the corresponding downstream or upstream sector. This particular investment is defined as "**Business Investment**" in the paper.

In a few of the recent studies, Chakraborty and Raveh (2018), Chen and Steinwender (2019), and Karaivanov et al. (2019) show that family-owned firms behave differently than professionally-managed firms in response to input-trade liberalization and import competition. On the other hand, there are quite a few newspaper articles and studies, such as one by Credit Suisse (2018), which highlights that family-owned firms in India outperform their counterparts in terms of the output they produce, their performance and efficiency, thereby

[1] In this chapter, we focus on two different types of tariffs changes following the trade liberalization, namely input tariffs and output tariffs. In particular, input tariffs is defined as the import tariffs on imported foreign inputs imposed by India. Output tariffs is defined as the import tariffs on final goods imposed by India on foreign imports.

[2] On the other hand, there is already a large theoretical literature which examines the effect of uncertainty on firm investment dynamics, such as Caballero (1991), Dixit and Pindyck (1994), Abel and Eberly (1994), Guiso and Parigi (1999), Bloom et al. (2007), etc.

dominate the growth of the India's manufacturing sector.[3] Therefore, we divide our sample between family and non-family firms and show that the result is substantially different for family firms. Family firms, on average, drop investments about 50–98% less than non-family firms. Investigating the cause for this differential effect for family firms, our results suggest that risk-taking behaviour and banking relationships play an important role.

To the best of our knowledge, this is the first paper to exploit such unique data on business investments and show (a) how foreign competition in terms of drop in output tariffs affect such kind of investments, and (b) how ownership of firms and its interactions with risk-taking attitudes and banking relationships play a key role in portraying the differential effect.[4]

A key contribution of our work is that we bring to bear unique data on investments that appropriately captures the activities directly related to secure or expand the businesses along the supply chain at the firm level. Previous studies studying the investments dynamics of a firm looked at physical investments: either short-term investments like Advertising, R&D Expenditure, Software, Computer, IT or long-term investments like Land and Buildings, Plant and Machinery, Electrical Installations, Transport and Communication etc.[5] All these investments, although might be related to businesses of a firm but may not directly capture whether it has been undertaken for securing the input-output linkages of firm's businesses or just a routine expenditure of the firm (say, to offset depreciation).

The unique variable we use — Business investment: (i) is one of the core investments of a firm that translates into productive capital and are non-reversible (as it is long-term); (ii) constitutes around 20–25% of the total flow of investments for an average firm; and (iii) is

[3]Evidence from the media, e.g., articles, news reports etc., show that family managed business contribute the most to GDP and growth of the economy globally. See articles in *Forbes India*, *ISBInsight*, *Business Today* and *The Economic Times Markets*

[4]Some of the previous studies also show that the degree of competitiveness that a firm face plays an important role in its investment activity or the effect of competition depends on firm performance and characteristics (Aghion et al. (2005); Akdoğu and MacKay (2008); Gutiérrez and Philippon (2017); Stoughton et al. (2017); Pierce and Schott (2018)).

[5]All the other studies focusing on the investment behaviour of firms such as Garicano and Steinwender (2016), Gutiérrez and Philippon (2017), Pierce and Schott (2018), Fromenteau et al. (2019), Karaivanov et al. (2019) utilizes data on fixed capital investments such as investments in structures, machinery, equipment, transport infrastructure, furniture or advertising expenditure, IT equipment, R&D, etc.

an unique information which has not been utilized in the literature before.[6] In this regard, we contribute and complement the existing small empirical literature on the effect of trade liberalization or globalization on investment dynamics of firms (Gutiérrez and Philippon (2017); Pierce and Schott (2018); Fromenteau et al. (2019)).

To establish a causal link, we exploit India's Eight-Plan trade reform, a quasi-natural experiment. The details of this reform, and its merits in the context of our case, are outlined separately. Utilizing the reform has two key advantages: (a) this reform provides plausibly exogenous changes in industry level input and output tariffs, with ample cross-industry variation, which we use as the basis of our identification strategy;[7] and (b) output tariff reductions effectively represent the degree of foreign or product market competition prevailing in the domestic market. We conduct a series of tests to show that these tariff changes are quasi-random and are not related to either a firm's investments or for that matter any industry level lobbying indicators.

We have three sets of results. First, we find a remarkably persistent and economically meaningful negative trade liberalization effect on firms' business investment that is entirely driven by changes in output tariffs. The relative dominance of output, over input tariffs suggests that this effect is manifested via changes in the product market or foreign competition rather than through a production side. Higher degree of product market competition invokes higher degree of uncertainty in the market and this curtails long-term business plans (investments) of a firm. We start by showing this in a simple diagram, **Figure 3.1**. The figure plots the average amount of real business investments (corrected for inflation using WPI) of Indian manufacturing firms and the output tariff rates (at 4-digit industry level) for 1990–2006.[8] We observe a sharp drop in output tariffs during the 1990s as a consequence of the trade reforms initiated by India. And during the same period, change in business

[6]We have also examined the effect of the output tariffs on other types of investments (physical) following the literature, but do not find any consistent result apart from business investments.

[7]We follow the empirical methodology, and data sources of previous studies that examined the effects of this trade reform on the Indian economy, including Goldberg et al. (2010), Khandelwal and Topalova (2011), Ahsan and Mitra (2014), De Loecker et al. (2016), Bas and Berthou (2017), and Chakraborty and Raveh (2018).

[8]We focus on output tariffs primarily, while controlling for input tariffs in all our estimations, as the former effectively captures the degree of foreign or product market competition in a domestic economy.

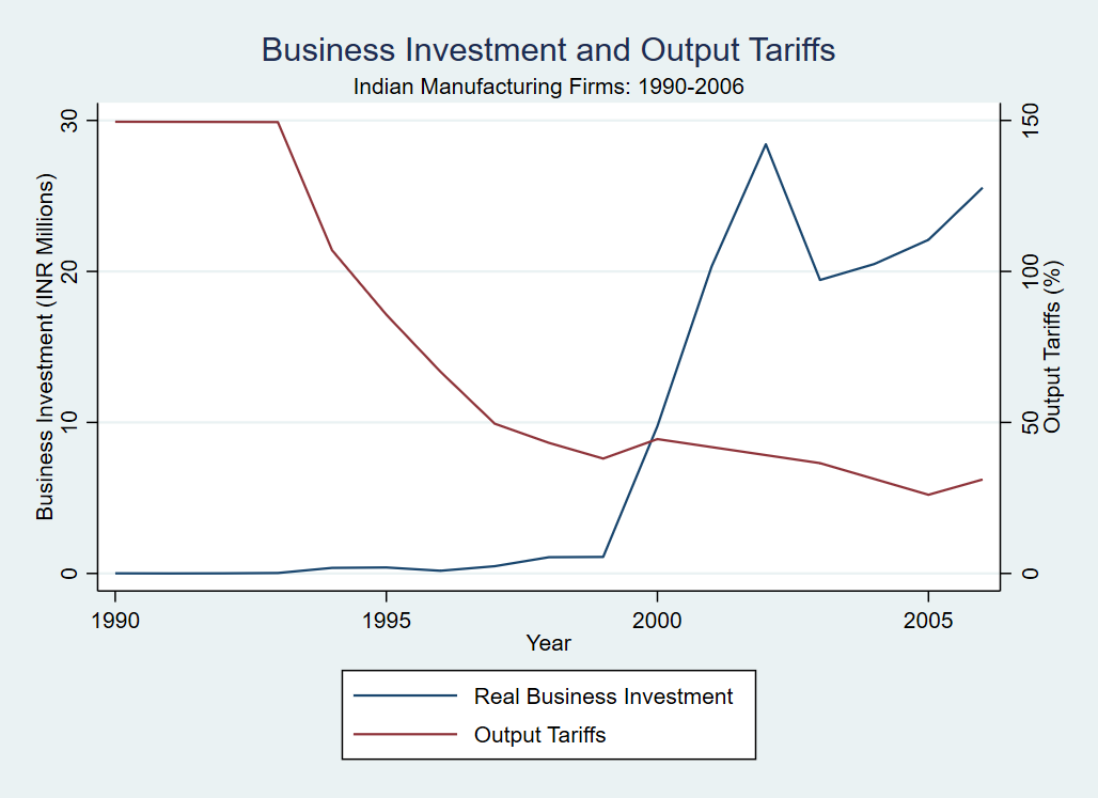


Fig. 3.1 Business Investment and Output Tariffs

Note: The blue line in this figure presents the yearly average of the real absolute value of business investment (corrected for inflation using WPI) for all manufacturing firms over the period 1990-2006. The red line plots the average output tariffs in India. The correlation coefficient $\rho = -0.656$, and is significant at 1% level.

investments appear to be minimal. However, when the drop in tariffs (output) started to slow down from 1999-2000 onward, business investments started to rise significantly.

Next, in specifications that control for firms' characteristics, we find that, for an average firm, larger reductions in tariffs are associated with reductions in business investment, though these reductions are smaller for firms with high levels of productivity, and family-owned firms (the higher the share of family ownership, the smaller is the reduction).[9] The result echos our finding in **Figure 3.2**: in response to rise in product market competition following the

[9]There is an existing literature on different, both positive and negative, attributes of family-owned firms (Caspar et al., 2010). Khanna and Yafeh (2007) characterize business groups, while Bertrand and Schoar (2006) review worldwide evidence on family controlled businesses. They put forward arguments for the higher efficiency of family firms vs. cultural theories. Others looked at Thai SMEs (Kinnan and Townsend, 2012), Swedish firms (Cronqvist and Nilsson, 2003), French firms (Sraer and Thesmar, 2007) and a sample of Western European countries (Maury, 2006).

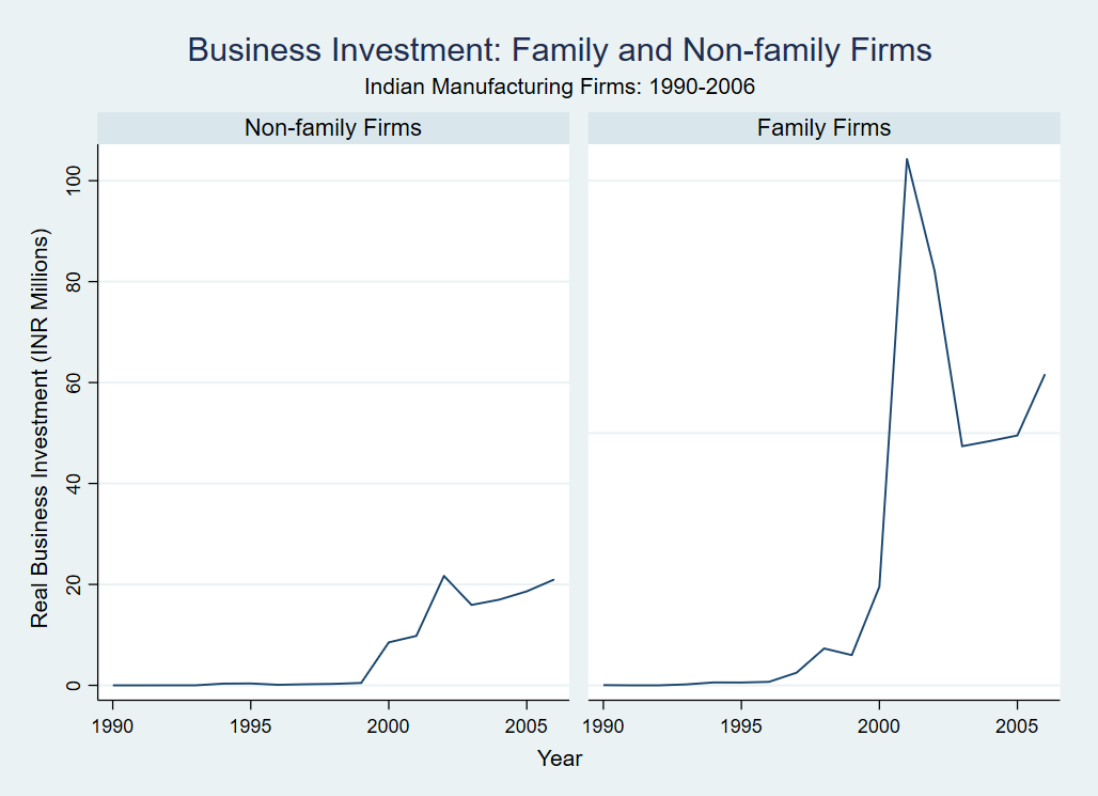


Fig. 3.2 Business Investments: Family Firms

Note: This figure presents the yearly average of the real absolute value of business investment (corrected for inflation using WPI) for Non-family firms and Family firms in India, 1990-2006. Family firm is defined as a firm for which a Hindu Undivided Family (HUF) owns any positive share.

trade reform, a family-owned firm's business investment reacts differently than non-family or professionally managed firms.

The reason(s) for this differential behaviour can be multi fold. However, two reasons have primarily been highlighted in the literature: first, family firms undertake more risk or risker projects than professionally-managed firms since the former set of firms have a long-term approach than the latter who care more for short-term profits (Lee et al., 2018)[10]; second, family firms appear to be less credit constrained or they have better access to credit (Karaivanov et al., 2019).

[10]Lee et al. (2018) investigating the association between family ownership and undertaking of risky projects point out that higher the proportion of family ownership in a firm, the higher is the probability of undertaking risky projects.

We examine such issues and show that both risk taking attitudes (measured through standard deviation of stock prices) of a firm and their connection to state-owned banks (as an indicator of financial constraints; state-owned banks in India are larger than other banks, especially in the 1990s) explain this differential pattern. We run a horse-race regression between these two factors, but fail to find any one of them to be consistently dominating the other.

These results point towards two important questions and/or implications: first, does ownership of firms matter when a firm is facing a rise in foreign competition? Second, does the undertaking of these investments (less drop in investments) by family firms helped them to achieve more in terms of productivity, output produced, sales, etc? We show such is the case: undertaking of the business investments, due to the drop in output tariffs, affected the family firms positively in terms of their productivity, output, and overall sales.[11]

We have several contributions to the literature. Apart from the first contribution that we use unique data on business investments, the second key contribution is that we complements the growing empirical literature examining how different types of firms respond to changes in competition based on their ownership. A small and growing literature in economics highlights that family firms respond or behave differently to input trade liberalization (Chakraborty and Raveh, 2018), import competition (Chen and Steinwender, 2019), investment activities (Karaivanov et al., 2019), risk sharing (Kinnan and Townsend, 2012), etc. We show, as the first evidence, that investment responses of firms can differ based on their ownership patterns in response to trade liberalization process. Our focus on heterogeneous responses to trade liberalization across firms within similarly exposed industries is most closely related to (Gutiérrez and Philippon, 2017), which uses firm level data for the US to show that increased competition due to Permanent Normal Trade Relations to China (PNTR) induces relative increases in the capital stock among "leaders," defined as firms with high market to book value.

[11] Khandelwal and Topalova (2011) show that drop in output tariffs generated positive productivity growth for Indian firms. Our results provide two interesting implications of this finding: this productivity growth may be driven by the family-owned firms and business investments is a crucial factor in explaining such productivity growth.

This brings us to our third contribution. We show that (a) risk-taking attitudes and (b) financial constraints (in terms of banking relationships of firms, specifically state-owned banks), explain the differential effect between family and non-family firms in terms of their investment responses.

In case of the former, our results portraying that family firms take more risk than other types of firms in the event of tariff reductions uncertainty contribute to two different types of literature: (i) risk preferences and firm investment, in other words the organization behaviour literature (Kahneman and Tversky (1979); Shoham and Fiegenbaum (2002); Triana et al. (2014); Meschi and Métais (2015)), and (ii) family firms and their risk taking attitudes (La Porta et al. (1999); Anderson and Reeb (2003); Morck and Yeung (2003); Nguyen (2011); Lee et al. (2018)).[12] Our paper, to our belief, is the first to put together the main issues across these two different literature in the context of a trade liberalization process.

As for the latter, there is now a sizeable amount of literature which shows that access to finance, internal (Fazzari et al. (1988); Kaplan and Zingales (1997); Garicano and Steinwender (2016)) and/or external (Petersen and Rajan (1994); Elston (1996); Houston and James (2001); Karaivanov et al. (2019)), matters for investment. We show it is the ownership of banks (the ones firms are connected to) that matters in terms of explaining the differential effect for family firms. The lesser amount of drop in investments in case of family firms, than other firms, is explained by their connection to the state-owned banks. Such behaviour can be explained by many reasons: lending capital of the state-owned banks may be higher, state-owned banks may finance more risky projects as they are driven by long-term developmental goals and not profit-maximization exercises, less informational asymmetry for family firms, borrowing costs for the family firms may be different, etc. We explore such reasons and show that it is the “development/social" view of the state-owned banks and their higher lending towards the firms belonging to the key sectors, such as R&D intensive, that explains the differential drop in investments for family firms.

[12] In a seminal paper, Burkart et al. (2003) show that the percentages of shareholdings of a family in a firm is positively correlated with their risk-taking attitudes. Our result provides significant support to Burkart et al. (2003) and contributes to the literature that family firms take more risk than others, in this case induced by rise in foreign competition.

Fourth, we contribute to the relatively small number of empirical studies associated with the large theoretical literature on investment under uncertainty (Pindyck (1993); Rob and Vettas (2003)). Finding plausibly exogenous shocks to uncertainty is an important challenge in these studies and several papers, including Guiso and Parigi (1999), Schwartz and Zozaya-Gorostiza (2003), and Bloom et al. (2007) have estimated such shocks using surveys, cost data for specific information technology investments, or detailed information from firms' annual reports. India's trade reform provides a large and plausibly an exogenous shock to firms' cost uncertainty, and we identify effects on investment that are broadly consistent with the literature.

Lastly, our results also contribute to the literature on estimating the impact of trade liberalization on various firm level outcomes. Unlike a host of previous studies that focus on the firm productivity (De Loecker (2011); Bloom et al. (2016)) labour employment and growth (Amiti and Konings (2007); Bernard et al. (2003); Fernandes (2007)), we focus on investments which is in fact a crucial source for firm and overall economic growth. The existing small literature is only based on Spain (Garicano and Steinwender (2016); Karaivanov et al. (2019)) and US (Pierce and Schott (2018); Fromenteau et al. (2019); Amiti et al. (2020)). Our paper, adopting the case of India, provides the first empirical evidence on firm level investment responses to trade reforms in the case of a developing economy.

The paper is structured as follows. **Section 3.2** outlines the details of the firm level dataset, the tariffs dataset we use and some descriptives in terms of the investment dynamics of the firms. **Section 3.3** examines the effects of trade liberalization on a firm's investment activity while explaining the trade reform process. We show the differential trade liberalization effect on firms in terms of their family ownership in **Section 3.4**. We discuss the implications of our results and provide some concluding remarks in **Section 3.5**.

3.2 Datasets and Descriptives

3.2.1 Data: Firm level (PROWESS)

The data is drawn from the PROWESS database, constructed by the Centre for Monitoring the Indian Economy (CMIE). The database contains information on approximately 50,000 publicly listed companies, all within the organized sector, of which almost 15,000+ are in the manufacturing sector. We use data for around 10,000+ firms, for which there is consolidated information on different types of investments done by the firms. The dataset is classified according to the 5-digit 2008 National Industrial Classification (NIC). We then re-classify it to 4-digit NIC 2004 to facilitate matching with other important industry level variables, such as our main variable of interest – the tariffs. Hence, all the categorizations made throughout the paper are based on the 2004 NIC classification. The dataset spans 105 (4-digit 2004 NIC) disaggregated manufacturing industries that belongs to 22 (2-digit 2004 NIC) aggregate ones.

The PROWESS data is captured from the annual income statements and balance sheets of all the publicly listed companies. Majority of the firms in the dataset are either private Indian firms or affiliated to private business groups, whereas a small percentage of firms are either government or foreign-owned. The database covers large companies, companies listed on the major stock exchanges and small enterprises. Data for large companies are worked out from balance sheets, while CMIE periodically surveys smaller companies for their data. However, the database does not cover the unorganized sector. The dataset accounts for more than 70% of economic activity in the organized industrial sector, and 75% (95%) of corporate (excise duty) taxes collected by the Indian Government (Goldberg et al., 2010). We use data on all the manufacturing firms from 1990 through 2006.

Most importantly, the PROWESS database collects data on different types of investments made by firms. Specifically, we utilize data on **business-related investments**. Business-related investments are those that are made by a firm to promote and/or secure one's business along the supply chain. Particularly, investments made in the securities of firms with which the investing firm has a business relationship, say as a supplier, customer, etc. For example, the steel manufacturing firm in India, 'Tata Steel' made business-related investments in equity

shares of 'Tata Metaliks' (supplier), 'Tata Sponge Iron' (supplier) and 'Tinplate Company of India' (customer), among others on 30th March, 2006. These kinds of investments are counted as business-related investments. We provide some key stylized facts on this variable in the next sub-section.

We use this as our main outcome variable of interest and examine the effect of trade liberalization, in terms of reduction in output tariffs. We also utilize information on other types of investments, both short- and long-term, such as advertising, R&D expenditure, IT and Software (short-term); non-business, land and buildings, plant, machinery, computer, and electrical installations, transport and communication, furniture and other fixed assets, and investments outside of India (long-term) to check whether other types of investments also react in response to trade liberalization.[13] More details on these variables in **Appendix A**.

We exploit another key aspect of PROWESS, central to our analysis – using information on family-owned firms by following the approach of the Securities and Exchange Board of India (SEBI).[14] SEBI defines a family firm to be one that is at least partly owned by Hindu undivided families (HUF).[15] Based on this, we construct three versions of the family-owned firm indicator: i) *binary*: a binary indicator that takes the value 1 for firms with any positive equity share of Hindu undivided families; ii) *medium*: an indicator that takes the value 1 for firms in which Hindu undivided families have an equity share higher than 30%; and iii) *dominant*: an indicator that is similar to the one described in (ii), but only with a cut-off of more than 50%. Across these definitions, on average around 11% of the firms in our dataset are family-owned firms.[16]

[13] This classification is following Fromenteau et al. (2019) and Garicano and Steinwender (2016).

[14] Patnaik (2014) concludes that SEBI's definition captures the vast majority of family firms in PROWESS. The continuous family ownership measure indicates that the ownership share of HUF has a mean of 3%, and ranges from 0% to about 94%. The second and third family firm indicators are stricter definitions, under which a firm is considered family-owned if the equity share of HUF is substantial.

[15] According to Hindu law, a Hindu undivided family is one that consists of all persons lineally descendent from a common ancestor.

[16] Firms started disclosing ownership information to SEBI only from 2007 onward. In an attempt to mitigate potential measurement errors, we compute the average equity share of Hindu undivided families over the period 2007–2009, and use that to create a cross-sectional division of firms. This is under the assumption that firms that reported being family owned in 2007–2009 were also such during our sample period (1990–2006). This is supported by the findings of Patnaik (2014) that indicate little variation of family ownership patterns in publicly-listed Indian firms during our sample period.

We exploit two other key features of the dataset: information on the banking relationships of these firms and their daily stock prices. The dataset provides with the names and the types of banks (domestic public-sector, domestic private, foreign) for all firms in each year. We have information on 52 public-sector banks (including state-sponsored financial institutions), 88 private banks (including cooperatives), and 53 foreign banks.[17] We use those banks which are listed as major banks (excluding the state-sponsored financial institutions, cooperatives)[18] by the *Reserve Bank of India*.[19]

In addition to this, the dataset also rolls out information on a vast array of firm level characteristics, such as total sales, exports, imports, cost, compensation (wages plus incentives), production factors employed, expenditure, gross value added, assets and other important firm and industry characteristics. Variables are measured in Indian Rupees (INR) million, deflated to 2005 using the industry-specific Wholesale Price Index. CMIE uses an internal product classification that is based on the HS (Harmonized System) and NIC schedules. Around 20% of firms in the data set belong to chemicals, followed by food products and beverages (12.81%), textiles (10.81%) and basic metals (10.46%).

Data Quality

PROWESS has been used in various previous similar studies on trade liberalization (Goldberg et al. (2010); Khandelwal and Topalova (2011); Ahsan (2013); Ahsan and Mitra (2014); Chakraborty and Raveh (2018)) providing some assurance for its relevance and applicability to the particular issues studied, as well as for its overall reliance. To the best of our knowledge, we are the first to use investments related to expansion and securing of new businesses by a firm in this context. That said, we discuss here two quality-related aspects of these measures: accuracy and consistency, as these may take a central role in the empirical analysis.

[17]Moreover, the dataset gives information on about 9000 private NBFCs, 250 public-sector NBFCs, 173 foreign NBFCs, and 80 other small co-operative banks.

[18]Our analysis includes only a handful of the state-sponsored financial institutions and co-operatives. Excluding them also produces the same result.

[19]However, in spite of all these advantages there is one potential limitation (in terms of the banking information) that is worthy of mention here: there is no way to understand which bank is the main 'reference bank' for a firm. Therefore, we treat all banks with equal importance.

Starting with accuracy, as mentioned CMIE retrieves most of the data from balance sheets, reported in publicly available annual reports. Moving to consistency, the analysis implicitly assumes that there is consistency in the reporting of such investments across firms. We note that all firms included in the analysis are listed in the major stock exchanges of India, and hence are subject to the same corporate governance regulations. This provides a more homogeneous, and regulated, environment that mitigates the given concern.

3.2.2 Dataset: Tariffs

Tariff data are derived from the TRAINS-WITS tariff database, at the HS 6-digit level. We pass these output tariffs through India's input-output matrix for 1993–1994 to construct input tariffs (for details, please see Chakraborty and Raveh (2018)).[20] We concord both the input and output tariffs to the 4-digit 2004 NIC level using the Debroy and Santhanam (1993) concordance table.[21] The tariffs are then matched with our firm level data.

Hence, using a within-industry perspective, and similar to Ahsan and Mitra (2014), De Loecker et al. (2016), and Chakraborty and Raveh (2018), we investigate our research question using industry level tariffs. The empirical strategy makes use of the exogeneity feature discussed below to undertake the main analysis using OLS. Realizing tariff changes may have a lagging effect, and to better address further endogeneity concerns we consider liberalization shocks in the previous period (albeit experimenting with different lags later in the analysis). In effect, we follow the empirical strategy of previous studies that investigated the effects of trade liberalization using the same reform (Khandelwal and Topalova, 2011).

[20] We follow the methodology used in De Loecker et al. (2016). Fixing the input-output weights at 1993–1994 addresses related potential endogeneity concerns. Goldberg et al. (2010) report that this input-output table likely reflects India's production technology across industries at the start of the reform period.

[21] The concordance methodology employs the Debroy and Santhanam (1993) schedule to calculate (simple) average industry-level tariffs. This follows the methodology of previous studies that examined the effects of changes in (input and output) tariffs in Indian industries (e.g. De Loecker et al. (2016); Goldberg et al. (2010); Khandelwal and Topalova (2011)). As outlined in Topalova (2010), this methodology provides a relatively precise measure of industry level tariffs in India.

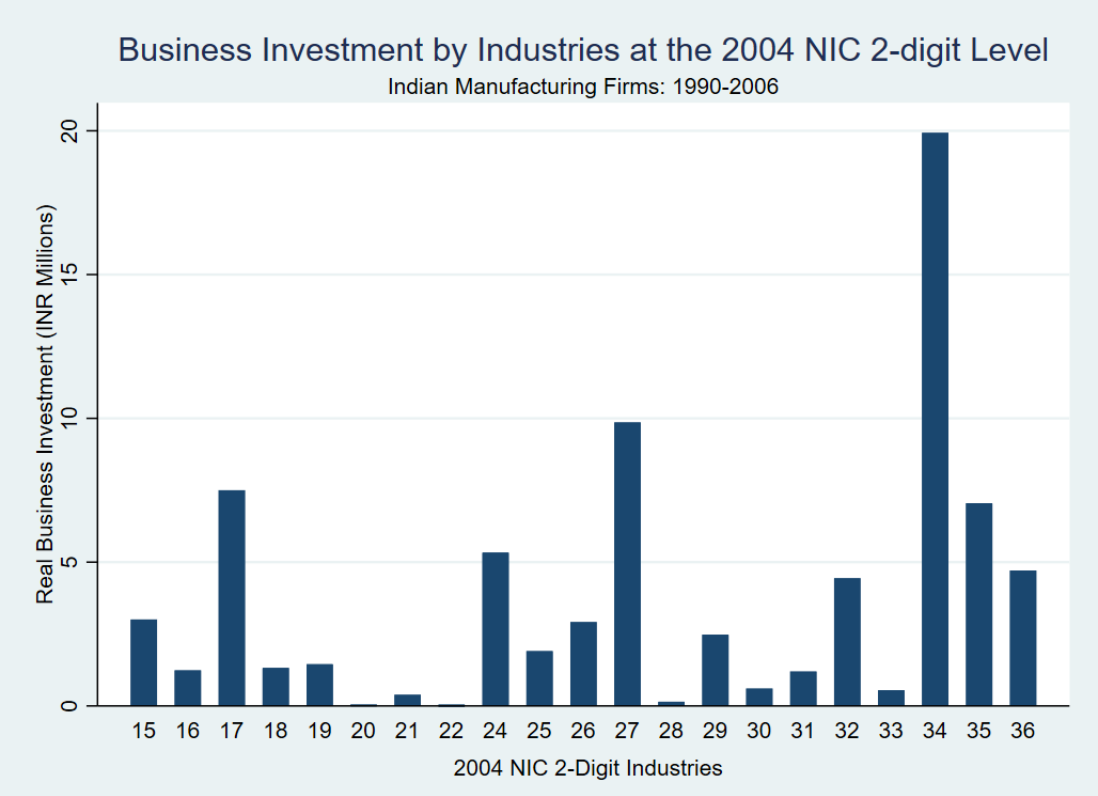


Fig. 3.3 Business Investment by 2-digit Industries (NIC 2004)

Note: The figure represents the real average business investments (corrected for inflation using WPI) across industries (NIC 2004 2-digit), 1990–2006.

