UNIVERSITY OF SOUTHAMPTON

FACULTY OF SOCIAL SCIENCES
SOUTHAMPTON BUSINESS SCHOOL

Six Empirical Essays on Firm Performance and Internationalization (Foreign Direct Investment and Trade)

by

Xiao Long Chen

Main Supervisor: Professor Tapas Mishra
Supervisor: Associate Professor Marta Degl'innocenti
Internal Assessor: Dr Soumyatanu Mukherjee
External Evaluator: Professor Prasad Sankar Bhattacharya

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Abstract

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This thesis theoretically and empirically explores firm performance mostly when firms conduct international operation by linking internal, external, direct, and indirect factors, including five-country components including human capital, institution, market competition, cluster development, and market size, export behaviors based on productivity cut-off, horizontal, backward and forward FDI agglomerations, the dynamic effect between FDI and trade, financial constraints in R&D investment, and the "black box" of firm efficiency. This thesis consists of six core chapters (Chapter 2-7) related to micro and macro studies. The study samples used in this thesis include the cross-sectional data obtained from 234 previous empirical studies in terms of firm performance and internationalization during the period 1969-2017 in Chapter 2, the panel data of 208,424 Chinese firms during the period 2005-2007 in Chapter 3, the panel data of 12,240 Chinese firms during the period 2010-2013 in Chapter 4, the panel data of China's 151 target countries during the 2007-2017 period in Chapter 5, the panel data of 414 British manufacturing firms during the period 2009-2018 in Chapter 6, and the panel data of 123 British listed manufacturing firms during the period 2006-2018 in Chapter 7. Due to the different study purposes in the six chapters, the study

data used in this study are from various data resources and different timelines. Even if this study uses the same database, such as China's Annual Industry Survey Database in Chapter 3 and Chapter 4, this study also uses a different timeline because of the non-availability of data for a consistent panel of firms. Furthermore, the analytic methods correspondingly used in this thesis mainly involve the comparative MAR with VWLS, Heckman two-stage procedure with Probit and Tobit models, analytical method of ROC, spatial econometric model, global PCA and system GMM, heterogeneity SFA with one stage, and two-stage (DEA and Tobit) model and three-stage (DEA-SFA) model.

There are multiple insight findings in this thesis. In Chapter 2, the five-country components, including human capital, institution, market competition, cluster development, and market size, substantially mediate the I-P relationship. Furthermore, the five-country components exert a positive mediating effect on the I-P relationship in developed countries while negatively mediating the I-P relationship in developing countries. In Chapter 3, productivity is likely to impact on firm's export propensity and irregular export positively. In contrast, it negatively affects the firm's export intensity and does not impact the firm's regular export. Enhancing productivity cut-off is not conducive to the firm's export propensity and regular export while it does not affect the firm's export intensity and irregular export. Productivity cut-off tends to impact on firm's export decision rather than its export scale.

Moreover, firms with regular export are more sensitive to productivity cut-off than firms with irregular export. In Chapter 4, the congestion effect (inverted U-shaped relationship) dominates the three types of FDI agglomerations on the local firm's productivity. The congestion effect also dominates the spatial backward and forward FDI agglomerations on neighboring firms' productivity, while a U-shaped relationship dominates the spatial horizontal FDI agglomeration on neighboring firms' productivity. Furthermore, the interaction intensity of backward and forward FDI agglomerations with local and neighboring firms is similar and much stronger than horizontal FDI agglomeration.

In Chapter 5, China is more likely to conduct horizontal FDI in developed countries, while vertical FDI in developing countries. There is a dynamic change from the substitution effect of FDI on export to the complementary effect of FDI on export along with the decreasing trend of horizontal motivation and the increasing trend of vertical motivation. In Chapter 6, the firm's financial constraints in R&D have a vital impact on its productivity and future financing uncertainty and show a difference in low, middle, and high-tech industries. Furthermore, the loss of firm productivity is about 20% due to its financial constraints in

R&D investment. In Chapter 7, the firm's technical, pure technical, and scale efficiencies reach a relatively high level (between 0.93 and 1) while its operational efficiency (between 0.65 and 0.7) and profitability efficiency (between 0.85 and 0.9) have a large room to improve. Moreover, the overall environment has a significant impact on firm efficiency in middle and high-tech industries than that in the low-tech sector. Therefore, the various findings in the six core chapters provide important implications for government policies and firm's domestic and foreign operations.

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List of Abbreviations

DEA	Data Envelopment Analysis
DMU	Decision-Making Unit
FAT	Funnel Asymmetry Testing
FDI	Foreign Direct Investment
FAME	Financial Analysis Made Easy
GDP	Gross Domestic Product
GLS	General Least Square
GMM	Generalized Method of Moments
I-P	Internationalization-Performance
i.i.d	Independent Identically Distributed
KMO	Kaiser-Meyer-Olkin
LR	Likelihood Ratio
MAR	Meta Regression Analysis
MEA	Multi-Directional Efficiency Analysis
ML	Maximum Likelihood
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
PEESE	Precision-Effect Estimate with Standard Error
PET	Precision Effect Testing
PPML	Poisson Pseudo Maximum Likelihood
PTE	Pure Technical Efficiency
R&D	Research and Development
RCA	Revealed Comparative Advantage
ROA	Return on Asset
ROC	Receive Operating Characteristic
ROE	Return on Equity
ROS	Return on Sale
SE	Scale Efficiency
SEM	Structure Equation Modelling
SFA	Stochastic Frontier Analysis
SLS	Stages Linear Square
SIC	Standard Industrial Classification
TE	Technical Efficiency
TFP	Total Factor Productivity
UN	United Nation
UNCTAD	United Nations Conference on Trade and Development
VIF	Variance Inflation Factor
VWLS	Variance Weight Linear Square

List of Appendices

Declaration of Authorship

I, Xiaolong Chen, declare that this thesis and the work presented in it is my own and has been generated by me as the result of my own original research.

I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University;
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- Where I have consulted the published work of others, this is always clearly attributed;
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
- I have acknowledged all main sources of help;
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;

Signature: .....Date:.....

Acknowledgments

Time flies like a fleeting horse！ At this moment, I nearly finish my Ph.D. study. My growth in every step during the Ph.D. study process always involves my family members and supervisors' painstaking effort and sweat. I am deeply grateful to the whole people who care and support me during my Ph.D. study.

I would like to express my sincere gratitude to my two supervisors and one previous supervisor, Professor Tapas Mishra, Associate Professor Marta Degl'innocenti, and Professor Laura A Costanzo, for their comments, suggestions, enthusiasm, and encouragement.

I also need to take the opportunity to say "thank you" to my parents and sister, Mr. Chen Wu, Mrs. Chen Shaolan, and Mrs. Chen Xiaoyan, who live and do small business in Argentina and give the financial and emotional support to me. I also need to say "thank you"to my wife, Mrs. Chen Liling who always accompanies me in the UK no matter whether I am happy or upset. Finally, I also need to say "thank you" to many of my other family members who live in the UK and care for me, especially when I was sick.

Saying goodbye to the University of Southampton, gently I flick my sleeves, not even a wisp of cloud will I bring away! I once again back up my bags and set off on a new journey.

To My Family Members Especially My Parents, Sister and Wife

‘‘Productivity isn’t everything, but in the long run it is almost everything’’

—Nobel Laureate Paul Krugman

Chapter 1

Introduction

1.1 Research Significance

This thesis theoretically and empirically explores firm performance, especially when firms conduct internationalization (FDI and trade), which links the internal, external, direct, and indirect impact factors that relate to country components, export behaviors, horizontal, backward, and forward FDI agglomerations, the dynamic effect between FDI and trade, financial constraints in R&D investment, and the "black box" of firm efficiency. It is worth noting that there are various ways to measure firm performance, such as return on assets (ROA), productivity, and firm efficiency, which is shown in this thesis. Although this thesis develops to explore multiple directions, it jointly returns to address the core issue of firm performance, which commonly contributes to business and economics. Krugman (1994) says, "Productivity is not everything, but in the long run, it is almost everything." Improving firm performance or productivity can help a firm better perform in the domestic and international market, obtain more benefits, and then promote a country's economic development. These macro and micro studies have important implications for government policies and firms' domestic and foreign operations. Therefore, this thesis is characterized by both academic and practical significance.

1.2 Research Aims

This thesis aims to combine multi-disciplinary views to solve the specific issues of how to improve firm performance. This thesis consists of six core chapters. The specific aim of each chapter is shown as follows:

The research aim of Chapter 2 is to combine resource, institution, and competitiveness-based views to explore the mediating effect of five-country components (human capital, institution, market competition, cluster development, and market size) on firm performance of

internationalization by employing the meta-regression analysis (MAR) with variance weight linear square (VWLS).

The research aim of Chapter 3 is to explore the effect of productivity cut-off on a firm's export propensity, export intensity, irregular export, and regular export by employing the Heckman two-stage procedure with Probit and Tobit models and the analytic method receiver operating characteristic (ROC).

The research aim of Chapter 4 is to expand the literature on industry agglomeration to explore the non-linear and spatial effect of horizontal, backward, and forward FDI agglomerations on firm productivity by employing the spatial econometric model with random effect.

The research aim of Chapter 5 is to explore the dynamic effect of FDI on export along with the decreasing tendency of horizontal motivation and the increasing trend of vertical motivation by employing the global principal component analysis (PCA) and generalized method of moments (GMM).

The research aim of Chapter 6 is to develop the theoretical model of the financial constraints in research and development (R&D) investment, uncertainty, and firm productivity and test it by employing the heterogeneity stochastic frontier analysis (SFA) with a one-stage approach.

The research aim of Chapter 7 is to develop a conceptual framework for firm efficiency and uncover the "black box" of firm efficiency by combining the two-stage with data envelopment analysis (DEA) and Tobit models and three-stage with DEA and stochastic frontier analysis (SFA) models.

1.3 Research Objectives

The research aim of each core charter in this thesis can be further divided into specific research objectives shown as follows:

Chapter 2:

- To identify the five-country components that moderate on the I-P relationship through a theoretical exploration.
- To empirically quantify the mediating effect of five country components on the I-P relationship by using the MAR with VWLS.
- To further compare the mediating effect of five-country components on the I-P relationship between developing and developed countries by standardizing data.
- To provide the significant implications for government policies that help firm better conduct internationalization by improving these country components.

Chapter 3:

- To theoretically interpret the four types of firm behaviors, including export propensity, export intensity, irregular export, and regular export.
- To measure productivity cut-off by using the analytic method of ROC
- To empirically quantify the effect of productivity cut-off on a firm's behaviors by using the Heckman two-stage procedure with Probit and Tobit models.
- To afford the crucial implications for the firm's international operation.

Chapter 4

- To theoretically explain the effect of the horizontal, backward, and forward FDI agglomerations on firm productivity.
- To build the new indices of horizontal, backward, and forward FDI agglomerations that can well capture the three types of FDI agglomeration and overcome the measurement bias due to the difference in absolute economy scale of different regions in China

- To empirically quantify the non-linear and spatial effect of horizontal, backward, and forward FDI agglomerations on firm productivity.
- To provide important implications for government policies that reasonably induce FDI and alleviate the congestion effect of FDI agglomeration in regions and industries.

Chapter 5:

- To theoretically illustrate the effect of FDI on trade.
- To rank the target countries based on the tendency of horizontal and vertical FDI by employing the global PCA approach.
- To empirically quantify the dynamic effect of FDI on trade along with the decreasing tendency of horizontal motivation and the increasing trend of vertical motivation by using Poisson pseudo maximum likelihood (PPML) estimation.

Chapter 6:

- To illustrate the theoretical derivation of financial constraints in R&D investment, uncertainty, and productivity.
- To estimate to what extent financial constraints in R&D investment impact firm productivity, productivity loss, and future financing uncertainty using the heterogeneity SFA with a one-stage approach.
- To further investigate the differences in the effect of financial constraints in R&D investment on firm productivity, productivity loss, and future financing uncertainty in the low, middle, and high-tech industries.
- To provide significant implications for helping firms combine internal and external financing to transform the R&D investment into its productivity.

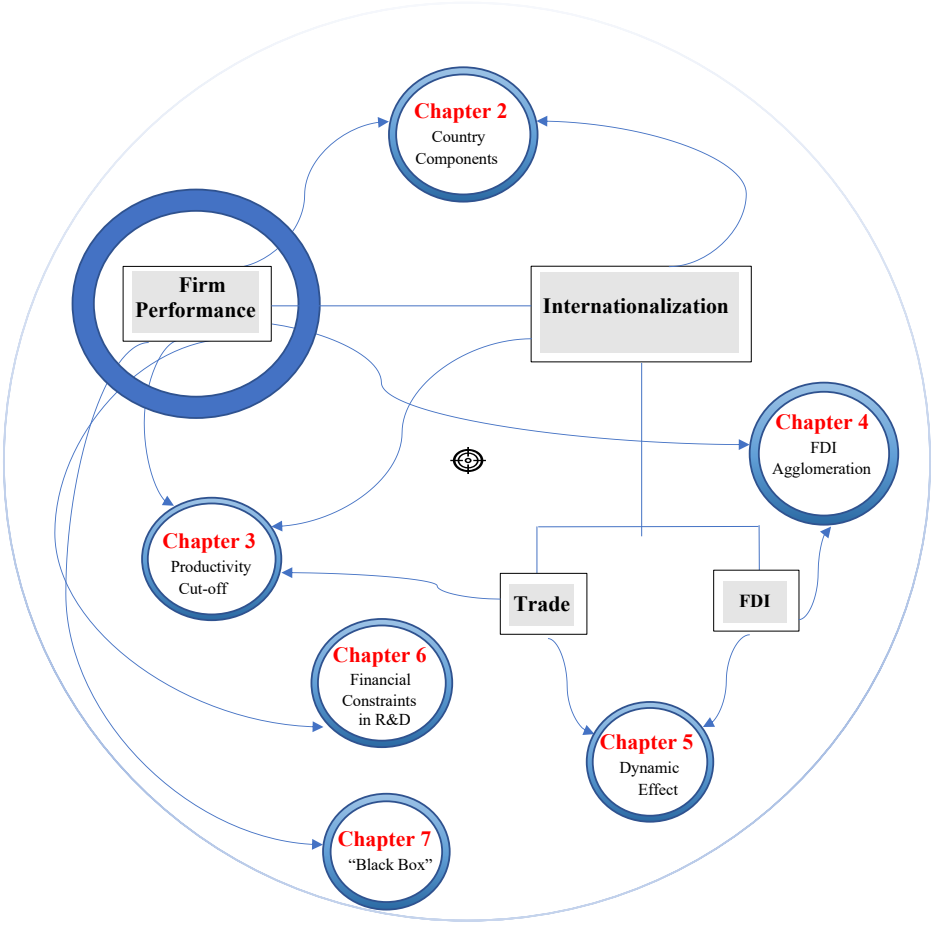
Chapter 7

- To develop a conceptual framework for firm efficiency.
- To gauge the values of unadjusted and adjusted operational efficiency, profitability efficiency, technical efficiency, pure technical efficiency, and scale efficiency by using the three-stage (DEA-SFA) model.
- To further quantify the effect of external environmental factors on firms' technical efficiency in the low, middle, and high-tech industries by using the two-stage (DEA-Tobit) model
- To provide important implications for local government and firms to improve firm efficiency and then enable firms to make more profits and better compete in the domestic and foreign markets.

1.4 Thesis Structure

This thesis structure focuses on firm performance (productivity), especially when firms conduct international operation (FDI and trade) by linking the multiple internal, external, direct, and indirect factors, including country components, export behaviors based on productivity cut-off, FDI agglomeration, dynamic effect between FDI and trade, financial constraints in R&D investment, and the "black box" of firm efficiency through theoretical and empirical investigations. It integrates multi-discipline knowledge into a framework and adopts a rigorous study process of theoretical exploration, modeling, and empirical test, which attempts to extend multiple directions while commonly returning to solve the core issue of improving firm performance. The overview of this thesis structure is shown in Figure 1.1. Moreover, the abstracts of the six core chapters and conclusion chapter are illustrated in the following sections.

Figure 1.1: Thesis structure with six empirical essays



1.4.1 Chapter 2: The Effect of Country Components on Firm's Internationalization-Performance Relationship: A Comparative Meta-Analysis

This study combines resource, institution, and competitiveness-based views to explore the mediating effect of the five-country components, including advanced factor (human capital), institution, market competition, cluster development, and market size on the I-P relationship. This study further investigates its difference and priorities of importance in the samples of firms from developing and developed countries. This study employs the MAR with VWLS based on 234 independent studies that include 99,398 firms and 34 economies (32 countries and 2 regions) during 1969-2017. The regression results show that the whole country

components positively affect the I-P relationship except for market size that exerts a negative effect. Furthermore, the five-country components are identified as the advantageous factors for the firm performance of internationalization in developed countries, while the disadvantageous factors for the firm performance of internationalization in developing countries. The priorities of the five-country components that moderate the I-P relationship are different in the firms from developed and developing countries. The findings provide some critical implications for firms and governments to maximize the advantageous factors to improve firms' capability and strategic resources or minimize the disadvantageous factors to constrain their capabilities and strategic resources in the firm's international expansion.

Keywords: Country component · internationalization · performance · meta-analysis

1.4.2 Chapter 3: The Study of Chinese Firm's Export Behaviors: A Perspective of Productivity Cut-Off

This study employs the Heckman two-stage procedure with Probit and Tobit models and the analytic method of ROC to explore the effect of productivity cut-off on a firm's export behaviors, including export propensity, export intensity, irregular export, and regular export by using the data of 208,424 Chinese firms during the period 2005-2007. Productivity is likely to impact on firm's export propensity and irregular export positively. In comparison, it exerts a negative effect on a firm's export intensity and does not impact its regular export. Enhancing productivity cut-off is not conducive to the firm's export propensity and regular export while it does not affect the firm's export intensity and irregular export. Productivity cut-off tends to impact firm export decisions rather than export scale. Moreover, firms with regular export are more sensitive to productivity cut-off than firms with irregular export.