3.2.3 Descriptives

Table 3.1 presents the descriptive statistics for all the variables we use in our empirical analysis. An average manufacturing firm in India spends about 8 Million INR (150,000 – 160,000 USD) in business investment in a given year. This is about one-fourth of the total investment flows of a firm. And, the extensive margin of business investment (the probability of making a new investment) shows that on average, the probability of a firm making investments related to business is 2%. On average, 3% of the shares of an Indian firm are owned by a HUF. [22]

[22]For a firm owned by a HUF, which is defined as a family firm in India, the probability of making business investment is about 7.9%, which is lager than for a non-family firm (about 1.2%). Moreover, for a firm that is above median size in their corresponding industry, the probability of making business investment is about 5.3%, which is lager than for a firm who's size is below the industry median (about 0.96%).

Table 3.1 Descriptive statistics

	Mean	Std.dev	Median	Min	Max
Dependent Variables:					
Business Investment	7.793	479.499	0	0	98,670
Business Investment/Real Assets	0.042	0.093	0.010	0	1.250
Extensive Margin (Business Investment)	0.019	0.137	0	0	1
Non-business Investment	8.960	450.276	0	0	139,415
R&D Expenditure (current)	0.889	23.452	0	0	4,863.6
Advertising Expenses	3.015	70.272	0	0	10,056.7
Software, Computer and IT Investment	0.426	19.176	0	0	3,018.8
Land and Building	40.236	519.361	0	0	54,149.1
Plant, Machinery, Computer, and Electrical Installations	222.958	4,413.15	0	0	752,899.7
Transport and Communication	4.551	182.114	0	0	29,228.2
Furniture and Other Fixed Assets	11.463	440.463	0	0	89,485.2
Investment Outside of India	1.540	64.689	0	0	9,726
Trade liberalization indicators:					
Output Tariffs	76.203	58.632	49.83	13.198	298.065
Input Tariffs	71.701	48.881	46.586	13.020	202.019
Effective Rate of Protection	76.200	58.627	49.826	13.197	298.065
Export tariffs	2.739	3.645	1.901	0	47.138
Firm Characteristics Variables:					
Age	16.921	17.201	12	0	117
Real Assets	2,403.996	20,055.11	305.173	0	848,583.5
Gross Value Added	1571.574	22,143.01	135.256	0.086	1,277,957
R&D Expenditure (Capital)	9.216	106.148	0	0	8,302.4
R&D Intensity	0.015	0.606	0	0	79.000
Managerial Compensation/Total Compensation	0.115	0.190	0.046	0	1
Capital Employed/GVA	4.986	73.747	0.300	0	8,925.001
Productivity	25.069	115.922	12.478	0.010	11,673.24
Family Share	3.028	11.194	0	0	94.38

Notes: 'Business Investment' is the amount of investments made by a firm on account of businesses. 'Business Investment/Real Assets' is the share of business investments in total assets of a firm. 'Extensive Margin of Business Investment' is the probability of making a new investment. 'Non-business Investment' is the amount of non-business investments made a firm. 'R&D Investment' is the total outlay of a firm on research and development expenditure of a firm over a year. 'Advertising Expenses' is all expenses done by a firm for advertising purposes. 'Software, Computer and IT Investment' captures the gross value of software of a firm. 'Land and Building' captures the gross value of all the real estate and buildings that a firm owns or has taken on lease. 'Plant, Machinery, Computer, and Electrical Installations' stores the gross value of plant and machinery, computers and its peripherals and electrical installations, equipment and fittings reported by a firm. 'Transport and Communication' stores the gross value of the following three kinds of assets: Transportation infrastructure, Transport equipment and vehicles, and Communication equipment. 'Furniture and Other Fixed Assets' stores the gross value of furniture and fixtures, social amenities and other fixed assets owned by a firm. 'Outside of India' is the amount of outward FDI by a firm in India. 'Output Tariffs', 'Input Tariffs', 'Effective Rate of Protection', and 'Export tariffs' is the output tariffs, input tariffs, effective rate of protection, and export tariffs defined at 2004 NIC 4-digit level. 'Age' is the age of a firm. 'Real Assets' is the total assets of a firm. 'Gross Value Added' is sales minus raw material expenditure. 'R&D Expenditure' is the research and development expenditure of a firm. 'Managerial Compensation/Total Compensation' is the share of managerial compensation in a firm. 'Capital Employed' is the total amount of capital employed in a firm. 'Productivity' is the productivity estimate of a firm as defined by Levinshon-Petrin (2003) methodology. 'Family Share' is the share of a HUF (Hindu-Undivided Family) in a firm. All the variables (except the ratios, age, and productivity estimates) are expressed in INR Millions.

Next, the dataset also provides ample variation across firms and industries in terms of investment dynamics. In **Figure 3.3**, we plot the average real business investments across 21 2-digit industries for the period of 1990–2006.[23] Going from a low of approximately 0.5 Million INR to a high of around 394 INR Million, the difference across industries is clearly observed. This is also seen when measuring changes over time. Averaging the annual rate of changes over the same period, we observe that the range runs from –50% to 823.68% with the average being 88%. This translates to the firm level, where such variation is even more prominent.

Finally, in order to understand how heterogeneous the firms are, we compare firms with positive business investment and zero business investment in **Table 3.2**. Overall, firms with business investment are older, larger, generates more output, more productive, do more R&D, trade more, and has higher value of family share. These differences across firms will help us to tease out the effect of trade liberalization on firm investment.

3.3 Trade Liberalization and Investment Responses

Before examining the effect of changes in tariffs-–a major liberalization tool-–on investment responses of firms, we briefly describe India's trade reform in the 1990s and show that the process is exogenous to several industry and firm level indicators in the next subsection.

3.3.1 India's Trade Reform: A Quasi-natural Experiment

Prior to 1990, India was one of the most trade-restrictive economies in Asia, having high tariff and non-tariff barriers. In 1991, following a balance-of-payments crisis, India turned to the IMF for assistance. The latter conditioned such assistance on an implementation of a major adjustment program that was to include liberalization steps, among others, that would abandon the restrictive trade policies. As a result, average tariffs fell by more than half

[23]There are 22 2-digit industries included in our sample. However, we exclude 2-dgit industry 23 from our schematic presentation for the following reason: industry 23's average business investments is really large (around 394 INR Million), which is significantly large than that of the other industries. Therefore, here we exclude industry 23 when plotting the average real business investments to show the variation across the industries.

Table 3.2 Firms with Positive Business Investment vs. Firms with Zero Business Investment

	Mean	Std.dev	Median	Min	Max
Panel A: Firms with Positive Business Investment:					
Age	32.074	21.646	26	0	117
Real Assets	10,227.88	53,980.15	1,128.362	2.599	848,583.5
Gross Value Added	8,129,741	65,750.25	492.474	0.101	1,277,957
R&D Expenditure (Capital)	50.079	273.566	0	0	6,397.2
Productivity	39.477	77.992	21.505	0.011	1,420.489
Total Imports	2,853.586	29,418.5	31.9	0	772,455.1
Total Exports	950.220	7,895.067	27.5	0	308,196
Family Share	9.438	17.630	0	0	93.108
Panel B: Firms with Zero Business Investment:					
Age	16.488	16.858	12	0	113
Real Assets	1,735.348	13488.79	281.9	0	743,553.9
Gross Value Added	1,011.096	12,604.27	132.31	0.086	980,339.9
R&D Expenditure (Capital)	5.724	75.375	0	0	8,302.4
Productivity	23.544	119.133	11.833	0.010	11,673.24
Total Imports	43.952	1,513.113	0	0	330,160.3
Total Exports	28.822	491.312	0	0	119,211
Family Share	2.903	10.994	0	0	94.38

Notes: 'Age' is the age of a firm. 'Real Assets' is the total assets of a firm. 'Gross Value Added' is sales minus raw material expenditure. 'R&D Expenditure' is the research and development expenditure of a firm. 'Productivity' is the productivity estimate of a firm as defined by Levinshon-Petrin (2003) methodology. 'Total Imports' is the sum of import of capital goods, raw materials, finished goods, and stores and spares. 'Total Exports' is the total exports of a firm. 'Family Share' is the share of a HUF (Hindu-Undivided Family) in a firm. All the variables (except the ratios, age, and productivity estimate) are expressed in INR Millions.

between 1990 and 1996 (Khandelwal and Topalova, 2011). Non-tariff barriers made a similar drop between the late 1980s and the mid-1990s (Goldberg et al., 2010). More specifically, starting at around 150% in 1990, the average tariff level dropped to approximately one-tenth of that by 2006. These major tariff changes form the key policy measure that we plan to exploit.

The trade reform, we exploit as a quasi-natural experiment to estimate the effect of product market or foreign competition on investment dynamics of firms, presents several advantages that make it particularly appealing for the purpose of this study. First, the crisis that led to the adjustment program was triggered by external events, such as the sudden increase in oil prices, drop in remittances from Indian workers abroad, etc. This, in conjunction with the fact that the reforms were passed quickly, led to sudden changes that were unanticipated

by Indian firms, establishing the reform as being a quasi-natural experiment. Second, the liberalization reform did not seem to have targeted industries within the manufacturing sector in a way that was related to pre-reform conditions.

Table 3.3 shows that changes in industry level tariffs are not associated with any kind of past industry and firm level measures of lobbying, performance, investment, and any interaction between family firms and investment decisions; **Panel A** looks at output tariffs, while **Panel B** checks for the exogeneity of input tariffs.

Our first check uses data from the Annual Survey of Industries (ASI) to test for political protection. We test whether measures of trade protection are correlated with politically important characteristics by regressing the change in output and input tariffs, between 1990 and 2006 on various industrial characteristics at $t-1$ period. We start by looking at lobbying effort by the industries in columns (1) and (2) for 1990–2006, column (7) for 1990–2001.[24] These characteristics include number of factories (a larger industry with more factories may lead to more electoral power and more protection), share of skilled workers (policymakers may protect industries where relatively low skilled/vulnerable workers are employed) in the 1990s. Each cell is a separate regression of output and/or input tariffs on the industry characteristics reported in the respective columns. The result indicates no statistical correlation between output and/or input tariffs and any of the industry characteristics.

Columns (3) – (6) and (8) – (9) test the same hypothesis using firm level characteristics. We start with firm productivity relative to total assets to understand whether there is any size effect. Big firms may influence changes in tariffs in order to reap gains from liberalization. Our estimates do not support such hypothesis across both the time periods. Next, we look at any correlation between changes in tariffs and firm level investments and its interaction with family firm. One of our key finding is that family firms drop their investments less than other firms and among them those who are risk takers and have relations with state-owned banks increase their investments in response to drop in tariffs. And, a significant number of family firms are the “superstar" or big firms. None of these characteristics is correlated with any aspect of the trade reform. In particular, we do not find any evidence of correlation between

[24] All these regressions use industry-year fixed effects at either 2- or 3-digit level, since the industry level variables vary at 3- or 4-digit level.

Table 3.3 Exogeneity Tests: Output and Input Tariffs

	1990-2006						1990-2001		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Output Tariff									
Factories$_{jt-1}$	–0.00002						–0.00004		
	(0.00001)						(0.00003)		
Skill Intensity$_{jt-1}$		0.016							
		(0.168)							
$\frac{TFP}{Assets}_{it-1}$			–0.002						
			(0.003)						
Ln(Business Investment)$_{it-1}$				0.001	0.001	0.0008		0.002	0.001
				(0.001)	(0.0005)	(0.001)		(0.001)	(0.002)
Ln(Business Investment)$_{it-2}$					–0.0002				
					(0.0004)				
Family$_i \times$ Ln(Business Inv)$_{it-1}$						0.0002			0.0003
						(0.001)			(0.002)
R-Square	0.976	0.976	0.991	0.991	0.990	0.991	0.965	0.986	0.986
Panel B: Input Tariff									
Factories$_{jt-1}$	–0.000004						–0.000004		
	(0.00002)						(0.00001)		
Skill Intensity$_{jt-1}$		0.114							
		(0.167)							
$\frac{TFP}{Assets}_{it-1}$			–0.005						
			(0.003)						
Ln(Business Investment)$_{it-1}$				–0.001	–0.0005	0.0007		0.0003	0.0003
				(0.001)	(0.0004)	(0.001)		(0.001)	(0.001)
Ln(Business Investment)$_{it-2}$					–0.0007				
					(0.0006)				
Family$_i \times$ Ln(Business Inv)$_{it-1}$						–0.003			–0.00007
						(0.002)			(0.001)
R-Square	0.980	0.980	0.992	0.992	0.990	0.992	0.989	0.997	0.997
N	34,727	34,727	12,090	36,829	30,099	36,829	19,258	21,368	21,368
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes	Yes					Yes		
Industry (3-digit)*Year FE			Yes	Yes	Yes	Yes		Yes	Yes

Notes: Panel A and B uses $OutputTariff$ and $InputTariff$ as the dependent variable, respectively. 'Factories' and 'Skill Intensity' is the number of factories and ratio of non-production workers and employees at NIC 2004 3-digit level. 'TFP' and 'Assets' are total factor productivity and total assets of a firm. 'Business Investment' is the natural logarithm of business investment by a firm. 'Family' is a binary indicator which takes a value 1 if a firm has shares by HUF (Hindu Undivided Family). Numbers it the parentheses are robust standard errors clustered at the firm level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

investment dynamics and its interaction with family firm indicator either for output or input tariffs.[25] These results further establishes the plausibly exogenous nature of the reform and the shocks we study.[26]

Third, there is much variation in tariff changes across industries. While being reported in previous studies (e.g. Khandelwal and Topalova (2011)), this feature is also observed in our sample. The 4-digit industry level average annual decreases in tariffs range from as low as 2% to as high as 25%, with a mean of 6% and a standard deviation of approximately 2.5%. Lastly, the usage of this quasi-natural experiment as a tool to identify the effects of trade liberalization on firm level behavior has been done in several previous studies, thus establishing its familiarity and reliability. We exploit this feature next, as we outline our empirical strategy.

3.3.2 Benchmark Results

We now examine the association between trade liberalization and the investment responses of firms exploiting the 1990s reform as a quasi-natural experiment using the firm level data as described above. This is done in various steps.

We start by investigating the effect of drop in tariffs (both input and output) on business investment. We estimate the following OLS reduced form equation using fixed effects method:

$$\mathrm{x}_{ijt} = \alpha_i + \beta_1 \mathrm{Ln(Output\ Tariffs)}_{jt-1} + \beta_2 \mathrm{Ln(Input\ Tariffs)}_{jt-1} + \mathbf{X}_{it-1} + \theta_{jt} + \varepsilon_{it} \quad (3.1)$$

where x_{ijt} is the business-related investments made by a firm. *Output Tariffs*$_{jt-1}$ and *Input Tariffs*$_{jt-1}$ are output and input tariffs, respectively, at NIC 2004 4-digit level for

[25] This result also controls for the fact that after 1999–2000, a major privatization drive was adopted by the Indian Govt. This may affect some industries more than others and family firms may have benefited more from it than others. Our results show such is not the case.

[26] Chakraborty and Raveh (2018) and Khandelwal and Topalova (2011) also show that changes in industry level tariffs during the years 1990–2006 and 1990-–2001, respectively, were not correlated with any pre-reform industry and/or firm characteristics.

industry j in year $t-1$. [27] $\mathbf{X}_{it-1}$ is a vector of firm characteristics. α_i counts for the firm fixed effects, while θ_{jt} is the interactions of industry and year fixed effects.

One of the most important difficulties in testing for the effect of trade liberalization on firm level investments is the high prevalence of observations with zero investment in annual consolidated accounts. One solution is to drop these zeros and only consider the positive value of these investments. The problem would then be: lack of zeros in the dataset would reject the canonical real options model of a single investment decision with its region of inaction (lack of zeros at the firm level is suggestive of aggregation over types of capital, production units, and time). And we need to assume that these firms made a single investment decision in each year, which is necessarily not true, especially in case of business investments. What we will end up measuring is the effect of trade reforms on lumpy investments of firms (Bloom et al., 2007). Therefore, to include zeros we use x_{ijt} as the natural logarithm of business-related investments plus 1 in our regressions. Since, adding 1 is somewhat arbitrary and may bias the coefficients, we also present our results using inverse hyperbolic sine transformation as a robustness check in later section; the results remain the same.[28]

Here, β_1 and β_2 are our coefficients of interest. Specifically, the above equation examines the determinants of business investments made (or not) by the manufacturing firms in India in response to the trade liberalization process – increase in product market competition (drop in output tariffs) and availability of high-quality foreign intermediate inputs (drop in input tariffs).

Our benchmark setting includes several points. First, as mentioned before, we use an annual-based, unbalanced panel over the period of 1990–2006. Second, standard errors are clustered at the industry level in all cases. Third, on top of firm fixed effects, α_i, we also use the interactions of industry and year fixed effects, θ_{jt}, where industry j is at the more aggregated level (NIC 2004 2- or 3-digit). These interaction terms would control for

[27] We use the logarithm of the tariffs variables, which is commonly used in the literature. Alternatively, one may also see tariff variable defined as logarithm of one plus the tariff rate in the literature. However, the results using log of one plus the tariff rate are the same as what we present here.

[28] Apart from the two methods presented in this thesis for the solution to the zeros, we did add PPML estimator as robustness check and the results still hold. We did not include the result in the chapter given the length of the paper.

various within-year industry changes, such as the industry-year specific delicensing or FDI liberalization phenomena,[29] and/or various industry-specific labour laws and federal subsidy initiatives.

As for the vector of firm characteristic, $\mathbf{X}_{it-1}$, it includes: a firm's age, age squared, assets, technology adoption intensity, and output of a firm. Realizing that investment responses might vary with age, for example newer firms may do more investments than old, the first measure controls for potential differences in the flexibility of undertaking investment decisions. Addressing potentially related U-shaped effects, we also include the square term of age. The third variable controls for firm size, given that larger firms may do larger investments than the small ones. Next, we include technology adoption intensity. This is measured as the share of R&D expenditure and royalty payments for technical knowhow in GVA (gross value-added); it captures differences in technological orientation, which is essential for considering the investment effects of technological flows. Later, we discuss separately further controls and potential channels.

Table 3.4 presents our benchmark results from our preliminary analysis estimating Equation (3.1). We start by looking at the entire period, 1990–2006, in columns (1) and (2). Our estimates show the following: (a) drop in output tariffs or rise in product market competition reduces business-related investments by firms in India which is related to expansion or procurement of business by firms. In particular, a 10% drop in output tariffs reduces a firm's business investment by about 2.46%–2.65%; (b) we find the opposite in case of input tariffs. A 10% drop in input tariffs increases the business-related investments of an average manufacturing firm in India by 2.64%–3.18%.

Next, following the discussion by Khandelwal and Topalova (2011) on the exogeneity of industry level tariff changes during the trade reforms in India, we restrict our benchmark estimation to the sample period of 1990–2001 in column (3). They argue that the tariff adjustments after 2001 may be correlated with certain economic and political factors across

[29] Until the 1980s large firms were required to obtain an operating license, and FDI was capped at 40% in most industries. Starting in 1985, and continuing in the 1990s, industries went through both a delicensing reform and a FDI-liberalization process (Nataraj, 2011).

Table 3.4 Trade Liberalization and Business Investments: Benchmark Result

Dependent variable:	Business Investment				
	Input/output Tariff Rates			ERP	
	1990-2006		1990-2001	1990-2006	1990-2001
	(1)	(2)	(3)	(5)	(6)
Ln(Output Tariff)$_{jt-1}$	0.246***	0.265***	0.110**		
	(0.069)	(0.088)	(0.054)		
Ln(Input Tariff)$_{jt-1}$	–0.264**	–0.318**	–0.007		
	(0.112)	(0.124)	(0.119)		
Ln(ERP)$_{jt-1}$				0.137**	0.108***
				(0.065)	(0.037)
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes
R-Square	0.486	0.495	0.323	0.485	0.324
N	36,855	36,829	21,386	36,855	21,386
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes		Yes	Yes	Yes
Industry (3-digit)*Year FE		Yes			

Notes: Columns (1) – (6) use logarithm of investments related to promote or secure business (refer to as 'business investments'). These are long-term business investments of a firm. Columns (1) – (2) and (5) use the time period of 1990-2006, otherwise mentioned on the top of the row. $Ln(OutputTariff)_{jt-1}$ and $Ln(InputTariff)_{jt-1}$ are lagged output and input tariffs at NIC 4-digit level. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry levels. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

industries.[30] As column (3) demonstrates, the effect of drop in output tariffs on firms' business investment remains robust with the sample period restrictions. A 10% change in output tariffs now forces a firm to drop 1.1% in their business-related investments. On the other hand, in the case of input tariff, while the sign remain the same as our initial case, the effect is now indistinguishable from zero.

Our initial findings show that the effect of trade liberalization on a firm's business investment comes from two different channels: higher degree of product market or foreign competition (changes in output tariffs) and input-trade liberalization (changes in input tariffs). Although the effect of input tariffs is not robust across different time periods, we now make an attempt to address the net effect of the trade reform process on the business investments by taking into account both channels. For this, we follow Khandelwal and Topalova (2011)

[30] Chakraborty and Raveh (2018) show that such is not the case; tariff levels were exogenous till 2006.

and construct Effective Rates of Protection (ERP) as defined by Corden (1966):

$$\text{ERP}_{jt} = \frac{\text{output tariffs}_{jt} - \text{input tariffs}_{jt}}{1 - \sum_s \alpha_{js}} \tag{3.2}$$

where α_{js} is the share of input from industry s in the value of output in industry j. We source these α_{js} for different industries from input-output matrix for 1993–1994. We then use this index to investigate the net effect of trade liberalization using the following reduced form equation:

$$\ln(\text{Business Inv})_{ijt} = \alpha_i + \beta_1 \text{Ln(ERP)}_{jt-1} + \mathbf{X}_{it-1} + \theta_{jt} + \varepsilon_{it} \tag{3.3}$$

β_1, therefore, is our coefficient of interest, denoting the net effect of the output and input tariffs. In **Table 3.4**, columns (5) and (6) report the required results for 1990–2006 and 1990–2001, respectively. Overall, the drop in the effective rate of protection or increase in the degree of product market competition undermines a firm's business investment behavior in India. The net competition effect following the trade reform is robust across both the time periods. In particular, in response to a 10% decrease of effect rate of protection, a firm reduces its business-related investment by 1.08% – 1.37%. These findings using ERP instead of output tariffs and input tariffs support our initial findings on the product market competition channel, which motivate us to further explore our primary research question.[31]

Our results on the effect of output tariffs are in line with the existing theoretical literature (Pindyck (1993); Guiso and Parigi (1999); Rob and Vettas (2003); and Bloom et al. (2007)) and complements the literature showing that drop in output tariffs, which effectively measures higher degree of product market or foreign competition, has similar effects on investments, particularly business investments in our case.

Before proceeding to check for the robustness of our benchmark result, the immediate question that may crop up is: which industries drive the benchmark results? We check for

[31] While our primary focus is on the effect of trade liberalization on business-related investments, we also look at other types of investments made by firms to understand which type(s) of investment responded significantly to the trade liberalization process. In fact, this analysis also provide additional support and motivate our primary research question better. **Table B1 (Appendix B)** checks for the effect of drop in output tariffs on various types of investments, both short- and long-term.

those in **Panel A** of **Table B2**. The results support our initial conjectures: (a) the decrease of investments in R&D-intensive industries which are above the median of the R&D investments for the manufacturing sector are 1.7% less than those below the median; (b) the entire drop in investments is driven by sectors which are highly dependent on external finance.[32]

3.3.3 Robustness Checks

Having observed an economically meaningful effect of trade liberalization on business investments of the Indian manufacturing firms, we now conduct a few robustness checks on the persistence and stability of the benchmark result. Most of the robustness checks we conduct refer to Equation (3.1) with a focus only on business investments. Results are presented in **Table 3.5**.

We start by using an alternative method addressing the problem of zeros in our outcome of interest. The inverse hyperbolic sine (IHS) transformation is frequently applied to transform right-skewed variables that include zero or negative values. One may argue that arbitrary choices like adding 1 to logarithmic transformation of the outcome variable of interest can have a considerable effect on the results. In order to address this problem, we transform our outcome of interest, business investments, using inverse hyperbolic sine transformation in column (1). The impact of trade liberalization remains the same: a 10% drop in output tariffs reduces a firm's business-related investments by 2.8%. Another efficient way of tackling the zeros would be to aggregate investments over a longer time horizon, e.g., 3-5 years per firm. Column (2) presents result from 3-years moving average. Our estimate increases considerably: a 10% drop in output tariffs reduces a firm's business-related investments by 5.3%.[33]

Next, we drop sector 23 (NIC 2004 2-digit) which is manufacture of coke, refined petroleum products and nuclear fuel in column (3). The reason for doing so is that one of the important beneficiaries of the trade reform was the petroleum products sector, especially after 1999–2000 when the delicensing and privatization of the industries started. Dropping

[32] We also divide our industries based on their upstreamness. **Panel A** of **Table B3** presents these additional result. Our estimates show that the benchmark result is driven by firms belonging to the upstream sector.

[33] Results remain the same qualitatively if we use a 5-year moving average (results available on request).

Table 3.5 Trade Liberalization and Business Investments: Robustness Checks

Dependent variable:	Business Investment							Business Investment/Real Assets	
	IHS Transformed	3-Years Moving Average	Drop Sector 23	Industry Level 4-digit	Arellano-Bond	Long-term Effects		1990-2006	1990-2001
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
asinh(Output Tariff)$_{jt-1}$	0.277***								
	(0.079)								
asinh(Input Tariff)$_{jt-1}$	–0.289**								
	(0.128)								
Ln(Output Tariff)$_{jt-1}$		0.527***	0.252***	0.934*	0.093*	0.111*	0.098	0.004**	0.002*
		(0.140)	(0.069)	(0.547)	(0.053)	(0.058)	(0.062)	(0.002)	(0.001)
Ln(Input Tariff)$_{jt-1}$		–0.620***	–0.260**	–2.153***	–0.088	–0.133	–0.125	–0.007***	–0.0005
		(0.187)	(0.112)	(0.675)	(0.070)	(0.138)	(0.137)	(0.003)	(0.002)
ln(Business Investment)$_{it-1}$					0.480***				
					(0.047)				
Ln(Output Tariff)$_{jt-2}$						0.239***	0.146***		
						(0.079)	(0.053)		
Ln(Input Tariff)$_{jt-2}$						–0.221	–0.080		
						(0.153)	(0.088)		
Ln(Output Tariff)$_{jt-3}$							0.187**		
							(0.080)		
Ln(Input Tariff)$_{jt-3}$							–0.247		
							(0.163)		
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.486	0.600	0.475	0.798	NA	0.497	0.512	0.462	0.320
N	36,878	23,893	36,353	36,869	30,527	35,553	34,088	33,438	19,338
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Column (1) use the IHS-Transformed (Inverse Hyperbolic Sine Transformed) business investment. Column (2) use logarithm of the 3-year moving average of the business investment. Columns (3) – (7) use logarithm of trade investments. Columns (8) and (9) use business investments as a ratio of real assets of a firm as dependent variable, respectively. Columns (1) – (8) use the time period of 1990-2006, otherwise mentioned on the top of the row. Column (3) aggregates our dependent variable at the NIC 4-digit level. $asinh(OutputTariff)_{jt-1}$ and $asinh(InputTariff)_{jt-1}$ are lagged IHS-Transformed output and input tariffs at NIC 4-digit level. For Column (2), $Ln(OutputTariff)_{jt-1}$ and $Ln(InputTariff)_{jt-1}$ are lagged logarithm of the 3-year moving average of output and input tariffs at NIC 4-digit level. For Columns (3)–(9), $Ln(OutputTariff)_{jt-1}$ and $Ln(InputTariff)_{jt-1}$ are lagged logarithm of output and input tariffs at NIC 4-digit level. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry levels. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

petroleum products sector also does not change our results and the coefficient estimate remains almost the same. Next, in column (4) we aggregate our firm level dependent variable to 4-digit industry level (NIC 2004). This is to check whether our within-industry effects also hold for between-industry or not. We use the sample period, 1990–2006, same as our benchmark estimation. The coefficient of interest indicate that the decline in output tariffs continue to have a significant negative effect on the business investments at the industry level.

We use Arellano-Bond approach (Arellano and Bond, 1991) in column (5) with lag (one year) of business investment as an additional control. Although lagged investment is significantly correlated with current investment, this additional control does little to alter our benchmark result. Next, we check whether the effect of product market competition on investment is only short-term by adding 2- and 3-year lags of output and input tariffs to the baseline specification in columns (6) and (7). The sign and significance of the effect of output tariffs remain robust in both the cases. Our estimates show that product market competition has both a short-term and long-term effect on the business investments done by firms in India. In terms of input tariff, we find no significant effect of the reduction of input tariffs at 2- and 3-year lag period on business investments despite the consistency of the signs.

Lastly, we use business investments as a ratio of real assets as our dependent variable in columns (8) and (9) for 1990–2006 and 1990–2001, respectively. Although we control for the size of a firm in all of our specifications, we do this to double check whether our results are only being driven by big firms. The estimates continue to provide support for our benchmark result – dampening effect of output tariffs on a firm's business investment. Again, we do not find any effect for input tariffs.

Overall, our robustness checks show that the negative effect of drop in output tariffs on firms' business investment is persistent and stable across different time periods, change of the estimation method, change of the dependent variable, etc. Our findings are interestingly similar to what Pierce and Schott (2018) find in case of the US firms. On the other hand, we do not find that drop in input tariffs affects business investments consistently. Therefore, from the next section onward, we will only present results for output tariffs while still controlling for input tariffs in all the estimations we run. Another reason to do so is that the main focus

of the paper is to estimate the effect of rise in product market or foreign competition in terms of drop in output tariff.

3.3.4 Additional Controls

Having now identified the main channel explaining the changes in business investments in India, we now test for some of the potential complementary channels that can affect the same using the following specification:

$$\begin{aligned}\ln(\text{Business Inv})_{ijt} = \alpha_i + \beta_1 \text{Ln(Output Tariffs)}_{jt-1} + \phi \text{Ln(Output Tariffs)}_{jt-1} \times Z_{i(j)t-1} \\ + \vartheta Z_{i(j)t-1} + \mathbf{X}_{it-1} + \theta_{jt} + \varepsilon_{it}\end{aligned} \tag{3.4}$$

where $Z_{i(j)t-1}$ represents the vector of additional controls either at the firm and/or industry level (2004 NIC 3-digit): number of factories, skill and capital intensity, productivity, and export tariffs. We use all these variables for the previous year.[34] We now have three coefficients of interest: (1) β_1, which presents our benchmark effect controlling for the other potential complementary channels; (2) ϕ capturing the interacted effect of output tariffs and other complementary channels; (3) ϑ denoting the direct effect of the additional controls on a firm's business investments. The estimation results appear in **Table 3.6**.

We start by looking at the level of its productivity in column (1). We measure firm level TFP using Levinsohn and Petrin (2003a) methodology.[35] Using these estimates, we regress business investments by a firm on the productivity estimates and interaction with output tariffs in column (4). The estimate on the interaction term between productivity and output tariffs, ϑ, turns out to be negative and significant. This implies that relatively more productive firms experience smaller drops in investments due to rise in the product market competition. In particular, their investment drops by 2.68% less than the overall effect in response to 10% drop in output tariffs.

[34] Using them when it first appears in the sample also produces the same result.
[35] For details, please see Levinsohn and Petrin (2003a).

Table 3.6 Trade Liberalization and Business Investments: Additional Controls

Dependent variable:	Business Investment				
	Productivity	Factories	Skill Intensity	Cap Employed/GVA	Export tariffs
	(1)	(2)	(3)	(4)	(5)
Ln(Output Tariff)$_{jt-1}$	0.807***	0.242***	0.235*	0.242***	0.271***
	(0.164)	(0.071)	(0.138)	(0.069)	(0.079)
Productivity$_{it-1}$	1.062***				
	(0.203)				
Factories$_{jt-1}$		0.00002			
		(0.0001)			
Skill Intensity$_{jt-1}$			0.043		
			(0.127)		
$\frac{Capital}{GVA}_{it-1}$				0.0004	
				(0.001)	
Ln(Export Tariff)$_{jt-1}$					0.004
					(0.017)
Ln(Output Tariff)$_{jt-1}$×Productivity$_{it-1}$	–0.268***				
	(0.051)				
Ln(Output Tariff)$_{jt-1}$×Factories$_{jt-1}$		–0.00001			
		(0.00001)			
Ln(Output Tariff)$_{jt-1}$×Skill Intensity$_{jt-1}$			0.001		
			(0.028)		
Ln(Output Tariff)$_{jt-1}$×$\frac{Capital}{GVA}_{it-1}$				–0.0001	
				(0.0001)	
Ln(Output Tariff)$_{jt-1}$×Ln(Export Tariff)$_{jt-1}$					–0.001
					(0.004)
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes
R-Square	0.544	0.511	0.508	0.486	0.506
N	12,126	34,737	13,179	36,761	33,768
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes	Yes	Yes	Yes	Yes

Note: Columns (1) – (5) use logarithm of business investments as the dependent variable. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. 'Productivity' is calculated at the firm level using Levinshon-Petrin (2003) methodology. 'Factories' is the number of factories at NIC 2004 3-digit level. 'Skill Intensity' is the ratio of managerial compensation to total compensation at firm level. 'Capital/GVA' is the share of capital employed to gross value-added of a firm. 'Export Tariff' is the tariff at NIC 4-digit level that Indian exporters facing when export to other countries. All the regressions control for input tariffs and its interactions as well. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. Numbers it the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Second, we look at the total number of factories (at NIC 2004 3-digit level) in column (2). Following a rise in product market competition, firms may choose to close their factories and this could lead to drop in investments. The interaction between output tariffs and factories shows no such evidence — the coefficient is close to zero and insignificant.

Then, we examine a potential connection between a firm's skill intensity with their investment responses to drop in output tariffs in column (3). Skill intensity at the firm level is measured by the share of managerial compensation in total compensation. We assume that managers represent the set of skilled workers (who has had a university degree at the minimum or certain years of experience in the same sector). Potentially, firms with higher level of skill intensity may act differently while facing a higher degree of product market competition. We fail to find any support for such hypothesis — the interaction term for heterogeneous effect of trade liberalization across different levels of firm skill intensity is indistinguishable from zero.

Column (4) tests for another additional control – capital intensity. Capital intensity is defined as the share of capital employed to gross value-added of a firm. We are interested in understanding whether firms with capital intensive production processes have different investment responses to rise in competition or not. Our point estimate, however, suggests no such correlation of firm investment behavior with its capital intensity. Introduction of this additional control does little to our benchmark result.

The last potential channel, that we investigated, which might affect business investments for Indian firms is the export tariffs they face. During the 1990s, apart from India there were various multilateral trade liberalization episodes, for instance the 1995 Uruguay round, which may affect the access of Indian firms to foreign markets. This, in turn, may alter the firms' responses to investments, irrespective of the domestic trade reforms. Therefore, with easier access to foreign markets, firms may intend to invest more on securing businesses.

To capture the changes in foreign markets, we follow Chakraborty and Raveh (2018) and generate export tariffs faced by Indian firms at NIC 2004 4-digit level. To do that, we first source HS6 level tariff data on Indian exports for 1990–2006 from the TRAINS-WITS database and export data for India for the years 1990, 1995 and 2000 from the

UN-COMTRADE database. Then at each HS6 level, we take a weighted average of tariffs imposed on Indian exports using $\tau_{jt}^{export} = \sum_m \alpha_{mj}\tau_{mjt}$. τ_{mjt} is the tariffs introduced by partner m on imports from India in industry j at time t; α_{mj} is the share of partner m in the Indian exports in industry j. We now use the shares in 1990, 1995 and 2000 as weights (for tariffs) for the years 1990-1994, 1995-1999 and 2000-2006, respectively. Finally, we convert the HS6 level export tariffs to the NIC 2004 4-digit industry level using the Debroy and Santhanam (1993) concordance table. The effect of export tariffs and its interaction with output tariffs is displayed in column (5). We find no evidence of the effect of export tariffs on business investments.

3.4 Family firms

Bertrand and Schoar (2006) in a survey paper highlight family arrangements are predominant among privately held firms, and also present in a large proportion of publicly listed firms. Involvement of families in businesses is very common across Latin America, Africa, Middle East, Asia, and some part of western Europe, though with a lot of heterogeneity across countries.[36] Bloom et al. (2013) investigating how management practices affect Indian firms note that family firms is a common feature of the Indian economy. A study on the Indian family firms from the Thomas Schmidheiny Centre for Family Enterprise at the Indian School of Business highlights that in 1990, family firms represented 15.7% of the GDP in terms of their total income and this increased to 25.5% in 2015.[37]

Farhard Forbes, current Chairman of the Family Business Network International, in an interview argues that in general family businesses have a long-term vision, and are not

[36] A study by Credit Suisse, Credit Suisse Family 1000, shows that India ranks third in terms of family-owned businesses in the Asian markets. More than 50% of the top 30 best performing family-owned firms in Asia, excluding Japan, are from India. Among them, 12 Indian family-owned firms with a total market capitalization of USD 192.2 Billion generated average annual CFROI (cash flow return on investment) of 22.7–43% in the last decade.

[37] Family firms accounted for 28% of all indirect taxes and 18% of all direct corporate taxes in 2015, while non-family firms accounted for 26% and 25%, respectively. Although the pattern has oscillated over the years, overall, the contribution of family firms has gone up steadily.

motivated as much by short-term pressures.[38] Realizing that presence of a large fraction of family firms and their differential objectives may yield different reactions to changes in trade policies, we now evaluate whether family firms have a differential response to the business investment or not using the following equation:

$$\ln(\text{Business Inv})_{ijt} = \alpha_i + \beta_1 \text{Ln(Output Tariffs)}_{jt-1} + \phi \text{Ln(Output Tariffs)}_{jt-1} \times \text{Family Firm}_i + \mathbf{X}_{it-1} + \theta_{jt} + \varepsilon_{it} \tag{3.5}$$

where Family Firm$_i$ is an indicator for a firm being family-owned. We use three different versions of the family-owned firm based on the proportion of shares owned.

The three versions of Family Firm$_i$ are: (1) *Binary* – it takes a value 1 if a HUF owns any positive share in a firm, 0 otherwise; (2) *MediumShare* – equals to 1 if the ownership share of HUF is greater than 30%, and 0 otherwise; and (3) *DominantShare* – a binary index that takes a value of 1 if a firm has greater than 50% share owned by a HUF. We use these different indicators to explore whether different versions of family-owned firms play any differential role in explaining the effect of output tariffs on investment behaviour of firms. The estimation results for *Binary*, *MediumShare* and *DominantShare* are presented in columns (1) – (12) in **Panel A** of **Table 3.7**. Apart from our benchmark results (columns 1–3), we also present results for the period 1990–2001 (columns 4–6), dropping sector 23 (columns 7–9), and altering the outcome variable of interest using inverse hyperbolic sine transformation (columns 10–12).

Our examination on the role of family firms yields the following result: family firms, especially the ones with *MediumShare* and *DominantShare*, respond differently to non-family firms when there is a drop in output tariffs. Specifically, for any firm which have more than 30% ownership shares by a HUF, a 10% drop in output tariffs induces only about 0.6–1.5% drop in business investments. [39] This is about 50–80% less than the non-family

[38] https://www.businesstoday.in/opinion/interviews/family-businesses-contribute-over-70-to-india-gdp-says-farhad-forbes-of-family-business-network/story/378135.html

[39] See column (2), (8) and (11), the "*Joint effect of trade liberalization and family ownership*" in **Panel A** of **Table 3.7** for family firms.

firms in magnitude. In case of firms with *DominantShare* ($> 50\%$), the effect is even starker. Either the drop in investments are 98% less or it increases investments by 0.2–1.5% in response to drop in output tariffs (by 10%).[40] This highlights an important perspective: that ownership (family-owned firms and non-family firms) may play a crucial role in terms of their behavior (regarding business investments).[41]

Likewise the overall effect, we also check for similar effects for family firms in terms of dividing industries into low and high R&D-intensive, dependent on external finance and the upstreamness. These additional robustness checks and extensions are summarised in **Panel B1** and **B2** of **Table B2**, and **Panel B1** and **B2** of **Table B3 (Appendix B)**.

Next, we follow Karaivanov et al. (2019) and divide the family firms further into 'stand-out family' and 'family-networked' firms in **Panel B**. Specifically, a firm belongs to 'Family Network' when it is a part of a business group or network within the set of family firms. 'Stand-out Family firm' is a firm which is not a part of a business group or a private Indian firm owned by a family. The idea here is to explore the effects within the family firms e.g., a 'mom-and-pop store' vs. a firm which belongs to a business group. Our estimates show that the differential effect, which is lesser reduction in investments for family firms, is completely driven by 'family-networked' firms. Our results provide strong support to Karaivanov et al. (2019) in showing that family ownership and network play a major role in smoothing out investment levels.[42]

There could be many reasons why family firms behave differently from non-family firms in terms of their business investment behaviour. One such reason that has consistently been highlighted across the literature, such as by Bertrand and Schoar (2006), is that in contrast with other firms with short-termism and myopia of corporate managers, family-controlled firms embrace a long-term approach. In particular, family firms with links binding the current

[40] See column (3), (6), (9) and (12), the "*Joint effect of trade liberalization and family ownership*" in **Panel A** of **Table 3.7**.

[41] We have also checked our results by three different interaction terms in the same specification, our benchmark finding does not change: the higher the family share in a firm, the less is the drop in investments. We also check for differential effect, if any, for family firms in case of both short-term and other long-term investments in **Panel B** of **Table B1 (Appendix B)**.

[42] We also check for other firm characteristics, such as size, export orientation, end use and ownership (domestic and foreign). Results appear in **Table B4 (Appendix B)**.

Table 3.7 Trade Liberalization and Business Investments: Family Firms

Dependent variable:	Business Investments											
	1990-2006			1990-2001			Drop Sector 23			IHS-transformed		
	Binary	Medium	Dominant	Binary	Medium	Dominant	Binary	Medium	Dominant	Binary	Medium	Dominant
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Family Firms												
Ln(Output Tariff)$_{jt-1}$	0.123	0.221***	0.257***	0.089	0.136**	0.120**	0.148*	0.276***	0.272***	0.136	0.289***	0.291***
	(0.084)	(0.068)	(0.076)	(0.060)	(0.056)	(0.055)	(0.081)	(0.075)	(0.075)	(0.095)	(0.089)	(0.087)
Ln(Output Tariff)$_{jt-1}$×Family$_i$	0.340**	–0.121	–0.251	0.086	–0.209*	–0.253	0.288**	–0.219*	–0.423*	0.388**	–0.144	–0.313
	(0.052)	(0.165)	(0.299)	(0.076)	(0.119)	(0.233)	(0.133)	(0.129)	(0.250)	(0.157)	(0.186)	(0.354)
Joint Effect of Trade Liberalization and Family Ownership												
Family Firms	0.463***	0.100***	0.006***	0.175**	-0.073**	-0.133*	0.436***	0.057***	–0.151***	0.524***	0.145***	–0.022***
Non-Family Firms	0.123	0.221***	0.257***	0.089	0.136**	0.120**	0.148*	0.276***	0.272***	0.136	0.289***	0.291***
R-Square	0.487	0.486	0.486	0.325	0.324	0.324	0.476	0.476	0.475	0.487	0.486	0.486
N	36,855	36,855	36,855	21,386	21,386	21,386	36,353	36,353	36,353	36,878	36,878	36,878
Panel B: Family Network Firms												
Ln(Output Tariff)$_{jt-1}$	0.639***	0.023	0.156	0.311***	0.009	0.132	0.642***	0.024	0.157	0.719***	0.015	0.170
	(0.117)	(0.123)	(0.170)	(0.095)	(0.120)	(0.112)	(0.117)	(0.123)	(0.171)	(0.133)	(0.146)	(0.195)
Ln(Output Tariff)$_{jt-1}$	–0.458***	–0.426***	–0.390*	–0.244***	–0.237***	–0.123	-0.454***	–0.431***	–0.401*	–0.522***	–0.501***	–0.458*
×(Family Network)$_i$	(0.074)	(0.081)	(0.213)	(0.041)	(0.063)	(0.129)	(0.074)	(0.081)	(0.213)	(0.084)	(0.092)	(0.245)
Joint Effect of Trade Liberalization and Family Ownership												
Family Network Firms	0.181***	–0.403***	–0.234	0.067***	-0.228***	0.009	0.188***	–0.407***	–0.244	0.197***	–0.486***	–0.288
Stand-out Family Firms	0.639***	0.023	0.156	0.311***	0.009	0.132	0.642***	0.024	0.157	0.719***	0.015	0.170
R-Square	0.494	0.522	0.515	0.335	0.350	0.388	0.494	0.524	0.516	0.496	0.521	0.515
N	13,357	5,261	1,950	8,131	3,125	1,126	13,240	5,222	1,930	13,361	5,262	1,950
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) – (6) use logarithm of business investments as the outcome variable. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. 'Binary' is a binary index that takes the value 1 if the firm has positive ownership share of Hindu undivided families. 'Medium' ('Dominant') is a binary index that takes the value 1 if the firm's ownership share of Hindu undivided families is greater than 30% (50%). A firm belongs to 'Family Network' when it is a part of a business group or network within the set of family firms. 'Stand-out Family firm' is a firm which is not a part of a business group or a private Indian firm owned by a family. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

and future generations have “patient capital" (Bertrand and Schoar, 2006), which is defined as a focus on maximizing long-run returns and the desire to pursue investment opportunities that more myopic widely held firms would not. Therefore, the investment philosophy of the family and non-family firms could be very different, which may drive the differential effect. In our case of tariff rates reduction uncertainty, the stand-alone private firms may find it too risky to invest which may not be the case for family firms belonging to a business group.

This brings us to the second reason. The long-term objectives of a firm could very well drive its risk taking decisions. Studying the founding families in the S&P 500 firms, Anderson and Reeb (2003) show that families do not take risk averse decisions and they engage in opportunistic activities. On the other hand, La Porta et al. (1999) point out that families are more risk averse since they have more concentrated assets in their firms.

A theory model built by Burkart et al. (2003) sheds light on the potential explanation for the contradicting results about the risk-aversion of family firms. They argue that, whether a firm’s management strategy is driven by the maximization of firm value or expropriation for private benefit depends on the fraction of family’s shareholdings. Specifically, when the fraction of family shareholding is significant, family can reduce the expropriation to some extent, then the management strategy is aligned with the firm’s interest. On the other hand, if a family holds relatively small shareholdings, they may fail to control expropriation, hence, not pursue their utility maximization by maximizing the firm’s value. Taking this into account, family firms risk-aversion will depend on the ownership structure. In particular, firms with more significant family ownership will take more risk that will generate firm value. Our results on the different indicators of family firms, *Binary*, *Medium*, *Dominant*, suggests similar evidence – the higher the share of the family ownership in a firm, the higher the differential effect or less the drop in investments.

Third, a large literature on firm investment studies the role of financial constraints.[43] For instance, investigating the effect of financial constraints, through banking relationships, on firms’ investment and cash flow, Karaivanov et al. (2019) show that family firms are less financially constrained as they have higher number of banking relationships. This helps them

[43] Schiantarelli (1996), Hubbard (1998), and Strebulaev and Whited (2012) provide extensive reviews.

to smooth out their investment flows. Banks are thought to have a comparative advantage in collecting information on borrowing firms thereby mitigating the informational problems (Diamond, 1984). However, this also depends on the strength of the banking relationships: (i) relationship's length (Petersen and Rajan (1994); Berger and Udell (1995)); (ii) scope, that is, type and number of financial services (Degryse and Van Cayseele, 2000); (iii) bank's ownership (Elston (1996); Garcia-Marco and Ocana (1999); Fohlin (1998); and Chirinko and Elston (2006)); and (iv) the number of banks (Houston and James (2001); Fuss and Vermeulen (2006)). We explore both the risk-taking and financial constraints channel in the following sections.

3.4.1 Investigating the risk taking attitude channel

Risk attitude is one of the most important personal preferences that influences financial decisions (Kahneman and Riepe (1998); Nosić and Weber (2010); Faig and Shum (2006); Hoffmann et al. (2015)). Following this, we now investigate whether a family firm's risk taking attitude can explain the difference in the business investments responses in comparison to other firms. For such an exercise, based on the previous studies about a firm's risk taking (Anderson and Fraser (2000); Coles et al. (2006); Nguyen (2011), and others), we first measure a firm's total risk by estimating standard deviation of daily stock returns from 1990–2006.[44] We then use the total risk as a measurement for a firm's risk taking attitude. Using the volatility of stock return as a firm's risk taking measurement has several benefits. Specifically, we can control both the leverage effect and the total market risk.

Based on the distribution of the standard deviation of stock returns across the sample years, firms which have a higher standard deviation of stock returns than the median of the distribution are classified as risk takers otherwise it is classified as non-risk taker. We use the

[44]PROWESS provides information on daily stock returns of firms if a firm is listed in Bombay Stock Exchange or BSE (which is the largest stock exchange in India).

following specification to estimate the required effect:

$$\begin{aligned}\ln(\text{Business Inv})_{ijt} = {} & \alpha_i + \beta \text{Ln(Output Tariffs)}_{jt-1} + \phi \text{Ln(Output Tariffs)}_{jt-1} \times \text{Risk Taker}_i \\ & + \lambda \text{Ln(Output Tariffs)}_{jt-1} \times \text{Family}_i \\ & + \vartheta \text{Ln(Output Tariffs)}_{jt-1} \times \text{Risk Taker}_i \times \text{Family}_i \\ & + \mathbf{X}_{it-1} + \theta_{jt} + \varepsilon_{it}\end{aligned} \tag{3.6}$$

Risk Taker$_i$ is a binary variable, which takes the value 1 if a firm's standard deviation is greater than the median standard deviation of the distribution of stock prices over the years 1990–2006 and 0 otherwise. All the specifications use firm, and 3-digit (NIC 2004) industry-year fixed effects.

Similar to **Table 3.7**, we classify family firms in three ways: *Binary*, *MediumShare* and *DominantShare*. Our coefficients of interest in this case are: β, ϕ, λ and ϑ. To make it clearer, we list four groups of firms and their corresponding indicators for the effect of output tariff on their investment:

- Family firm and Risk Taker: $\beta + \phi + \lambda + \vartheta$
- Non-family firms and Risk Taker: $\beta + \phi$
- Family firms and Non-risk Taker: $\beta + \lambda$
- Non-family firms and Non-risk Taker: β

Panel A of **Table 3.8** presents the results from the estimations, while **Panel B** presents the joint effect (and its significance) of the four groups of firms.

Our main finding is as follows: family firms drop (or increase) investments the least (the most), whether it is a risk-taker or not in comparison to non-family firms. For instance, as shown in columns (2) and (3) **Panel B** of **Table 3.8**, comparing a family firm and a non-family firm who are both not risk-takers, family firm (ownership more than 30%) drops their business investments less than the non-family firm. Now, when classifying a firm as

Table 3.8 Trade Liberalization and Business Investments: Risk Taking Behaviour

Dependent variable:	Business Investments					
	Family Firm			Family Network		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Ln(Output Tariff)$_{jt-1}$	0.273	0.341**	0.350***	0.462**	0.152	0.012
	(0.215)	(0.144)	(0.122)	(0.220)	(0.176)	(0.234)
Ln(Output Tariff)$_{jt-1}$	–0.423*	–0.378*	–0.380**	0.148***	–0.001	0.068
×Risk Taker$_i$	(0.220)	(0.215)	(0.177)	(0.048)	(0.055)	(0.174)
Ln(Output Tariff)$_{jt-1}$×Family$_i$	0.190	–0.099	–0.188			
	(0.316)	(0.215)	(0.550)			
Ln(Output Tariff)$_{jt-1}$×Risk Taker$_i$	0.021	–0.101	–0.148			
×Family$_i$	(0.280)	(0.475)	(0.720)			
Ln(Output Tariff)$_{jt-1}$×Family Network$_i$				–0.423***	–0.393***	–0.219
				(0.088)	(0.095)	(0.159)
Ln(Output Tariff)$_{jt-1}$×Risk Taker$_i$				0.184*	0.155	–0.979
×Family Network$_i$				(0.105)	(0.271)	(0.836)
Panel B: Interpretations of the effects on different firm categories						
Family firm & Risk Taker	0.061***	–0.237***	–0.366***			
Non-family firm & Risk Taker	–0.150	-0.037**	-0.030**			
Family firm & Not Risk Taker	0.463***	0.242***	0.162***			
Non-family firm & Not Risk Taker	0.273	0.341**	0.350***			
Family Network & Risk Taker				0.371***	–0.087***	–1.118
Stand-out family firm & Risk Taker				0.610***	0.151	0.080
Family Network & Not Risk Taker				0.039***	–0.241***	–0.207
Stand-out family firm & Not Risk Taker				0.462**	0.152	0.012
Family Firms Indicators	Binary	Medium	Dominant	Binary	Medium	Dominant
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.499	0.502	0.499	0.510	0.543	0.555
N	21,167	21,167	21,167	12,648	4,855	1,686
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry (3-digit)*Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) – (6) use logarithm of business investments as the outcome variable. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. 'Binary' is a binary index that takes the value 1 if the firm has positive ownership share of Hindu undivided families. 'Medium' ('Dominant') is a binary index that takes the value 1 if the firm's ownership share of Hindu undivided families is greater than 30% (50%). A firm belongs to 'Family Network' when it is a part of a business group or network within the set of family firms. 'Stand-out Family firm' is a firm which is not a part of a business group or a private Indian firm owned by a family. 'Risk Taker' is a binary index denoting a firm's risk-taking behaviour. We use standard deviation of the stock prices as an indicator of the total risk taken by a firm. A firm is a 'Risk Taker' if its standard deviation of the stock prices is above the median (of the standard deviation of the stock prices). Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. All the regressions also control for all the other possible double interaction terms. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

family firm and risk taker, those firms actually increase their investments in response to rise in foreign competition. We observe the same for whether a firm belongs to a family-network or a stand-out family firm. Specifically, see columns (5) and (6), family-networked firm increases their business investments in comparison to stand-out family firms who have the same risk-taking attitude. Our results complement and support the findings of Gutiérrez and Philippon (2017) who show that rise in foreign competition in the US induces increase in investments among "leaders", defined as firms with high market to book value.

Our results also contribute to the literature on the different risk taking theories of firms. Studies have adopted two different approach on risk taking behaviour in the field of organization behaviour. One line of argument is related to threat-rigidity hypothesis. This suggests that organizations or firms will behave conservatively under adverse or unfavourable external conditions (Triana et al., 2014). On the other hand, there is prospect theory (Kahneman and Tversky, 1979) which argues that a firm will behave in a risk-taking manner when the firm is below a specific self-perceived reference point. This could mean that the family firms were operating under a reference point during the trade-restrictive regime (i.e., before the liberalization) and perceived the new regime as a new opportunity, became more flexible and more willing to try out new repertoires. In a related set of studies on firm risk, the literature argues that firms equipped with more network resources or a part of network may undertake more risk-taking behaviour (Spithoven and Teirlinck, 2015). The idea here is that firms can transfer or share risk with competent partners who are capable of dealing with specific risks. Our results on family-networked firms suggest such similar theoretical underpinnings.

3.4.2 Investigating the financial constraint channel

One of the important determinants of a firm's investment decision in an imperfect capital market is the financial constraint(s) it faces (Schiantarelli, 1996). And, this strongly depends on the banking relationships that a firm has (Karaivanov et al., 2019). Realizing that we are analyzing firm investment in a country where investment decisions are overwhelmingly dominated by banking relationships and in a period that corresponds to continuous expansion of the Indian economy, we now examine the role of ownership of banks and its interaction

with family firms to show that one of the reasons for the differential effect for the family firms is due to the type of banks they are connected to.[45]

While examining the effect of how different banking relationships can influence investment decisions of firms, one of the major issues that can affect our results is the endogeneity of firm-bank relationships. There are several reasons why a bank(s) choose a firm(s) to provide credit. For example, size of a firm, the industrial sector a firm belongs, etc. or unobservables like legacy, trust, relationship between senior management of a firm and a bank, etc. Second, firms may switch banks or establish new banking relationships. For example, they may observe that some other firms are facing less financial constraint(s) due to connection with certain type of banks while facing rise in foreign competition. Third, firms may have differential trends in terms of their banking relationships.[46]

All these, if not addressed carefully, may significantly bias our estimates. We, therefore, take the following steps: (a) to control for issues like time trends, effect of the rise in competition, any unobservables that may affect the banking relationships of a firm, and switching of the banks due to an external shock such as the one we utilize, we randomly allocate the banking relationships over the years for each firm. In other words, we match the firms with their banking relationships, but not according to the years of those relationships. (b) to control for any other firm characteristics, such as size, which may affect the banking relationships of a firm, we interact a key firm characteristic with the banking relationship dummies.[47] We use this matched dataset (of firms and banks) with random allocation of the banks for our estimation purposes.

One interesting aspect of the Indian banking system during our sample period is that the Indian banks can be categorized into three different types: state-owned, domestic private, and foreign banks. Das and Ghosh (2006) and Kaur and Srivatsav (2019), using data for

[45]We also check for other aspects of banking relationships, such as the length and the number of banks and show that it is the ownership of the banks that matter. More on this later.

[46]Another issue in this type of estimation is the problem of multiple banking relationships. An Indian manufacturing firm on average has relationship with 5 banks. This is similar to what has been observed in case of other datasets for countries like Spain, Japan, US, Peru, etc. However, this will not affect our estimates as we use our data at firm-year and not firm-bank-year level.

[47]For example, foreign banks and/or private banks that rely on international funding may lend to different types of firms in which case measuring the true impact of the shock on the investments may require accounting for firm fundamentals.

1992–2001 and 2000–2017, respectively, show that the operational mechanism of the state-owned banks in India are significantly different from other (private and foreign) banks in terms of their responses to reforms, profit maximization behaviour, and risk taking attitudes. In addition, the state-owned banks controlled about 70% of the total assets of the banking industry.

Given this as our background, we estimate an equation similar to Equation (3.6), but by replacing Risk Taker$_i$ with State-owned Bank$_i$. State-owned Bank$_i$ is a binary variable, which takes the value 1 if a firm has a relationship with a domestic state-owned bank and 0 otherwise. We use domestic private and foreign banks as the base or excluded group in our estimations. Estimates appear in **Table 3.9**. The corresponding indicators for the effect of output tariff on their investment are as follows:

- Family firms with state-owned banking relationships: $\beta + \phi + \lambda + \vartheta$
- Non-family firms with state-owned banking relationships: $\beta + \phi$
- Family firms with other banking relationships: $\beta + \lambda$
- Non-family firms with other banking relationships: β

Overall, we find the following: (a) family firms, when the ownership share is relatively large ($> 30\%$), having connection with state-owned banks drop less or even increase in business investment with the trade liberalization shock. (b) among family firms, especially "family-networked" firms when the family share in a firm is greater than 30%, irrespective of their connection to the type of banks increase their investments in response to output tariff liberalization.[48] In addition, a family-networked firm drops its investments about 7 times less than stand-out family firms. (c) the type of bank has no significant effect on investments in family-networked firms and stand-out family firms; and (d) professionally managed firms with connections to private banks drop their investments the most.[49]

[48] Khanna and Palepu (2000) analyzing the performance of affiliates of the diversified Indian business groups relative to unaffiliated firms show that performance of a firm, in terms of their Tobin's Q-ratio, increases once the group diversification exceeds a certain level.