Keywords: Productivity cut-off · export behavior· Heckman two-stage procedure · receive operating characteristic

1.4.3 Chapter 4: The Congestion Effect of Foreign Direct Investment's Agglomeration on Firm Productivity in China: A Spatial Analysis

This study expands the literature on industry agglomeration to explore the non-linear and spatial effects of horizontal, backward, and forward FDI agglomerations on domestic firms' productivity by employing a spatial econometric model with a random effect based on the data 12,240 firms covering the period 2010-2013. This study also identifies that the congestion effect (inverted U-shaped relationship) dominates the three types of FDI agglomerations on local firm productivity. This study also identifies the congestion effect dominating the spatial backward and forward FDI agglomerations on neighboring firms' productivity while the U-shaped relationship between spatial horizontal FDI agglomeration and local firm's productivity. This study further captures that the interaction intensity of backward and forward FDI agglomerations with local and neighboring firms is similar and more robust than horizontal FDI agglomeration. The empirical findings provide some important implications for the region and industry policies.

Keywords: FDI agglomeration · productivity · spatial econometrics · geography · China

1.4.4 Chapter 5: The Dynamic Effect of Foreign Direct Investment on Export: The Evidence from China

This study explores the dynamic effect of China's FDI on its export by employing the global PCA, PPML methods, and Hausman-Taylor methods and using the panel data of 151 target

countries during 2007-2017. The results of global PCA show that China is more likely to conduct horizontal FDI in developed countries while vertical FDI in developing countries. Using PPML estimation displays the dynamic effect between FDI and export along with the decreasing tendency of horizontal motivation and the increasing trend of vertical motivation. Thus, this study confirms that the complementarity effect of FDI on export is the dominant role in the case of China. The findings provide some important implications for Chinese firms and government policy.

Keywords: Export · FDI · dynamic effect · PPML · global PCA · China

1.4.5 Chapter 6: Financial Constraints in R&D Investment, Uncertainty, and Productivity: The Evidence from British Manufacturing Firms

This study investigates the financial constraints in R&D investment, uncertainty, and productivity in British manufacturing firms. Cash flow (external financing) does not impact the financial constraints in R&D investment. Whereas the increase in debt (internal financing) can enhance the financial constraints in R&D investment and then reduce firm productivity. Moreover, there is a significant difference in low, middle, and high-tech industries. The loss of the firms' productivity is about 20% due to the financial constraints in R&D investment. In addition, firm productivity displays an upward trend during the period 2009-2018. The findings have crucial implications for the improvement of firm productivity.

Keywords: Financial constraint · production function · productivity · Heterogeneous SFA · R&D

1.4.6 Chapter 7: Investigating the Efficiency of British Listed Manufacturing Firms: What Is a Matter in the "Black Box" ?

This study tries to uncover the "black box" that is a matter for firm efficiency using 123 British listed manufacturing firms during 2006-2018. The overall environment gradually deteriorates, especially since 2015. The firm's technical, pure technical, and scale efficiencies reach a relatively high level (between 0.93 and 1) while its operational efficiency (between 0.65 and 0.7) and profitability efficiency (between 0.85 and 0.9) have a large room to improve. Moreover, the overall environment significantly impacts firm efficiency in middle and high-tech industries than firm efficiency in the low-tech sector. The findings have important implications for the self-checking of firm efficiency and the implementation of government policy.

Keywords: Technical efficiency · DEA · SFA · Tobit model · environmental factor · British firm

1.4.7 Chapter 8: Conclusions

Chapter 8 consists of three sections. Section 8.1 presents the concluding remarks and relevant implications for government policies and domestic and foreign operations. Section 8.2 outlines the outputs beyond academic research during my Ph.D. study, followed by Section8.3 of research limitations and future research directions.

Chapter 2

The Effect of Country Components on Firm's Internationalization-Performance Relationship: A Comparative Meta-Analysis

2.1 Introduction

The topic in terms of a firm's Internationalization-Performance (I-P) relationship is ongoing dialogues among scholars in business and management fields during the past four decades. Previous empirical studies exhibit inconsistent results that mainly include positive and negative linear, U-shaped, and inverted U-shaped and horizontal S-shaped I-P relationships (Goerzen & Beamish, 2003; Contractor et al., 2007; Qian et al., 2010; Singla & George, 2013; Oh & Contractor, 2014). The conflicting results may stem from the moderators and control of firm, industry, and country-level variables, estimation methods, and the measurements of I-P (Chang & Thomas, 1989; Qian, 2002; Kotabe et al., 2002; Ruigrok & Wagner, 2003; Boehe & Jiménez, 2016; Marano et al., 2016). Therefore, meta-analysis is a powerful tool to explore the relevant topic by examining and controlling the bias based on the broad information of previous empirical studies in terms of the I-P. Meta-analytic studies (e.g., Ruigrok & Wagner, 2004; Bausch & Krist, 2007; Kirca et al., 2011; Kirca et al., 2012; Yang & Driffield, 2012; Essen et al., 2015; Marano et al., 2016) have explored it. These meta-analytic studies do not systematically consider what components in a country moderate the firm performance of internationalization and their difference and priorities of their importance. According to resource, institution, and competitiveness-based views, this study finds five-country components, including advanced factor (human capital), institution, market competition, cluster development, and market size, moderating on I-P relationship. Thus, this study attempts to answer three main questions: First, what are the mediating effects of the five-country components on the I-P relationship? Second, what are the difference between the samples of the firms from developing and developed countries? Third, what are the priorities of their positive or negative importance?

This study employs the meta-regression analysis (MRA) with variance weight linear square (VWLS) based on a large sample of 234 individual studies during the period 1969-2017 covering 32 countries and 2 regions (Hong Kong and Taiwan). This study combines resource,

institution, and competitiveness-based views to develop the conceptual model about the mediating effect of the five-country components on the I-P relationship. The explanation is that the five-country components improve or constrain the firm's different capabilities and strategic resources and then impact the firm performance of internationalization. The empirical results show that these country components have a positive mediating effect on the I-P relationship except for market size that negatively affects it. Moreover, the effect shows a significant difference between developing and developed countries. The five-country components are the advantageous factors for a firm's internationalization performance in developed countries, while they are disadvantageous factors for that in developing countries. This study further investigates the priorities of their importance and finds a significant difference in developing countries or developed countries. Therefore, this study conducts horizontal and vertical comparisons between developing and developed countries. The findings have important implications for a firm's internationalization strategies and government policies in developed and developing countries.

The structure of this study is shown as follows. In addition to Section 2.1 Introduction, Section 2.2 reviews relevant literature, followed by hypothesis development in Section 2.3. Section 2.4 illustrates the research methodology (data collection and sample, analytic specification, and the measurements of variables). Section 2.5 and Section 2.6 relate to empirical findings and discussion, respectively. Finally, Section 2.7 draws conclusions and links to the implications for a firm's strategy of internationalization and government policies.

2.2 Literature Review

The theories of firm internationalization have well-distinguished the explanation of firm internationalization for both developing and developed countries. The early theories of firm internationalization such as the theory of product life cycle suggested by Vernon (1966), monopoly advantage theory suggested by Hymer (1976), internalization theory suggested

by Buckley & Casson (1976), and the eclectic theory of international production suggested by Dunning (1977) can reasonably interpret the internationalization of firms from developed countries rather than developing countries. For example, product life cycle theory is based on a dynamic perspective to explore the shifts in international investment and trade by combing the product life cycle to investigate the investment of American manufacturing firms in western countries. However, this study is deficient and cannot sufficiently explain the phenomenon of developing countries' firm in developed countries. The monopoly advantage theory applies market imperfection to explore international capital flow. The theory cannot interpret why firms must conduct foreign direct investment (FDI) instead of export and the phenomenon that firms from developing countries without specific advantages can directly invest in developed countries. Therefore, some theories of firm internationalization, such as small-scale technology theory proposed by Well (1983), technology location theory proposed by Lall (1983), and the theory of technology innovation and industry upgrade proposed by Cantwell & Tolentino (1990), shift to explore the situation of the internationalization of firms from developing countries rather than developed countries. Besides, some theories of firm internationalization, such as the Uppsala model proposed by Johanson &Valhle (1977), transaction cost theory proposed by Williamson (1985), international network theory proposed by Johanson & Mattson (1986), four-factor model proposed by Pedersen & Petersen (1998), and resource advantage theory proposed by Hunt (2002), tend to be neutral and can well interpret both situations of the internationalization of firms from developing and developed countries.

Based on the solid development of the theories of firm internationalization, previous empirical studies introduce different perspectives such as resource, knowledge, institution, and learning perspectives to explore the I-P relationship. Furthermore, the intrinsic analysis of different relationships should focus on internationalization benefits (positive linear I-P relationship), internationalization costs (negative linear I-P relationship), and the trade-off between internationalization benefits and costs (U-shaped, inverted U-shaped, and

horizontal S-shaped I-P relationships). Internationalization benefits are mainly associated with economies scale and scope through pursuing foreign markets especially when domestic market is small (Hymer, 1976; Kogut, 1985; Porter, 1986; Grant et al., 1988; Tallman & Li, 1996; Caves, 1996; Ruigrok, 2007). Firms have opportunities to explore and exploit their firm-specific asset due to imperfections in foreign products and factors market (Caves, 1971; Buckley & Casson, 1976; Williamson, 1979; Thomas & Eden, 2004). Firms geographically distribute their value chain activities across overseas countries to enhance operational flexibility and reduce operational risks, which firms can minimize the effect of fluctuations in factor and reasonable prices and interest rate, choose source sites and production location and prevent the variation of supply and demand (Rugman, 1981; Kogut, 1985; Kim et al., 1993; Mitchell et al., 1993; Qian, 1996; Ramirez-Aleson & Antinio, 2001; Baek, 2004). Firms can seek low input costs such as low labor and material costs in the host country and improve the knowledge base and capabilities through organizational learning (Daniels & Bracker, 1989; Zahra et al., 2000; Ruigrok, 2007; Contractor et al., 2007; Hsu & Pereira, 2008). Besides, multinational firms with large size possess a greater bargaining and market power than their domestic rivalries (Kim et al., 1993; Thomas & Eden, 2004; Lu & Beamish, 2004; Hennart, 2007; Qian et al., 2010).

However, firms encounter the liability of foreignness and newness when they conduct internationalization because of the heterogeneity of foreign environment (Stinchcombe & March, 1965; Hymer, 1976; Zaheer & Mosakowski, 1997; Johanson & Vahlne, 2009; Qian & Rugman, 2013). The increase of firm's coordination, transaction, governance, and control costs is associated with increasing geographical diversification and multinationality (Jones & Hill, 1988; Rosenzweing & Singh, 1991; Hitt et al., 1997; Xu & Shenkar, 2002; Contractor et al., 2003; Lu & Beamish, 2004; Ruigrok & Wagner, 2007; Eckert, 2010). Agent problem stems from information asymmetry and becomes more severe when firms expand into the complex international environment (Lee & Knok, 1988; Morck et al., 1990; Burgman, 1996;

Sanders & Carpenter, 1998). Furthermore, managers with limited capabilities tare difficult to adjust to the international environment (Grant, 1987; Stulz, 1990; Contractor et al., 2007).

A mass of previous empirical studies focuses on developed countries, while more and more empirical studies tend to pay attention to developing countries. The main results of previous empirical studies include a positive linear relationship (e.g., Geringer et al., 1989; Tallman & Li, 1996; Zahra et al., 2000; Wan & Hoskisson, 2003; Goerzen & Beamish, 2003; Carpenter & Sanders, 2004; Elango & Sethi, 2007; Hsu & Pereira, 2008; Hashai, 2015), a negative linear relationship (e.g., Siddharthan & Lall, 1982; Geringer et al., 2000; Kim et al., 2004; Kim et al., 2010; Chen & Tan, 2012; Singla & George, 2013; Dau, 2013; Elango et al., 2013), a U-shaped relationship (e.g., Lu & Beamish, 2001; Capar & Kotabe, 2003; Ruigrok & Wagner, 2003; Nachum, 2004; Thomas, 2006; Lu & Beamish, 2006; Contractor et al., 2007; Gaur & Kumar, 2009; Yang et al., 2013; Madaleno et al., 2018), an inversed U-shaped relationship (e.g., Hitt et al., 1997; Aulakh et al., 2000; Chiao et al., 2006; Qian et al., 2008; Chao & Kumar, 2010; Chen & Hsu, 2010; Qian et al., 2010; Li et al., 2012 ; Gaur & Delios, 2015; Kirca et al., 2016; Mohr & Batsakis, 2017) and an S-shaped relationship (e.g., Contractor et al., 2003; Lu & Beamish, 2004; Chang &Wang, 2007; Ruigrok et al., 2007; Lavie & Miller, 2008; Oh & Contractor, 2014; Tsai, 2014; Boehe & Jiménez, 2016; Benito-Osorio et al., 2016; Thi Ngoc Huynh et al., 2018; Huang & Marciano, 2020).

The conflicting results may stem from the moderators and control of firm, industry, and country-level variables, estimation methods, and the measurements of I-P (Chang & Thomas, 1989; Qian 2002; Kotabe et al., 2002; Ruigrok & Wagner, 2003; Boehe & Jiménez, 2016; Marano et al., 2016). It seems that a simple empirical study is a little power to solve the inconsistent results presented in previous empirical studies. Therefore, this study employs the systematic analytical method to comprehensively diagnose and control these heterogeneities, resulting in conflicting results in previous empirical studies. There is no doubt that meta-analysis is the most powerful analytical method to address this issue. There

are several meta-analysis studies about I-P. Ruigrok & Wagner (2004) explore moderators' presence and find that the effect of internationalization on firm performance relies on contexts such as firm size and nationality. Moreover, they develop an exploratory framework to integrate object, goal, pace & rhythm of internationalization, scale, scope, and mode into potentially significant moderators that impact the I-P relationship. Bausch & Krist (2007) focus on context-related moderators that influence the I-P relationship and try to reconcile the fragmented results with direction and magnitude in previous empirical studies. Their study shows consistent findings with Ruigrok & Wagner (2004) that corroborate a positive I-P relationship at an aggregate level. Moreover, their study reveals that the I-P relationship is coordinated by context-related moderators, including firm age, firm size, R&D, and country origin. Kirca et al. (2012) investigate the role of context and find that the firm's strategic motivations, type of multinationality, industry characteristics, and country factors show the mediating effect on the I-P relationship.

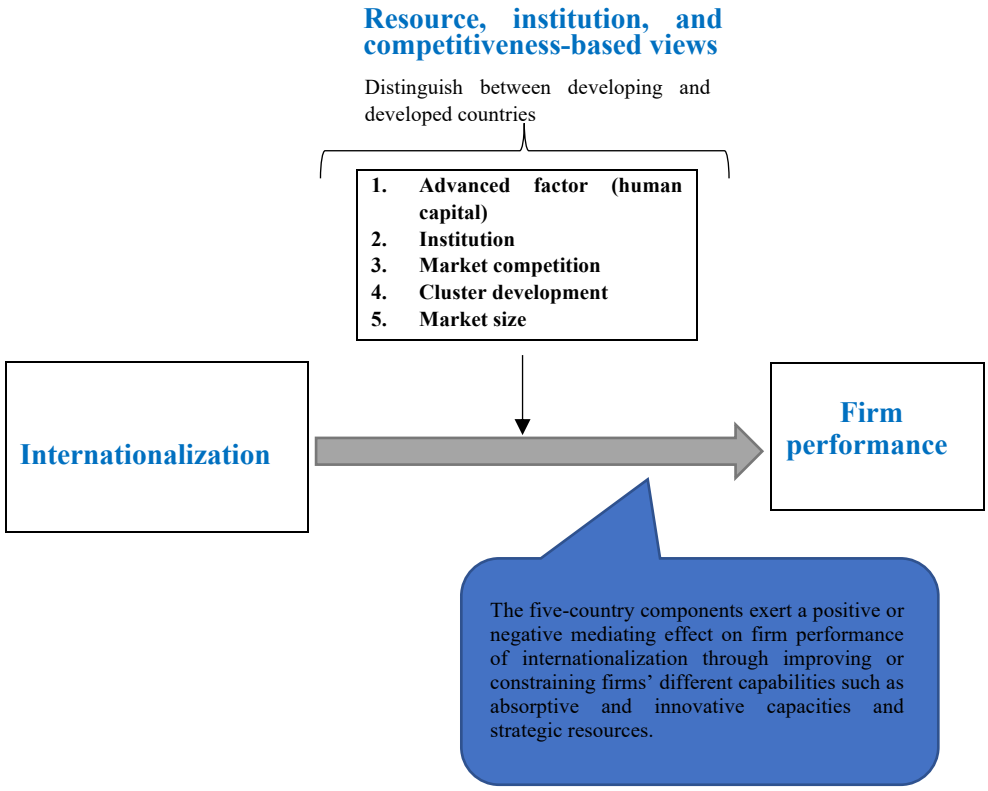
Kirca et al. (2011) explore firm-specific assets that moderate the effect of internationalization on firm performance. The findings show that firms can obtain higher returns in the international market by transferring firm-specific assets through an effective organizational form provided by multinationality. Yang & Driffield (2012) pay attention to the research method heterogeneity, including I-P measurements, sample heterogeneity, and period time. The main findings show that non-US firms have higher return to internationalization than US firms in U-shaped relationship rather than inversed U-shaped relationship. Essen et al. (2015) analyze the impact of family control on firm strategy and performance. In their findings, the balance of evidence displays that listed family firms have better performance than other types of public firms. Furthermore, they also find that the performance of listed family firms rapidly goes down after the first generation, and conservative strategic decision-making results in a negative impact on performance. Marano et al. (2016) develop a theoretical logic based on the strategic perspective of an institution to interpret the impact of home country institution's embeddedness on the strength of the I-

P relationship. Furthermore, their study displays the importance of embedding the firm's institutions in analyzing the I-P relationship.