[49] We also compare firms which are only connected to state-owned banks with the ones which are only connected to domestic private and foreign banks. The observations drop to about one-third of the total sample. But, we continue to find similar results as before.

Table 3.9 Trade Liberalization and Business Investments: Banking Relationships – Investigating the Financial Constraint Channel

Dependent variable:	Business Investments					
	Family Firm			Family Network		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Ln(Output Tariff)$_{jt-1}$	0.604**	0.616**	0.689***	0.546***	0.123	0.025
	(0.275)	(0.276)	(0.250)	(0.205)	(0.214)	(0.223)
Ln(Output Tariff)$_{jt-1}$	–0.508*	–0.359	–0.424*	–0.013	–0.004	–0.010
×State-owned Bank$_i$	(0.271)	(0.263)	(0.235)	(0.010)	(0.011)	(0.016)
Ln(Output Tariff)$_{jt-1}$×Family$_i$	0.012	0.153	–0.455			
	(0.476)	(0.399)	(0.585)			
Ln(Output Tariff)$_{jt-1}$×State-owned	0.377	–0.283	0.177			
Bank$_i$×Family$_i$	(0.491)	(0.426)	(0.674)			
Ln(Output Tariff)$_{jt-1}$×Family Network$_i$				–0.470***	–0.489***	–0.489**
				(0.092)	(0.112)	(0.234)
Ln(Output Tariff)$_{jt-1}$×State-owned				0.012	0.068	0.040
Bank$_i$×Family Network$_i$				(0.061)	(0.066)	(0.055)
Panel B: Interpretations of the effects on different firm categories						
Family firm with state-owned banks	0.485***	0.127**	–0.013**			
Non-family firm with state-owned banks	0.096*	0.257**	0.265**			
Family firm with other banks	0.616**	0.769***	0.244**			
Non-family firm with other banks	0.604**	0.616**	0.689**			
Family Network with state-owned banks				0.075***	–0.302***	–0.434
Stand-out family firm with state-owned banks				0.533***	0.119	0.015
Family Network with other banks				0.076***	–0.366***	–0.464
Stand-out family firm with other banks				0.546***	0.123	0.025
Family Firms Indicators	Binary	Medium	Dominant	Binary	Medium	Dominant
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.493	0.493	0.492	0.508	0.533	0.543
N	29,851	29,851	29,851	13,045	5,038	1,757
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry (3-digit)*Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) – (10) use logarithm of business investments. 'State-owned Bank' is a binary index that takes the value 1 if the firm has relationship with a domestic state-owned bank. There are three versions of Family firms indicators: 'Binary' is a binary index that takes the value 1 if the firm has positive ownership share of Hindu undivided families; 'Medium' ('Dominant') is a binary index that takes the value 1 if the firm's ownership share of Hindu undivided families is greater than 30% (50%). A firm belongs to 'Family Network' when it is a part of a business group or network within the set of family firms. 'Stand-out Family firm' is a firm which is not a part of a business group or a private Indian firm owned by a family. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. All the regressions also control for all the other possible double interaction terms. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Before proceeding further, we run a horse-race between the two channels, risk taking attitudes and banking relationships of firms, which explains the differential behaviour of the family firms with other firms. Results are presented in **Table B8**. We do not find any clear evidence of one channel dominating over other consistently across different specifications. Both the channels appear to be significantly explaining the differential effect for family firms.

3.4.3 Size Effect

Previous studies (Angori et al., 2017) also indicate that firm size play an important role in evaluating the effect on firm investment. Although, we control for firm size (in terms of their total assets) in all of our estimations, we now explicitly explore the heterogeneous effect of size on four different groups (based on family and non-family firms and their interactions with risk taking attitudes and banking relationships) as described above. But, we only use the *DominantShare* of HUF as the required indicator for a family firm and estimate Equation (3.6) for firms by putting them into above and below median of the size distribution.

We classify firms in above and below median based on the size of their corresponding industry. If a firm's assets is below the 50th percentile of the total assets of the corresponding industry, we classify them as below median and otherwise. The estimation results together with their interpretations of the joint effects on different firm categories appears in **Table 3.10**. The estimates show that the overall effect is extensively driven by firms above the median, which is consistent with our initial average effect examining the role of firm size. In effect, a relatively large family firm who is risk taker increases its business investments by 5.84% and the same in 1.17% for firms connected to state-owned banks in response to a 10% drop in output tariffs. This again goes back to one of the key finding of Gutiérrez and Philippon (2017) on how "leaders" react to foreign competition in terms of their investments differently.

Table 3.10 Trade Liberalization and Business Investments: Size Effect

Dependent variable:	Business Investments			
	Risk Taking & Firm Size		Banking Relationship & Firm size	
	Below Median	Above Median	Below Median	Above Median
	(1)	(2)	(3)	(4)
Panel A:				
Ln(Output Tariff)$_{jt-1}$	0.068	0.339***	–0.044	1.251***
	(0.088)	(0.128)	(0.107)	(0.422)
Ln(Output Tariff)$_{jt-1}$×Family$_i$	–0.016	–0.272	0.030	–1.015
	(0.075)	(0.498)	(0.963)	(0.751)
Ln(Output Tariff)$_{jt-1}$×Risk Taker$_i$	–0.081	–0.476***		
	(0.081)	(0.147)		
Ln(Output Tariff)$_{jt-1}$×Risk Taker$_i$	0.048	–0.175		
×Family$_i$	(0.168)	(0.764)		
Ln(Output Tariff)$_{jt-1}$×State-owned Bank$_i$			0.039	–1.026**
			(0.105)	(0.403)
Ln(Output Tariff)$_{jt-1}$×State-owned Bank$_i$			0.035	0.673
×Family$_i$			(0.949)	(0.869)
Panel B: Interpretations of the effects on different firm categories				
Family firm & Risk Taker	0.019	–0.584***		
Non-family firm & Risk Taker	–0.013	–0.137***		
Family firm & Not Risk Taker	0.052	0.067**		
Non-family firm & Not Risk Taker	0.068	0.339***		
Family firm with state-owned banks			0.060	–0.117**
Non-family firm with state-owned banks			–0.005	0.225**
Family firm with other banks			–0.014	0.236**
Non-family firm with other banks			–0.044	1.251***
Family Firms Indicators	Dominant	Dominant	Dominant	Dominant
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes
R-Square	0.468	0.504	0.443	0.505
N	5,323	15,766	8,780	20,993
Firm FE	Yes	Yes	Yes	Yes
Industry (3-digit)*Year FE	Yes	Yes	Yes	Yes

Notes: Columns (1) – (4) use logarithm of business investments. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. 'State-owned Bank' is a binary index that takes the value 1 if the firm has relationship with a domestic state-owned bank. We use only one version of family firms indicator: 'Dominant'. It is a binary index that takes the value 1 if the firm's ownership share of Hindu undivided families is greater than 50%. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. All the regressions also control for all the other possible double interaction terms. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

3.4.4 Business Investment and Firm Performance

One key question remains open. How are these findings important for understanding the impact of the investments done by the family firms in terms of their overall productivity, growth of the economy and welfare implications? To check for this, we examine how business investments, a crucial source of promoting firm productivity and growth, impact firm performance and the role of family firms in mediating such impact. Our purpose here is to understand the correlation between business investments and firm performance and whether such correlation is different for family firms or not.

To do this, we use the following estimation specification:

$$\begin{aligned} \mathrm{x}_{ijt} = \alpha_i + \lambda_1 \mathrm{Ln(Business\ investment)}_i \times \mathrm{Ln(Output\ Tariffs)}_{jt-1} \\ + \lambda_2 \mathrm{Ln(Business\ investment)}_i \times \mathrm{Ln(Output\ Tariffs)}_{jt-1} \times \mathrm{Family}_i + \mathbf{X}_{it-1} + \theta_{jt} + \varepsilon_{it} \end{aligned} \tag{3.7}$$

where x_{ijt} is an indicator for firm performance. It is either total factor productivity (TFP), or gross value-added (GVA), or sales of a firm i belonging to industry j in year t.

Business investment$_i$ denotes the level of business-related investments undertaken by firm i. We use stock of investment, which is calculated using 15% depreciation rate[50]. Family$_i$ is a binary variable (it takes a value 1 if a HUF has any share greater than 0). All the estimations use firm, and 2-digit (NIC 2004) industry-year fixed effects. We are particularly interested in coefficients λ_1 and λ_2, which will indicate the effect of drop in tariffs on firm performance via the investment channel for non-family firms and family firms, respectively.

Table 3.11 presents our coefficients of interest: λ_1 and λ_2. Columns (1), (2), and (3) use TFP, GVA, and sales as the dependent variable, respectively. Overall, the coefficient λ_2, which denotes the effect for family-owned firms, is positive and significant across most of the specifications, especially in case of TFP and output produced. Effects are similar with the other two definitions, *MediumShare* and *DominantShare*, of family firms as well. This shows that family firms may have contributed towards the overall productivity and output

[50] We also use the amount of business investment a firm i undertakes when it first enters the sample. Outcomes remain the same (results available on request).

Table 3.11 Business Investments and Firm Performance

Dependent variable:	TFP	GVA	Sales
	(1)	(2)	(3)
Ln(Business Investment Stock)$_i$×Ln(Output Tariff)$_{jt-1}$	–0.004	–0.008*	–0.006
	(0.005)	(0.004)	(0.004)
Ln(Business Investment Stock)$_i$×Ln(Output Tariff)$_{jt-1}$	0.036**	0.031*	0.020
× Family Firm$_i$	(0.018)	(0.018)	(0.015)
R-Square	0.743	0.899	0.903
N	11,492	33,121	33,151
Firm Controls$_{t-1}$	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes	Yes	Yes

Note: Columns (1), (2), and (3) use total factor productivity, gross value added, and total sales of a firm, respectively as the dependent variable. Total factor productivity is measured using Levinshon and Petrin (2003) methodology. Gross value-added is the total sales of a firm minus raw material expenditure. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. 'Family Firm' is a binary index that takes the value 1 if the firm's ownership share of a Hindu undivided family is greater than zero. 'Business Investment Stock' is estimated using 15% depreciation of investment capital. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. All the regressions also control for all the other possible double interaction terms. Numbers it the parentheses are robust standard errors clustered at 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

growth in India during the major trade liberalization episode, and business investments is one channel explaining such phenomenon. Putting it differently, this differential observation between family-owned and professional managed firms indicate that in the wake of trade reforms due to its business investment response, family firms may have reaped the gains from trade reform process when comparing with other firms.

3.5 Discussion of Results and Conclusion

How do manufacturing firms adjust their investment (financial) decisions in response to trade liberalization? We investigate the role of trade liberalization on investments done by manufacturing firms in India for the sole purpose of securing new and/or expanding their current businesses. In particular, we look at the drop in output tariffs, as a result of the Indian trade liberalization process in the 1990s and estimate firms' investments responses.

The results provide significant evidence of the effect of trade liberalization or drop in output tariffs on firms' business investment and the differential role of family ownership, their risk taking attitudes, and banking relationships. To provide further interpretations of our findings, let's start by summarizing our main findings: in response to drop in output tariffs (due to trade liberalization exercises), an average Indian manufacturing firm drops its business-related investment decision. We find that higher degree of product market competition reduces business investments by around 2.5%. This effect is robust and persistent to various specifications, potential intermediate channel checks and additional controls.

Further estimation suggests that family firms is less affected by the competition shock. In particular, on average the drop is 50–98% less for family firms when compared to non-family firms. And, we observe an increase of business investments for firms which are family-networked or part of a business group and firms above median of the size distribution. Firms' risk taking behaviour and/or their connection to state-owned banks could be the potential mechanisms explaining this differential pattern. The main contribution of our study is to show how ownership of firms provide a new perspective and evidence regarding the effect of trade liberalization on investments.

Our analysis sheds light on the growing literature estimating the impact of trade liberalization on firm level outcomes, such as productivity, employment and growth. Investment, a crucial source of productivity and growth, however, is understudied. Our findings, in the case of India, fill in the gap and provide further empirical evidence on the trade liberalization effect on firm investment response, in this case business investments, which is a crucial element for overall expansion of firms' businesses.

Second, our results also complement the literature in examining the role of pre-reform firm characteristics including productivity, ownership, etc. Utilizing an unique feature of Indian dataset, we focus on the role of family firms. Chen and Steinwender (2019) suggest evidence of heterogeneous preference of managers in family-owned and professionally managed firms, and finds productivity improvements in initially unproductive family firms in reaction to import competition shock. Our finding, consistent with the literature, also show

the heterogeneous response of family firm, in terms of their investment decisions, to trade reform.

Lastly, our analysis also contributes to the literature investigating the determinants of firm level investment. Previous theoretical and empirical studies relate the investment decision with (a) uncertainty (Bloom et al. (2007); Carruth et al. (2000); Dixit and Pindyck (1994); Leahy and Whited (1996)); (b) competition which shows the balance of the "Escape-competition effect" and "Schumpeterian effect" (Aghion et al. (2005); Akdoğu and MacKay (2008); Gutiérrez and Philippon (2017)); (c) financial constraints (Schiantarelli (1996); Gomes (2001); Karaivanov et al. (2019)); and (d) risk attitudes (Kahneman and Riepe (1998); Nosić and Weber (2010); Hoffmann et al. (2015); Ferreira et al. (2018)). Our results, in line with this strand of the literature, show that uncertainty introduced by rise in foreign or product market competition and its interaction with firm ownership, risk taking attitudes and banking relationships shape a firm's investment behaviour.

Our result complements the literature that finds heterogeneous effect of trade liberalization on firms with family ownership (Chakraborty and Raveh (2018) and Chen and Steinwender (2019)). In the case of India, family managed businesses have been making a significant contribution to GDP and have been one of the primary drivers of economy growth in both the manufacturing and services sector. Comparing with its non-family-owned peers, family firms grew faster and dominated the industry in terms of output produced, investments and financial performance.[51] Consistent with this, our findings show that with increasing product market competition, family firms remain the vanguard in the sector and promote the growth of India's economy.

Our results on family firms on their behaviour and performance provide additional evidence that family-owned firms are different than professionally managed firms. Ownership of a firm plays a vital role in terms of their responses to external shocks and this can affect their overall growth and performance. The performance of the Indian family firms is similar

[51] Articles, news and reports on family-owned firms in India and other Asian countries shows that family firms lead the growth in both the manufacturing and service sectors. For example: "*Family Businesses: The Emerging Landscape 1990-2015*"; "*Family businesses contribute over 70% to India's GDP, says Farhad Forbes of Family Business Network*"; "*India's family-owned firms making more money for investors than others*", and "*Are family firms superior performers?*" etc.

to what Sraer and Thesmar (2007) finds for French and Garicano and Steinwender (2016) and Karaivanov et al. (2019) finds for Spanish firms, which suggests that family firms play an important role towards the overall contribution to the GDP of an economy.

On the other hand, our results on the performance of family-networked firms in India differs from the performance of US conglomerates, findings in Pierce and Schott (2018) for instance. One should bear in mind that there are substantial differences in group structure in India relative to diversified firms in advanced economies. For example, unlike US conglomerates, which own a collection of lines of business, firms affiliated with Indian business groups are owned by distinct sets of shareholders. Also, unlike Japanese *keiretsu*, Indian business groups cannot own banks. The differences in our findings for India from those for the US and other economies, therefore, are not only affected by differences in institutional context, but also by differences in organizational structure. Lastly, more research is needed on the differential effect on family and non-family firms when analysing different aspects of firm performance.

Chapter 4

Cross-border M&A and the Performance of Acquirer

In the Presence of the Origin Effect and Heterogeneous Treatment

4.1 Introduction

During the last decades of globalization, foreign direct investment (FDI) has drawn a lot of attention. Cross-border mergers and acquisitions (M&A), as the major share of the transnational investment, amounted to $869 billion in 2016 (UNCTADb, 2017). Although cross-border M&A activities was driven by firms from developed countries for several decades, multinationals from developing countries and transition economies have become more important in recent years. Cross-border M&A by purchaser from developing and transition economies captured 54% of the global Cross-border M&A value in 2013 (UNCTADa, 2014), exceeding the share of developed countries' purchasers for the first time. Such phenomenon, in turn, has led to great attention in policy in both home and host economies. From a political point of view, the effects of the cross-border M&A on firms' performance, especially productivity, are of special interest.

Moreover, there is a dearth of literature(empirical) on the cross-border M&A effect on the acquiring firms. In the small literature of analyzing acquiring firms post-deal performance, previous studies examine financial and accounting performance, more specific, firm value and profitability. Also, little is known about how the effect of international M&A differs in the specific deal characteristics and target firm pre-deal performance. This paper makes an empirical attempt to fill the literature gap and investigates three research questions. Would the acquiring firm benefit from the cross-border M&A in terms of firm productivity? Would acquiring firms from developing countries experience differential effect of cross-border M&A comparing with investing firms from developed countries? How do features of the deal and target firm pre-deal performance alter the effect of Cross-border M&A on the acquirers?

4.1.1 What we do

In this approach, we compile an unique multiple country firm-level dataset that merges M&A deal data and firm financial data. The global M&A database we use is the cross-border M&A deals worth over $1 billion completed in 2009-2016 from UNCTAD cross-border M&A database. This data set includes the value, ownership purchased of the deal and the information on both the acquired and acquiring companies including firm name, industry and country. The number of countries included in the M&A data set is 48, 25 of which are developed countries and 23 are developing countries. The firm level data in the period of 2005-2017 are collected from OSIRIS and firm annual reports posted on the website, which match the companies' name, industry and country in the M&A deal data.

Using the unique panel data set, this paper contributes to the literature in three ways. First, this paper, to the best of our knowledge, is the first multi-country empirical research that estimates the effect on acquirer performance recogonizing the role of the investor's origin, which contributes to our understanding of the overall consequences of cross-border M&A. Even through this paper is mostly an empirical work, to motivate the empirical analysis and to address the potential mechanisms behind the M&A effect, we construct an analytical framework following the literature. Following Guadalupe et al. (2012), we adapt a trade model with heterogeneous firms (Melitz, 2003, Melitz and Redding, 2014). Under this

framework, we assume that all the improvement of firm performance could be transformed into the growth of the productivity. We identify the investor origin by distinguishing M&A deals with investing firms from developing and developed economics. The result shows that cross-border acquisition has a positive and significant effect on the growth of acquiring firms productivity for firms from both developing and developed countries. The size of the treatment effect, however, is different by acquirers' origin, with larger effect on developing acquirers while smaller effect on developed acquirers.

Second, this paper attempts to address the effect of the heterogeneous treatment. Different form the existing literature focusing on simple treatment effect, we estimate how varying features of a treatment alters the effect of cross-border acquisition. The varying features of M&A we analyzed are a) target firms' country origins (be it developing or developed countries), b) whether the deal is horizontal or vertical, c) whether target firms is 100% acquired or not. The result on the heterogeneous treatment indicates that the potential channels that acquirers would benefit from the deal could be extended market, lower input costs and the access to target firm's specific assets, which is consistent with the analytical framework.

Last, target firms' characteristics are also important features of the acquisition, which could generate differential cross-border M&A effect on the acquiring firms. In our unique dataset, we also have the information on target firms, which allows us to match their firm performance data, including market performance (total revenue), productivity, country and industry information. With specific performance data of the target, we show how the treatment effect depends on the target firms characteristic such as its comparative productivity level and comparative market performance level. This paper estimates acquirers' performance one and two years following the acquisition, thereby analyzing whether there is continuous post-acquisition impact on firm performance.

4.1.2 Related Literature

Comparing with the large literature of international trade, research focusing on cross-border M&A (one particular form of FDI) is still sparse and mostly limited to the analysis of M&A

between developed countries (North-North) and from developed to developing countries (North-South). Little is known about the cross-border M&A purchased by developing and transition economies (South-North and South-South). The international M&A, however, could be different with acquiring firms from different origins, for instance, the motivations, firm characteristics, country merger and acquisition policies etc., which would affect the deal effect. Chen (2011), estimating the effect of acquiring firm origin on target firm performance, finds differential effect on firms receiving developing country firm acquisition and firms that are acquired by industrialized country firms. In this paper, we investigate the M&A effect considering the country origins, which allow us to analysis those four types of deals (North-North, North-South, South-North and South-South).

Moreover, the majority of research estimating cross-border M&A effect mainly focuses on target firms. In the small literature of analyzing acquiring firms post-deal performance, most of the studies are from the view of financial and accounting performance, more specific, firm value and profitability. To the best of our knowledge, there are only two papers in the area focus on the economic performance, which provide evidence of M&A effect on acquiring firms' sales, employment and productivity (Stiebale and Trax, 2011) and innovation activity (Stiebale, 2016). Furthermore, little is known about how the effect of transnational M&A differs in the specific deal characteristics and target firm pre-deal performance. Our paper fills the literature gap and aims to identify the effect of cross-border M&A on the acquiring firms productivity, and to find out whether cross-border M&A purchased by developed countries differs from that by developing and transition economies considering heterogeneous treatment.

Before comparing the transnational M&A effect on firms from North and South Country, it is worth to take a step back and compare their motivations behind the deals. Within the FDI literature, the main motives of foreign direct investment are the access of host country market, differences of relative input costs and the access of strategic assets (Helpman et al., 2004, Dunning and Lundan, 2008, Yeaple, 2009). Cross-border M&A, as a mode of FDI, could also be market-driven, lower-costs-driven and technology-driven, which are all expected to affect the performance of the multinational firm. Considering the origin of

the acquiring firms, these from industrialized countries could follow any of the patterns, while for those from non-industrialized economies are more likely to be technology-driven in a south-north M&A, given the relatively lower productivity level and lower input costs in their home country. Investing firm from developed economies, with higher productivity level, are likely to exploit their existing assets and to increase the efficiency of the operation, or to acquire complementary firm-specific assets from foreign country (Nocke and Yeaple, 2007). Acquiring firms from emerging countries, however, are likely to be attracted by the strategic resources abroad, using international acquisition as a tool to offset their competitive disadvantage (Rui and Yip, 2008, Bertrand and Betschinger, 2012).

The channel of cross-border M&A effect on investing firms' productivity performance, therefore, could be linked to these motivations. For market-seeking multinationals, cross-border M&A might be incentives for headquarter activities such as management and innovation activities along with the expansion of foreign market (Fors and Svensson, 2002). Investing firm may benefit from the economics of scale and scope, increased market power and competitive ability accompanied with the increased market size. In the case of lower-cost-driven acquirers, cross-border M&A provides access to relative lower input costs, hence it becomes cheaper to boost one's productivity. For technology-driven M&A, different from greenfield investments, multinationals can get access to the stock of foreign knowledge in terms of specific assets such as technology and brand name (Nocke and Yeaple, 2007), which therefore would improve firm productivity with potential technology transfer from the target firm or complementary firm strategic assets (Nocke and Yeaple, 2007).

As discussed above, acquiring firms from North and South countries are different in terms of their motivations, while the differential motivations lead to different patterns of cross-border M&A effect. For the case of cross-border M&A purchased by emerging economies, Buckley et al. (2014) indicate that the benefit for involving firms might be from the complementarity between the strong tangible assets (because of various home country specific advantages) of the acquirers and the intangible assets of the target firms (such as organizational, technology-incentive resources). However, apart from the benefit of international M&A, acquiring firms also face challenges, for instance, management challenge

with reallocation of resources and activities, culture distance between home and foreign country (Li et al., 2016), the difference of the institutional and governmental environment in the new economy, especially for acquiring and target firms that are from countries at different levels of development. Here, in this paper, considering the motivations behind different types of M&A deals, we take into account the deal features and target firms' pre-deal performance to provide insights for the potential channels of the effect.

We also contribute to the relatively small number of empirical studies analysing the effect of cross-border M&A on the acquiring firms. Exiting studies without recognizing the origins of investing and target firms show mixed results. Estimating the effects of cross-border M&A on acquirers'performance, Stiebale and Trax (2011) provide evidence that the acquisition is associated with the boost of sales, investment in home country and improvement in domestic productivity for the case of acquirers in the UK and France (North-North). The later research, Stiebale (2016) finds that cross-border M&A is followed by a considerable increase in innovation activities of the merged entity, which is mainly driven by inventors in acquirer's home country, also focusing on the case of North-north M&A. From the financial point of view, the existing literature on acquiring firms' post-acquisition operating performance provides inconclusive result. Some find possible effect for North-south pattern M&A (Chari et al., 2010) and for acquisitions by Chinese firm (Li et al., 2016), while some find deterioration or no gains (Aw and Chatterjee, 2004, Bertrand and Betschinger, 2012, Rao-Nicholson et al., 2016). Note that, Li et al. (2016) shows that although cross-border acquisitions do create value for the acquiring firms' shareholders, the extent of value creation depends on the culture distance between home and host country and also investing firms' learning and absorptive capability.

Comparing with literature on acquirer's post-acquisition performance, there are numerous economic studies on the target's post-acquisition performance, which can also provide some implications for the analysis of investing firms. Most of the research in the literature suggest that firms with foreign ownerships generally outperform domestic firms. The empirical issue, however, is whether the out-performance is due to the treatment effect of acquisition (also referred to as "Pushy Parents") or because of the "Cherry Picking"of targets (Arnold and

Javorcik, 2009). We believe such empirical issue, also exist in the estimation of cross-border M&A effect on the acquiring firm.

Specifically, on one hand, similar to “Cherry Picking”of targets, acquiring firms are expected to be more productive and with superior performance than their peers, as cross-border M&A involves larger fixed costs and barriers between countries (Helpman et al., 2004, Yeaple, 2009, Antràs and Yeaple, 2014, Grossman et al., 2006). Consequently, the post-deal out-performance of the investing firm may simply be a result of its superior pre-acquisition performance. On the other hand, previous studies on target firm provide evidence that multinationals intend to acquire the most productive targets (Arnold and Javorcik, 2009, Chen, 2011, Stiebale, 2016, Blonigen and Pierce, 2016). The acquiring firms, therefore, could benefit from the superior technology and organizational practices transferred from the target firms, which is similar to the “Pushy Parents" in the target firms studies. Moreover, the multinationals can also get access to new foreign market, lower innovation costs such as lower capital costs, which thereby amplify the benefits from innovation.

Because of the limited number of studies on the acquiring firm post-deal performance and the similar empirical challenge on estimating the causal effect of cross-border M&A on target firms performance, we review the empirical studies estimating treatment effect on all the involving firms regardless of acquiring or target to address the empirical issues. Most research use propensity score matching and difference-in-difference approach to disentangle correlation and causality, where they find mixed effect of international M&A on targets firms. Some finding positive effect (Arnold and Javorcik, 2009, Chen, 2011, Oberhofer, 2013, Girma et al., 2015), while some show negative or no effect (Benfratello and Sembenelli, 2006, Blonigen and Pierce, 2016).

Particularly, after controlling for the endogeneity of acquisition, Benfratello and Sembenelli (2006) suggests that foreign ownership has no effect on Italian target firm’s productivity. However, their result shows the important role of the investor origin and indicates that technology transfer would only occur if the technology gap is sufficiently pronounced. A latter study, Chen (2011), also recognizes the effect of investor’s origin and finds that M&A purchased by both industrial and developing countries leads to an increase in labour

productivity and profit, but finds lower gains for those from developing countries. The effect on target firm's employment and revenue, however, shows contrary result for developing and developed investors. Our paper complements this literature by showing that investor's origin also plays an important role in the cross-border M&A effect on acquiring firms.

The rest of the paper is organized as follows. In **section 4.2**, we set up the theoretical model illustrating the potential relationship between firm productivity change and acquisition to frame the empirical analysis. Then, we show the data sources and description, and explain the empirical strategy used in this paper addressing the selection issue in **section 4.3**. Then, we present the empirical result using different method for homogeneous treatment in **Section 4.4** and discuss how varying treatment features alter the effect in **Section 4.5**. **Section 4.6** provides the robustness checks and we conclude with suggestions for future research in **Section 4.7**.

4.2 Analytical Framework

Although this paper is an empirical one, we construct a theoretical model to motivate our following empirical estimation. Closely related to the model in Guadalupe et al. (2012) and Girma et al. (2015), we consider a heterogeneous firm model (Melitz, 2003, Melitz and Redding, 2014) with Constant Elasticity of Substitution (CES) utility. Under monopolistic competition market, the price set by each company from the first-order condition for profit maximization is a constant mark-up over marginal cost:

$$p(\varphi) = \frac{\sigma}{\sigma - 1}\frac{1}{\varphi}, \sigma > 1 \tag{4.1}$$

Where σ is the constant elasticity; φ is the initial productivity of firm i.

The equilibrium firm profits, therefore, with an index of market demand A_i, is:

$$\pi_i = A_i p(\varphi_i)^{1-\sigma} = B_i \varphi_i^{\sigma-1}, \tag{4.2}$$

$$B_i = \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}} A_i \tag{4.3}$$

For the sake of simplification, we use B_i as a measure of the market size of firm i. Under this structure, the profit for each firm depends on the market size B_i and firm productivity φ_i.

Suppose each firm choose a level of productivity-increasing investment to achieve the productivity increase by γ_i, where $\gamma_i > 1$, then the post-investment productivity would be $\varphi_i\gamma_i$ (Guadalupe et al., 2012). Hence, the above equilibrium firm profit would be:

$$\pi_i = B_i(\varphi_i\gamma_i)^{\sigma-1} \tag{4.4}$$

The value V_i of each firm, therefore, is the profit π_i less the total additional cost of the productivity-enhancing investment $C_i(\gamma_i^{\sigma-1})$:

$$V_i = B_i(\varphi_i\gamma_i)^{\sigma-1} - C_i(\gamma_i^{\sigma-1}) \tag{4.5}$$

To simplify, we denote that $\Phi_i = \varphi_i^{\sigma-1}$, $\Gamma_i = \gamma_i^{\sigma-1}$, which represent the transformed measurement of initial productivity level and change on the productivity level following the investment, respectively.

Additionally, in our framework, some firms engage in cross-border M&A, while other firms do not. For firms that do not engage in M&A deals, we assume the total additional cost of such productivity-improving investment is equal to a fixed cost and a variable component that is directly related to the productivity improvement:

$$C_i(\Gamma_i) = a_i + b_i f(\Gamma_i) \tag{4.6}$$

Where $f(\Gamma_i)$ a general positive function of Γ_i with $f'(\Gamma_i) > 0$, without specific functional form.

On the other hand, for firms that engage in cross-border M&A, different from Guadalupe et al. (2012), in **Equation 4.6**, we allow a partial technology transfer from target firm to the acquiring firm. More specifically, for investing firm in a cross-border M&A deal, we

introduce term $\alpha_i\Phi_j$, $(0 < \alpha_i < 1)$, indicating technology spillover. α_i is the absorptive capacity of the investing firm i, and Φ_j is the productivity level of the target firm j. Assume that Φ_j is large enough so that $\alpha_i\Phi_j > 1$. We assume that introducing technology spillover between the target and acquiring firm, for acquiring firms, **Equation 4.6** become:

$$C_i^A(\Gamma_i^A) = a_i^A + \frac{b_i^A f(\Gamma_i^A)}{\alpha_i\Phi_j} \tag{4.7}$$

The cost of the technology-increasing investment for the cross-border M&A acquiring firms is inversely related to firm absorptive capacity and the target's initial productivity level. As a result, the technology transfer between firms is considered as a productivity-enhancing investment in the form of reduced investment cost. By doing so, it allows us to add the unobserved technology spillover into the heterogeneous firm model, which motivates the empirical analysis of potential technology transfer in the later section.

Back to firm value in **Equation 4.5**, for domestic firms and acquiring firms involved in international M&A deals, firm value equations are:

$$V_i = B_i\Gamma_i\Phi_i - a_i - b_i f(\Gamma_i) \tag{4.8}$$

$$V_i^A = B_i^A\Gamma_i^A\Phi_i - a_i^A - \frac{b_i^A f(\Gamma_i^A)}{\alpha_i\Phi_j} \tag{4.9}$$

, respectively. For each firm, to maximize firm value, we take the first derivative $\frac{dV_i}{d\Gamma_i}$ and set it to zero, thereby, get the optimal post-investment productivity improvement level $\Gamma_i^\star$, which satisfies the first order conditions:

$$f'(\Gamma_i^\star) = \frac{B_i\Phi_i}{b_i} \tag{4.10}$$

$$f'(\Gamma_i^{\star A}) = \frac{B_i^A\Phi_i\alpha_i\Phi_j}{b_i^A} \tag{4.11}$$

for domestic firm and acquiring firm, respectively.

Equation 4.10 indicates that for domestic firms, the optimal change in the productivity level following the productivity-enhancing investment is increasing in the initial productivity level and the market size, and decreasing in the cost of the technology investment. Different from Guadalupe et al. (2012) , as in **Equation 4.11** for investing firms in international M&A deal, the optimal change of the productivity level is also increasing in firm absorptive capacity and initial productivity level of the acquired firm in the M&A deal.

As a result, the productivity change after the cross-border M&A deal is associated with three factors: a) the change of the market size, b) cost of the technology investment, c) initial productivity level and technology transfer from the target. Correspondingly, these three factors indicate three potential mechanisms of M&A effect on firm productivity performance comparing with the domestic firms:

- The increase of the market size after the deal. We anticipate that following the cross-border M&A, investing firms would have access to a relatively larger market comparing with the domestic firms. The increase in the market size, $(B_i^A > B_i)$, is positively related to the growth of firm productivity level.

- Lower investment cost. Following the merger and acquisition, acquiring firm may be benefit from the relatively lower cost in the foreign country. Such lower investment cost comparing with domestic firms, $(b_i^A < b_i)$, would also increase firm productivity growth.

- Potential technology spillover. We showed that the growth of firm productivity is also positively related to the technology spillover from the deal, increasing in the initial productivity level of the target firm and acquiring firm's self absorptive capacity.

The expected optimal productivity improvement $\Gamma^{\star A}$ for cross-border investing firm, therefore, is bigger than that $\Gamma^{\star}$ for domestic firm, $\Gamma^{\star A} - \Gamma^{\star} > 0$. Productivity grows more quickly following an international M&A.

From **Equation 4.8 and 4.9**, the change in the optimal firm value for acquirer after the cross-border M&A can be written in the following equation:

$$V_i^A - V_i = (B_i^A \Gamma_i^{\star A} - B_i \Gamma_i^{\star})\Phi_i - (a_i^A - a_i) - (\frac{b_i^A f(\Gamma_i^{\star A})}{\alpha_i \Phi_j} - b_i f(\Gamma_i^{\star})) \tag{4.12}$$

As suggested in **Equation 4.12**, the post-acquisition value gains are also from three components following the optimal productivity improvement: market size change, costs change and technology spillover. Firstly, $B_i^A \Gamma_i^{\star A} - B_i \Gamma_i^{\star}$ is expected to be greater than zero. The M&A effect via market channel, furthermore, is also increasing in firm initial technology Φ_i. Secondly, the cost mechanism including the direct fixed cost change, $a_i^A - a_i$, and difference between variable components of the cost before and after M&A because of $(b_i^A < b_i)$, also generate gains in the firm value. The technology transfer, in the form of variable components of the cost, $(\frac{b_i^A f(\Gamma_i^{\star A})}{\alpha_i \Phi_j} - b_i f(\Gamma_i^{\star}))$, also suggests an increase of the firm value.

4.3 Data and Empirical Strategy

The analytical framework in the last section indicates that cross-border M&A encourages a larger technology-enhancing investment, which leads to an increase of firm technology growth comparing with that before the deal. It also suggests three potential channels driving the M&A effect. The interests of this paper are to ask whether there is evidence that participating in cross-border M&A will improve the subsequent technology performance of the firm, and to test how varying features of the treatment associated with the potential channels alter the effect of the international M&A deals. In this section, we talk about the data sources and discuss the empirical strategy used in this paper.

4.3.1 Data Description

The empirical estimations are based on our unique firm-level data set that merges M&A data and firm financial data. The global M&A database we use is the cross-border M&A deals worth over $1 billion completed in 2009-2016 from UNCTAD cross-border M&A database.

This dataset includes the value, ownership purchased of the deal and the information on both the acquired and acquiring companies including firm name, industry and country. Instead of focusing on one single country, this M&A database contains acquiring and target firms from different country origins, which includes 702 deals in total where 568 acquiring firms are from developed countries and 134 investing firms are from developing countries, allowing us to compare the treatment effect of different M&A types. Moreover, for target firms' origin, among all the deals, there are 151 targets from developing countries and 550 targets from developed countries.

The firm level data in the period of 2005-2017 are collected from OSIRIS database published by Bureau van Dijk, and firm annual reports posted on the website matching the companies' name, industry and country in our M&A dataset. The variables we include in the dataset are operating revenue, EBITDA, number of employees, total assets, tangible assets, intangible assets, labour cost, working capital ratio, number of ultimate owned foreign subsidiaries, year of operation. Using these variables we got from OSIRIS and financial report, we construct the value added and intermediate inputs for each firm to calculate TFP using Wooldridge (2009).[1]

We also merge the country and industry data from World Bank and OECD STAN Industrial Analysis with our firm dataset for control variables. It is worth noting that the UNCTAD cross-border M&A database does not include all the international M&A deals completed in the world during 2009-2016. Hence, to construct the control group for the estimation, firms that have ever been involved in any merger or acquisition (both domestic and international) during 2009-2016 are exclude from the control group. Additionally, due to the large number of missing observations, our full sample have some treated firms and control firms for which not all the necessary variables are observed. We also exclude such firms from our analysis, thus the number of observations reduced to 19945 for control group and 702 for treated group.

Table C1 briefly summarizes the definitions of the main variables included in the final database, while **Table 4.1** presents the descriptive statistics for the full sample, control group

[1] We discuss the method estimating TFP in **Section 4.3.2**.

Table 4.1 Descriptive Statistics

Variables	Full sample		Acquiring firms		Non-acquiring firms	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Outcome variable						
TFP growth rate	-0.0038	1.315	0.0131	0.127	-0.0045	1.341
Pre-acquisition variables						
TFP	6.3667	1.798	7.4791	1.739	6.3276	1.788
Log revenue	14.6810	1.734	16.098	1.716	14.6311	1.714
Log value added	13.2971	1.993	15.107	1.619	13.2334	1.975
Foreign subsidiaries	0.4668	0.499	0.6054	0.489	0.4619	0.499
Government owned	0.0405	0.197	0.1083	0.311	0.0381	0.191
Developed country firm	0.7684	0.422	0.8091	0.393	0.7670	0.423
Log employee number	8.6792	1.832	9.9345	1.820	8.6350	1.817
Log age	3.5577	0.922	3.4540	0.984	3.5613	0.919
$(Logage)^2$	13.5060	6.174	12.8693	6.697	13.5275	6.153
ROA	1.0293	0.829	0.7051	0.515	1.0407	0.835
Tangible asset ratio	0.3043	0.209	0.2848	0.223	0.3050	0.208
Intangible asset ratio	0.1187	0.175	0.2274	0.216	0.1149	0.173
Working Capital	0.1365	0.187	0.1029	0.156	0.1376	0.188
No. of obs	20647		702		19945	

and treated group separately. As shown in the table, based on the descriptive statistics, acquiring firms as treated groups are different in many characteristics comparing with domestic firms as control group. Specifically, investing firms, on average, have higher and positive annual productivity growth rate after the acquisition comparing with the control firms. Furthermore, for pre-acquisition performance, treated firms, on average, capture higher TFP level, better market performance in terms of log revenue and firm size with more employees, have more foreign investment experience in comparison to the non-acquired firms. However, it also shows that acquiring firms are younger, with lower working capital ratios, ROA and tangible assets but higher intangible intensity.

To sum up, the pre-deal out-performance of the acquiring firms in respect of productivity and market performance, supports the literature. Further estimation, controlling for firm characteristics with regard of pre-acquisition performance, is important for analyzing the causal effect of cross-border M&A on firm productivity growth.

4.3.2 Treatment Effect

First, we examine productivity growth rates over one and two years for acquiring and non-acquiring firms. Empirically, following Bernard and Jensen (1999) and let y_{it+n} denotes the productivity of firm i in period $t+n$, the regression equation is specified as:

$$\Delta y_{it+n} = \frac{1}{n}(lny_{it+n} - lny_{it}) = \alpha + \beta_1 MA_{it} + \delta y_{it-1} + X'_{it-1}\lambda + \varepsilon_{it} \tag{4.13}$$

where, n=1,2. Here, MA_{it} is the dummy variable which takes the value as 1 if firm i is involved in the international M&A deal at year t. y_{it-1} is the initial productivity level, and X_{it-1} is a vector of control variables for firm i at year $t-1$. An *iid* error term ε_{it}, is also included in the estimation. The vector of lagged control variables, X_{it-1}, includes the firm-specific (e.g. log firm sales, log firm age, log firm age square, ROA, firm tangible resources ratio, intangible resources ratio, log number of employees, working capital ratio), industry-specific and country-specific control variables.

Since firm productivity is the key outcome variable of interest and the main control for the systematic selection into merger and acquisition activity (Helpman et al., 2004, Yeaple, 2009), as shown in **Equation 4.13**, it is important to measure the firm level productivity. In the literature, some researchers use log of sales divided by number of employees, a proxy of labour productivity (Chen, 2011), while some use total factor productivity (TFP) (Arnold and Javorcik, 2009, Stiebale and Trax, 2011, Blonigen and Pierce, 2016, Stiebale and Vencappa, 2016). In this approach, we measure TFP using an estimation method suggested by Wooldridge (2009). This is based on Levinsohn and Petrin (2003b) method using intermediate inputs as proxy variable addressing the simultaneity problem, and also deal with potential problem highlighted by Ackerberg et al. (2006) with the application of a generalized method of moments (GMM) framework.

In the Cobb-Douglas case, using value added as dependent variables of the production function, the estimated TFP is constructed using the following equation:

$$TFP_{it} = va_{it} - l_{it}\hat{\beta}^W - k_{it}\hat{\gamma}^W \tag{4.14}$$

where va_{it} is the natural logarithm of the firm's value added, l_{it} is log free variable, labour, and k_{it} is the log state variable, capital. Specifically, labour is the number of employees hired in the firm for production and the capital variable is the tangible assets. The estimated parameters, $\hat{\beta}^W$ and $\hat{\gamma}^W$ are identified using Wooldridge (2009) production function estimation technique. Such parameters, moreover, are estimated by industry since firms in different industries may have different production functions.

The effect of M&A suggested in **Equation 4.13**, however, is not causal because of the non-random selection of MA_{it-n}. The growing literature, attempting to identify the causal effect of international M&A deals on the performance of either acquiring or target firms, faces the selection issue. As mentioned before, the acquirer and targets are not randomly selected to the M&A deal, and the acquirers are most likely to be more productive comparing with their peers (Helpman et al., 2004, Yeaple, 2009, Antràs and Yeaple, 2014). The selection of the targets to M&A deal, moreover, could be due to "Cherry Picking", in which case the targets are outperforming in the host country (Arnold and Javorcik, 2009, Chen, 2011, Stiebale, 2016, Blonigen and Pierce, 2016). In the literature, researchers use a few methods to establish the causal effect. The majority of the studies use propensity score matching approach (Arnold and Javorcik, 2009, Guadalupe et al., 2012). Other studies like Stiebale (2016) using Dynamic count data model and Oberhofer (2013) using Full information maximum likelihood, also attempt to estimate the causal effect.

Following the literature, to capture the causal effect of cross-border M&A, we use the matching technique to address the selection issue but with three different methods, namly Propensity Score Weighting (PSW) (Hirano et al., 2003), Propensity Score Matching (PSM) (Rosenbaum and Rubin, 1985, Leuven and Sianesi, 2018) and Multivariate Distance Matching (MDM) (Ben, 2017). The first two methods involve the estimation of the propensity score. PSW uses the propensity score as weight for treated and control group, while PSM uses the differences in propensity score between treated and control to find the match pairs.

In the context of our study, the propensity score is computed from a probit regression of a dummy variable indicating whether or not the firm is selected to the M&A deal as acquirer

using pre-deal firm characteristics.

$$ps = Pr(MA_i = 1|Z) = \Phi(Z_i'\theta), \tag{4.15}$$

$$MA_i^* = Z_i'\theta + \mu, \tag{4.16}$$

$$MA_i = 1, \text{if } MA_i^* > 0 \tag{4.17}$$

Z_i denotes the pre-deal firm characteristics that affect the probability a firm is selected to the deal, including pre-deal firm productivity, log firm sales, log firm age, log firm age square, ROA, firm tangible resources ratio, intangible resources ratio, log number of employees, working capital ratio, number of ultimate owned subsidiaries. The propensity score, therefore, is the estimated probability of a firm being involved in cross-border M&A, $\hat{ps}$.

Using PSW, such predicted propensity score, then, is transformed into weights in the previous regression aiming to re-weight treated and control firms to make them representative of the population of interest. The use of different types of weights, however, depends on whether Average Treatment Effect (ATE) or Average Treatment Effect on Treated (ATT) is estimated. [2] For PSM method, we use kernel matching with automatic bandwidth selection using cross validation with respect to the outcome variable (Frölich, 2005). MDM, however is an alternative to match based on a distance matrix that measures the proximity between observations in the multivariate space of Z, instead of the difference in the propensity score. In our approach, we use:

$$MD(Z_i, Z_j) = \sqrt{(Z_i - Z_j)'\Sigma^{-1}(Z_i - Z_j)} \tag{4.18}$$

[2] For ATE estimation, the weights are defined as:

$$w(MA_i, Z_i) = \frac{MA_i}{\hat{ps}(Z_i)} + \frac{1 - MA_i}{1 - \hat{ps}(Z_i)}$$

For ATT estimation, the weights are defined as:

$$w(MA_i, Z_i) = MA_i + (1 - MA_i)\frac{\hat{ps}(Z_i)}{1 - \hat{ps}(Z_i)}$$

as distance metric. By using three different methods, we attempt to get results which are robust to the use of alternative methods.

4.3.3 Multiple Treatment

Another empirical strategy of this paper aims to identify the heterogeneity of the treatment and how the effect varies in the characteristics of the deal and target firm. As suggested in the analytical framework in previous section, international M&A may lead to expanded market size ($B_i^A > B_i$), potential technology transfer or complementary assets $\alpha_i \Phi_j$ and lower cost, namely market channel, technology transfer channel and cost channel. With the interpretation from the theoretical framework and availability of the data, we construct multiple treatment variables T in terms of target firm pre-deal market and productivity performance addressing the two mechanisms empirically.

Moreover, we also look into deal specific factors that may be associated with merger and acquisition effect, such as the deal type, the ownership purchased after the deal, the origin and status of acquirers and targets. We introduce a few other multiple treatment variables in terms of those deal factors, shedding light on the effect of heterogeneous treatments. With multiple treatment, we use PSW with multinomial logit estimating the propensity score. As using multiple treatment matching, we can estimate a number of parameters simultaneously.

4.4 Estimation Result

4.4.1 Propensity Score Estimation

As indicated in the descriptive statistics, acquiring firms are typically different from domestic firms and on average outperform them in several variables. To identify the causal effect of cross-border M&A on the growth of productivity, matching technique is applied for further estimation. As described in **Section 4.3.2**, first, we need to estimate predicted propensity score using probit regression. We estimate **Equation 4.15** for the full sample with a binary outcome indicating whether a firm is involved in the international M&A deal as acquiring

Table 4.2 Probit Regression – Dependent variable: MA_{t+1}

MA_{t+1}	Full Sample	Developed Countries	Developing Countries
TFP	.0011	.0021**	.0004
	(.013)	(.015)	(.028)
Log Revenue	.0134***	.0143***	.0103***
	(.023)	(.027)	(.050)
Foreign Subsidiaries	.0039	.0032	.0067
	(.041)	(.047)	(.104)
Government Owned	.0202***	.0132	.0162**
	(.075)	(.128)	(.113)
Log Age	-.0053	-.0109	.0159
	(.096)	(.108)	(.283)
$LogAge^2$	-.0001	.0010	-.0032*
	(.014)	(.016)	(.048)
ROA	-.0194***	-.0206***	-.0110**
	(.041)	(.048)	(.082)
Tangible Asset Ratio	.0021	.0002	.0002
	(.114)	(.132)	(.246)
Intangible Asset Ratio	.0474***	.0452***	.0374*
	(.118)	(.132)	(.347)
Log Employee Number	-.0020	-.0030*	-.0009
	(.021)	(.025)	(.043)
Working Capital	.0220**	.0165	.0196
	(.139)	(.163)	(.274)
No. of obs	20647	15866	4781
No. of M&A	702	568	134
Chi^2	724.08	641.89	134.92
Prob >Chi^2	0.0000	0.0000	.0000
Pseudo R^2	0.1182	0.1310	0.1104

Table reports Probit marginal effect followed by standard errors in parentheses

*, **, *** indicate statistical significance at 10, 5 and 1 % levels, respectively

firm, MA_{t+1} [3], and with observable pre-deal characteristics (a year before acquisition) as independent variables. The predicted probability for a firm to invest abroad is constructed as propensity score. We run the estimations for the full sample, firms from developing countries and firm from developed countries separately, which helps us to capture the origin effect.

As documented in **Table 4.2**, the result using all the observations, firms from developing and developed countries shows some similarities and differences. Firstly, the estimating result for full sample indicates that a larger total sales or revenue makes engaging in a cross-border M&A more likely. Same positive coefficients for operating revenue are also found for both developed and developing countries' firms. However, the returns conditional on the total assets are negatively related to the possibility of investing abroad, as suggested by the significant negative ROA coefficient. Considering these two coefficients together, acquiring firms seems to have better market performance in terms of turnover and larger firm size in terms of total assets, but not necessarily to have better returns on assets. Additionally, in line with previous empirical studies (Stiebale and Trax, 2011), we find large significant positive coefficient for intangible assets, which indicate that acquiring firms are likely to have higher innovation potentials and larger strategic assets, supporting the idea of exploring existing assets as motivation for international investment (Nocke and Yeaple, 2007).

Despite of the similarities of result for these three groups, we do find some varying results. The significant and positive coefficient of government ownership and non-significant coefficient of TFP for developing countries suggest that firms from developing countries with government support are more likely to invest abroad. Such result supports the idea of using cross-border acquisitions as a tool for emerging country firms to get access to the foreign strategic assets and leverage their unique ownership advantages with institutional incentives (Rui and Yip, 2008, Bertrand and Betschinger, 2012). The positive association between a firms' productivity and its cross-border M&A propensity is in line with the theoretical prediction and empirical result in the literature (Antràs and Yeaple, 2014, Helpman et al., 2004, Yeaple, 2009, Grossman et al., 2006). International acquirers from industrialized countries, seems to have higher productivity level comparing with the domestic firms, which

[3] We use whether firms invest abroad at $t+1$ as dependent variable. All the independent variables are at time t to addressing the pre-acquisition characteristics.

Table 4.3 Balancing Test for PSM

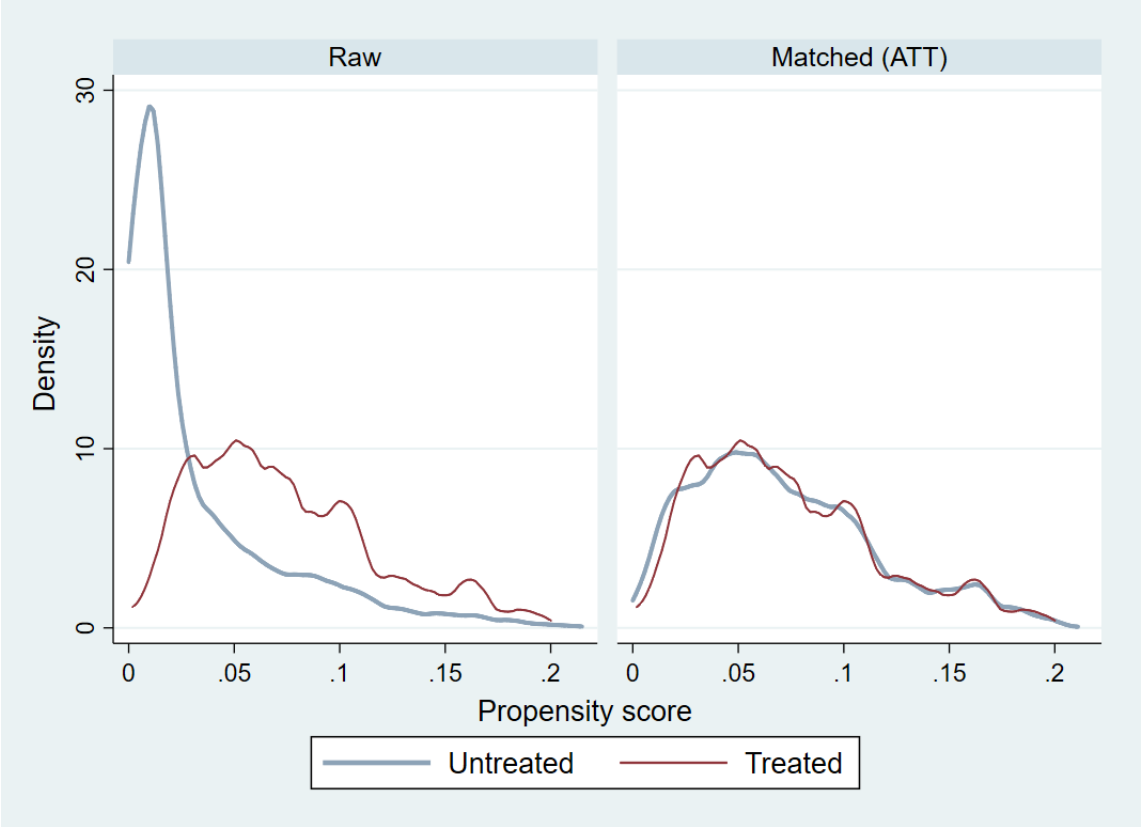
Variables	Sample	Mean			Variances		
		Treated	Control	StdDif	Treated	Control	Ratio
TFP	Raw	7.469	6.402	.605	3.043	3.173	.959
	Matched	7.469	7.425	**.025**	3.043	2.982	**1.020**
Log Revenue	Raw	16.117	14.707	.813	2.957	3.057	.967
	Matched	16.117	16.066	**.029**	2.957	2.960	**.999**
Foreign Subsidiaries	Raw	.598	.481	.236	.241	.250	.965
	Matched	.598	.592	**.012**	.241	.242	**.995**
Government Owned	Raw	.117	.042	.278	.103	.040	2.559
	Matched	.117	.103	**.050**	.103	.093	**1.114**
Log Age	Raw	3.455	3.568	-.116	1.009	.872	1.156
	Matched	3.455	3.446	**.010**	1.009	1.051	**.960**
$LogAge^2$	Raw	12.947	13.603	-.100	46.593	38.830	1.200
	Matched	12.947	12.923	**.004**	46.593	46.214	**1.008**
ROA	Raw	.703	1.041	-.501	.261	.652	.400
	Matched	.703	.699	**.006**	.261	.196	**1.333**
Tangible Asset Ratio	Raw	.290	.306	-.075	.051	.043	1.186
	Matched	.290	.297	**-.033**	.051	.048	**1.058**
Intangible Asset Ratio	Raw	.221	.117	.533	.046	.030	1.546
	Matched	.221	.216	**.026**	.046	.046	**1.011**
Log Employee Number	Raw	9.934	8.685	.681	3.368	3.361	1.002
	Matched	9.934	9.909	**.013**	3.368	3.276	**1.028**
Working Capital	Raw	.099	.135	-.214	.023	.034	.673
	Matched	.099	.098	**.004**	.023	.025	**.920**

Note: This table shows the balance test for PSM (Propensity Score Matching) for the list of the variables of interest. Specifically, for each variable, we report the standardised mean difference of the treated and control groups before and after the matching technique. We also report the variance ratio of the treated and control groups before and after the matching.

indicates that firm heterogeneity in terms of productivity is positively correlated with foreign market entry. Working capital, which reflects firms' liquidity and ability of raising funds for M&A, is found to be positively related to the cross-border M&A propensity. The coefficient, however, loses its significance when estimating separately for developing and developed countries.

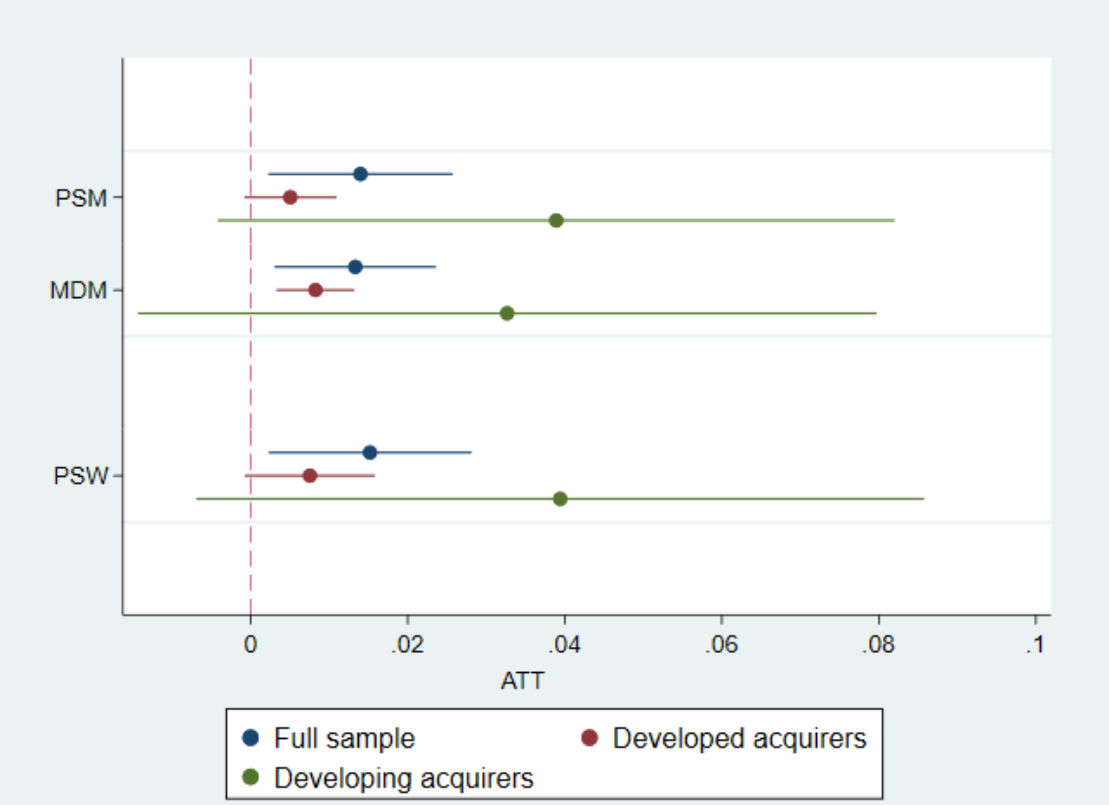
In comparison with experimental data, for observational data, the treatment assignment is dependent of the covariates which also affect the outcome of interest as shown in **Table 4.1**. Matching technique is used in this approach to balance the covariates. Hence, to check

Fig. 4.1 Propensity Score Density



whether our model is well specified, we assess how well the PSW, PSM and MDM do at balancing the conditional variables. Here, we show the balancing test for PSM in **Table 4.3**. The balancing test results for MDM and PSW are included in the Appendix as **Table C2** and **Table C3**. The standardized mean difference are all close to zero after matching and most of the variance ratios are close to one. As indicated in **Table 4.3**, the matching procedure reduces a substantial amount of differences between treated and control group in the observed covariates. To make the matching procedure clearer, we also construct the density of propensity score of treated and untreated group before and after the matching in **Figure 4.1**. The shape of the propensity score distribution of both treated and untreated groups show that after matching the difference in the propensity score is reduced significantly.