Previous empirical studies and meta-analytic studies in terms of I-P do not systematically consider what components in a country moderate firm performance of internationalization and their difference and priorities of importance. It is not enough to consider an institution or other single factors as a matter of a country for the firm performance of internationalization. Firms cannot build their core competencies from a vacuum by overemphasizing the role of institutions and neglecting other country factors, and need to combine different country resources for competition (Wan & Hoskisson, 2003; Wan, 2005). Porter's model relates to production factors, demand condition, relevant and supporting industries, market competition, and government role, which consists of a country's competitiveness and has an essential impact on the firm performance of internationalization through transforming firm's strategy and capabilities (Porter, 1990; Grant, 1991). This meta-analytic study combines resource, institution, and competitiveness-based views to identify and explore the mediating effect of these country components, including advanced factor, institution, market competition, cluster development, and market size on the I-P relationship. It is worth noting that cluster development is related to the geographic concentrations of firms, suppliers, producers of related products and services, and specialized institutions in a particular field. These country components consist of a country's competitiveness factors that are the essential determinants of a firm's international competitiveness (Porter, 1990; Depperu & Cerrato, 2005). The difference in country-specific factors such as economic and institutional environments force domestic firms to generate different capabilities and advantages when they conduct international expansion. Firms from developed countries have a more favorable resource base, competitive condition, and mechanism to improve their efficiency and leverage firm-specific assets than firms from developing countries. This study further explores the differences and priorities of importance between developing and

developed countries. Therefore, this study develops hypotheses in the next section, and the conceptual model is shown as follows:

Figure 2.1: The conceptual model about the effect of country components on the I-P relationship



2.3 Hypothesis Development

2.3.1 The mediating effect of human capital

Human capital as an advanced factor equips with knowledge, skills, and capability is the crucial asset for a firm's international expansion and closely associated with firm performance (Coff, 2002; Bobillo et al., 2010; Raj Adhikari, 2010; Crook et al., 2011).

Workers with poor health result in the rise of unit labor cost by reducing worker's productivity and increasing employee compensation. Bloom et al. (2004) estimate that the increase in life expectancy with one year can enhance 4% of overall labor productivity. Education and training are important channels to increase human's knowledge and professional skills (Mincer, 1974; Crook et al., 2011). Barney (1991) and Crook et al. (2011) interpret that knowledge embedded in human capital is the source of a firm's competitive advantage. However, the system of education is backward in developing countries than in developed countries. For example, with roughly 50,000 doctoral degree holders, China surpasses all other countries, even America, in 2009 (Cyranoski et al., 2011). However, it is a standard consensus that China has much fewer creative inventions and Noble laureates than America's.

In contrast, China's education pays more attention to cultivating students' examination-oriented ability while ignoring the importance of student's creativity. Furthermore, human capital is also associated with an absorptive capability. Vermeulen & Barkema (2002) indicate that a strong base of human capital could help firms develop a high absorptive capability to handle and absorb complexities that accompanying a firm's international operation.

Hypothesis 1: Human capital as an advanced factor has a positive effect on the I-P relationship. The effect is more robust in firms from developed countries than firms from developing countries.

2.3.2 The mediating effect of institution

North (1990) indicates that "institution is the rule of game". Furthermore, institution constrains firm's behaviors and competitiveness under the institutional structure associated with a set of fundamental legal, political, and social institutions (North, 1990; Scott, 1995;

Peng & Heath, 1996; Peng, 2009). There are fundamental differences in the institutional environment between developing and developed countries (Makino et al., 2004; Puffer et al., 2010; Luo & Wang, 2012). In developed countries, an institution with higher quality plays a dominant role in the firm's activities of economic exchanges. However, the institution in developing countries is characterized by the weak protection of intellectual property rights, poor enforcement of commercial laws, and nontransparent judicial and litigation systems, which leads to institutional voids (North, 1990; Peng, 2003; Fuentelsaz et al., 2015). Institutional embeddedness can help firms sustain global competitiveness by developing their capabilities (Zhu et al., 2006). An effective institution, such as strong protection of intellectual rights and weak corruption, can encourage firms to conduct technological innovation and develop innovative capability (Teece, 1986; Wonglimpiyarat, 2010). Moreover, the market-supporting institution also can enhance a firm's marketing capability that increases the firm's brand visibility and meet or shape customer preferences (Cuervo-Cazurra & Genc, 2008). In comparison, the weak institution in developing countries can reduce firms' absorptive capability for investment and technology due to impeding supply response (Stiglitz, 2000). Besides, firms may develop their capabilities, such as political capability, when an institution fails (Wan, 2005; Tan & Meyer, 2010; Chen & Wu, 2011). However, these capabilities, such as political capability, tend to be location-bound and are challenging to transfer into other countries (Tan & Meyer, 2010; Cuervo-Cazurra et al., 2018).

Hypothesis 2: Institution has a positive effect on the I-P relationship. The effect is more robust in firms from developed countries than firms from developing countries.

2.3.3 The mediating effect of market competition and cluster development

The increasing competition induces deeper involvement by entrants and substantially impacts the firm's innovation and innovative capability (Khan & Manopichetwattana, 1989;

Porter, 1990). Hennart & Park (1993) indicate that market competition can affect a firm's international behavior and performance. The cluster refers to the competition and collaboration among proximate geographical firms. In the cluster, firms can share their resources, information, and knowledge (Zaheer et al., 2009). Cluster can make firms easily acquire and develop resources for internationalization and transfer local advantages into the firm-specific advantages that can help them involve internationalization (Chetty & Wilson, 2003; Zaheer et al., 2009). Zhao et al. (2009) argue that the coexistence of competition and collaboration could promote innovative ideas and then contribute to superior performance among firms. In developing countries, unlike developed countries, market competition is imperfect and frequently intervened by the government (Khanna & Palepu, 1997; Bruton & Ahlstrom, 2003), which leads to the failure of the market mechanism. Moreover, the fragments of the industry chain constrain the cluster development. Therefore, market competition and cluster development tends to have a less positive effect on the firm performance of internationalization in developing countries than in developed countries (Guillen, 2000; Kim et al., 2010).

Hypothesis 3: Market competition has a positive effect on the I-P relationship. The effect is more robust in firms from developed countries than firms from developing countries.

Hypothesis 4: Cluster development has a positive effect on the I-P relationship. The effect is more robust in firms from developed countries than firms from developing countries.

2.3.4 The mediating effect of market size

The large market size in the home country allows firms to explore economies of scale (Li & Yue, 2008). Firms that generate economies of scale before internationalization can facilitate their competitiveness when they conduct international expansion. In a large domestic market, more and more competitors would lead to fierce competition that forces firms to update their

products to meet the demand of customers and even pushes firms to seek foreign market by drawing resources from a large domestic market to develop an international competitive advantage (Porter, 1990; Li &Yue, 2008). Furthermore, once firms acquire a large stable share in a maturing market and conduct international expansion, they can obtain more benefits in the foreign market than in a marginal market share (Qian, 2000). The home country's market size in home country reflects its market demand, and constumers are its subject. Consumers in developed countries have a higher level of consumption and are pickier about commodities than consumers in developing countries. Therefore, consumers in developed countries with a higher preference enforce firms to develop a firm's marketing capability and produce relevant commodities to meet or shape their demands. Furthermore, marketing capability is the vital source of a firm's competitive advantage and has an essential impact on its internationalization performance (Kotabe et al., 2002; Blesa & Ripolles, 2008; Nath, 2010).

Hypothesis 5: Market size has a positive effect on the I-P relationship. The effect is more robust in firms from developed countries than firms from developing countries.

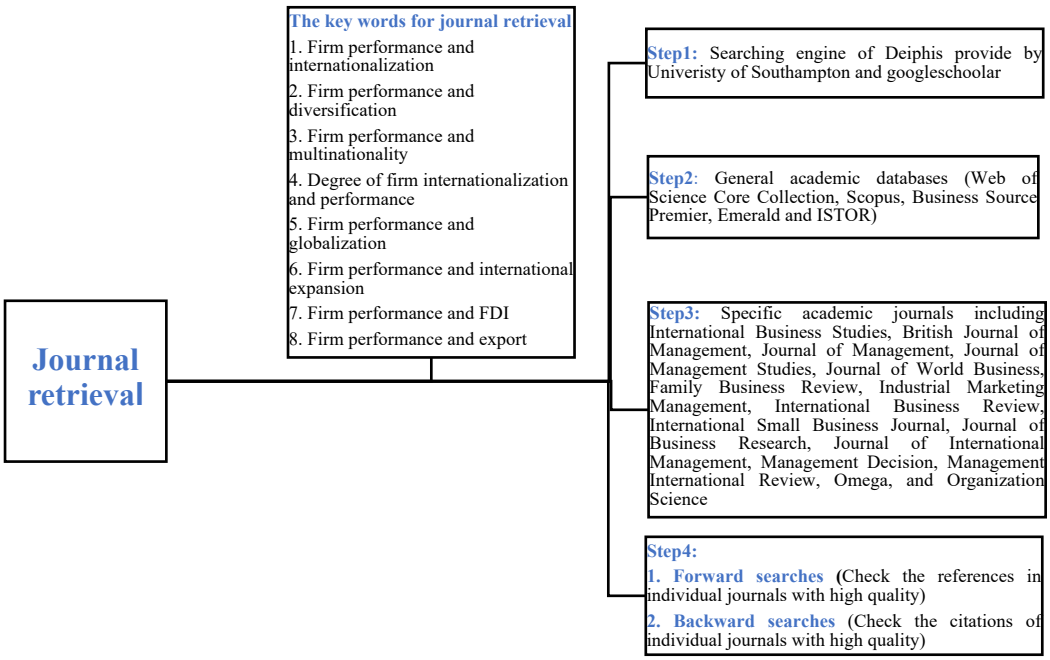
2.4 Research Method

2.4.1 Data collection and sample

This study adopts meta-analysis and conducts four steps to collect relevant information from previous empirical studies associating I-P. Before doing this, how to define the critical retrieval words is essential, which replaces the term "internationalization" by similar terms, such as multinationality, diversification, the degree of internationalization, international expansion, and globalization. Moreover, firm internationalization can be broadly divided into export and FDI. This study also considers export or FDI intensity as internationalization.

Thus, export and FDI are also used as the vital retrieval words. The first step is to apply the search engine of Delphis provided by the University of Southampton and google scholar by using these terms. The second step is to consider the specific databases (Web of Science Core Collection, Scopus, Business Source Premier, Emerald, and ISTOR). The third step is to conduct further retrieval in the seventeen specific journals (Academy of Management Journal, Strategic Management Journal, Journal of International Business Studies, British Journal of Management, Journal of Management, Journal of Management Studies, Journal of World Business, Family Business Review, Industrial Marketing Management, International Business Review, International Small Business Journal, Journal of Business Research, Journal of International Management, Management Decision, Management International Review, Omega, and Organization Science). Besides, to guarantee that the studies collected cover the primary studies regarding I-P, the final step is to conduct backward and forward searches that check the references in individual studies with high quality (at least three stars by ABS journal ranking) and its citations in google scholar. The logic of journal retrieval is shown as follows:

Figure 2.2: The logic of journal retrieval



The selection of sample collection in previous empirical studies is according to the following criteria: First, this study chooses regressions in previous empirical studies that should include firm internationalization and performance as independent dependent variables, respectively. Second, this study would choose the most complex regression if the same table shows more than one regressions in the study because more control variables in the regression can better reduce regression bias. Third, this study generally gives before considering the author's preferred results; Fourth, this study mainly obtains one sample from the relevant individual study to keep the sample independent (Stanley & Doucouliagos, 2012). Besides, following the procedures suggested by Lipsey & Wilson (2001), this study develops a coding protocol to extract the relevant data such as the estimation coefficients and sample size from primary empirical studies. This study primarily obtains 276 studies that are strongly associated with I-P. Furthermore, this study conducts a comparative meta-analysis between developing and developed countries[1] and merely considers the studies that explore a single country. Thus, this study removes 42 studies that include data with diverse countries. Finally, this study obtains 234 studies (55 for developing countries and 179 for developed countries), including 32 countries and 2 regions (Hong Kong and Taiwan) and covering the period 1969-2017.

2.4.2 Analytic specification

This study considers applying an objective statistic test rather than employing the funnel plot to judge publication selection bias due to its vulnerable subjective interpretation. Furthermore, the Begg test proposed by Begg & Mazumdar (1994) is a non-parametric MRA for detecting funnel asymmetry, which uses the rank-order correlation between standardized intervention effect and its variance. Stanley (2005) explains that the Begg test has low power

[1] The country category between developing and developed countries is defined by the International Monetary Fund.

because rank correlations must cut down the much crucial information of the sample. The mathematical expression of the Egger test (parametric estimation) suggested by Egger et al. (1997) is consistent with funnel asymmetry testing (FAT) and is often recommended to diagnose publication bias. In contrast, Ringquist (2013) interprets that the shortcomings of the Egger test are lack of power to identify publication bias and over rejected the null hypothesis of no publication bias. Thus, this study employs the FAT- precision effect testing (PET) MRA test recommended by Stanley (2005), Stanley (2008), Doucouliagos & Stanley (2009), and Stanley & Doucouliagos (2012) for the test of publication selection bias.

Stanley (2008) and Doucouliagos & Stanley (2012) suggest the VWLS applied in the MRA by accommodating heteroscedasticity. Furthermore, Ringquist (2013) indicates that the VWLS is the best approach to estimate meta-regression, and the VWLS with the inverse of variances, unlike WLS, is considered actual variances rather than proportional variances. Thus, this study performs the MRA with VWLS. Besides, this study uses VIF and Breusch-Pagan/Cook-Weisberg to test multicollinearity and heteroscedasticity, respectively, before conducting the MRA with VWLS.

2.4.3 Model specification and datasets

The general regression model adopted in this study is shown as follows:

$$\begin{aligned} \textit{Fisher's\_Z} = {} & \beta_0 + \beta_1 country\_componet + \beta_2 structure\_index + \\ & \beta_3 financial\_index + \beta_4 composite\_index + \beta_5 accounting\_index + \\ & \beta_6 marketing\_index + \beta_7 operational\_index + \beta_8 OLS + \beta_9 2and3\_SLS + \beta_{10} GLS + \\ & \beta_{11} endogeneity + \beta_{12} fixed\_effect + \beta_{13} random\_effect + \\ & \beta_{14} advertising\_intensity + \beta_{15} leverage\_ratio + \beta_{16} firm\_age + \beta_{17}\, firm\_size + \\ & \beta_{18} capital\_intensity + \beta_{19}\, international\_experience + \beta_{20} ownership + \beta_{21} R\&D + \\ & \beta_{22} firm\_risk + \beta_{23} firm\_growth + \beta_{24} industry\_growth + \\ & \beta_{25} product\_diversification + \beta_{26} business\_group + \beta_{27} industry\_concentration + \\ & \beta_{28} lagged\_performance + \beta_{29} industry\_control + \beta_{30} year\_control + \varepsilon \end{aligned}$$

This study transfers the values of the relevant coefficients collected from the regression models in 234 previous empirical studies into Fisher's Z to reduce skewness distribution and become more symmetric (Rosenthal, 1994; Card, 2015). In this study's regression model, the effect size (Fisher's Z) reflects the I-P relationship and is treated as the dependent variable in the MRA. Country components include advanced factor, formal institution, market competition, cluster development, and marker size and are considered as the moderators in the MRA. The advanced factor is measured by composite values that include secondary education enrolment rate, tertiary education enrolment rate, local availability of specialized training services, and extent of staff training by using the principal component analysis (PCA). The institution is measured by composite values that include property rights, intellectual property protection, irregular payments and bribes, judicial independence, the burden of government regulation, the efficiency of the legal framework in settling disputes, and efficiency of the legal framework in settling disputes by using the PCA. Market competition and cluster development are measured by the country's competitiveness index. Market size is measured by gross domestic product (GDP). The whole variables of country components are obtained from the source of the World Economic Forum and adopt its mean values during the period 2012-2017 except for market size extracted from the source of Neesco Institution for Statistics.

Furthermore, this study also controls the measurements of firm performance (accounting index, market index, and operational index) and internationalization (structure index, financial index and composite index) based on the definition of Ruigrok & Wagner (2004), the estimation methods (ordinary least squares (OLS), 2 and 3 stages linear square (SLS), general least square (GLS), generalized method of moments (GMM), endogeneity, fixed effect, and random effect), firm and industry-level variables (advertising intensity, leverage ratio, firm size, firm age, capital intensity, ownership, R&D, firm risk, firm growth, industry growth, product diversification, business group, industry concentration, lagged performance, and year and industry controls). The whole control variables are dummy variables ("1" or

"0"). "1" means that the variable is used in the regressions in previous empirical studies while "0" otherwise. Finally, ε is an error term. The primary datasets are summarized in Table 2.1.