Fig. 4.2 ATT (T+1) of Cross-border M&A



Note: The lines indicate the 95% confidence interval of the estimates. The X-axis is the estimated ATT, while the Y-axis represents the methods used to estimate the ATT.

4.4.2 Treatment Effect

Results from the three matching methods, PSW PSM and MDM for the treatment effect of cross-border M&A on the acquiring firms are documented in **Table 4.4** and **Figure 4.2**. For PSM, we adopt kernel matching with automatic bandwidth selection using cross validation with respect to the outcome variables as indicated in Frölich (2005). Additionally, we use Mahalanobis distance metrics with Nearest-Neighbour matching for MDM. To address the origin effect of the acquiring firms, we estimate the treatment effect on the treated for firms from industrialized and emerging countries separately. The outcome variables of interest are the one or two years annual productivity growth.

The effect of cross-border M&A on the investing firms' growth of productivity one year after the acquisition is quite robust across the three groups regardless of the method used.

Table 4.4 ATT of Cross-border M&A on the Acquirer's Growth of Productivity

	ATT(T+1)	Matched Pairs	No. of Obs	ATT(T+2)	Matched Pairs	No. of Obs
Full Sample						
PSW	.0152**		16492	.0040		14433
	(.0066)			(.0030)		
PSM	.0140**	634	16492	.0030	521	14433
	(.0068)			(.0023)		
MDM	.0133***	634	16492	.0042***	521	14433
	(.0052)			(.0030)		
Developed Firms						
PSW	.0075*		13284	.0029		11859
	(.0042)			(.0027)		
PSM	.0051*	507	13284	.0016	417	11859
	(.0028)			(.0019)		
MDM	.0083***	507	13284	.0029*	417	11859
	(.0025)			(.0015)		
Developing Firms						
PSW	.0394*		3208	.0035		2574
	(.0237)			(.0031)		
PSM	.0389*	127	3208	.0037	104	2574
	(.0211)			(.0029)		
MDM	.0327	127	3208	.0083*	104	2574
	(.0240)			(.0031)		

Robust, Bootstrapped and AI Robust Std. Err. are in parentheses for PSW, PSM and MDM, respectively.
*, **, *** indicate statistical significance at 10, 5 and 1 % levels, respectively
T is the year of the international M&A.

Acquirers from both developing and developed countries experience higher increase of the productivity growth rate one year after the deal. The size of the effect, however, varies across these groups.

Using three different matching techniques, ATT estimated for the full sample is significant and positive, indicating that after international M&A, acquirers experience an increase of productivity growth between 1.33% and 1.52%. Such effect, moreover, is heavily driven by the ATT on firms from developing countries as displayed in **Figure 4.2**. It shows that the effect on the developing acquirers is relatively larger than that on the developed acquirers with approximately five times. Investing firms in industrialized and developing countries achieve around 0.7% and 3.5% growth in the one year productivity growth rate, respectively. It is worth noting that although developing acquirers achieve larger effect, the standard error is also relatively larger comparing with the result for other groups. As shown in **Figure 4.2**, the intervals for developing acquirers are quite large, with some lower intervals even negative. Such result may due to the small sample size of developing country firms.

The positive effect of cross-border M&A, however, seems "faded away" after two years. Most of the estimators become insignificant and much smaller in magnitude two years after the acquisition with the exception of result using MDM. The ATT estimators are around .004, .003 and .008 for full sample, developed and developing acquirers, respectively. The effects all decrease substantially comparing with that at $T+1$, while the significant positive ATT for the full sample is still driven by acquirers from emerging countries. As displayed in **Table 4.4**, the effect on the annual productivity growth two years after the acquisition for developing acquirers is over two times larger than that for industrialized investing firms. One possible explanation for larger effect on developing investing firms is that as shown in the propensity score estimation result, acquirers from emerging economies are likely to be less developed with lower initial productivity level, therefore, the productivity gap between acquirers and target is relatively larger. Such pre-characteristics leave more room for them to learn or growth with the intervention of cross-border M&A.

Although the result suggests a positive treatment effect of international M&A on the acquirers' productivity growth after one year, little is known about how different features of

the treatment would influence the effect for different origin groups. Hence, we compute the further estimation results with heterogeneous treatment in next section.

4.5 Multiple Treatment

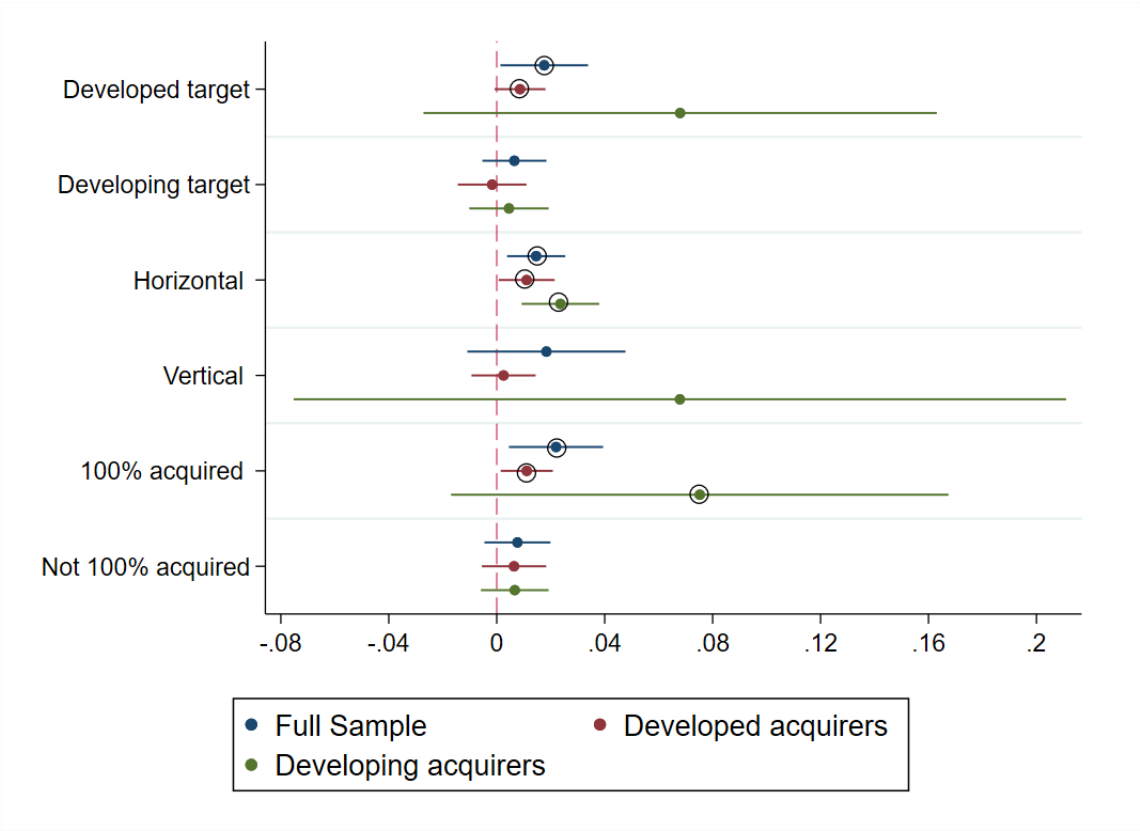
Another empirical strategy of this paper is to explain the effect of international M&A on investing firms productivity growth by focusing on the deal features and characteristics of the targets. Specifically, we estimate three deal features: 1) four types of M&A by origin of the targets and acquiring firms, namely north-north, north-south, south-north and south-south); 2) vertical or horizontal M&A ; 3) 100% acquisition or not.

Additionally, as discussed in the theory framework, targets' pre-acquisition heterogeneity could also interact with the deal effect on acquiring firms productivity growth in at least two aspects. Firstly, target firms initial productivity level before the acquisition would affect investing firms post-deal productivity with the potential technology transfer or the complementarities of the firm specific assets. Secondly, as the market expands following the cross-border M&A, the size of foreign market may also be associated with the treatment effect on the acquiring firms. Due to the limitation of data, we do not have the specific market size data for each foreign country. we use acquired firm market performance in respect of the operation revenue to test such channel. In this section, we display effects of heterogeneous treatment by the types of the cross-border M&A and target firm characteristics.

4.5.1 Deal Feature

The effect of the heterogeneous treatment by the cross-border M&A deal characteristics is displayed in **Figure 4.3**. The X-axis is the estimated ATT, while the Y-axis is the features of the acquisition. Points that are in a small circle represent ATT estimators with at least 10% statistical significance. Instead of assigning to a simple identical M&A, acquiring firms face different options based on whether to acquire firms in developing countries or developed countries; whether to acquire firms in the same industry or different industry; whether to acquire 100% of the ownership of the target firms or not. Same as the results shown before,

Fig. 4.3 ATT of Heterogeneous Treatment by Deal Features



Note: The lines indicate the 95% confidence interval of the estimates. The X-axis is the estimated ATT, while the Y-axis is the features of the acquisition. Points that are in a small circle represent ATT estimator with at least 10% statistical significance.

we examine the ATT of multiple treatment separately for different origin groups, namely full sample, acquiring firms from industrialized and emerging countries. The detailed result is attached in the Appendix C as **Table C3**.

Figure 4.3 does suggest different result with varying features of the treatment. Firstly, considering the origin of the targets, target firms in developed countries are more likely to have positive effect on the investing firms' productivity growth, with about 1.76%, 0.86% and 6.8% increase in general, for acquirers from developed and developing countries, respectively. Such phenomenon may due to the relatively higher productive level of target firms from industrialized economies, in which case, the acquirers are more likely to benefit from the strategic assets and out-performance of the acquired firm. However, in contrast with the large and significant ATT for investing firms from South countries in previous section, the

effect loses significance after recognizing the origin of targets. In other words, we find that the significant treatment effect only exists for north to north acquisitions. However, the non-significant estimates found for South-North acquisitions may be due to the small sample size of developing firms. We can not ignore the economic significance as the estimate is quite large comparing with North-North estimate. A possible explanation for the large estimate is the big technology gap between developed target and developing acquirers, where there is more likely to be technology transfer.

Secondly, we find positive and significant effect of horizontal international M&A on the acquiring firms productivity growth, while no effect of vertical acquisitions. It shows that horizontal acquisition is followed by 1.46%, 2.36% and 1.11% increase of firm productivity growth rate a year after the deal for the full sample, developed and developing acquirers, respectively. The ATT estimated for vertical acquisition are larger but not significant. Such result indicates that the treatment effect are more likely to stem from the market expansion rather than cost reduction. Moreover, comparing the estimated ATT of 100% cross-border M&A with that of not 100% acquired, acquirers seems to take advantage of the full control of the target firm with 100% ownership. Similar result is found across all sample groups.

The varying ATT estimators of the heterogeneous treatment provide some implications for firms considering to invest abroad. It shows that acquiring target firms from industrialized countries in the same industry with 100% ownership, investing firms would benefit more from the cross-border M&A and achieve higher increase of the productivity growth rate.

4.5.2 Target firm pre-deal characteristics

Market performance

As discussed before, there are two target firm's pre-acquisition characteristics, market performance and productivity level, which are expected to be related to the cross-border M&A effect on acquiring firms' post-acquisition productivity. To start with, we construct two variables indicating the acquired firms' comparative market performance and comparative productivity level. We get the target firms operating revenue weighted by the mean of the

Table 4.5 Target Firms' Comparative Market Performance Categories

	Total	Developed Investor	Developing Investor	Category Description
1	51	42	9	$MarketPerformance^T_{ijt} < 1.175$, around or below the average.
2	133	95	38	$1.175 \leq Market\ Performance^T_{ijt} < 1.30$
3	138	98	40	$1.30 \leq Market\ Performance^T_{ijt} < 1.425$
4	100	68	32	$1.425 \leq Market\ Performance^T_{ijt} < 1.55$
5	83	61	22	$1.55 \leq Market\ Performance^T_{ijt}$

industry operating revenue for each year, as shown in **Equation 4.19**.

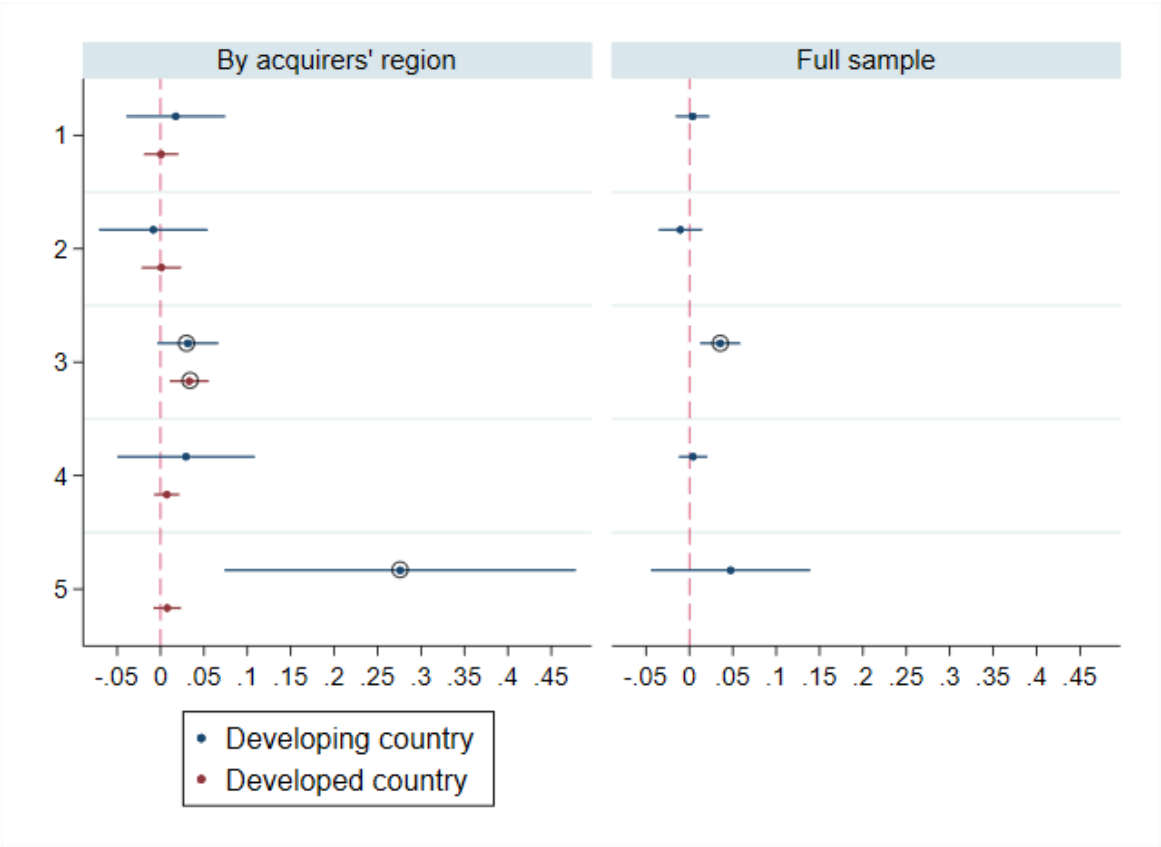
$$Market\ Performance^T_{ijt} = \frac{Rev^T_{ijt}}{1/n\sum_{q=1}^{n} Rev_{qjt}} \tag{4.19}$$

where Rev_{ijt} is the log operating revenue for target firm i in industry j at year t. Rev_{qjt} is the log operating revenue of firm q in the same industry j at same year t, and n is the total number of the firms in the industry. The relative market performance measured by revenue of the target firms in our sample is between 0.478 and 1.953.

Based on the comparative market performance of the acquired firms, we put these firms into five categories, one to five, representing the firm size in terms of turnover from small to large. The detailed categories is shown in **Table 4.5**. It is clear that most of the target firms' size are above the average in the industry, consistent with the literature suggesting the out-performance of the acquired firm before the acquisition (Arnold and Javorcik, 2009, Blonigen and Pierce, 2016, Chen, 2011, Stiebale, 2016, Guadalupe et al., 2012). Additionally, similar across groups, most of the acquired firms are in the category 2 and 3, where target firms are slightly larger, between 1.175 to 1.425, comparing with the average of the industry.

Hence, we differentiate the cross-border M&A by these five categories of target firms' size in terms of firm revenue. The ATT estimators of the multiple treatment regarding acquired firms' market performance are displayed in **Figure 4.4** and **Table C4** in the Appendix. Points that are in a small circle represent ATT estimators in at least 10% statistical significance level. The results of the full sample and acquirers from developed countries show the same pattern, where only acquiring target firm in category 3 would have a significant and positive

Fig. 4.4 ATT of Heterogeneous Treatment by Target Firms' Market Performance



Note: The lines indicate the 95% confidence interval of the estimates. The X-axis is the estimated ATT, while the Y-axis represents the heterogeneous treatment by target firm's market performance corresponding to the 5 categories in **Table 4.5**. The left panel shows the result from the multiple treatment by the origin of the acquiring firms. The right panel shows the result for the full sample. Points that are in a small circle represent ATT estimators with at least 10% statistical significance.

effect on investing firm's productivity growth rate by 3.56% and 3.30%, respectively. There is no effect of investing in firms which are relatively too large or too small, which would be understandable for acquisitions in category 1 and 2. However, for category 4 and 5, such result may reflects the management challenge faced by the acquiring firms when the target firm is too large to "control".

The estimated ATT for acquiring firms from developing countries, however, show different result. The positive and significant effect is found in category 3 and category 5, about 0.314% and 27.6%. The surprisingly large effect may due to the disadvantages of pre-acquisition performance of acquiring firms from developing countries. Comparing with industrialized acquirers, the positive effect from the super performance of the target firms is

Table 4.6 Target Firms' Comparative Productivity Level Categories

	Total	Developed Investor	Developing Investor	Category Description
1	80	56	24	$Productivity^T_{ijt} < 1.15$, around or below the average.
2	89	68	21	$1.15 \leq Productivity^T_{ijt} < 1.25$
3	71	57	14	$1.25 \leq Productivity^T_{ijt} < 1.35$
4	97	79	18	$1.35 \leq Productivity^T_{ijt}$

relatively larger, which therefore overcome the management challenge of large firms. The positive effect on firm productivity of international M&A by firms from developing countries increases in the target firm size.

Productive performance

Similarly, target firms comparative productivity level are constructed in the form of **Equation 4.20**.

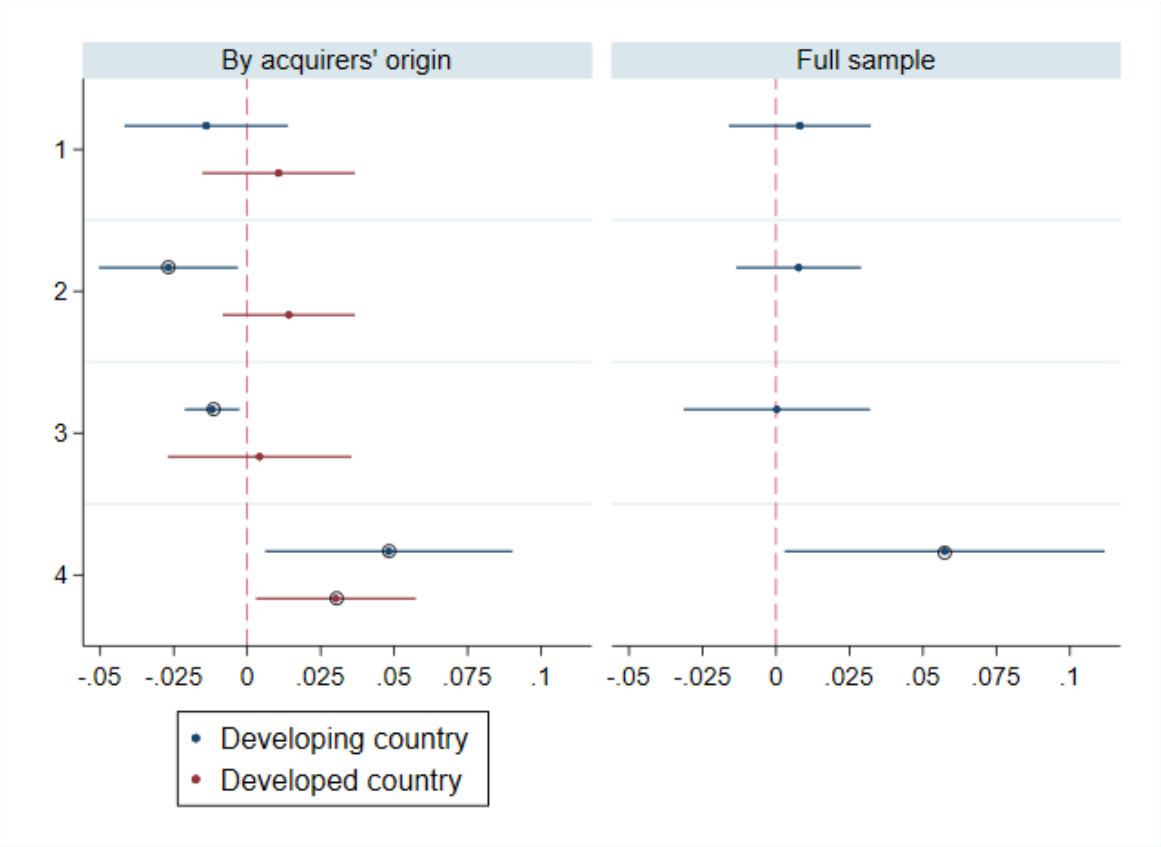
$$Productivity^T_{ijt} = \frac{TFP_{ijt}}{1/n\sum_{q=1}^{n} TFP_{qjt}} \tag{4.20}$$

where TFP_{ijt} is the total factor productivity for target firm i in industry j at year t. TFP_{qjt} is the total factor productivity of firm q in the same industry j at same year t, and n is the total number of the firms in the industry. The comparative productivity level of the target firms in our sample is between .823 to 1.697.

Similar with the comparative market size, we construct four categories for target firms with respect to their comparative productivity level, which is shown as **Table 4.6**. In line with the literature, most of the target firms are relatively more productive than the average of the industry before cross-border M&A (Arnold and Javorcik, 2009, Blonigen and Pierce, 2016, Chen, 2011, Stiebale, 2016, Guadalupe et al., 2012). The bands selection of the categories is due to the sample size of each categories. We differentiate the cross-border M&A by these four categories of target firms' productivity level and display the result in **Figure 4.5** and **Table C5** in the Appendix.

As suggested by the full sample result, acquiring firms would achieve an increase in productivity growth rate about 5.74% when takeover foreign target firms in category 4, which

Fig. 4.5 ATT of Heterogeneous Treatment by Target Firms' TFP Performance



Note: The lines indicate the 95% confidence interval of the estimates. The X-axis is the estimated ATT, while the Y-axis represents the heterogeneous treatment by target firm's productivity performance corresponding to the 4 categories in **Table 4.6**. The left panel shows the result from the multiple treatment by the origin of the acquiring firms. The right panel shows the result for the full sample. Points that are in a small circle represent ATT estimator with at least 10% statistical significance.

is the highest productive level category. If the target firm is below or just slightly above the average productivity, there may not be significant effect on the acquiring firms' productive performance. Similar result is also found for investing firms from developed countries, with a bit lower ATT, about 3.02%. The estimated ATT for the sample group of emerging countries, however, indicates different pattern. Interestingly, the estimates are negative for category 2 and 3, suggesting a decrease of acquirers' productivity growth by 2.68% and 1.19%. Furthermore, the negative effect disappears when the target firms are in category 4, indicating an increase of acquirers' productivity growth rate by about 4.82%. The treatment effect are shown to increase in the target firms productivity, which provides the evidence for the technology transfer from the target to the investing firm.

The possible explanation for the negative treatment effect in category 2 and 3 while positive effect in category 4 is the combined or balanced effect of the potential negative and positive effect. The previous literature suggests that acquiring firms investing abroad face the culture difference, business environment, institution difference and management challenge (Bertrand and Betschinger, 2012, Li et al., 2016). On the other hand, as discussed in the theory framework, the expected technology transfer is associated with acquiring firms' learning and capacity skill and the gaps between acquirers and targets. For international M&A in category 2 and 3, the gaps between the acquirers and targets are probably relatively small, and acquirers from developing countries are expected to have lower learning skills. The potential positive effect from technology spillover, therefore, is relatively smaller comparing with the negative effect from the acquisition challenges. However, if the target firm is in category 4, where the productivity gap between acquirer and target is more likely to be large, the positive effect from the technology transfer is large enough to offset the negative effect. Hence, the emerging acquiring firms would achieve an improvement of productivity performance.

Productivity gap

To test whether the above result is associated with the technology gap between acquirer and target, we construct a new variable indicating the technology gap in the form of **Equation 4.21**:

$$Productivity\ Gap = \frac{Productivity^{Target}}{Productivity^{Acquirer}} \tag{4.21}$$

where $Productivity^{Target}$ and $Productivity^{Acquirer}$ is the relative productivity level of target and acquirer estimated using the similar form of **Equation 4.20**. similar as before, we divide the treatment by productivity gap into four categories, which is shown in **Table 4.7**. The multiple treatment estimates, hence, are displayed in **Figure 4.6** and **Table C6** in the appendix. Points that are in a small circle represent ATT estimators in at least 10% statistical significance level.

Base on the descriptive result, the target firm is relatively less productive than acquiring firms from developed countries, given that the mean of the Target-Acquirer productivity gap

Table 4.7 Productivity Gap Categories

	Total	Developed Investor	Developing Investor	Category Description
1	76	77	9	$ProductivityGap < 0.90$, acquirer is more productive
2	103	90	13	$0.90 \leq ProductivityGap < 1$, acquirer is a little bit more productive
3	66	54	12	$1 \leq ProductivityGap < 1.10$, target firm is a little bit more productive
4	35	23	12	$1.10 \leq ProductivityGap$, target is more productive

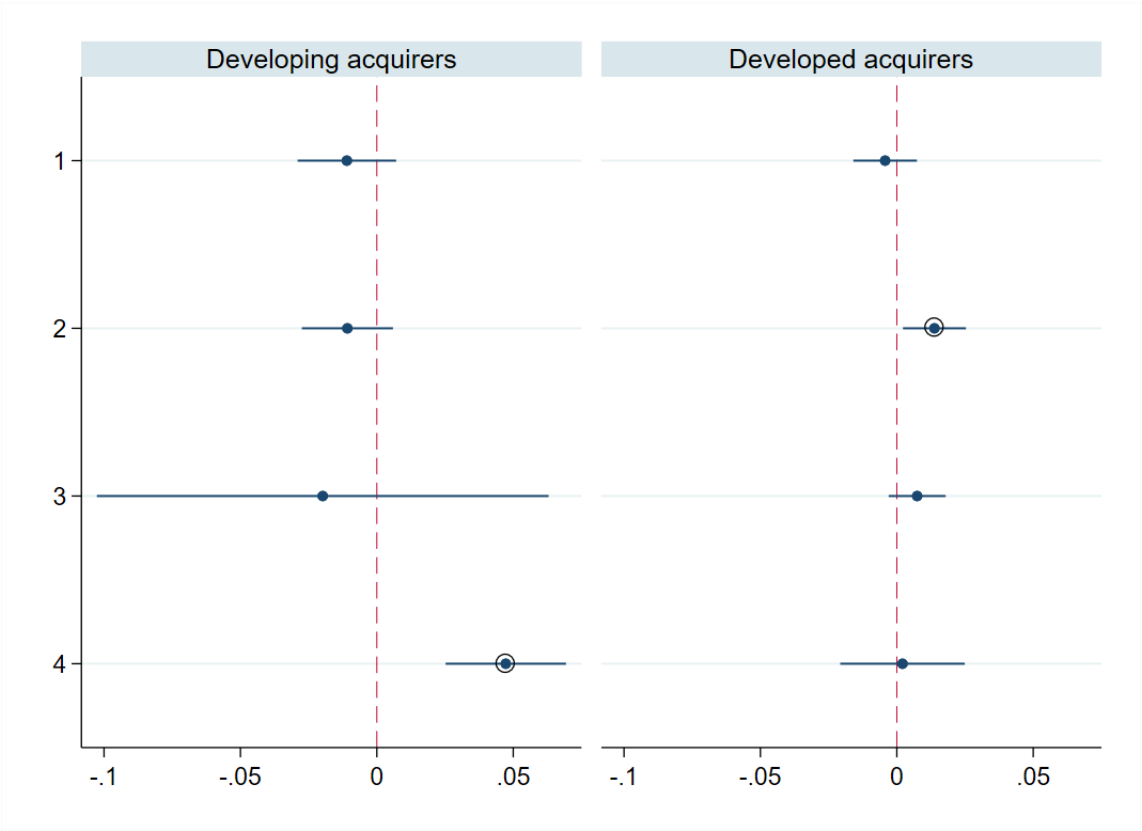
for developed acquirers is 0.950. In contrast, investing firms from developing countries tend to acquire target that is relatively more productive than itself as the mean of productivity gap is 1.043.

The ATT estimates for firms from different country groups also show various result. For emerging acquiring firms, a big technological gap when the target is much more productive, has a big impact on the acquirer's post-acquisition productivity growth with an increase of growth rate by 4.73%. For industrialized acquirers, we found positive effect only when acquiring firm is slightly more productive than the target, followed by an increase of productivity growth rate by 1.38%. Combining with the result of heterogeneous treatment by targets' productivity performance, acquiring firm from developing country are more likely to achieve larger post-acquisition productivity growth when target firm is much more productive than industry mean and the acquirer. Investing firms from industrialized countries, however, tend to experience positive effect of the acquisition when target firm is much more productive in the industry but not necessarily outperform the acquirer.

Lasting effect

The outcome variable for the above result is the acquiring firms' productivity one year after the acquisition, while we also construct the result for two years after the deal. Even through the previous result suggests that the treatment effect "faded away" after two years, we do find lasting effect of cross-border M&A in some categories. The result is shown in **Figure 4.7** and **Figure 4.8** for multiple treatment by target firms market and productivity performance, respectively. Points that are in a small circle represent ATT estimators in at least 10% statistical significance level. Because of limitation of the sample size, we could not construct

Fig. 4.6 ATT of Heterogeneous Treatment by Target-Acquirer Productivity Gap



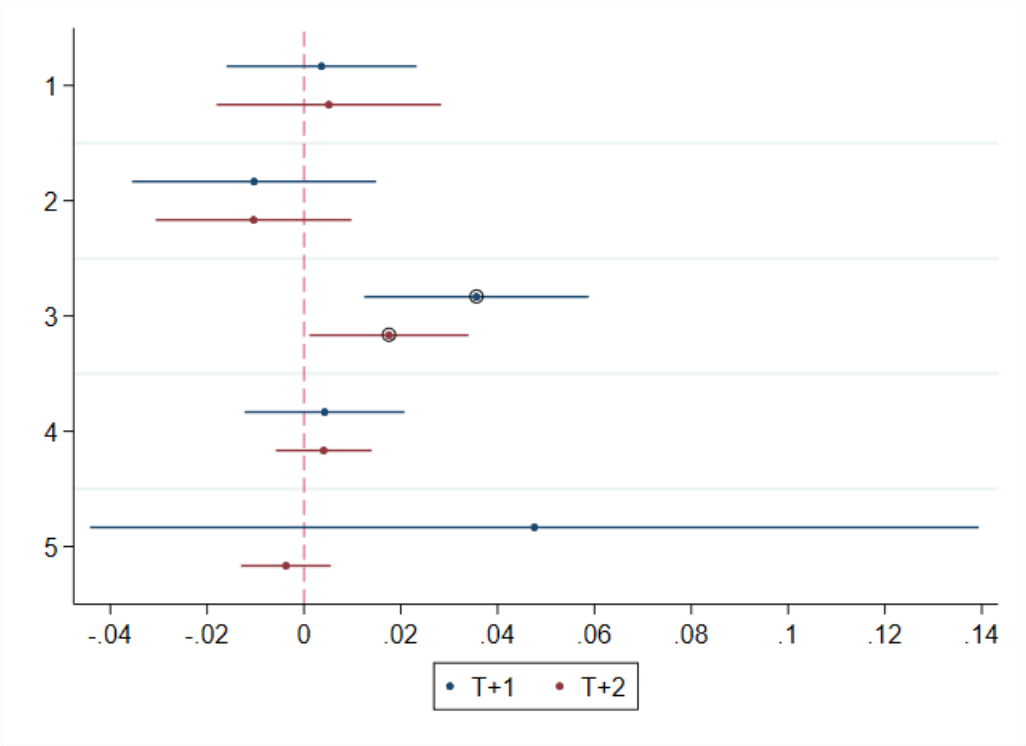
Note: The lines indicate the 95% confidence interval of the estimates. The X-axis is the estimated ATT, while the Y-axis represents the heterogeneous treatment by the productivity gaps between the acquirer and target firms corresponding to the 4 categories in **Table 4.7**. The left panel shows the result from the multiple treatment by the origin of the acquiring firms. The right panel shows the result for the full sample. Points that are in a small circle represent ATT estimators with at least 10% statistical significance.

the ATT estimator by country groups, therefore only the full sample result is displayed in these figures. The estimated ATT shows similar pattern in different categories, where the significant effect only exists in category 3 for market size and category 4 for productivity level for both year $T+1$ and year $T+2$, while the treatment effect at year $T+2$ is lower than in year $T+1$.

4.6 Robustness Check

We check the robustness of our results for the acquiring firms' productivity growth in the following ways: (1) we use alternative methods to measure firms' productivity; (2) we use

Fig. 4.7 ATT_{T+1} and ATT_{T+2} of Heterogeneous Treatment by Target Firms' Market Performance

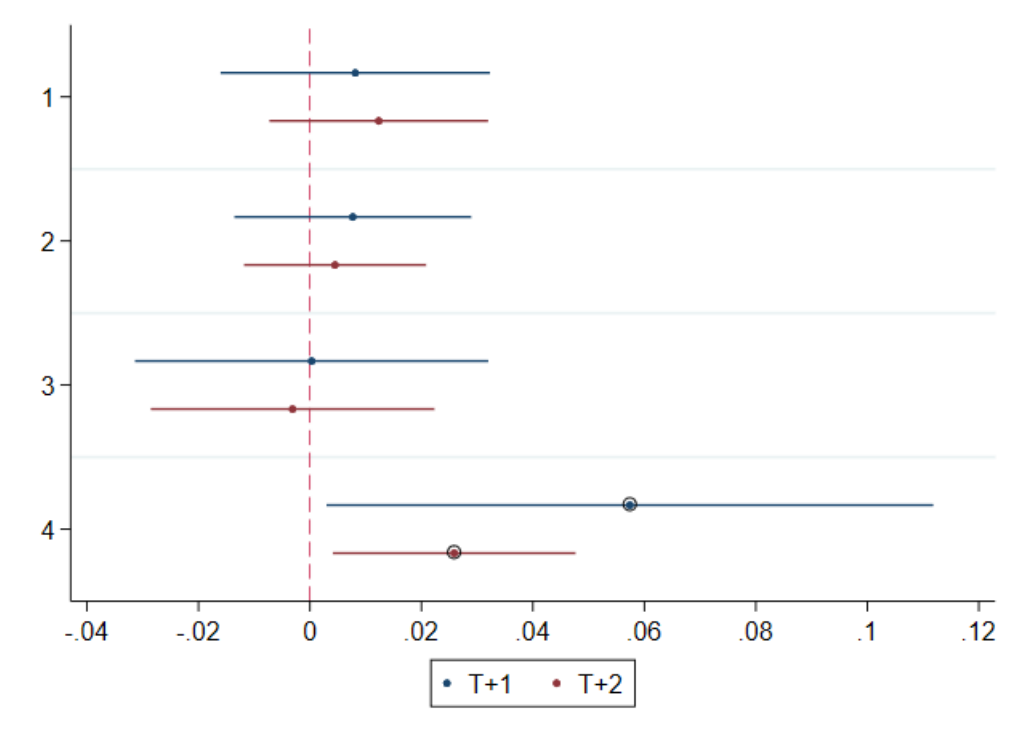


Note: The lines indicate the 95% confidence interval of the estimates. The X-axis is the estimated ATT, while the Y-axis represents the heterogeneous treatment by target firm's market performance corresponding to the 5 categories in **Table 4.5**. Points that are in a small circle represent ATT estimator with at least 10% statistical significance.

alternative matching methods; (3) we use different sets of covariates in the matching models to control for the acquiring firms' pre-acquisition characteristics. As discussed before, there are several methods of computing the total factor productivity, where the most frequently used method is Levinsohn and Petrin (2003b) instead of Wooldridge (2009). Therefore, the alternative measure of productivity used to check the robustness of our result is constructed using Levinsohn and Petrin (2003b) instead of Wooldridge (2009). Although the estimated ATT are slightly lower than before, all the estimators still remain positive and significant.

A second robustness check refers to the methodology used to estimate the treatment effect. Previous estimation use three different matching techniques, while there are numerous alternative matching methods regarding the matching algorithms, number of neighbours for the matched control group, various ways of bandwidth selection for kernel matching,

Fig. 4.8 ATT_{T+1} and ATT_{T+2} of Heterogeneous Treatment by Target Firms' Productivity Performance



Note: The lines indicate the 95% confidence interval of the estimates. The X-axis is the estimated ATT, while the Y-axis represents the heterogeneous treatment by target firm's productivity performance corresponding to the 4 categories in **Table 4.6**. Points that are in a small circle represent ATT estimator with at least 10% statistical significance.

different distance metrics. We investigate the robustness of our estimates using various matching methods. None of the alternative matching methods significantly changes the result.

The final set of the robustness check relates to the covariates set used in the estimation. Using the matching approach, the selection of the covariates included in the propensity score estimation or the multivariate distance measurement is crucial for the estimated result. We introduce some further covariates to the estimation, such as the total assets, labour productivity (value added per employee). We also change some variables to their alternatives, for instance, changing the operating revenue to value added, changing the intangible and tangible asset ratio to the log real intangible and tangible assets. Our results remain robust to these changes.

4.7 Conclusion

With increasingly internationalization, cross-border M&A becomes a major mode of entry for foreign direct investment. Additionally, emerging economies have also grown to play a significant role in the international market, not just the major host country but also home country for the multinationals firms. Regardless of the growing importance of international M&A and the developing countries, the literature is still sparse and limited to the analysis focusing on target firms and developed economies cases. Little is known about the cross-border M&A effect on the acquiring firms and for the developing country group, and whether there are different responses to differences in terms of deal features and partner firm characteristics. To the best of our knowledge, this paper is the first to provide the evidence on the cross-border M&A effect on acquiring firms productivity performance in the presence of the country origin effect and heterogeneous treatment. Our empirical research is not limited in one-country-analysis but provides a comparison between developing and developed country groups using our unique dataset of completed international M&A in the world.

Based on three matching approaches, our result provides an evidence of a significant and positive effect of cross-border M&A on acquiring firms' productively growth for the single treatment estimation, with approximately 1.4% increase in the productivity growth rate. The effect on acquirers from emerging countries, however, is relatively larger than that on industrialized investing firms, 3.9% compared to 0.75%. However, the overall treatment effect are expected to "faded away" two years after the acquisition.

The results recognizing the heterogeneous treatment by deal features and target firms pre-acquisition characteristics show different responses to differences of the M&A. We find positive effect on acquiring firms productivity growth only if target firm is from developed countries, in the same industry with the acquirers, and 100% ownership acquired. When it come to targets' pre-deal performance, the optimal case of the cross-border M&A for the industrialized investing firms is to acquire target which have slightly larger revenue than the industry average level and is the most productive in the relevant industry. However, for acquirers from developing economies, the better the target firms' market performance and

productivity and the larger the Target-Acquirer productivity gap, the bigger the positive effect from the acquisition. Lastly, the effect of cross-border M&A is also shown to last two years after the deal when target firm is sightly larger than industry mean and the most productive. Multiple robustness checks indicate similar result.

These findings provide some insights for firms considering investing abroad and for government devising foreign investment policies. However, the implication of our result should takes account of the limitations of this approach. Due to the sample size of our analysis, we could not estimate the lasting effect of cross-border M&A by target firms characteristics for different country groups. The completed deals estimated in our paper are worth over $1 billion from UNCTAD cross-border M&A database. The effect may be different for deals with the lower value. For future research, it might be interesting to investigate the lasting effect on acquiring firms by country groups and heterogeneity of target firms using larger and more detailed data.

Chapter 5

Conclusion

Given the growing interdependence of the world's economies, cultures, and populations, the international economic environment has became more complex. There are also mixed views in the public about how integrated the global economy should be. In recent years, policymakers have been adjusting their economic partnerships and trade policies to accommodate the debates over globalization, which makes the global economy even more complex. This thesis attempt to provide evidence and findings to understand consequences of various elements of globalization.

In the essay presented in **Chapter 2**, I build a computable general equilibrium model to quantify the welfare and employment effects of trade policy changes. With the input-output linkage and the frictional labour market, the model is able to investigate the changes in real wages and employment rates at both the sector and national level following changes in the trade openness. The result shows that without taking into account the value added chain and frictional employment, the trade gains in terms of real wages would be underestimated. With the proposed the model, one can perform policy evaluations on complex trade policy in a particular sector and country, and estimate the potential effect on the economy at the home country and the rest of the world.

Chapter 3 presents an empirical study, which analyses the impact of trade liberalization on firm's investment decisions. The specific type of investment we focus on is business investment, which reports all the expenses incurred by a firm to promote and/or secure

one's business along the supply chain. Given that such investment is a crucial source of promoting firm's productivity and growth, our findings shed light on the growing literature estimating trade liberalization effect on firm level outcomes. Our results on family firms on their differential response to trade liberalization also provide additional evidence that family-owned firms are different than professionally managed firms: the investment decisions of family firms are less hampered by the foreign competition shock in comparison with non-family owned firms. Ownership of a firm plays a vital role in terms of their responses to external shocks and this can affect their overall growth and performance.

In **Chapter 4**, I focus on a different element of international economics: cross-border M&A, which has become a major mode of entry for foreign direct investment. In particular, the essay provide evidence of cross-border M&A effect on acquiring firms' productivity performance. Taking into account the involving firms' origin and the heterogeneous treatment, this study is not limited in one-country-analysis but provide a comparison between deals involves emerging and advanced country groups. The effect of cross-border M&A on acquiring firms are shown to be different by the investor's origin, deal features and target firms' pre-deal characteristics. For instance, acquiring firms from developing countries benefit more from the international acquisition in comparison with investing firms from advanced economies. The findings in this chapter provide some insights for firms considering investing abroad and for government policymakers devising foreign investment policies.

In this thesis, the first two studies only focus on one aspect of trade policies, changes in the tariff structure. Nevertheless, trade policies have more provisions than only changing the tariff rates between the involving countries, For instance, changes in the other unobserved and non-tariff trade costs. For future study, it might be interesting to quantify the effect of trade openness in terms of relaxing the non-tariff trade barriers on the economy. Moreover, this thesis only analyses two elements of globalization, namely trade in goods and one mode of foreign direct investment. There are other elements which have became more important in the world economy, for instance, trade in service and international migration, etc. These elements can be incorporated into the frameworks used in this thesis. For future study, it

might be interesting to explore those elements to understand the overall impact of global integration.

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Appendix A

Frictional Unemployment and Trade in Value Added

Table A1: Sectors Description

WIOT Number	ISIC Rev.3	Description
1	AtB	Agriculture, Hunting, Forestry and Fishing
2	C	Mining and Quarrying
Manufacturing Sectors		
3	15t16	Food, Beverages and Tobacco
4	17t18	Textiles and Textile Products
5	19	Leather, Leather and Footwear
6	20	Wood and Products of Wood and Cork
7	21t22	Pulp, Paper, Paper , Printing and Publishing
8	23	Coke, Refined Petroleum and Nuclear Fuel
9	24	Chemicals and Chemical Products
10	25	Rubber and Plastics
11	26	Other Non-Metallic Mineral
12	27t28	Basic Metals and Fabricated Metal
13	29	Machinery, nec
14	30t33	Electrical and Optical Equipment
15	34t35	Transport Equipment
16	36t37	Manufacturing, nec; Recycling
Non-tradable Sectors		
17	E	Electricity, Gas and Water Supply
18	F	Construction
19	50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
20	51	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
21	52	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
22	H	Hotels and Restaurants
23	60	Inland Transport
24	61	Water Transport
25	62	Air Transport
26	63	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
27	64	Post and Telecommunications
28	J	Financial Intermediation
29	70	Real Estate Activities
30	71t74	Renting of M&Eq and Other Business Activities
31	L	Public Admin and Defence; Compulsory Social Security
32	M	Education
33	N	Health and Social Work
34	O	Other Community, Social and Personal Services
35	P	Private Households with Employed Persons

Table A2: Employment Effects of Tariff Reductions from 2000 to 2010

Country	Changes of Employment Rate			
	Tariffs Reduction			
	Chinese Tariffs Reduction	on Chinese Products	Joining WTO	Without Joining WTO
Australia	-0.17%	-0.16%	-0.17%	-0.17%
Austria	-0.17%	-0.26%	-0.19%	0.10%
Belgium	-0.08%	-0.09%	-0.10%	-0.09%
Brazil	0.09%	-0.16%	0.20%	0.88%
Bulgaria	0.23%	1.26%	2.01%	8.22%
Canada	-0.33%	-0.32%	-0.32%	0.56%
China	4.93%	0.30%	5.26%	-0.33%
Cyprus	1.24%	0.32%	2.05%	2.89%
Czech Republic	-0.32%	-0.30%	-0.37%	-0.38%
Denmark	-0.24%	-0.24%	-0.25%	-0.25%
Estonia	0.52%	-0.22%	0.53%	2.38%
Finland	-0.28%	-0.27%	-0.31%	-0.30%
France	-0.17%	-0.17%	-0.19%	-0.20%
Germany	-0.24%	-0.22%	-0.26%	-0.25%
Greece	-0.29%	-0.28%	-0.34%	-0.37%
Hungary	0.91%	1.71%	3.02%	4.99%
India	-0.002%	1.88%	2.12%	3.31%
Indonesia	0.04%	0.26%	0.63%	3.28%
Ireland	-0.37%	-0.36%	-0.40%	-0.38%
Italy	-0.31%	-0.29 %	-0.34%	-0.34%
Japan	-0.29%	0.27%	-0.31%	-0.23%
Latvia	0.40%	-0.003%	0.66%	2.18%
Lithuania	0.11%	-0.23%	0.14%	2.01%
Malta	-0.03 %	0.72%	0.95%	2.81%
Mexico	-0.15%	0.75%	0.93%	2.07%
Netherlands	-0.19%	-0.19%	-0.21%	-0.21%
Poland	0.50%	0.15%	1.08%	4.36%
Portugal	-0.37%	-0.35%	-0.42%	-0.44%
Romania	0.81%	2.10%	3.31%	6.35%
Russia	-0.23%	-0.11%	-0.02%	0.63%
Slovakia	0.29%	-0.22%	0.22%	2.50%
Slovenia	0.37%	0.60%	1.31%	3.92%
South Korea	-0.23%	1.44%	1.64%	2.04%
Spain	-0.35%	-0.33%	-0.40%	-0.42%
Sweden	-0.24%	-0.23%	-0.26%	-0.25%
Turkey	-0.24%	0.05%	0.19%	1.89%
UK	-0.24%	-0.24%	-0.25%	-0.25%
USA	-0.16%	-0.17%	-0.16%	-0.18%

Appendix B

Trade Liberalization, Business Investments, and Family Firms

B.1 Data

We use an annual panel of Indian manufacturing firms that covers around 10,000+ firms, across 105 industries, over the period of 1990-2006. Data is used from the PROWESS database of the Centre for Monitoring Indian Economy (CMIE). All monetary-based variables measured in Millions of Indian Rupees (INR), deflated by 2005 industry-specific Wholesale Price Index (WPI). We use 2004 National Industrial Classification (NIC).

Variable Definitions

(1) **Business Investments**: business-related investments are those that are made by a firm to promote and/or secure one's business. In other words, investments made in the securities of firms with which the investing firm has a business relationship, say as a supplier, customer, etc. This variables captures the book value of all the business-related investments made by a firm.

(2) **Non-business Investments**: non-business investments are investments made by a firm in shares and bonds of those firms, which are not related to its business. These are

the investments made by a firm for the purpose of efficiently utilising surpluses generated from the business. For example, when a FMCG firm, say Hindustan Unilever (the Indian counterpart of the FMCG multinational Unilever) invests in shares of companies like Scooters India Limited, it is a non-business investment. Non-business investments generally exclude the investments made by the company into its business associates, subsidiaries and other strategic business partners.

(3) **Advertising Expenses**: All expenses done by a firm for advertising purposes are captured in this data field. Usually, such expenses are largely incurred for promotion of sales by consumer goods firms.

(4) **Research and Development Expenses**: This captures the total outlay of a firm on research and development expenditure of a firm over a year. It is the expenditures incurred on current account only. Research and development expenses information is mostly furnished by manufacturing firms. The disclosure is mandatory as per section 217 of the Companies Act.

(5) **Software, Computer and IT Expenses**: This variable captures the gross value of software, computers and its peripherals owned by a firm during the year.

(6) **Land and Buildings**: This variable captures the gross value of all the real estate and buildings that a firm owns or has taken on lease. In other words, it captures the historical cost of acquisition of the aforementioned classes of fixed assets, that are in the possession and control of an entity.

(7) **Plant, Machinery, Computer, and Electrical Installations**: This variable stores the gross value of plant and machinery, computers and its peripherals and electrical installations, equipment and fittings reported by a firm. Plant and machinery are essentially production facilities, typically for manufacturing goods. While all computer hardware is included, computer software is not part of this data field since it is considered to be an intangible asset and is captured separately. Electrical machinery includes switchgear, transformers and other stationary plant and wiring, fitting of electric light and fan installations.

(8) **Transport and Communication**: This data field stores the gross value of the following three kinds of assets: (i) Transportation infrastructure (railway sidings, bridges, rolling

stock, jetties, pipelines, etc.); (ii) Transport equipment and vehicles (motorcars, trucks, ships, tankers etc.); and (iii) Communication equipment (radars, VSAT equipments, air traffic control equipments, telephone, fax etc.)

(9) **Furniture and Other Fixed Assets**: This variable stores the gross value of furniture and fixtures, social amenities and other fixed assets owned by a firm. Furniture and fixtures include wide array of articles used in a business.

(10) **Input/Output Tariffs**: Input/Output tariffs at the 4-digit industry level computed collected from the TRAINS-WITS tariff database.

(11) **Skill Intensity**: It is defined as the ratio of non-production workers to total employees at the 3-digit level of 2004 NIC. We obtain this from various publications of the Annual Survey of Industries, Central Statistical Organization, India.

(12) **Factories**: The number of factories at the 3-digit level of 2004 NIC. We obtain this from various publications of the Annual Survey of Industries, Central Statistical Organization, India.

(13) **Productivity**: Total Factor Productivity (TFP) is computed using the Levinsohn and Petrin (2003) methodology.

(14) **Intermediate Goods**: Goods classified according to the I-O table as inputs by end-use. It combines intermediates, capital and basic goods.

(15) **Final Goods**: Goods classified according to the I-O table as final products by end-use. It combines consumer durable and consumer non-durable goods.

(16) **TechAdop/GVA**: Share of R&D expenditure and Royalty Payments for Technical Knowhow in gross value-added.

(18) **Cap/GVA**: Share of the total amount of capital employed in gross value-added of a firm.

(19) **GVA**: Gross Value-Added = Total Sales - Total Raw Material Expenditure.

(20) **Assets**: Total assets of a firm.

(21) **Age**: Age of a firm in years = (Year - Year of Establishment)

B.2 Additional Results

Apart from the empirical estimation included in the main text in **Chapter 3**, we also did several additional checks and investigations in the project. Here, in this appendix, we list the additional results with a brief discussion.

While our primary focus is on the effect of trade liberalization on business-related investments, we also look at other types of investments made by firms to understand which type(s) of investment responded significantly to the trade liberalization process. In fact, this analysis also provide additional support and motivate our primary research question better. **Table B1 (Appendix B)** checks for the effect of drop in output tariffs on various types of investments, both short- and long-term. Columns (1) – (3) of **Panel A** use expenses on R&D, advertising, software, computer, and IT as the different components for short-term investments. Columns (4) – (9) of **Panel A** in **Table B1 (Appendix B)** focuses on other long-term investments separately – land and buildings, plant, machinery, computer, and electrical installations, transport and communication, furniture and other fixed assets, investments outside of India, and non-business investments (investments made by a firm in shares and bonds of those firms, which are not related to the business of the investing firm). Our estimates do not provide any consistent evidence for any of the categories. We also check for differential effect, if any, for family firms in case of both short-term and other long-term investments. **Panel B** of **Table B1 (Appendix B)** examines such claims. We do not find any differential effect in case of any other types of investments, both short- and long-term. This shows that this differential effect for family firms is not a general phenomenon, but only specific to business investments.

Having observed the benchmark result, the immediate question that may crop up is: which industries drive the benchmark results? For example, does the firms belonging to strategic industries, such as R&D intensive drop their investments less than their counterparts? Or does the industries which are highly dependent on external finance experience such phenomenon? We check for those in **Panel A** of **Table B2**. Columns (1) – (4) divides R&D intensive industries into below and above median based on their median R&D expenditure of the respective industry, and columns (5) – (8) does the same, but based on their external financial

dependency (we use total borrowings from banks by a firm as an indicator of external financial dependency). The results support our initial conjectures: (a) the decrease of investments in R&D-intensive industries which are above the median of the R&D investments for the manufacturing sector are 1.7% less than those below the median; (b) the entire drop in investments is driven by sectors which are highly dependent on external finance.

Likewise the overall effect, we also check for similar effects for family firms in terms of dividing industries into low and high R&D-intensive, and dependent on external finance. **Panel B1** and **B2** of **Table B2** presents those findings. Our results portray some interesting facts: (a) although there is no differential effect for non-family firms across low and high R&D-intensive industries, family firms drop investments around two-thirds less for high R&D-intensive or strategic industries, when compared to low R&D-intensive industries; (b) drop in investments is significant for sectors which are highly dependent on finance, but the effect is about half for family firms. On the other hand, family-owned firms increase their investments in those sectors which are less dependent on external finance.

We also divide our industries based on their upstreamness. Following Antràs et al. (2012), we compute upstreamness at the industry level for the manufacturing firms. We thank the authors for making their code available for public use. Upstreamness is a standard statistic that is widely used in the firm networks literature. It is computed by assigning discrete weights based on the distance from final use of an industry's output. For this purpose we use the 1993-94 I-O table. For details on the estimation method, please see Kisat and Phan (2020). **Panel A** of **Table B3** presents the required result. Our estimates show that the benchmark result is driven by firms belonging to the upstream sector. To give some perspective to this particular result, let's think of a firm that belongs to the petroleum sector. They reduce their investments regarding their expansion of business as they might fear that firms in the downstream sector may not buy its output, since it will be negatively affected due to the rise in foreign competition. We also examine the upstreamness effect for family firms in **Panel B1** and **B2** of **Table B3 (Appendix B)**. Family firms also differ in this dimension as well: a family firm belonging to the upstream industry either drops their investment about 60–90%

less than a non-family firm or increases its investment by 0.81–1.1% in response to 10% drop in output tariffs. We do not find any effect in case of downstream industries.

We also check for other firm characteristics, such as size, export orientation, end use and ownership (domestic and foreign). Results appear in **Table B4 (Appendix B)**. Column (1) compare firms below and above median size; column (2) divides exporters and non-exporters; column (3) does the same for intermediate and final goods producer; and column (4) looks at domestic and foreign firms. We find: (a) the entire phenomenon of the drop in investments is driven by firms above the median; (b) both the exporters and non-exporters react in similar fashion in response to trade reform; a 10% drop in output tariffs lead to drop in business investments of exporters by 2.3%, whereas the same is 2.7% for non-exporters; (c) the effect is found to be significantly larger for firms that produce final goods in comparison to firms that produce intermediates; and (d) both domestic and foreign firms reduce their business investment, but the magnitude of the effect is 3.5 times higher for foreign firms.

Realizing that bank lending or credit availability may place a crucial role in explaining our key result, we investigate the role of lending mechanism of banks on a firm's business investments. In particular, we focus on (a) deposits and advances per employee and (b) loans and advances of a bank as the possible indicators for a bank's credit lending. **Table B5** produces the required result. The coefficient of the triple interaction terms either Output Tariffs $\times$ State-owned Bank$_i$ $\times$ Deposits and Advances/Employee$_b$ or Output Tariffs $\times$ State-owned Bank$_i$ $\times$ Loan Advances$_b$ is negative and significant. This shows that firms connected to state-owned banks drop their investments less (as a result of the drop in output tariffs) than firms connected to other banks and higher lending from the state-owned banks have may somewhat helped them in the process. On the other hand, the counterfactual term Output Tariffs $\times$ Deposits and Advances/Employee$_b$ or Output Tariffs $\times$ Loans and Advances$_b$ is indistinguishable from zero; firms with loans from other kinds of banks does not have any effect on their investments. Overall, a firm connected to state-owned bank drops investment around 5 – 50% than other firms. We have also checked our results with profitability ratios of banks such as operating profit as a ratio to working funds and return on assets; we find similar results. Although, a large part of the literature

highlights that foreign and private banks have a higher profitability ratio than state-owned banks, but in contrast, Sathye (2003) and Işık and Hassan (2003) show that is not the case for India and Turkey. We explore for other possible mechanisms in the next section.

Table B6 checks whether having more information about the family firms due to their long-standing customer relationships influence the lending activities of the state-owned banks toward the family-owned firms. We check for this argument by using the number and the length of the banking of banking relationships of a firm instead of the ownership of a bank. We do find that the higher the number and length of banking relationships of a firm is, the less is their reduction in their investments. But, our estimates show no differential effect for (a) state-owned with other banks and (b) family and non-family firms.