Table 2.1: The primary datasets in Meta-analysis

Variable	Source	Measurement and processing
Fisher's Z	Coefficients of regression models in 234 empirical studies	Fisher's Z formula, see Appendix A.12
Market competition	World Economic Forum	Country's competitiveness index
Market size	Neesco Institution for Statistics	GDP
Cluster development	World Economic Forum	Country's competitiveness index
Institution	World Economic Forum	Composite value of Country's competitiveness index by using PCA
Advanced factor	World Economic Forum	Composite value of Country's competitiveness index by using PCA
Structure index	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Financial index	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Composite index	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Accounting index	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Market index	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Operational index	Previous 234 empirical studies in terms of I-P	d dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
OLS	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
2 and 3SLS	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
GLS	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
GMM	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Endogeneity	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Fixed effect	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Random effect	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Advertising intensity	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Leverage ratio	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Firm age	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Firm size	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Capital intensity	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
International experience	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Ownership	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
R&D	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Firm risk	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Firm growth	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Industry growth	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Product diversification	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Business group	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Industry concentration	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Lagged performance	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Industry control	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise
Year control	Previous 234 empirical studies in terms of I-P	dummy variable, "1" means the variable is included in previous empirical study while "0" otherwise

2.5 Empirical Findings

Table 2.2 shows the results of the FAT-PET MRA test for publication selection bias. The results show that the coefficients of 1/ standardized error in the all sample, the sample of developed countries, and the sample of developing countries are insignificant. According to Stanley (2005), Stanley (2008), and Stanley & Doucouliagos (2012), this means that there is no publication bias in the previous empirical studies in terms of I-P. This study also employs variance inflation factor (VIF) and Breusch-Pagan/Cook-Weisberg tests. The values of VIF are under 3 in the whole regression models shown in Tables 2.3, 2.4, and 2.5, which implies that there is no multicollinearity problem. The Breusch-Pagan/Cook-Weisberg test results reject homoscedasticity and confirm the presence of heteroscedasticity in this study.

Table 2.3 (all sample) shows that the coefficients of the measurements of internationalization and performance, estimation methods, and omitted variables are statistically significant in all regression models. However, this study focuses on the mediating effect of country components on the I-P relationship. In Models 1, 5, 7, and 9, the coefficients of market competition, cluster development, institution, and advanced factor are positive and statically significant at 1%. The coefficients of their corresponding interactive terms are also positive and statically significant at 1% in Models 2, 6, 8, and 10, which means the interactive effects are more robust in firms from developed countries than firms from developing countries. Therefore, the evidence supports Hypotheses 1, 2, 3, and 4. Besides, the coefficient of market size is negative with 1% statistical significance in Model 3, and its interaction is positive with 1% statistical significance in Model 4, which implies that market size has a negative mediating effect on the I-P relationship and the effect is more robust in firms from developed countries than firms from developing countries. Thus, the evidence partly supports Hypothesis 5. The negative effect can be explained that firms may be willing to stay in enough large domestic market rather than pursue a foreign market with foreignness

and uncertainty. The positive interactive effects on the I-P relationship in Models 2, 4, 6, 8, and 10 also confirm the difference between developed and developing countries. Thus, this study further divides the total sample into two subgroup samples of developed and developing countries. Table 2.4 shows the regression results in developed countries. The results show that the coefficients of country components (market competition, market size, cluster development, institution, and advanced factor) are all positive with statistical significance at 1%, which means that the five-country components positively affect the I-P relationship. Table 2.5 shows the regression results in developing countries. However, the results show that the coefficients of country components are all negative with statistical significance at 1%, implying that the whole five-country components negatively impact the I-P relationship.

Table 2.2: FAT-PET MRA test for publication selection bias

	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
All sample (N=237)						
1/SE	0.003	0.002	1.29	0.200	-0.002	0.007
Cons	1.689	0.539	3.14	0.002	0.628	2.750
Developed countries (N=180)						
1/SE	0.003	0.002	1.27	0.206	-0.002	0.008
Cons	1.862	0.709	2.63	0.009	0.463	3.262
Developing countries (N=57)						
1/SE	0.000	0.002	0.07	0.943	-0.004	0.004
Cons	1.251	0.560	2.23	0.03	0.128	2.373

Note: 1. SE=standardized error 2. Dependent variable is T-Value

Table 2.3: Regression results (all sample)

Variable	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Structure_index	-0.102***	-0.075***	-0.095***	-0.096***	-0.099***	-0.099***	-0.079***	-0.084***	-0.120***	-0.104***	-0.111***
Financial_index	-0.104***	-0.078***	-0.101***	-0.102***	-0.099***	-0.095***	-0.082***	-0.085***	-0.134***	-0.098***	-0.112***
Composite index	-0.066***	-0.058***	-0.091***	-0.064***	-0.063***	-0.079***	-0.065***	-0.056***	-0.102***	-0.068***	-0.083***
Accounting index	-0.056***	-0.092***	-0.100***	-0.056***	-0.054***	-0.083***	-0.074***	-0.063***	-0.055***	-0.062***	-0.062***
Market index	-0.036***	-0.078***	-0.086***	-0.035***	-0.032***	-0.057***	-0.053***	-0.044***	-0.041***	-0.038***	-0.040***
Operational index	-0.101***	-0.115***	-0.135***	-0.111***	-0.107***	-0.112***	-0.108***	-0.120***	-0.139***	-0.095***	-0.107***
OLS	-0.104***	-0.111***	-0.114***	-0.104***	-0.106***	-0.109***	-0.105***	-0.104***	-0.100***	-0.106***	-0.101***
2 and 3SLS	0.063***	0.108***	0.104***	0.064***	0.055***	0.079***	0.078***	0.094***	0.068***	0.063***	0.056***
GLS	0.003***	-0.006***	-0.007***	0.002***	0.000	-0.003***	0.002***	-0.009***	-0.006***	-0.001***	0.004***
GMM	-0.003	-0.023***	-0.009***	0.005	0.006*	-0.008**	-0.007**	-0.004	0.006*	-0.010***	-0.002
Endogeneity	0.000	-0.010***	-0.006***	0.001	0.005***	0.000	-0.002***	0.002***	-0.001***	0.003***	0.002***
Fixed effect	0.025***	0.028***	0.028***	0.024***	0.022***	0.030***	0.036***	0.022***	0.040***	0.028***	0.036***
Random effect	-0.088***	-0.088***	-0.095***	-0.087***	-0.090***	-0.080***	-0.080***	-0.087***	-0.090***	-0.084***	-0.085***
Advertising intensity	0.105***	0.099***	0.096***	0.102***	0.105***	0.113***	0.110***	0.112***	0.109***	0.114***	0.114***
Leverage ratio	0.007***	0.009***	0.003***	0.006***	0.003***	0.004***	0.006***	-0.002***	-0.006***	0.005***	0.003***
Firm age	0.016***	0.033***	0.037***	0.016***	0.019***	0.039***	0.033***	0.038***	0.027***	0.032***	0.026***
Firm size	-0.047***	-0.051***	-0.050***	-0.052***	-0.051***	-0.050***	-0.046***	-0.058***	-0.050***	-0.046***	-0.041***
Capital intensity	-0.021***	-0.025***	-0.019***	-0.025***	-0.025***	-0.021***	-0.008***	-0.027***	-0.011***	-0.020***	-0.006***
International experience	0.013***	-0.023***	-0.035***	0.014***	0.016***	-0.003***	-0.010***	-0.018***	-0.035***	0.005***	-0.002***
Ownership	0.028***	0.007***	0.009***	0.025***	0.026***	0.018***	0.027***	0.023***	0.038***	0.029***	0.040***
R&D	-0.088***	-0.080***	-0.076***	-0.086***	-0.090***	-0.085***	-0.080***	-0.084***	-0.075***	-0.090***	-0.084***
Firm risk	0.037***	0.048***	0.067***	0.040***	0.043***	0.037***	0.035***	0.036***	0.046***	0.033***	0.036***
Firm growth	0.012***	0.029***	0.034***	0.011***	0.009***	0.034***	0.039***	0.012***	0.013***	0.019***	0.025***
Industry growth	-0.049***	-0.062***	-0.071***	-0.047***	-0.048***	-0.055***	-0.060***	-0.048***	-0.053***	-0.048***	-0.054***
Product diversification	0.053***	0.050***	0.045***	0.055***	0.053***	0.046***	0.044***	0.050***	0.046***	0.048***	0.044***
Business group	0.007***	0.014***	-0.029***	0.005***	0.002**	0.001	-0.017***	0.023***	-0.027***	0.010***	-0.025***
Industry concentration	0.135***	0.087***	0.103***	0.133***	0.143***	0.119***	0.126***	0.101***	0.128***	0.131***	0.148***
Lagged performance	-0.009***	-0.017***	-0.016***	-0.006***	-0.006***	-0.020***	-0.021***	-0.004***	-0.003**	-0.015***	-0.017***
Industry control	0.028***	0.015***	0.015***	0.027***	0.030***	0.013***	0.013***	0.022***	0.019***	0.024***	0.023***
Year control	-0.001***	0.003***	0.006***	0.002***	0.002***	0.006***	0.003***	0.011***	0.008***	0.001*	-0.002***
AD_sample	-0.021***	-0.079***	0.021***	-0.025***	-0.026***	-0.042***	0.032***	-0.050***	0.051***	-0.048***	0.121***
Market competition		0.091***	-0.151***								
Market competition*AD			0.278***								
Market size				-0.000***	-0.000***						
Market size *AD					0.000***						
Cluster development						0.045***	-0.141***				
Cluster development*AD							0.191***				
Institution								0.030***	-0.098***		
Institution*AD									0.135***		
Advanced factor										0.019***	-0.099***
Advanced factor*AD											0.124***
Constant	0.357***	0.420***	0.346***	0.362***	0.361***	0.389***	0.285***	0.373***	0.300***	0.375***	0.206***
Model chi2	530,721.08***	544,300.52***	568,878.82***	531,515.11***	532,747.09***	540,368.07***	553,685.67***	545,920.48***	574,543.13***	533,476.02***	548,409.64***
Goodness-of-fit chi2	650,000***	630,000***	610,000***	650,000***	640,000***	640,000***	620,000***	630,000***	600,000***	640,000***	630,000***
Observations	237	237	237	237	237	237	237	237	237	237	237

Note: 1. Standard errors are not reported and put in the Appendix A.4 2. *** $p<0.01$, ** $p<0.05$, * $p<0.1$ 3. AD= Advanced country v.s Developing country 4. Variables of market competion, market size, cluster development, institution, and advanced factor are handled by the mean-centered method to reduce its serial corroletion with iterative term

Table 2.4: Regression results (developed countries)

Variable	Model 0	Model 1	Model 3	Model 5	Model 7	Model 9
Structure index	0.006***	-0.001	-0.002**	-0.007***	0.006***	-0.017***
Composite index	0.035***	0.020***	0.032***	0.011***	0.034***	0.016***
Accounting index	-0.059***	-0.092***	-0.063***	-0.096***	-0.022***	-0.078***
Market index	-0.039***	-0.074***	-0.042***	-0.064***	-0.001	-0.045***
Operational index	0.067***	0.002	0.080***	0.028***	0.010***	0.056***
OLS	-0.096***	-0.104***	-0.098***	-0.100***	-0.093***	-0.099***
2 and 3SLS	0.141***	0.173***	0.137***	0.157***	0.164***	0.133***
GLS	0.007***	-0.013***	0.007***	-0.003***	-0.010***	-0.002***
Endogeneity	-0.022***	-0.036***	-0.021***	-0.023***	-0.021***	-0.010***
Fixed effect	0.081***	0.071***	0.082***	0.083***	0.069***	0.088***
Random effect	-0.082***	-0.087***	-0.084***	-0.068***	-0.086***	-0.070***
Advertising intensity	0.120***	0.119***	0.123***	0.134***	0.132***	0.144***
Leverage ratio	0.011***	0.013***	0.012***	0.008***	-0.007***	0.002***
Firm age	-0.004***	0.034***	-0.003***	0.043***	0.038***	0.048***
Firm size	-0.009***	-0.022***	-0.004***	-0.019***	-0.032***	-0.009***
Capital intensity	-0.009***	-0.012***	-0.007***	-0.003***	-0.013***	-0.002***
International experience	-0.039***	-0.092***	-0.040***	-0.073***	-0.091***	-0.067***
Ownership	0.051***	-0.002*	0.057***	0.022***	0.034***	0.056***
R&D	-0.098***	-0.107***	-0.101***	-0.106***	-0.099***	-0.106***
Firm risk	0.052***	0.049***	0.053***	0.016***	0.029***	0.014***
Firm growth	-0.010***	0.013***	-0.010***	0.028***	-0.004***	0.013***
Product diversification	0.063***	0.058***	0.059***	0.058***	0.060***	0.054***
Business group	0.058***	0.024***	0.065***	0.045***	0.048***	0.062***
Lagged performance	-0.090***	-0.094***	-0.097***	-0.111***	-0.075***	-0.122***
Industry control	0.016***	0.002***	0.018***	-0.005***	0.007***	0.005***
Year control	0.000	0.012***	-0.002***	0.013***	0.024***	0.005***
Market competition		0.128***				
Market size			0.000***			
Cluster development				0.072***		
Institution					0.046***	
Advanced factor						0.056***
Constant	0.198***	-0.491***	0.193***	-0.131***	0.164***	0.187***
Model chi2	450,138.72***	470,099.24***	450,743.47***	467,893.48***	478,768.19***	468,087.82***
Goodness-of-fit chi2	530,000***	510,000***	530,000***	510,000***	500,000***	510,000***
Observations	180	180	180	180	180	180

Note: 1. Standard errors are not reported and put in Appendix A.6 2. *** p<0.01, ** p<0.05, * p<0.1

Table 2.5: Regression results (developing countries)

Variable	Model 0	Model 1	Model 3	Model 5	Model 7	Model 9
Structure index	0.049***	0.073***	0.057***	0.057***	0.052***	0.094***
Composite index	0.071***	0.074***	0.048***	0.093***	0.080***	0.071***
Accounting index	-0.020***	0.020***	-0.019***	0.017***	0.023***	0.010*
Market index	0.052***	0.115***	0.083***	0.099***	0.094***	0.106***
Operational index	-0.530***	-0.488***	-0.563***	-0.516***	-0.540***	-0.476***
OLS	-0.077***	-0.050***	-0.078***	-0.077***	-0.075***	-0.029***
2 and 3SLS	-0.064***	-0.072***	-0.094***	-0.080***	-0.081***	-0.053***
GLS	0.102***	0.120***	0.101***	0.094***	0.050***	0.122***
Endogeneity	-0.019***	0.009***	0.019***	-0.008**	-0.014***	0.007**
Fixed effect	-0.043***	-0.072***	-0.072***	-0.058***	-0.046***	-0.079***
Random effect	0.341***	0.332***	0.373***	0.329***	0.338***	0.327***
Advertising intensity	0.755***	0.767***	0.753***	0.756***	0.754***	0.768***
Leverage ratio	-0.108***	-0.109***	-0.121***	-0.096***	-0.130***	-0.126***
Firm age	0.011***	0.022***	0.038***	0.007***	-0.008***	0.000
Firm size	-0.276***	-0.275***	-0.272***	-0.273***	-0.270***	-0.292***
Capital intensity	-0.108***	-0.111***	-0.149***	-0.090***	-0.063***	-0.090***
International experience	0.019***	0.054***	-0.013**	0.029***	-0.013**	0.036***
Ownership	0.090***	0.120***	0.129***	0.113***	0.164***	0.138***
R&D	-0.479***	-0.512***	-0.520***	-0.489***	-0.495***	-0.504***
Firm risk	0.113***	0.092***	0.162***	0.063***	0.035***	0.040***
Firm growth	-0.819***	-0.816***	-0.766***	-0.796***	-0.814***	-0.847***
Product diversification	-0.116***	-0.125***	-0.078***	-0.129***	-0.157***	-0.139***
Business group	-0.124***	-0.124***	-0.164***	-0.118***	-0.118***	-0.106***
Lagged performance	0.542***	0.553***	0.607***	0.555***	0.571***	0.524***
Industry control	-0.024***	-0.038***	-0.017***	-0.016***	-0.004	-0.032***
Year control	-0.063***	-0.043***	-0.027***	-0.060***	-0.069***	-0.053***
Market competition		-0.083***				
Market size			-0.000***			
Cluster development				-0.068***		
Institution					-0.081***	
Advanced factor						-0.073***
Constant	0.498***	0.860***	0.535***	0.764***	0.382***	0.339***
Model chi2	153,312.6***	153,850.14***	154,951.82***	153,854.46***	156,312.35***	15,4002.77***
Goodness-of-fit chi2	27,983.31***	27,445.77***	26,344.09***	27,441.45***	24,983.56***	27,293.14***
Observations	57	57	57	57	57	57

Note: 1. Standard errors are not reported and put in Appendix A.5 2. *** p<0.01, ** p<0.05, * p<0.1

To further compare the priorities about the importance of the mediating effect of five-country components on the I-P relationship, this study standardizes the whole variables in Models 1, 3, 5, 7, and 9. Figure 2.3 shows the standardized coefficients of five-country components by using the whole sample as the baseline. Market competition (0.105) is the critical effect on the I-P relationship, which is followed by the institution (0.093), cluster

development effect on the I-P relationship, which is followed by the institution (0.093), cluster development (0.065), advanced factor (0.058), and market size (-0.015). Figure 2.4 displays the standardized coefficients of five-country components by using the sample of developed countries. The advanced factor (0.166) is the most critical effect on the I-P relationship, which is followed by market competition (0.15), institution (0.125), cluster development (0.107), and market size (0.038). Finally, Figure 2.5 displays the standardized coefficients of five-country components by using the sample of developing countries. Compared with the sample of developed countries, the five-country components negatively affect the I-P relationship in developing countries. The most adverse factor is the institution (-0.249), which is followed by the advanced factor (-0.215), market size (-0.167), cluster development (-0.102), and market competition (-0.092).