Given the results above, the following questions immediately crop up: why a family firm connected with a state-owned bank drop their investment less than other firms? Is there a nexus between the family firms in India and the state-owned banks? Did they have more credit available (from the banks) to invest more than other firms? Or are the state-owned banks in India more 'development/socially' oriented? To check for the first part of the argument, we run a simple regression, where we interact State-owned Bank$_i$ with output tariffs, and show that such is not the case. The effect comes out to be negative. This implies that any firm, be it family or professionally managed, which is connected to a state-owned bank experiences less drop in their business investments. If there has been a nexus between the family firms and state-owned banks, we should have either got a positive or no effect for this interaction term.

Table B7 checks for the possibly hypothesis for the "development" view of government owned banks by dividing industries into R&D intensive and non-R&D intensive. We find some evidence of the "development" view – investments either dropped less or did not drop for firms (mostly for family-owned) connected to state-owned banks in case of R&D-intensive industries.

Table B1 Trade Liberalization and Different Types of Investment Responses

Dependent variable:	Short-term Investments			Long-term Investments					
	R&D	Advertising	Software, Computer, IT	Land and Buildings	Plant, Machinery Computer and Electrical Install	Transport and Communication	Furniture and Other Fixed Assets	Outside of India	Non-Business Investment
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Overall Trade Liberalization Effect									
Ln(Output Tariff)$_{jt-1}$	0.140	0.110	–0.003	–0.113	–0.145	0.210**	0.018	0.135**	0.012
	(0.087)	(0.076)	(0.040)	(0.111)	(0.091)	(0.082)	(0.074)	(0.058)	(0.090)
R-Square	0.775	0.834	0.489	0.780	0.764	0.713	0.829	0.469	0.484
Panel B: Trade Liberalization and Interaction of Family Firm									
Ln(Output Tariff)$_{jt-1}$	0.073	0.083	0.0004	–0.088	–0.166	0.060	0.028	0.073	–0.056
	(0.094)	(0.079)	(0.040)	(0.102)	(0.101)	(0.092)	(0.073)	(0.064)	(0.119)
Ln(Output Tariff)$_{jt-1}$	0.180**	0.070	–0.014	–0.103	0.017	0.385**	–0.051	0.159*	0.160
$\times$ Family$_i$	(0.088)	(0.090)	(0.070)	(0.112)	(0.157)	(0.154)	(0.098)	(0.087)	(0.211)
R-Square	0.776	0.834	0.489	0.782	0.766	0.716	0.831	0.472	0.487
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	39,552	36,829	36,829	36,829	36,829	36,829	36,829	36,829	36,829
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (3-digit)*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: In Panel A, we present the overall trade liberalization effect and Panel B shows the effect of the interaction between trade liberalization and family firms. Columns (1) – (3) use the short-term investments as dependent variables; column (1) use R&D expenditure; column (2) use investments on advertising; and column (3) use investments on software, computer and IT expenditure. Columns (4) – (8) use the long-term Investment as dependent variables. Specifically, column (4) uses investments on land and buildings; column (5) investments on plant, machinery, computer and electrical installations; column (6) and (7) use investment on transport and communication, and furniture and other fixed assets, respectively. Column (8) uses investment outside of India. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. $Family_i$ is a binary index that takes the value 1 if the firm has positive ownership share of Hindu undivided families. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Table B2 Trade Liberalization and Business Investments: Industry Characteristics

Dependent variable:	Business Investments							
	R&D Intensive				External Financial Dependence			
	Above the Median		Below the Median		Above the Median		Below the Median	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Overall Trade Liberalization Effect								
Ln(Output Tariff)$_{jt-1}$	0.291**		0.308**		0.291***		0.172	
	(0.115)		(0.132)		(0.104)		(0.156)	
R-Square	0.525		0.503		0.531		0.464	
Panel B1: Trade Liberalization and Interaction of Family Firm								
Ln(Output Tariff)$_{jt-1}$	0.303**	0.298**	0.310**	0.323**	0.304***	0.295***	0.224	0.188
	(0.122)	(0.117)	(0.138)	(0.135)	(0.111)	(0.107)	(0.164)	(0.158)
Ln(Output Tariff)$_{jt-1}$×Family$_i$	–0.214	–0.229	0.015	–0.146	–0.134	–0.155	–0.370**	–0.361*
	(0.218)	(0.397)	(0.122)	(0.137)	(0.194)	(0.299)	(0.155)	(0.207)
Panel B2: Joint Effect of Trade Liberalization and Family Ownership								
Non-Family Firms	0.303**	0.298**	0.310**	0.323**	0.304***	0.295***	0.224	0.188
Family Firms	0.089**	0.069**	0.295*	0.177*	0.170**	0.140**	–0.146*	–0.173
Family Firm Indicator	Medium	Dominant	Medium	Dominant	Medium	Dominant	Medium	Dominant
R-Square	0.525	0.525	0.503	0.503	0.532	0.531	0.465	0.464
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	19,368	19,368	16,323	16,323	23,429	23,429	12,774	12,774
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Panel A presents the overall trade liberalization effect and Panel B (B1 and B2) shows the effect of the interaction between trade liberalization and family firms. Columns (1) – (12) use logarithm of investments related to promote or secure business. Columns (1) – (4) divide industries into R&D intensive above (columns (1) and (2)) and below (columns (3) and (4)) the median. Columns (5) – (8) divide industries into capital intensive above (columns (5) and (6)) and below (columns (7) and (8)) the median. Lastly, columns (9) – (12) does the same for external financial dependency of industries. We measure the external financial dependency by the total external borrowing. 'Medium' ('Dominant') is a binary index that takes the value 1 if the firm's ownership share of Hindu undivided families is greater than 30% (50%). $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer.All the regressions control for input tariffs and its different interactions. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Table B3 Trade Liberalization and Business Investments: Industry Upstreamness

Dependent variable:	Business Investments			
	(1)	(2)	(3)	(4)
Panel A: Overall Trade Liberalization Effect				
Ln(Output Tariff)$_{jt-1}\times$ Upstream$_j$	0.185**		0.195*	
	(0.076)		(0.101)	
Ln(Output Tariff)$_{jt-1}\times$ Downstream$_j$	0.226		0.488	
	(0.176)		(0.313)	
R-Square	0.483		0.492	
Panel B1: Trade Liberalization and Interaction of Family Firm				
Ln(Output Tariff)$_{jt-1}\times$ Upstream$_j$	0.203**	0.195**	0.210**	0.206**
	(0.082)	(0.077)	(0.105)	(0.101)
Ln(Output Tariff)$_{jt-1}\times$ Downstream$_j$	0.190	0.230	0.448	0.500
	(0.193)	(0.186)	(0.320)	(0.318)
Ln(Output Tariff)$_{jt-1}\times$ Upstream$_j$	–0.186	–0.309	–0.160	–0.287
$\times$Family$_i$	(0.135)	(0.247)	(0.133)	(0.245)
Ln(Output Tariff)$_{jt-1}\times$ Downstream$_j$	0.329	0.034	0.306	–0.012
$\times$Family$_i$	(0.335)	(0.495)	(0.344)	(0.514)
Panel B2: Joint Effect of Trade Liberalization and Family Ownership				
Upstream and Non-Family Firm	0.203**	0.195**	0.210**	0.206**
Upstream and Family Firm	0.017**	–0.114**	0.050*	–0.081*
Downstream and Non-Family Firm	0.190	0.230	0.448	0.500
Downstream and Family Firm	0.519	0.264	0.754	0.488
Family Firm Indicator	Medium	Dominant	Medium	Dominant
R-Square	0.484	0.483	0.493	0.493
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes
N	36,275	36,275	36,239	36,239
Firm FE	Yes	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes	Yes		
Industry (3-digit)*Year FE			Yes	Yes

Notes: Panel A shows the overall trade liberalization effect, while Panel B shows the interaction effect of trade liberalization and family ownership. Columns (1) – (4) use logarithm of business investments.'$Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. '$Upstream_j$'('$Downstream_j$') is a binary index that takes the value 1 if a firm belongs to an upstream (downstream) industry. 'Medium' ('Dominant') is a binary index that takes the value 1 if a firm's ownership share of Hindu undivided families is greater than 30% (50%). Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. All the regressions also control for all the other possible double interaction terms. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Table B4 Trade Liberalization and Business Investments: Other Firm Characteristics

Dependent variable:	Business Investments			
	Size	Export Orientation	End Use	Ownership
	(1)	(2)	(3)	(4)
Ln(Output Tariff)$_{jt-1}$ × (Above Median)$_i$	0.277***			
	(0.087)			
Ln(Output Tariff)$_{jt-1}$ × (Below Median)$_i$	–0.045			
	(0.094)			
Ln(Output Tariff)$_{jt-1}$ × (Exporter)$_i$		0.229*		
		(0.133)		
Ln(Output Tariff)$_{jt-1}$ × (Non-Exporter)$_i$		0.271***		
		(0.075)		
Ln(Output Tariff)$_{jt-1}$ × (Final)$_i$			0.312**	
			(0.135)	
Ln(Output Tariff)$_{jt-1}$ × (Intermediate)$_i$			0.239***	
			(0.072)	
Ln(Output Tariff)$_{jt-1}$ × (Domestic)$_i$				0.203***
				(0.070)
Ln(Output Tariff)$_{jt-1}$ × (Foreign)$_i$				0.733***
				(0.265)
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes
R-Square	0.491	0.486	0.486	0.486
N	36,855	36,855	36,855	36,855
Firm FE	Yes	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes	Yes	Yes	Yes

Notes: Columns (1) – (4) use logarithm of business investments as the outcome variable. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. 'Binary' is a binary index that takes the value 1 if the firm has positive ownership share of Hindu undivided families. 'Medium' ('Dominant') is a binary index that takes the value 1 if the firm's ownership share of Hindu undivided families is greater than 30% (50%). 'Above (Below) Median' is a dummy that includes the firm-year observations with an above (below) median level of size; size-division is based on the assets of a firm. '(Non-) Exporter' is a dummy that captures firm-year observations with (zero) positive exports. 'Intermediate (Final)' is a dummy that captures firms in the intermediate, basic, and capital (consumer durable and non-durable) goods sectors. 'Domestic (Foreign)' is a dummy that captures domestically (foreign) owned firms. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Table B5 Trade Liberalization and Business Investments: Bank Ownership and Channels

Dependent variable:	Business Investments	
	(1)	(2)
Ln(Output Tariff)$_{jt-1}$	0.254*	0.545***
	(0.154)	(0.194)
Ln(Output Tariff)$_{jt-1}\times$ State-owned Bank$_i$	–0.010	0.009
	(0.016)	(0.012)
Ln(Output Tariff)$_{t-1}\times$Ln(Deposits and Advances/Employee)$_b$	0.038*	
	(0.021)	
Ln(Output Tariff)$_{t-1}\times$Ln(Deposits and Advances/Employee)$_b$	–0.009***	
$\times$ State-owned Bank$_i$	(0.003)	
Ln(Output Tariff)$_{t-1}\times$Ln(Loans and Advances)$_b$		–0.020*
		(0.012)
Ln(Output Tariff)$_{t-1}\times$Ln(Deposits and Advances)$_b$		–0.002*
$\times$ State-owned Bank$_i$		(0.001)
Firm Controls$_{t-1}$	Yes	Yes
R-Square	0.539	0.493
N	19,403	29,276
Firm FE	Yes	Yes
Industry (3-digit)*Year	Yes	Yes

Notes: Columns (1) – (2) use logarithm of business investments. $Ln(OutputTariff)_{t-1}$ is lagged output tariffs at NIC 4-digit level. 'State-owned Bank' is a binary index that takes the value 1 if the firm has relationship with a domestic state-owned bank. 'Deposits and Advance/Employee' and 'Loans and Advances' are both a simple average across all the banks that a firm has relationship with in a particular year. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. All the regressions also control for all the other possible double interaction terms. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Table B6 Trade Liberalization and Business Investments: Number and Length of Banking Relationships

Dependent variable:	Business Investments							
	Number of Banking Relationships				Length of Banking relationships			
			Family Firms				Family Firms	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Output Tariff)$_{jt-1}$	0.441***	0.433***	0.468***	0.460***	0.481***	0.484***	0.489***	0.483***
	(0.083)	(0.084)	(0.086)	(0.085)	(0.089)	(0.087)	(0.089)	(0.088)
Ln(Output Tariff)$_{jt-1}$	–0.090***		–0.085***		–0.028***		–0.029***	
×Number(Length) of Banks$_i$	(0.012)		(0.011)		(0.004)		(0.005)	
Ln(Output Tariff)$_{t-1}$×		–0.084***		–0.080**		–0.024***		–0.025***
Number(Length) of State-owned Bank$_i$		(0.016)		(0.015)		(0.004)		–0.022***
Ln(Output Tariff)$_{t-1}$×		–0.099***		–0.093***		–0.023***		–0.022***
Number(Length) of other Bank$_i$		(0.021)		(0.020)		(0.006)		(0.045)
Ln(Output Tariff)$_{jt-1}$×Family$_i$			–0.057	–0.064			–0.025	0.016
			(0.041)	(0.043)			(0.050)	(0.045)
Ln(Output Tariff)$_{jt-1}$×Family$_i$			–0.009				0.003	
×Number(Length) of Banks$_i$			(0.006)				(0.003)	
Ln(Output Tariff)$_{jt-1}$×Family$_i$				–0.005				0.001
×Number(Length) of State-owned Bank$_i$				(0.008)				(0.003)
Ln(Output Tariff)$_{jt-1}$×Family$_i$				–0.014*				-0.003
×Number(Length) of other Bank$_i$				(0.008)				(0.003)
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.496	0.496	0.497	0.497	0.485	0.488	0.485	0.488
N	29,863	29,863	29,863	29,863	29,863	29,863	29,863	29,863
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) – (8) use logarithm of business investments of a firm as the dependent variables. Columns (1) – (4) look at the number of banking relationships a firm has, while columns (5) – (8) focus on the length of banking relationships of a firm. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. 'State-owned Bank' is a binary index that takes the value 1 if the firm has relationship with a domestic state-owned bank. 'Other Bank' is a binary index that takes the value 1 if a firm has relationship with a bank that is not state-owned. 'Family' is a binary index that takes the value 1 if the firm has positive ownership share of Hindu undivided families. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. All the regressions also control for all the other possible double interaction terms. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Table B7 Trade Liberalization and Business Investments: Banking Relationships Family firms — Social/Development View

Dependent variable:	Business Investments							
	R&D Intensive				External Financial Dependency			
	Above the Median		Below the Median		Above the Median		Below the Median	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:								
Ln(Output Tariff)$_{jt-1}$	1.047**	1.071***	0.515**	0.569***	0.849**	0.842***	0.506*	0.604**
	(0.491)	(0.415)	(0.206)	(0.191)	(0.360)	(0.322)	(0.280)	(0.271)
Ln(Output Tariff)$_{jt-1}$	–0.776	–0.812*	–0.180	–0.219	–0.536	–0.545*	–0.188	–0.341
×State-owned Bank$_i$	(0.495)	(0.417)	(0.160)	(0.151)	(0.360)	(0.318)	(0.244)	(0.244)
Ln(Output Tariff)$_{jt-1}$×Family$_i$	0.426	1.866	0.047	0.349	0.061	0.182	–0.103	–1.567*
	(0.725)	(2.250)	(0.321)	(0.339)	(0.533)	(0.994)	(0.672)	(0.907)
Ln(Output Tariff)$_{jt-1}$×State-owned	–0.671	–2.129	–0.005	–0.424	–0.229	–0.376	–0.341	1.254
Bank$_i$×Family$_i$	(0.768)	(2.334)	(0.328)	(0.315)	(0.567)	(1.081)	(0.680)	(0.958)
Panel B: Interpretations of the effects on different firm categories								
Family firm with state-owned banks	0.026***	–0.004**	0.377**	0.275*	0.145**	0.103**	–0.126**	–0.050*
Non-family firm with state-owned banks	0.271**	0.259**	0.335**	0.350**	0.313***	0.297***	0.318	0.263*
Family firm with other banks	1.473***	2.937**	0.562***	0.145**	0.910***	1.024**	0.403	-0.963**
Non-family firm with other banks	1.047**	1.071***	0.515**	0.569***	0.849**	0.842	0.506*	0.604**
Family Firm Indicator	Medium	Dominant	Medium	Dominant	Medium	Dominant	Medium	Dominant
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.521	0.521	0.502	0.502	0.529	0.528	0.466	0.465
N	15,710	15,710	13,445	13,445	19,291	19,291	10,185	10,185
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (2-digit)*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) – (12) use logarithm of business investments of a firm. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. 'State-owned Bank' is a binary index that takes the value 1 if the firm has relationship with a domestic state-owned bank. 'Medium' ('Dominant') is a binary index that takes the value 1 if the firm's ownership share of Hindu undivided families is greater than 30% (50%). Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. All the regressions also control for all the other possible double interaction terms. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Table B8 Trade Liberalization and Business Investments: Horse-race between Risk Taking Behaviour and Relationship to State-owned Banks

Dependent variable:	Business Investments					
	Family Firm			Family Network		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
Ln(Output Tariff)$_{jt-1}$	0.650***	0.735***	0.826***	0.488**	0.196	0.011
	(0.435)	(0.424)	(0.364)	(0.220)	(0.174)	(0.230)
Ln(Output Tariff)$_{jt-1}$×Risk Taker$_i$	–0.039	–0.204	–0.257	0.177	0.134	–0.986
×Family (Network)$_i$	(0.433)	(0.517)	(0.498)	(0.148)	(0.278)	(0.859)
Ln(Output Tariff)$_{jt-1}$×State-Owned Bank$_i$	0.672	–0.180	0.389	0.021	0.070	0.071
×Family (Network)$_i$	(0.546)	(0.448)	(0.752)	(0.061)	(0.061)	(0.064)
Ln(Output Tariff)$_{jt-1}$×Family (Network)$_i$	–0.396	0.119	–0.515	–0.453***	–0.466***	–0.284*
	(0.575)	(0.577)	(0.735)	(0.104)	(0.105)	(0.158)
Ln(Output Tariff)$_{jt-1}$×Risk Taker$_i$	–0.353	–0.319	–0.338**	0.148***	–0.002	0.061
	(0.259)	(0.242)	(0.141)	(0.053)	(0.055)	(0.156)
Ln(Output Tariff)$_{jt-1}$×State-Owned Bank$_i$	–1.006*	–0.550	–0.652**	–0.012	–0.007	–0.011
	(0.511)	(0.397)	(0.326)	(0.010)	(0.010)	(0.016)
Panel B: Interpretations of the effects on different firm categories						
Family firm & Risk Taker	0.415***	0.449***	-0.146***			
Family firm & State-Owned Bank	0.473***	0.242***	0.186			
Family Network & Risk Taker				0.360***	–0.138***	–1.198*
Family Network & State-Owned Bank				–0.044***	–0.207***	–0.213
Family Firms Indicators	Binary	Medium	Dominant	Binary	Medium	Dominant
Firm Controls$_{t-1}$	Yes	Yes	Yes	Yes	Yes	Yes
R-Square	0.498	0.501	0.499	0.509	0.526	0.557
N	19,501	19,501	19,501	12,468	4,786	1,650
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry (3-digit)*Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) – (6) use logarithm of business investments as the outcome variable. $Ln(OutputTariff)_{jt-1}$ is lagged output tariffs at NIC 4-digit level. 'Binary' is a binary index that takes the value 1 if the firm has positive ownership share of Hindu undivided families. 'Medium' ('Dominant') is a binary index that takes the value 1 if the firm's ownership share of Hindu undivided families is greater than 30% (50%). A firm belongs to 'Family Network' when it is a part of a business group or network within the set of family firms. 'Stand-out Family firm' is a firm which is not a part of a business group or a private Indian firm owned by a family. 'Risk Taker' is a binary index denoting a firm's risk-taking behaviour. We use standard deviation of the stock prices as an indicator of the total risk taken by a firm. A firm is a 'Risk Taker' if its standard deviation of the stock prices is above the median (of the standard deviation of the stock prices). 'State-owned Bank' is a binary index that takes the value 1 if the firm has relationship with a domestic state-owned bank. Firm controls include age of a firm, age squared, size (assets), and share of technology adoption in gross value added. Both assets and technology adoption are used in their real values (corrected for inflation using WPI). Technology adoption is the sum of R&D expenditure and technology transfer. All the regressions control for input tariffs and its different interactions. All the regressions also control for all the other possible double interaction terms. Numbers in the parentheses are robust standard errors clustered at the 4-digit industry level. ***, **, * denotes statistical significance at 1%, 5%, and 10%.

Appendix C

Cross-border M&A and the Performance of Acquirer

Figure C1 Balancing Statistics

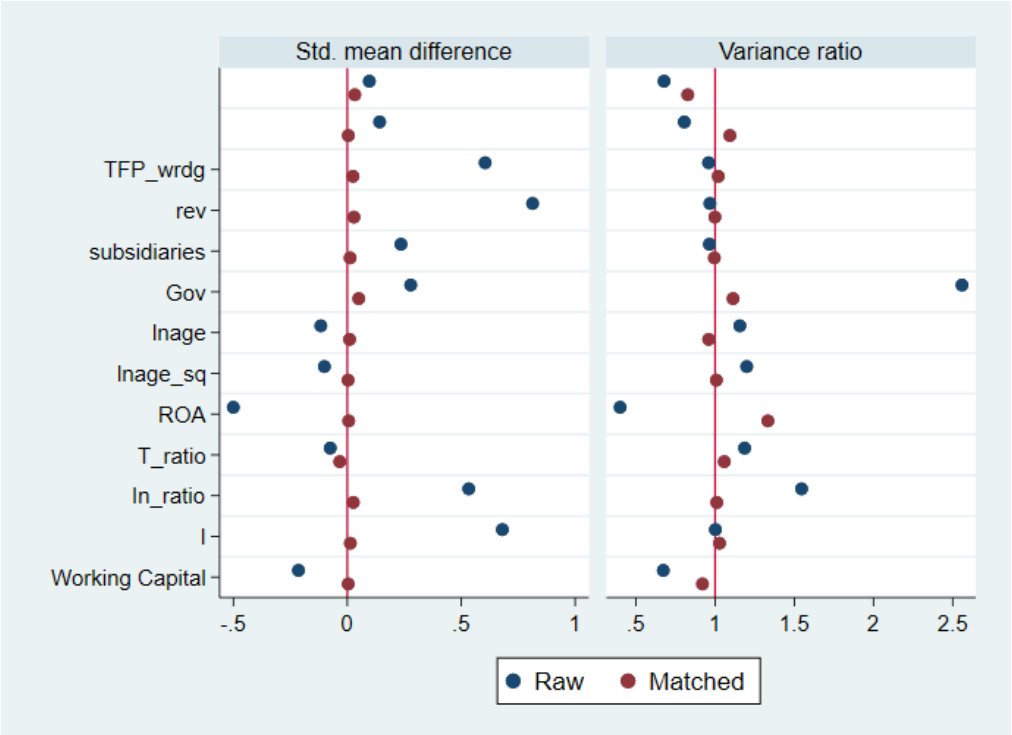

Table C1 Variables and Definition

Variable	Definition
Year	2005-2017
MA Year	The year when M&A deal finished
Value	the value acquires, USD in billions
Share	The ownership that acquired, %
For acquiring and target firm	
Firm	Firms' name
Country	Country code
ISIC	ISIC Rev.4 aggregated industry classification
Developed	=1 if firm is from developed countries;
	=0 if firms is from developing countries.
TFP_wrdg	Total factor productivity using Wooldridge (2009)
g_TFP_wrdg1	One year growth rate of TFP
g_TFP_wrdg2	Two years average growth rate of TFP
rev	Log of operating revenue/turnover
EMCOST	Employee expenses
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
va	Log of value added, va=log(EMCOST + EBITDA)
l	log of number of employees
subsidiaries	=1 if firm has foreign ultimate owned subsidiaries; =0 if not
Gov	=1 if firm is government owned; =0 if not
lnage	log of firm age, (age is calculated using year of operation)
lnage_sq	log of firm age square
ROA	Return on total assets
Assets	Total assets
T_ratio	Tangible assets/Total assets
In_ratio	Intangible assets/ Total assets
Working Capital	(Current assets - Current liability)/Total assets

Table C2 Balancing Test —- Using MDM

Variables	Sample	Mean			Variances		
		Treated	Control	StdDif	Treated	Control	Ratio
TFP	Raw	7.469	6.402	.605	3.043	3.173	.959
	Matched	7.469	7.446	**.013**	3.043	3.114	**.977**
Log Revenue	Raw	16.117	14.707	.813	2.957	3.057	.967
	Matched	16.117	16.102	**.008**	2.957	2.976	**.994**
Foreign Subsidiaries	Raw	.598	.481	.236	.241	.250	.965
	Matched	.598	.596	**.003**	.241	.241	**.999**
Government Owned	Raw	.117	.042	.278	.103	.040	2.559
	Matched	.117	.117	**0**	.103	.103	**1**
Log Age	Raw	3.455	3.568	-.116	1.009	.872	1.156
	Matched	3.455	3.440	**.016**	1.009	1.011	**.998**
$LogAge^2$	Raw	12.947	13.603	-.100	46.593	38.830	1.200
	Matched	12.947	12.842	**.016**	46.593	46.602	**1**
ROA	Raw	.703	1.041	-.501	.261	.652	.400
	Matched	.703	.713	**-.015**	.261	.265	**.986**
Tangible Asset Ratio	Raw	.290	.306	-.075	.051	.043	1.186
	Matched	.290	.292	**-.0118**	.051	.051	**1.010**
Intangible Asset Ratio	Raw	.221	.117	.533	.046	.030	1.546
	Matched	.221	.222	**-.003**	.046	.046	**1.002**
Log Employee Number	Raw	9.934	8.685	.681	3.368	3.361	1.002
	Matched	9.934	9.929	**.003**	3.368	3.313	**1.017**
Working Capital	Raw	.099	.135	-.214	.023	.034	.673
	Matched	.099	.098	**.005**	.023	.021	**1.042**

Table C3 Balancing Test —- Using PSW

Variables	StdDif		Variance Ratio	
	Raw	Weighted	Raw	Weighted
TFP	.605	**-.046**	.959	**.934**
Log Revenue	.813	**-.055**	.967	**.887**
Foreign Subsidiaries	.236	**-.013**	.965	**1.006**
Government Owned	.278	**-.016**	2.559	**.963**
Log Age	-.116	**.019**	1.156	**1.006**
$LogAge^2$	-.100	**.020**	1.200	**1.052**
ROA	-.501	**.027**	.400	**1.352**
Tangible Asset Ratio	-.075	**-.005**	1.186	**1.115**
Intangible Asset Ratio	.533	**-.034**	1.546	**.928**
Log Employee Number	.681	**-.050**	1.002	**.968**
Working Capital	-.214	**.035**	.673	**.932**

Table C4 ATT of Heterogeneous Treatment By Deal Features

	Full sample	Developed acquirers	Developing acquirers
Target firms country group			
Developed Countries	.0176**	.0086*	.0680
	(.0083)	(.0048)	(.0485)
Developing Countries	.0065	-.0017	.0045
	(.0061)	(.0065)	(.0075)
No.of obs	16483	13279	3204
Horizontal or Vertical			
Horizontal	.0146***	.0111**	.0236***
	(.0055)	(.0053)	(.0073)
Vertical	.0184	.0025	.0679
	(.0149)	(.0061)	(.0730)
No.of obs	16492	13284	3208
Ownership Acquired			
100% acquired	.0220**	.0111**	.0752*
	(.0089)	(.0049)	(.0470)
Not 100% acquired	.0077	.0064	.0067
	(.0063)	(.0061)	(.0067)
No.of obs	16492	13284	3208

Table reports probit coefficients followed by standard errors in parentheses
*, **, *** indicate statistical significance at 10, 5 and 1 % levels, respectively

Table C5 ATT of Heterogeneous Treatment by Target Firms' Market Performance

Market size categories	Full sample	Developed acquirers	Developing acquirers
1	.0036	.0007	.0175
	(.0100)	(.0102)	(.0291)
2	-.0103	.0010	-.0084
	(.0129)	(.0117)	(.0320)
3	.0356***	.0330***	.0314*
	(.0118)	(.0115)	(.0179)
4	.0043	.0072	.0293
	(.0084)	(.0074)	(.0404)
5	.0476	.0076	.2760***
	(.0468)	(.0081)	(.1033)
No.of obs	16166	13028	3138

Table reports probit coefficients followed by standard errors in parentheses

*, **, *** indicate statistical significance at 10, 5 and 1 % levels, respectively

Table C6 ATT of Heterogeneous Treatment by Target Firms' Productivity Performance

TFP categories	Full sample	Developed acquirers	Developing acquirers
1	.0081	.0107	-.0139
	(.0123)	(.0133)	(.0142)
2	.0077	.0142	-.0268**
	(.0108)	(.0115)	(.0121)
3	.0003	.0042	-.0119**
	(.0162)	(.0160)	(.0047)
4	.0574**	.0302**	.0482**
	(.0278)	(.0138)	(.0215)
No.of obs	16072	12964	3108

Table reports probit coefficients followed by standard errors in parentheses

*, **, *** indicate statistical significance at 10, 5 and 1 % levels, respectively

Table C7 ATT of Heterogeneous Treatment by Target-Acquirer Productivity Gap

Productivity gap categories	Full sample	Developed acquirers	Developing acquirers
1	-.0041	-.0043	-.0110
	(.0057)	(.0060)	(.0092)
2	.0130**	.0138**	-.0108
	(.0059)	(.0059)	(.0085)
3	.0086	.0075	-.0198
	(.0060)	(.0053)	(.0422)
4	.0002	.0021	.0473***
	(.0157)	(.0116)	(.0113)
No.of obs	16072	12964	3108

Table reports probit coefficients followed by standard errors in parentheses

*, **, *** indicate statistical significance at 10, 5 and 1 % levels, respectively