Figure 2.3: Standardized coefficients (all sample)

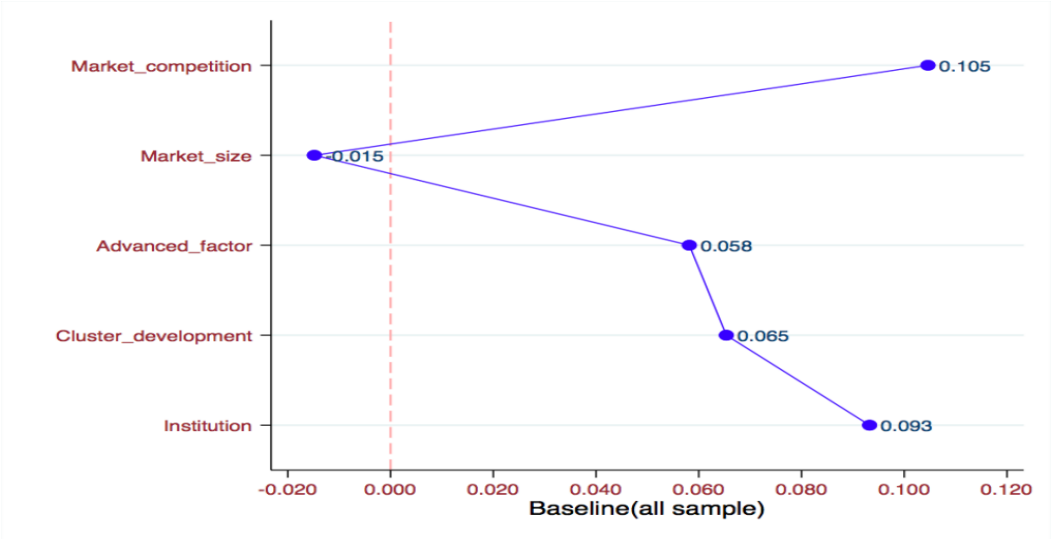


Figure 2.4: Standardized coefficients (developed countries)

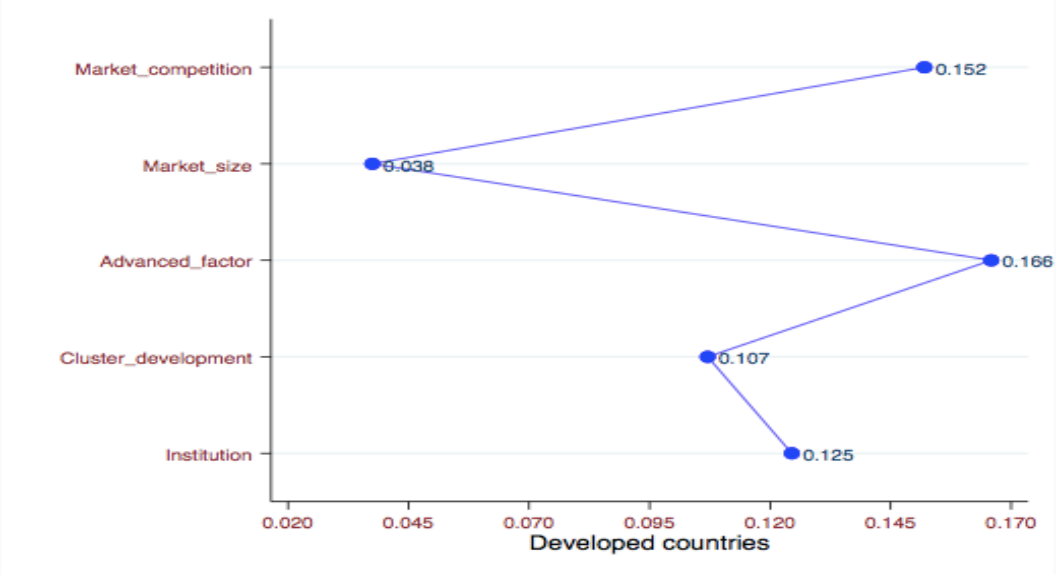
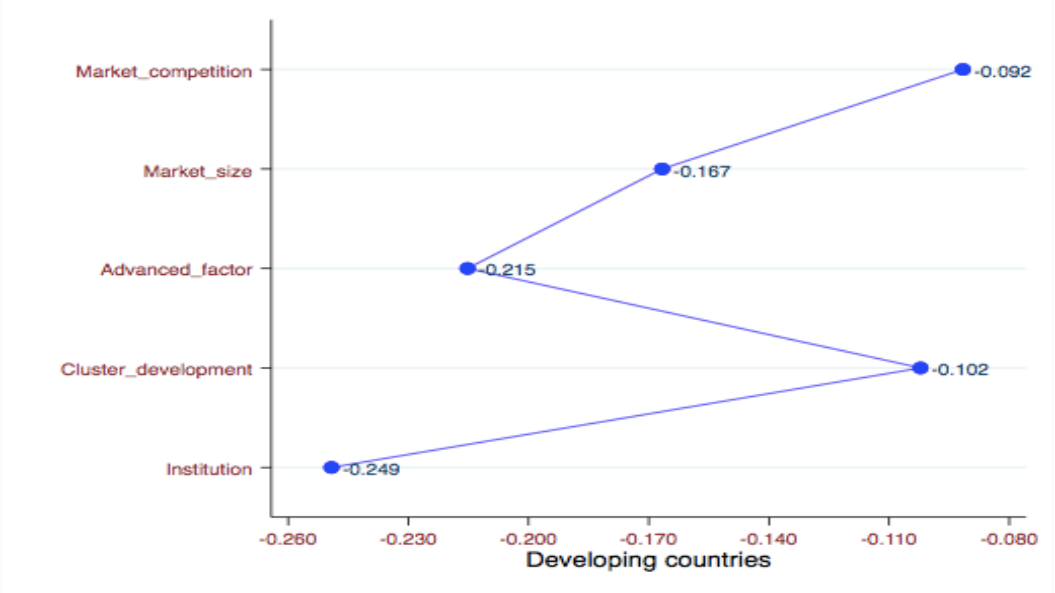


Figure 2.5: Standardized coefficients (developing countries)



2.6 Discussions

This study combines resource and institution, and competitiveness-based views to explore the mediating effect of country components on the I-P relationship by using the MAR with VWLS based on 234 previous empirical studies that involve 99,398 firms and 34 economies (32 countries and 2 regions) during the period 1969-2017. The measurements of I-P, estimation methods, and omitted variables generally have a significant effect on the I-P relationship. Therefore, future empirical studies regarding I-P should be more rigid about the measurements of a firm's internationalization and performance, the choice of estimation methods, and the control of omitted variables.

How firms obtain more benefits from increased internationalization is the crucial issue that scholars are exploring in international business and management fields. It is not enough to consider the institution or other single factors as a matter of a country for the firm performance of internationalization. Firms cannot build their core competencies from a vacuum by overemphasizing the role of institutions and neglecting other country factors, which needs to combine different country resources for competition (Wan & Hoskisson, 2003; Wan, 2005). Based on resource, institution, and competitiveness-based views, this study identifies the five-country components, including advanced factor, institution, market competition, cluster development, and market size, which have an essential mediating effect on the I-P relationship. Furthermore, this study conducts horizontal and vertical comparisons between developing and developed countries. Regarding the horizontal comparison, the five country components are the advantageous factors that positively moderate the I-P relationship in the sample of developed countries. At the same time, they are the disadvantageous factors that negatively moderate the I-P relationship in the sample of developing countries. Regarding the vertical comparison, advanced factor and market competition are more advantageous factors than the other three factors for a firm's internationalization performance in the sample of developed countries. However, market

competition and cluster development are less disadvantageous factors than the other three factors for a firm's internationalization performance in the sample of developing countries.

Firms from developed countries with a more favorable country environment can better develop their capabilities and transfer the home country's competitiveness into the firm's competitiveness in foreign markets. Firms from developing countries with less favorable environment are less likely to develop their capabilities and transfer the home country's competitiveness into the firm's competitiveness in the foreign market. Firms from developing countries need enough time to build their capabilities that match their home country's competitiveness. Firms with limited capabilities are challenging to transfer their home country's competitiveness into their competitiveness in the foreign market and even determinant to firm's benefits from increased internationalization because they must bear the cost of updating their capabilities (Zollo & Winter, 2002; Winter, 2003).

2.7 Conclusions and Implications

This study identifies the positive mediating effect of the five-country components by combining the resource, institution, and competitiveness-based views, including advanced factor, institution, market competition, cluster development, and market size on the I-P relationship. In addition, this study further investigates their differences (horizontal comparison) and importance priorities (vertical comparison) between developing and developed countries. In comparison with developing countries, developed countries with a more favorable environment make firms better develop their capabilities, transfer the home country's competitiveness into their competitiveness in the foreign market, and then promote their internationalization performance.

There are some important implications for both firms and governments in developing and developed countries. First, firms and governments need to understand better the mediating

effect of five country components on the I-P relationship and their priorities of importance, which would help firms maximize the advantageous factors to develop their capabilities and improve their competitiveness or minimize the disadvantageous factors to constrain its capabilities and competitiveness. Second, governments, especially in developing countries, should build a favorable home country's environment such as a good institution environment (protection of intellectual property rights, enforcement of commercial laws Etc.). The institution plays a crucial role in firm internationalization because a good institution can help firms improve their capabilities, such as innovative capability, and improve their competitiveness (Teece, 1986; Wonglimpiyarat, 2010). Besides, governments should also cultivate and attract innovative talents, construct a relatively perfect market competition mechanism, promote cluster development, and improve the economic level.

Chapter 3

The Study of Chinese Firm's Export Behaviors: A Perspective of Productive Cut-off

3.1 Introduction

Internationalization can broadly decompose into foreign direct investment (FDI) and trade. Although the amount of FDI outflow from China has substantial increase at the rate of an average of 46.68% per year during the period 1995-2017 and reaches 124,630 million dollars in 2017, it merely accounts for 5.51% of the total amount of export from China in 2017 (UNCTAD, 2017). This is because Chinese firms still stay at the early stage of internationalization, and export is the dominant model of international involvement. Furthermore, export is also the fastest and less expensive way to significantly participate in the foreign market when the domestic market shrinks or is saturated (Lee & Habte-Giorgis, 2004; Lu & Beamish, 2006). In addition, processing exports are prevalent in China and account for more than half of total China's exports.

The issue of learning-by-exporting versus self-selection between exporting and productivity is widely discussed in the extensive literature. Johanson & Wiedersheim-Paul (1975) identify four main stages of internationalization that firms should follow: sporadic export, export modes, the establishment of a foreign sales subsidiary, and foreign production. Moreover, Helpman et al. (2004) indicate that the least productive firms merely sell at home, the more productive firms sell domestically, and export to the foreign county, and the most effective firms sell domestically and engage in FDI. Roberts & Tybout (1997) & Melitz (2003) interprets that merely more productive firms can overcome high sunk costs and possible high variable costs and would be able to export. However, it is also possible that a firm's export activities increase its productivity. A firm's exporting-by-learning can incur through several channels. For example, exporting firms can learn from international buyers and competitors and obtain advanced knowledge and technology from foreign consumers and competitors (Opoku et al., 2020). In addition, exporting firms can expand their economies of scale or scope by entering a more extensive market or changing their product mix (Kiendrebeogo, 2020). Besides, exporting firms can also promote process and technology innovation (Salomon & Shaver, 2005; Damijan et al., 2010). A mass of empirical

studies, such as Yang & Mallick (2010), Silva et al. (2012), Wu & Chiou (2021), and Gkypali et al. (2021), confirm that firms can enhance their productivity through exports and support the hypothesis of learning-by-exporting. However, many empirical studies, such as Arnold & Hussinger (2005), Martins & Yang (2009), Haidar (2012), and Gkypali et al. (2021) confirm that more productive firms are likely to overcome the sunk costs of initiating exports and support the hypothesis of self-selection.

Previous studies mainly explore a firm's export propensity (export decision) and export intensity (export scale), while few studies consider irregular and regular exports. Moreover, productivity is not merely a factor associated with a firm's exports. Other factors such as firm size, R&D, ownership, capital intensity, wages, international productivity gap, financial constraints, export promotion, location Etc. are also the determinants of a firm's exports (Cole et al., 2010; Schank et al., 2010; Srinivasan & Archana, 2011; Yang & Chen, 2012; Bellone et al., 2014; Broocks & Van Biesebroeck, 2017; Lu et al., 2018; Brakman et al., 2020). At the same time, this study transfers the perspective into the effect of productivity cut-off on a firm's export behaviors. In addition to the firm's export propensity and export intensity, the study also explores the firm's irregular and regular exports. Based on the knowledge-based view and organizational learning theory, the knowledge-based view considers the knowledge as the strategically important source that firms possess, and organizational learning complements the knowledge-based view that organizations integrate new knowledge into the existing knowledge base (García-García et al., 2017). Knowledge development is fundamental to a firm's international operation and crucial to the learning process (Johanson & Vahlne, 2009). Firms with a lack of knowledge obtained in a foreign market are an enormous obstacle to internationalization (Johanson & Vahlne, 1977). Moreover, firms need to update the existing knowledge and adopt new knowledge from the foreign market, especially technological knowledge that is difficult and time-consuming (Demsetz, 1988; García-García et al., 2017). International understanding can also reflect the firm's resources and capabilities in supporting international activities (Yu, 1990; Eriksson et al., 1997; Johanson & Vahlne, 2009). In addition, organizational learning aims to develop

new knowledge acquired in a foreign market based on the existing knowledge base (Cohen & Levinthal, 1990).

This study employs the analytic method of receiver operating characteristic (ROC) suggested by Costa et al. (2019) to measure productivity cut-off. Moreover, this study conducts the Heckman two-stage procedure (Heckman, 1979) to correct sample selection bias by combining Probit and Tobit models. Therefore, there are three main contributions to this study. First, this study theoretically illustrates the various types of firm's export behaviors. Second, this study empirically investigates the effect of productivity cut-off on a firm's export behaviors. Third, this study combines various methods, including ROC, Heckman's two-stage procedure with Probit and Tobit models to explore this topic.

The remainder of this study is structured as follows: Section 3.2 discusses the empirical model, including econometric specification and estimation strategy. Section 3.3 interprets data collection and processing, followed by empirical findings in Section 3.4. Finally, this study concludes Section 3.5.

3.2 Empirical model

3.2.1 Econometric specification

This study explores the export firm's behaviors in the Chinese manufacturing industry based on the perspective of productivity cut-off. Thus, the econometric model setting is shown as follows:

$$\begin{aligned} Exports_{firt} = {} & \beta_0 + \beta_1 TFP + \beta_2 Productivity\_cutoff_{firt} + \beta_3 Firm\_size_{firt} \\ & + \beta_4 R\&D_{firt} + \beta_5 Ownership_{firt} + \beta_6 Capital\_intensity_{firt} \\ & + \beta_7 Firm\_age_{firt} + \beta_8 Firm\_age\_squared_{firt} \\ & + \beta_9 Foreign\_share_{firt} + \beta_{10} Year\_control_t + \beta_{11} Industry\_control_i \\ & + \beta_{12} Region\_control_r + \upsilon_{firt} \end{aligned}$$

"f", "i", "r", "t" represent firm, industry, region and year, respectively. Exports is the export propensity, export intensity, irregular, or regular export. Export propensity is measured by "1" if exports are more than zero, otherwise "0". Export intensity is measured by exports as a percent of total sales. Irregular export is measured by "1" if firm export is in t-1 while not in t. Regular export is measured by "1" if firm export is in t-1 and t. Irregular and regular exports are used in the regressions by comparing one-off export[2], which means irregular and regular exports are measured by "0" if firms conduct one-off export. Total factor productivity (TFP) is measured by the O-P method[3]. Productivity cut-off is measured by the analytic method of ROC and Youden's (1950) J index[4], which can identify a cut-off point based on a logit model. This method is widely applied in different disciplines, especially medicine (Costa et al., 2019). However, it is rarely used in economics. Firm size is measured by total assets. Research and development (R&D) intensity is measured by R&D expenses as a proportion of total sales. Ownership is measured by dummy variables ("1" is state-owned firms and "0" others). Capital intensity is measured by fixed assets per employee. Firm age is measured by the number of years since its incorporation. Foreign share is measured by foreign capital as a percent of total paid capital. Year, industry, and region controls are measured by dummy variables ("1" or "0"). υ is an error term. Finally, β_1-β_{10} are corresponding coefficients. All the variables are handled by the gross domestic product (GDP) price deflator (base-year 2005).

3.2.2 Estimation strategy

This study employs the Heckman two-stage procedure (Heckman, 1979) to correct sample selection bias. Because firms with more profitability tend to conduct export, in the meantime,

[2] One-off (new) export is measured by "1" if firm export is in t while not in t-1.
[3] The variables used include the log of output (dependent variable), export exit (exit variable), firm age (state variable), the log of capital (state variable), the log of investment (proxity variable), export status (control variable), ownership (state-owned or non-state-owned, control variable), the log of labor (free variable) and year, industry, and region dummies (free variables). All the variables are handled by the GDP price deflator (base-year 2005).
[4] Variables used include export status (state binomial variable) and TFP (test variable).

exporting firms can acquire international knowledge, specific skills Etc. through learning-by-exporting, which reddens them more productivity (Haddad & Harrison, 1993; Aitken et al., 1997; Aitken & Harrison, 1999; Blomstrom & Sjoholm, 1999; Farole et al., 2013). The Heckman two-stage procedure is also used in previous empirical studies such as Dastidar (2009), Farole et al. (2013), Kirca et al. (2016), and Upadhyayula et al. (2017). The Heckman two-stage procedure requires an exclusive variable. In other words, this study needs to identify at least one instrument variable that impacts the firm's export propensity, not export intensity. This study considers the average number of firms in a specific industry and region as an exclusive variable. Because more firms in a particular industry and area would lead to more competition among firms. Thus, firms would consider exporting to survive in the market. In contrast, it would not impact on firm's export scale after firms decide to export. In the first stage, this study explores the effect of productive cutoff on a firm's export propensity and estimates the Probit model to obtain the inverse Mills ratio (IMR). In the second stage, this study conducts Tobit model[5] to explore the effect of productive cut-off on a firm's export intensity. This study further explores the impact of productive cut-off on a firm's irregular and regular exports by using the Probit model.

3.2.3 Data

This study obtains the data from the Annual Industry Survey Database that has been published by the National Bureau of Statistics of China since 1998. This database embodies the information of more than 400,000 Chinese firms with an annual revenue exceeding 5,000 million RMB and accounts for about 95% of gross industrial outputs. Nie et al. (2012) indicate that the National Bureau of Statistics of China database has the potential problems of sample matching chaos, missing values, outliers of indicators, measurement errors Etc. Therefore, this study follows the suggestions by Xie (2008) and Cai & Liu (2009), Brandt

[5] Tobit model can competently deal with the limited dependent variable that the value is between 0 and 1 in this study

et al. (2012), and Nie et al. (2012) and combine this study characteristics (For instance, this study merely considers the firms with the data of continuous three years from 2005 to 2007) to deal with the relevant data issues. This study finally obtains the primary panel data, including 208,424 Chinese firms during the period 2005-2007.

3.3 Empirical results

Table 3.1 and Table 3.2 show descriptive statistics and correlation matrix. Moreover, this study also uses variance inflation factor (VIF) to test the complete regressions shown in Table 3.3 and find no serial correlation (the values are below 10). Table 3.3 displays the regression results. Furthermore, export propensity, export intensity, irregular export, and regular export are the dependent variables in Model 1, Model 2, Model 3, and Model 4, respectively. In model 1, the coefficient of TFP is 0.105 at statistical significance, which means that productivity has a positive impact on export propensity, namely export decision. In model 2, the coefficient of TFP is -0.022 at statistical significance. The evidence implies that productivity exerts a negative effect on export intensity, namely export scale. Wang et al. (2018) interpret that China's exports-productivity paradox is mainly due to the "self-selection effect" and "crowding-out effect". Firms with low efficiency are willing to export their products to the international market based on their low trade cost and favorable foreign trade environment. However, indeed, many firms that conduct processing trade are mainly located in the coastal areas of China.

Furthermore, inefficient firms are forced to export to survive in a fiercely competitive domestic market. As Model 3 and Model 4 shown, productivity has a positive impact on irregular export and no impact on regular export. In addition, the negative coefficient of IMR with -0-032 at statistical significance confirms the presence of sample selection bias, which also means that this study is necessary to conduct Heckman's two-stage procedure to deal with this issue.

This study mainly focuses on the effect of productivity cut-off on the firm's behaviors of export propensity, export intensity, irregular export, and regular export. In Model 1, the coefficient of productivity cut-off is -0.117 at statistical significance. The evidence reveals that the increase in productivity cut-off would reduce export propensity. In Model 2, the coefficient of productivity cut-off is 0.000 at statistical insignificance. The proof indicates that productivity cut-off does not exert an effect on export intensity. Therefore, productivity cut-off can impact on firm's export decision rather than its export scale. Enhancing a firm's productivity would reduce its comparative advantage in the domestic and foreign market and then hinder its export. A firm's export scale tends to be affected by its conditions such as learning ability, adaptive capability, operation efficiency, marketing, product quality Etc. rather than productivity cut-off after its export.

As Model 3 shown, the coefficient of productivity cut-off is -0.020 at statistical insignificance, implying that productivity cut-off does not impact the firm's irregular export. In Model 4, the coefficient of productivity cut-off is -0.089 at statistical significance, which means that enhancing productivity cut-off would negatively affect the firm's regular export. Firms with irregular export cannot timely update their existing knowledge and better adapt to foreign environments. When firms restart to conduct export, they must integrate new knowledge obtained from the foreign market into their existing knowledge base and pay learning costs again. Firm internationalization should be a gradual and accumulated process, and effective learning is accumulated in nature (Johanson & Vahlne, 1977; Helfat, 1994).

Moreover, efficient learning from previous experience of firm internationalization is an essential channel for firms to develop their capabilities that help firms better reap benefits from internationalization (Yang et al., 2017). In addition, Chinese exporting firms, especially firms with processing export, are likely to use the initial factor endowments such as low labor costs and trade conditions such as trade intermediaries rather than investment in technology improvement. Enhancing a firm's productivity cut-off would reduce its comparative advantage in domestic and foreign markets. Nevertheless, this comparative

advantage is derived from productivity and does not play a crucial role in firms with irregular export. Thus, the firm's irregular export does not require continuing comparative advantage and is not sensitive to productivity. However, the comparative advantage of firms with regular export is derived from the existing knowledge base, learning effect, labor cost, trade conditions Etc., and the crucial factor of firm productivity.

Table 3.1 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
1. export propensity	625,272	0.293	0.455	0	1
2. export intensity	145,602	0.672	0.353	0.000	1
3. irregular export	73,338	0.544	0.498	0	1
4. regular export	179,034	0.813	0.390	0	1
5. TFP	625,272	8.803	1.155	3.452	16.701
6. productivity cut-off	625,272	0.362	0.480	0	1
7. firm size*	625,272	10.000	1.428	1.116	20.249
8. R&D	625,272	0.002	0.015	0	2.958
9. ownership	625,272	0.129	0.336	0	1
10. capital intensity*	625,272	3.866	1.301	0	14.361
11. firm age	625,272	10.413	9.727	1	218
12. foreign share	625,272	0.084	0.259	0	3.024

Note: * means log

Table 3.2: Correlation matrix

Variable	1	2	3	4	5	6	7	8	9
1. Export propensity	1.000								
2. TFP	0.132	1.000							
3. Productivity cut-off	0.094	0.797	1.000						
4. Firm size	0.154	0.610	0.493	1.000					
5. R&D	0.025	0.033	0.028	0.096	1.000				
6. Ownership	-0.101	0.080	0.066	0.221	0.045	1.000			
7. Capital intensity*	-0.107	0.156	0.146	0.549	0.034	0.133	1.000		
8. Firm age*	0.000	0.079	0.063	0.219	0.032	0.377	0.053	1.000	
9. Foreign share	0.276	0.103	0.080	0.163	0.008	-0.101	0.063	-0.066	1.000

Note: 1. * means log 2. export intensity, irregular export, and regular export are not reported due to different sample sizes.

Table 3.3: Regression results

Variable	Model 1 Export propensity	Model 2 Export intensity	Model 3 Irregular export	Model 4 Regular export
TFP	0.105***	-0.022***	0.046***	-0.033
	(0.010)	(0.001)	(0.016)	(0.028)
Productivity cutoff	-0.117***	0.000	-0.020	-0.089*
	(0.015)	(0.001)	(0.031)	(0.052)
Firm size	0.769***	-0.038***	-0.023**	0.392***
	(0.009)	(0.001)	(0.011)	(0.022)
R&D	2.167***	-0.153***	-0.680	0.125
	(0.352)	(0.034)	(0.629)	(0.957)
Ownership	-0.659***	-0.018***	-0.045	-0.209***
	(0.021)	(0.003)	(0.033)	(0.064)
Capital intensity	-0.487***	-0.019***	-0.041***	-0.335***
	(0.007)	(0.001)	(0.009)	(0.018)
Firm age	0.017***	-0.004***	0.005***	0.029***
	(0.001)	(0.000)	(0.001)	(0.003)
Firm age_2	-0.000***	0.000***	0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Foreign share	2.374***	-0.021***	0.354***	0.577***
	(0.035)	(0.003)	(0.032)	(0.048)
IMR		-0.032***		
		(0.002)		
Constant	-11.122***	1.294***	-0.120	0.160
	(0.095)	(0.019)	(0.124)	(0.219)
Number of obs.	625,272	145,602	73,338	179,034
Log likelihood	-202852.870	24218.688	-12330.160	-29702.915

Note: 1. The whole models include year, industry, and region dummy variables 2. Standard errors in the parentheses 3.

3.4 Conclusions

This study uses a large sample with 208,424 Chinese manufacturing firms and employs the analytic method of ROC and Heckman's two-stage procedure with Probit and Tobit models. This study mainly explores the effect of productivity and its cut-off on a firm's behaviors, including export propensity (export decision), export intensity (export scale), irregular export, and regular export. Productivity is likely to impact on firm's export propensity and irregular export positively. In comparison, it exerts a negative effect on a firm's export intensity and does not impact its regular export. The presence of China's exports-productivity paradox is mainly derived from the "adverse self-selection effect" and "crowding-out effect". Enhancing productivity cut-off is not conducive to the firm's export propensity and regular export while it does not impact the firm's export intensity and irregular export. Productivity cut-off tends to affect the firm export decision rather than the export scale.

Moreover, firms with regular export are more sensitive to productivity cut-off than firms with irregular export. The findings have important implications for China's exporting firms and government policy. Firms can better integrate different resources and consist of their comparative advantage and adjust their behaviors with matching their comparative advantage. So that firms can better compete in the domestic and foreign markets. The local government should encourage firm's innovation, reduce firm's trade costs, and promote industry updating.

Chapter 4

The Congestion Effect of Foreign Direct Investment's Agglomeration on Firm Productivity in China: A Spatial Analysis

4.1 Introduction

Since China's reform and opening in 1978, its economy is becoming closer and closer to the rest. The cross-border flow of foreign direct investment (FDI) plays a vital role in the globalization process. According to UNCTAD (2018), the amount of FDI inflow rapidly increased at an average of 19.853 percent per year in developing countries and an average of 14.381 percent per year in developed countries during 1970-2017. China, as a developing country, is the third-largest economy for FDI receipt with US$136.320 billion in the world and the top economy for FDI receipt in developing countries in 2017 (UNCTAD, 2018). Moreover, eastern regions with the advantages of geography, endowments, and preferential policies attract a much more considerable FDI than western, middle, and north-eastern regions (Wei et al., 2009). The amount of FDI inflow to eastern regions accounts for roughly 78.153 percent of total FDI inflow into China while the amount of FDI inflow to western, middle, and north-eastern regions merely occupies about 8.111, 8.327, and 5.410 percent, respectively in 2017 (National Bureau of Statistics of China, 2018).

In terms of the distribution of industries, the amount of FDI inflow into the top four industries (manufacturing, information transmission, software and information technology, real estate, leasing and business services, and wholesale and retail trades) consists of 25.570, 15.964, 12.863, and 12.774 percent, respectively of total FDI inflow into China while the amount of FDI inflow into other industries[6] is mostly far below 10 percent of total FDI inflow into China in 2017 (National Bureau of Statistics of China, 2018). Thus, the large

[6]According to the 2002 edition of China Industry Classification National Standard, other industries include wholesale and retail trades (8.760%), financial intermediation (6.045%), scientific research and technical services (5.223%), transport, storage, and post (4.265%), production and supply of electricity, heat, gas, and water (2.687%), construction (1.999%), mining (0.994%), agriculture, forestry, animal husbandry and fishery (0.820%), culture, sports and entertainment (0.533%), management of water conservancy, environment and public facilities (0.435%), services to households, repair and other services (0.433%), hotels and catering services (0.320%), health and social service (0.233%), education (0.059%) and public management, social security and social organization (0.023%). The values in the parentheses stand for FDI inflow into each industry to total FDI inflow into China in 2017.

uneven distributions of FDI in specific regions and industries can easily result in over agglomeration (congestion effect).

The literature of agglomeration economies traditionally focuses on industry agglomeration with mixed domestic and foreign firms (Marshall, 1920; Krugman, 1991) and identifies two industry agglomerations, namely localization and urbanization agglomerations. Localization (intra-industry agglomeration) economies refer to the agglomeration of firms in the same industry arising knowledge spillovers and labor pooling (Marshall, 1920)). Urbanization (inter-industry agglomeration) economies relate to the variety and diversity of geographically proximate industries promoting productivity growth through sharing information and practices (Jacobs, 1969). This study expands the literature and explores the interaction of the agglomeration of foreign firms with domestic firms. New foreign firms would face the liability of foreignness when they enter host countries (Johanson & Vahlne, 2009).

Moreover, new foreign firms with comparative advantage expect a positive balance between inflow and outflow spillovers (Mariotti, et al., 2010). Therefore, new foreign firms are likely to agglomerate with prior foreign firms with different backgrounds and encounter different operational difficulties from domestic competitors, where they can overcome the liability of foreignness and obtain a competitive advantage by accessing local knowledge, predominantly local tacit knowledge from previous foreign firms through knowledge spillovers and information sharing (Shave et al., 1997; Barry et al., 2003; Mariotti, et al., 2010; Tan & Mayer, 2011; Lamin & Livanis, 2013). The study by He & Wang (2010) shows that foreign firms are obviously more agglomerative than domestic firms in China.

Simply considering overall FDI agglomeration may not explain well the interaction of FDI agglomeration with domestic firms. Thus, it is necessary to distinguish the diverse types of

FDI agglomerations including horizontal, backward, and forward FDI agglomerations, due to their different interaction mechanisms with domestic firms. Besides, horizontal FDI agglomeration relates to agglomerated foreign firms in the same industries, while vertical and forward FDI agglomerations refer to the agglomerated foreign firms in upstream and downstream industries.

No studies that have explored the non-linear and spatial effects of horizontal, backward, and forward FDI agglomerations on domestic firms' productivity. This study is original in three main respects. First, this study uses extensive firm-level data with 12,240 firms covering 2010-2013 to explore this topic by employing a spatial econometric model. Space dependence is a matter for exploring the spillover effect of foreign presence on firm productivity (Driffield, 2006; Coughlin & Segev, 2000; Van Oort, 2007; Ke, 2010). Second, this study combines the ideas of revealed comparative advantage (RCA) index suggested by Balassa (1965) and horizontal and vertical (forward and backward) indices proposed by Javorcik (2004) to construct the new indices of horizontal, vertical, and forward FDI agglomerations. These indices can capture the diverse types of FDI agglomerations well by reducing the impact of the enormous difference in the absolute economy scales of different regions in China. Third, this study illustrates the different mechanisms of the interactions of horizontal, vertical, and forward FDI agglomerations with domestic firms, including the three main differences, namely, inter-firm relationship, the trade-off between benefits and costs, and interaction intensity.

This study is structured as follows. After the introduction, Section 4.2 illustrates agglomeration economies' relevant literature and develops hypotheses by interpreting the interactions of the agglomeration of foreign firms with domestic firms. Section 4.3 presents the econometric model, variable measurements, estimation techniques, and study data

details. Section 4.4 interprets empirical findings, and Section 4.5 gives conclusions with policy implic**ations.**

4.2 Related literature review and hypotheses

The literature on agglomeration economies identifies two types of industry agglomerations, namely localization and urbanization agglomerations. The early seminal work of agglomeration effect on firm productivity can be traced to Marshall (1920), who finds the localization (intra-industry agglomeration) economies that refer to the agglomeration of firms in the same industry arising knowledge spillovers and labor pooling. In contrast, Jacobs (1969) discusses urbanization (inter-industry agglomeration) economies relate to the variety and diversity of geographically proximate industries promoting productivity growth through sharing information and practices. Both localization and urbanization economies can be regarded as centripetal forces resulting in the spatial concentration of economic activities. The relevant empirical studies present inconclusive results. The empirical findings support localization economies rather than urbanization economies when both are assessed together (Melo et al., 2009; Hu et al., 2015).

Duranton and Puga (2004) summarize that a positive agglomeration effect on firm productivity originated from sharing, matching, and learning mechanisms. The sharing mechanism refers to sharing indivisible goods and facilities, the gains from a wider variety of input and individual specialization, and risk. The matching mechanism relates to the efficient and effective matching between employers and employees in an extensive labor pooling. In addition, the learning mechanism involves knowledge creation, diffusion, and accumulation enforced by proximate firms. The empirical studies such as Ciccone (2002), Dekle (2002), Fan & Scott (2003), Henderson (2003a), Cingano & Schivardi (2004), Brülhart & Mathys (2008), Graham (2009), Martin et al. (2011), Melo et al. (2017) and

Klein & Crafts (2018) identify a positive effect of agglomeration on firm productivity. However, over-agglomeration can act as a centrifugal force to offset the benefits of agglomeration. This is because of the increased costs resulting from higher wages driven by competition among firms for skilled labor and higher rents due to increased housing and commercial land demands and negative externalities such as congestion (Lall et al., 2004; Rizov et al., 2012).The empirical studies such as Batisse (2002), Frenken et al. (2007), Brülhart & Mathys (2008), Broersma & Oosterhaven (2009), Azari et al. (2016), and Wei et al. (2020) confirm a adverse effect of agglomeration on firm productivity. However, it is not necessary to assume that agglomeration economies or diseconomies are linearly dependent on the level of agglomeration. Agglomeration externalities of economies and diseconomies tend to experience a dynamic trade-off between benefits and costs and are likely to increase or decrease at different rates. Therefore, it is reasonable to capture the dynamic (non-linear) effect of agglomeration economies or diseconomies on firm productivity. Empirical studies such as Henderson (2003b), Carlino et al. (2007), Lin et al. (2011), and Rizov et al. (2012) find an inverted U-shaped relationship (congestion effect) between a firm's agglomeration and productivity.

The literature of agglomeration economies traditionally focuses on industry agglomeration with mixed domestic and foreign firms (Marshall, 1920; Krugman, 1991), while the interaction of agglomerations of foreign firms with domestic firms is not concerned. Foreign firms are different from purely domestic firms because they are larger, more intensive in capital, skilled labor, and profitability, and pay higher wages (Haddad & Harrison, 1993; Aitken et al., 1997; Blomstrom & Sjoholm, 1999). The possession of these attributes makes foreign firms with a comparative advantage outperform domestic and foreign rivals in some dimensions in host countries especially developing countries where few domestic firms have a comparative advantage over foreign firms. New foreign firms with productivity advantage tend to choose relatively high production locations and expect

a positive balance between inflow and outflow spillovers rather than one-way spillovers to other firms in host countries (Shaver, 1998; Buckley et al., 2007; Graham & Kim, 2008; Mariotti et al., 2010). Moreover, prior foreign firms with diverse backgrounds encounter different operational difficulties from domestic competitors, and their knowledge spillovers to new foreign firms tend to be more useful (Tan & Mayer, 2011; Lamin & Livanis, 2013). In other words, new foreign firms are willing to locate at the geography proximity with existing foreign firms in host countries because of the demonstration effect and alleviation of the liability of foreignness through the knowledge spillovers and information sharing (Shaver et al., 1997; Barry et al., 2003; Mariotti et al., 2010). Therefore, accessing local knowledge is crucial for foreign firms when they enter the market in host countries for the first time.

Knowledge can be classified into tacit knowledge (e.g., mental models, values, and perceptions) and explicit knowledge (e.g., technicalor academic data or information described in formal language) (Polanyi, 1966; Smith, 2001). Tacit local knowledge rather than explicit local knowledge is more difficult to transmit due to its tacit nature (Polanyi, 1966; Kogut & Zander, 1996; Lord & Ranft, 2000). Furthermore, the extent to which two organizations benefit from knowledge sharing depends mainly on the quality of the relationship between them in host countries, especially in emerging economies where institution avoid makes firms rely to a large extent on relational contracts rather than legal contracts and increases the difficulty of identifying the trajectory changes of the local environment (Simonin, 1999; Tan & Mayer, 2011; Lamin & Livanis, 2013). The concentration of economic activities eases the geography ties among firms. Under such an agglomeration context, an elevated level of trust between firms strengthens their emotional ties and promotes knowledge transfer, especially more valuable tacit and locally embedded knowledge (Dirks & Ferrin, 2001; Levin & Cross, 2004; Tallman & Chacar, 2011).

Simply considering overall FDI agglomeration may not explain well the interaction of FDI agglomeration with domestic firms. Therefore, it is necessary to distinguish horizontal, backward, and forward FDI agglomerations due to their different interaction mechanisms with domestic firms. The interaction of horizontal FDI agglomeration with domestic firms refers to the competitive relationship between foreign firms and domestic firms. Technology diffusion through general horizontal effects works when imitation, competition, or labor turnover occurs. Local firms in host countries can improve their productivity by simply copying some technology used by foreign firms, and the increased competitive pressure from the entrants of foreign firms forces them to upgrade their technology by using the existing technology and resources more efficiently (Liu et al., 2000; Spencer, 2008).

Furthermore, Wang & Blomström (1992) emphasize that the more competition the foreign firms face from domestic firms, the more advanced technology it must bring in to retain its competitive advantage and the enormous potential it contributes to technology spillovers. Finally, if the local employees who receive training and absorb new technology in foreign firms can switch employers, they may transfer their knowledge from foreign firms to local firms (Javorcik & Spatareanu, 2008; Balsvik, 2011; Poole, 2013). Foreign firms with comparative advantage are unlikely to locate with domestic firms and tend to encounter a negative balance between inflow and outflow spillovers or even one-way outflow spillovers to domestic firms. Besides, in horizontal FDI agglomeration with domestic firms, foreign firms keeping a competitive relationship with domestic firms are unlikely to locate closely with them. Thus, FDI agglomeration externalities of economies (sharing, matching, and learning mechanisms) and FDI agglomeration externalities of diseconomies (such as higher wages for skilled laborers and higher rents for housing and commercial lands) tend to have a weak impact on the productivity of domestic firms. However, in the context of the agglomeration of foreign firms, the clustering of economic activity can also ease the

formation of business alliances and organizations to enhance their competitive advantages in the local market (Fan & Scott, 2003).

Moreover, sharing knowledge among new and prior foreign firms can promote them to gain competitive advantages (Kogut & Zander, 1992; Tallman & Chacar, 2011). The nature of competition is unlikely to be locally bounded and can spread across the market. The increased competition from foreign firms may be detrimental to local firms and even crowd them out both of local product and labor markets in host countries (Aitken & Harrison, 1999; Spencer, 2008). To improve their productivity, they may force stricter or more cost-conscious management and motivate employees to work harder instead of imitating technology.

The interaction of backward or forward FDI agglomeration with domestic firms relates to the cooperative relationship between foreign firms and suppliers or customers (domestic firms) operating between industries. Foreign firms can provide technical assistance or information to local suppliers to improve their product quality or facilitate their innovation, obtaining the high-quality or low-price intermediate products delivered on time (Javorcik, 2004; Kugler, 2006; Spencer, 2008). They can also help them set up their production facilities, provide training to them, and help them manage and organize (Javorcik, 2004; Kugler, 2006; Spencer, 2008). Customers can benefit from the improved performance by using the intermediate goods provided by foreign firms in their production process (Javorcik & Spatareanu, 2008; Du et al., 2012). Foreign firms with enormous size and international operation are expected to have much more bargaining power than domestic firms, which the asymmetries in bargaining power might lead to negative spillovers to domestic firms (Girma et al., 2008). Furthermore, foreign firms choose locations close to local suppliers or customers because they can easily purchase or supply intermediate goods from suppliers or customers (Amiti & Javorcik, 2008). Therefore, FDI agglomeration

externalities of economies and diseconomies tend to have a substantial impact on the productivity of domestic firms. Based on the discussion above, this study summarizes the comparisons of the interactions of horizontal, backward, and forward FDI agglomerations with domestic firms in Table 4.1 and develops the relevant hypotheses that are shown as follows:

Table 4.1: Comparisons of the interaction of horizontal, backward, and forward FDI agglomerations with domestic firms

	Horizontal FDI agglomeration	**Backward FDI agglomeration**	**Forward FDI agglomeration**
Inter-firm relationship	Competitive relationship between foreign firms and domestic firms. Coexistence of competitive and cooperative relationship between agglomerated foreign firms.	Cooperative relationship between foreign firms and local suppliers. Coexistence of competitive and cooperative relationship between agglomerated foreign firms.	Cooperative relationship. between foreign firms and local customers. Coexistence of competitive and cooperative relationship between agglomerated foreign firms.
Trade-off between benefits and costs	Horizontal effect through imitation, competition or labor turnover facilitates the increase of domestic firms' productivity. Whereas over-competition from foreign firms would lead to the reduction of domestic firms' productivity. Additionally, FDI agglomeration externalities of economies and diseconomies have a weak impact on domestic firms' productivity.	Backward linkage promotes the increase of suppliers' productivity. Whereas the asymmetries in bargaining power might lead to negative spillovers to suppliers. Additionally, FDI agglomeration externalities of economies and diseconomies have a strong impact on suppliers' productivity.	Forward linkage promotes the increase of customers' productivity. Whereas the asymmetries in bargaining power might lead to negative spillovers to customers. Additionally, FDI agglomeration externalities of economies and diseconomies have a strong impact on customers' productivity.
Interaction	Weak	Strong	Strong

Hypothesis 1: The increasing level of horizontal, backward, and forward FDI agglomeration (foreign firms) tends to enhance domestic firm's productivity initially and then reduce their productivity beyond its threshold value.

Hypothesis 2: The interaction intensity of backward and forward FDI agglomerations (foreign firms) with domestic firms is relatively robust and similar. The interaction intensity of horizontal FDI agglomeration with domestic firms is weaker than backward and forward FDI agglomerations based on Hypothesis 1.

4.3 Econometric Analysis

4.3.1 Model specification and estimation techniques

This study explores the non-linear and spatial effects of horizontal, backward, and forward FDI agglomerations on firm productivity and develops a general spatial econometric model by considering the suggestions of Anselin et al. (2008) and Elhost (2012)[7]. The model is described as follows:

Equation 4.1:

$$\begin{aligned} productivity_{f,r,t} &= \beta_0 + \beta_1 productivity_{f,r,t-1} + \beta_2 firm\_age_{f,r,t} \\ &+ \beta_3\, firm\_age^2_{f,r,t} + \beta_4 firm\_size_{f,r,t} + \beta_5 ownership_{f,r,t} \\ &+ \beta_6 capital\_intensity_{f,r,t} + \beta_7 export\_intensity_{f,r,t} \\ &+ \beta_8 real\_exchange\_rate_{f,r,t} + \beta_9 human\_capital_{r,t} \\ &+ + \beta_{10} infrastructure_{r,t} + \beta_{11}\text{fdi\_agglomeration}_{f,r,t} \\ &+ \beta_{12}\, fdi\_agglomeration^2_{f,r,t} + \beta_{13} W_1\text{fdi\_agglomeration}_{f,r,t} \\ &+ \beta_{14}\, W_1 fdi\_agglomeration^2_{f,r,t} + \beta_{15} W_1 export\_intensity_{fr,t} \\ &+ \beta_{16} W_1 human\_capital_{r,t} + \beta_{17} W_1 infrastructure_{r,t} + \mu_{fr} + \nu_{fr,t} \end{aligned}$$

Equation 4.2:

$$\upsilon_{fr,t} = \lambda W_1 \upsilon_{f,r,t} + \xi_{f,r,t}$$

Note: the footnotes "f", "I", "r", and "t" of variables in the regression model represent firm, industry, region, and time, respectively.

[7] According to Anselin et al. (2008) and Elhost (2012), a most general spatial dynamic panel model is not identified, and this unidentifiable issue can be solved by giving some restrictions. For instance, the coefficients of spatial $productivity_{f,r,t-1}$, $firm\_size_{f,r,t}$, $firm\_age_{f,r,t}$, $ownership_{f,r,t}$, $capital\_intensity_{f,r,t}$, $export\_intensity_{f,r,t}$ and $real\_exchange\_rate_{f,r,t}$ are equal to zero in this study, which excludes the corresponding endogenous and exogenous interactive effects.

$productivity_{f,r,t}$ detonates the firm's total factor productivity (TFP). This study uses the semiparametric approach suggested by Olley & Pakes (1996)[8] to estimate TFP[9].

$fdi\_agglomeration_{fr,t}$ represents inflow FDI agglomeration. This study combines the ideas of the RCA index suggested by Balassa (1965) and horizontal and vertical (forward and backward) indices proposed by Javorcik (2004) to construct three new indices of horizontal, backward, and forward FDI agglomerations. The economic scale and development level of different regions in China shows an obvious unbalance. The new indices can capture the three types of FDI agglomeration and overcome the measurement bias due to the difference in absolute economy scale of different regions in China. The three types of inflow FDI agglomerations include 4.3) Inflow FDI agglomeration within an industry (awi) =$(FC_{ri}/TC_{ri})/(FC_r/TC_r)$. FC_r and TC_r represent (inflow foreign capital/ equity) × output and total output in region "r", respectively. FC_{ri} and TC_{ri} represent (inflow foreign capital/total equity) × output and total output, respectively in region "r" and industry "i", respectively. 4.4) Inflow FDI agglomeration between backward industries (abi) = $a_o(FC_r/TC_r)$/(FC/TC). a_o denotes the input index from China's 2012 input-output table[10]. FC and TC represent (total inflow foreign capital/total equity) × total output and total output, respectively. 4.5) Inflow FDI agglomeration between forward industries (afi) = $b_o(FC_{r-e}/TC_{r-e})$/(FC_{-e}/TC_{-e}). b_o denotes the output index from China's 2012 input-output table. FC_{r-e} and TC_{r-e} represent [(inflow foreign capital/total equity) × output – export]

[8] There are several methods to estimate the TFP, such as the O-P method suggested by Olley & Pakes (1996), the L-P method proposed by Levinsohm & Petrin (2003), the OLS with fixed effect and the GMM method suggested by Blundell & Bond (1998). However, the L-P method requires the data of intermediate input, and the GMM method needs data with enough long-time span to conduct lots of difference and lag processing to create a favorable instrument variable. Therefore, because of the lack of relevant data, this study merely uses the O-P method in this study.

[9] The variables used include the log of output (dependent variable), export exit (exit variable), firm age (state variable), the log of capital (state variable), the log of investment (proxy variable), export status (control variable), ownership (state-owned or non-state-owned, control variable), the log of labor (free variable) and year, industry, and region dummies (free variables). All the variables used in this study are handled by the GDP price deflator (base-year 2010).

[10] China's 2012 input–output table can be obtained from the website (http://data.stats.gov.cn/ifnormal.htm?u=/files/html/quickSearch/trcc/trcc01.html&h=740).

and (total output – total export) in region "r", respectively. $FC\__e$ and $TC\__e$ represent [(inflow foreign capital/total equity) × output-export] and (total output – total export), respectively.

Concerning independent variables, $firm\_age_{fr,t}$ is measured by the number of years since its incorporation. $frim\_size_{fr,t}$ is measured by total assets. $ownership_{fr,t}$ is measured by "1" if firms are state-owned and "0" otherwise. $capital\_intensity_{fr,t}$ is measured by fixed capital/the number of employees. $export\_intensity_{fr,t}$ is measured by export/ total sales. Real exchange rate volatility is measured by the 2-year moving average of the standard deviation of annual percentage change in the multilateral real exchange rate. $human\_capital_{r,t}$ is measured by the average number of education years. $infrastructure_{r,t}$ is measured by the total length of the region's roads/area $W_1 fdi\_agglomeration_{r,t}$, $W_1 fdi\_agglomeration^2_{r,t}$, $W_1 export\_intensity_{fr,t}$, $W_1 human\_capital_{r,t}$, $W_1 human\_capital_{r,t}$ and $W_1 v_{fr,t}$ represent the spatial term of FDI agglomeration, export intensity, human capital, infrastructure, and error term, respectively. Besides, β_0-β_{17} and λ represent the corresponding coefficients. μ_{fr} represents the random effect. Finally, $\varepsilon_{fr,t}$ represents the error term. All the variables are handled by the gross domestic product (GDP) price deflator (base-year 2010)

This study uses the neighboring spatial weight matrix 4.6). The neighboring spatial weight matrix is equal to "1" if two regions are neighboring and "0" otherwise. Besides, the spatial weight matrices in regression models are row-standardized.

4.6)

$$w_{ab} = \begin{cases} 1 \ if \ \text{a and b are neighbouring adjacency} \\ 0 \ if \ \text{a and b are not neighbouring adjacency} \end{cases} \quad (a \neq b)$$

This study also pays attention to the two main econometric issues. Using the simple ordinary least squares (OLS) regression to estimate TFP would lead to some econometric problems, especially the simultaneity bias of production decision and sample selection bias. Production decision-makers can adjust production inputs based on currently observed firm productivity to maximize production outputs. Firms with a relatively large capital stock generally have a higher capability to deal with crisis, and firms with a relatively small capital stock are likely to exit the market. The semiparametric approach of TFP proposed by Ollep & Pakes (1996) can reduce the estimation bias caused by the selection issue and endogeneity problem.

Inflow FDI might choose relatively high productive locations in host countries (Shaver, 1998; Buckley et al., 2007; Graham & Kim, 2008). This study addresses this econometric issue by employing the test of Hausman (1978) with five instruments, including export intensity (exports/ sales) at the firm level, profitability (profits/sales) at the firm level, the lag of inflow FDI at the firm-level, the numbers of firms in each industry and market size (sales) in each industry. The test results reveal no evidence of the simultaneity links of foreign presence to firm productivity, consistent with the findings of Buckley et al. (2002) and Buckley et al. (2007). Furthermore, Graham & Kim (2008) and Graham (2009) indicate that the overall evidence shows no substantial bias in agglomeration estimates if agglomeration does have an endogenous component based on the summary of previous studies that had checked the endogenous issue. Before running the regression estimation, this study also conducts Moran's I test and the Hausman test. The results of Moran's I tests for each year (2010–2013) show the rejection of the null hypothesis at 1% significance, which means the existence of spatial dependence.

4.3.2 Data details

This study uses the firm, region, and nation-level data to explore the spatial effect of FDI agglomeration on domestic firms' productivity. The region-level data (human capital and infrastructure) and nation-level data (multilateral real exchange rate) are extracted from the National Bureau of Statistics of China and World Development Indicators. The whole other data at the firm level are extracted from Annual Industry Survey Database published by the National Bureau of Statistics of China since 1998. The Annual Industry Survey Database classifies firms into 4-digit ISIC and includes firms with the annual sales that are at least 5 million RMB (roughly 0.806 million US$)[11]. This database is also frequently used to explore the relevant topics of international business and strategic management, such as the studies of Chang & Xu (2008), Brandt (2012), Xiao et al. (2013), and Chang & Chung (2017).

There is no data of inflow FDI in the two regions, namely Hunan and Xizan, which leads to a total of 29 regions12 used in this study. Figure 4.1 shows the number of neighboring regions by the relevant region in China. Moreover, the economic development in these regions is extensive unbalance, which eastern regions are much higher than other regions. For instance, the GDPs of Guangdong and Jiangsu located in eastern regions are 10,076.579 million US$ and 9,637.640 million US$, respectively, while the GDPs of Ningxia and Qinghai located in western regions are merely 342.268 million US$ and 131.560 million US$, respectively in 2013 (National Bureau of Statistics of China, 2013). The final data used in this study involves 12,440 firms covering the period 2010–2013. Besides, Tables 4.2 and 4.3 show the descriptive statistics and correlation matrix of variables, respectively.

[11] This study uses the official 2013 exchange rate in the National Bureau of Statistics of China. This study also uses it to transfer the values of the GDPs of Guangdong, Jiangsu, Ningxia, and Qinghai from the Chinese currency into the US dollar.

[12] Western regions include Nei Mongol Zizhiqu, Guangxi Zhuangzu Zizhiqu, Chongqing Shi, Sichuan Sheng, Guizhou Sheng, Yunnan Sheng, ShanXi Sheng, Gansu Sheng, Qinghai Sheng, Ningxia Huizu Zizhiqu, and Xinjiang Uygur Zizhiqu. Northeastern regions include Liaoning Sheng, Jilin Sheng, and Heilongjiang Sheng. Middle regions include Shanxi Sheng, Anhui Sheng, Jiangxi Sheng, Henan Sheng, and Hubei Sheng. Finally, eastern regions include Beijing Shi, Tianjin Shi, Hebei Sheng, Shanghai Shi, Jiangsu Sheng, Zhejiang Sheng, Shandong Sheng, Fujian Sheng, Guangdong Sheng, and Hainan Sheng.

Figure 4.1: The number of neighboring regions by the relevant region in China

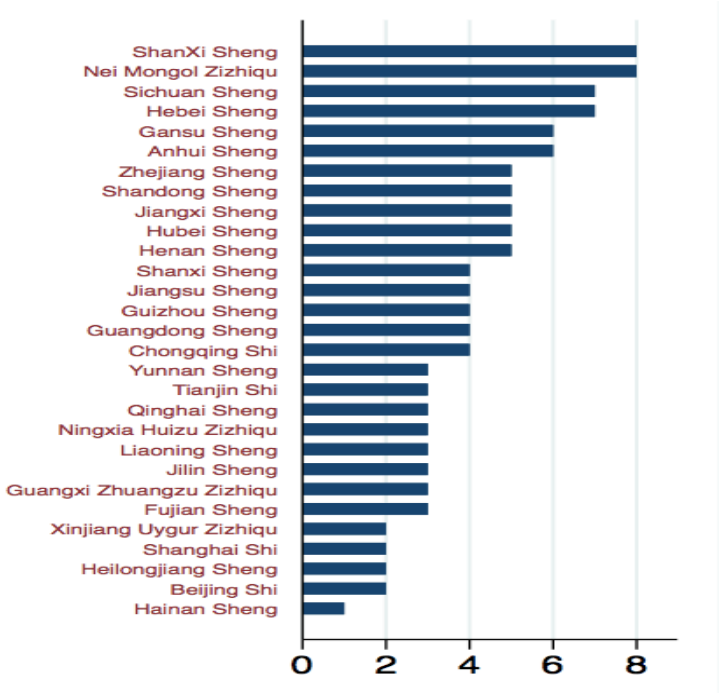


Table 4.2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Productivity	37,320	6.630	0.888	5.031	8.432
Productivity lag	37,320	6.599	0.877	5.031	8.432
Firm age	37,320	13.238	5.974	1	186
Firm size*	37,320	12.454	1.571	4.680	19.935
Ownership	37,320	0.049	0.215	0	1
Capital intensity*	37,320	4.464	1.609	-4.613	15.513
Export intensity	37,320	0.341	0.382	0	1
Real exchange rate	37,320	3.446	1.089	1.906	4.230
Human capital	37,320	9.551	0.720	7.589	12.028
Infrastructure	37,320	1.305	0.348	0.089	2
fdi_agglomeration (awi)	37,320	1.088	0.849	0	29.289
fdi_agglomeration (abi)	37,320	1.031	0.351	0	4.380
fdi_agglomeration (afi)	37,320	1.056	0.338	0	4.656
W_export_intensity	37,320	0.417	0.093	0.048	0.577
W_human_capital	37,320	9.391	0.511	8.049	10.715
W_infrastructure	37,320	1.254	0.315	0.220	1.565
W_fdi_agglomeration (awi)	37,320	1.162	0.262	0.936	3.371
W_fdi_agglomeration (abi)	37,320	1.047	0.239	0.225	1.977
W_fdi_agglomeration (afi)	37,320	1.124	0.229	0.213	1.898

Note: * means log

Table 4.3: Correlation matrix

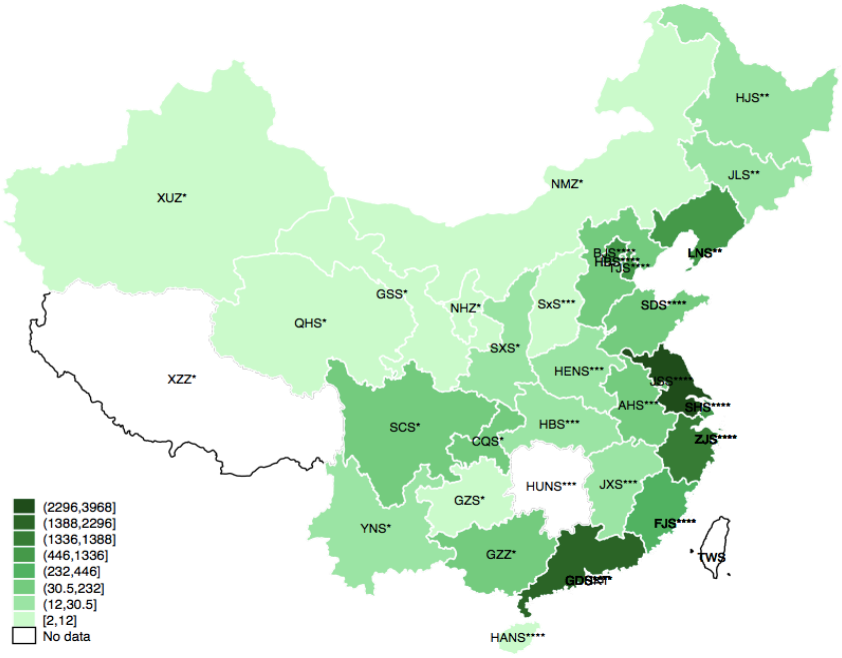
Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Productivity	1.000												
2. Productivity lag	0.793	1.000											
3. Firm age	0.038	0.065	1.000										
4. Firm size*	0.489	0.446	0.170	1.000									
5. Ownership	0.084	0.078	0.161	0.174	1.000								
6. Capital intensity*	0.186	0.173	0.056	0.653	0.104	1.000							
7. Export intensity	-0.145	-0.108	-0.032	-0.158	-0.102	-0.209	1.000						
8. Real exchange rate	-0.015	0.059	0.118	0.030	0.001	-0.030	-0.001	1.000					
9. Human capital	-0.025	0.028	0.065	0.008	0.054	-0.019	-0.090	0.119	1.000				
10. Infrastructure	-0.094	0.034	0.074	-0.034	-0.023	-0.005	0.000	0.054	0.371	1.000			
11. fdi_agglomeration (awi)	-0.020	-0.018	-0.003	0.002	-0.016	0.021	0.013	-0.016	0.027	-0.051	1.000		
12. fdi_agglomeration (abi)	-0.078	-0.095	-0.041	-0.058	-0.054	-0.013	0.066	-0.009	-0.110	0.413	-0.100	1.000	
13. fdi_agglomeration (afi)	-0.084	-0.098	-0.032	-0.066	-0.057	-0.027	0.091	0.008	-0.078	0.375	-0.097	0.960	1.000

Note: * means log

4. 4 Empirical Findings

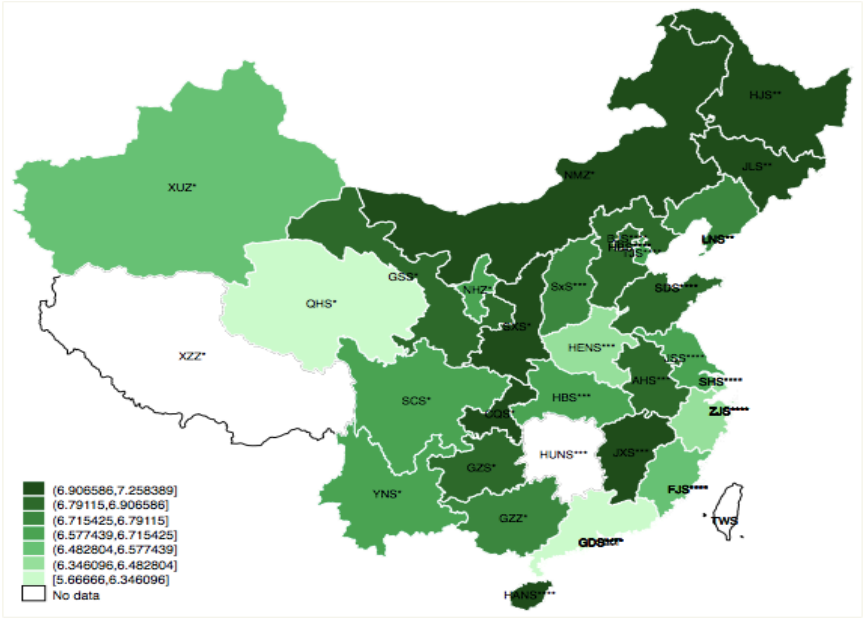
Figure 4.2 shows the regional distribution of Chinese firms. The distribution of the study sample concentrates on eastern regions. Wei et al. (2009) interpret that eastern regions with the advantages of geography, endowments, and preferential policies attract a much larger FDI than western, middle, and north-eastern regions. Figure 4.3 shows the regional distribution of average Chinese firms' productivity during the period 2010-2013. The average Chinese firm's productivity in some eastern regions such as Jiangsu, Zhejiang, and Fujian is relatively low. This may be why many low-level manufacturing firms in these regions, especially coastal regions, drag down their average firm productivity. Besides, Figures 4.4, 4.5, and 4.6 show the regional distributions of average horizontal, backward, and forward FDI agglomerations during 2010-2013, respectively. The significant difference in the agglomeration of foreign firms in China's different regions would easily lead to a congestion effect.

Figure 4.2: The regional distribution of Chinese firms



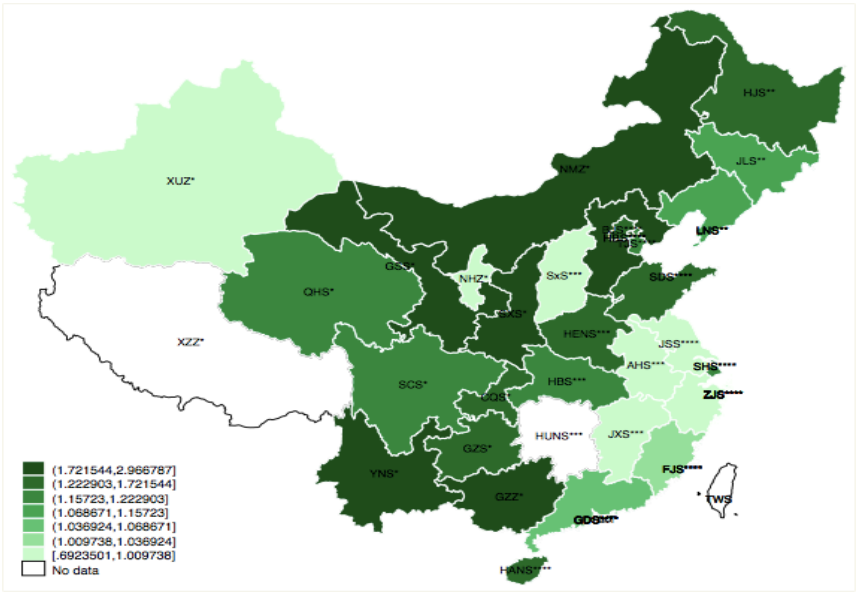
Note: 1. Western regions(*): Nei Mongol Zizhiqu (NMZ), Guangxi Zhuangzu Zizhiqu (GZZ), Chongqing Shi (CQS), Sichuan Sheng (SCS), Guizhou Sheng (GZS), Yunnan Sheng (YNS), Xizang Zizhiqu (XZZ), ShanXi Sheng (SXS), Gansu Sheng (GSS), Qinghai Sheng (QHS), Ningxia Huizu Zizhiqu (NHZ) and Xinjiang Uygur Zizhiqu (XUZ); Northeastern regions(**): Liaoning Sheng (LNS), Jilin Sheng (JLS) and Heilongjiang Sheng (HJS); Middle regions(***): Shanxi Sheng (SxS), Anhui Sheng (AHS), Jiangxi Sheng (JXS), Henan Sheng (HENS), Hubei Sheng (HUBS) and Hunan Sheng (HUNS); Eastern regions(****): Beijing Shi (BJS), Tianjin Shi (TJS), Hebei Sheng (HEBS), Shanghai Shi (SHS), Jiangsu Sheng (JSS), Zhejiang Sheng (ZJS), Shandong Sheng (SDS), Fujian Sheng (FJS), Guangdong Sheng (GDS) and Hainan Sheng (HANS). 2. Taiwan Sheng (TWS) and Hong Kong Tebiexingzhengqu (HKT) are not classified in this map. 3. This map is not the whole Chinese map and is only used for the research purpose in this study.

Figure 4.3: The regional distribution of average Chinese firm productivity during 2010-2013



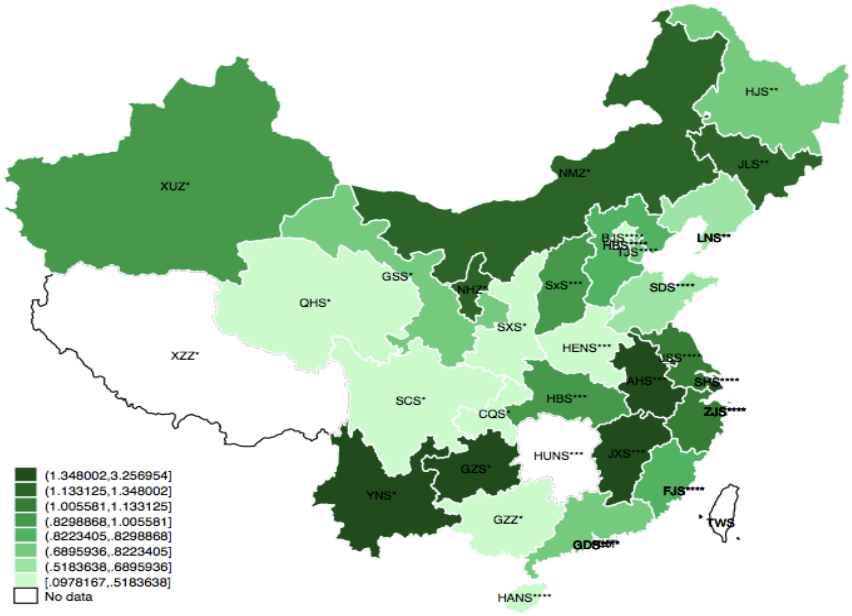
Note: This map is not the whole Chinese map and is only used for the research purpose in this study.

Figure 4.4: The regional distribution of average horizontal FDI agglomeration during 2010-2013



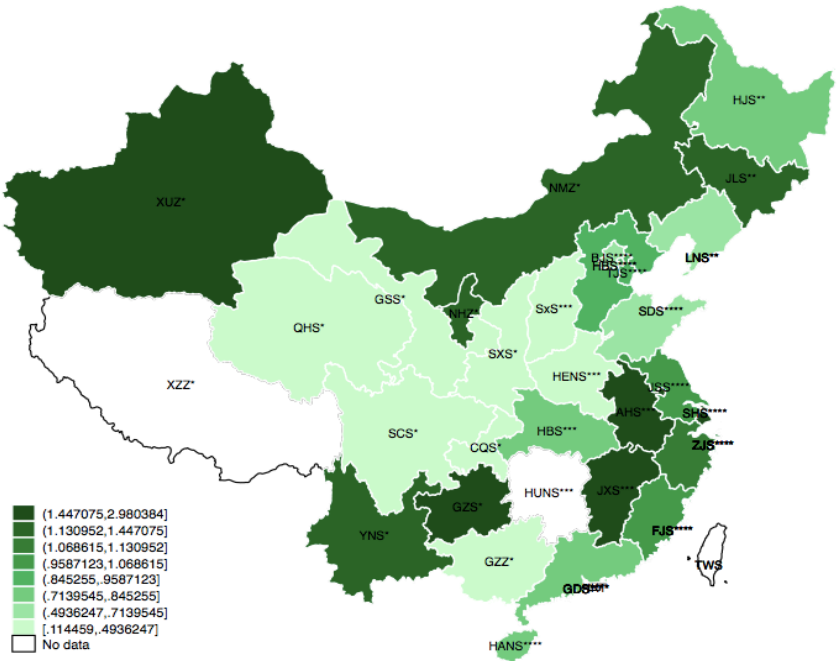
Note: This map is not the whole Chinese map and is only used for the research purpose in this study.

Figure 4.5: The regional distribution of average backward FDI agglomeration during 2010-2013



Note: This map is not the whole Chinese map and is only used for the research purpose in this study.

Figure 4.6: The regional distribution of average forward FDI agglomeration during 2010-2013



Note: This map is not the whole Chinese map and is only used for the research purpose in this study.

Table 4.4 shows the spatial regression results by employing the neighboring weight matrix. In Model 1, the coefficient of horizontal FDI agglomeration is not statistically significant, and the coefficient of its squared term is negative and statistically significant. In Model 3 and Model 5, the coefficients of backward FDI agglomeration and its squared term and the coefficients of forward FDI agglomeration and its squared term, are positive and negative with statistical significance, respectively. These results suggest an inverted U-shaped relationship between the three types of FDI agglomeration and local firm's productivity, which supports Hypothesis 1. The degree of backward and forward FDI agglomerations merely beyond its threshold value (the tipping point of the inverted U-shaped relationship) would lead to a decrease in local firms' productivity.

In contrast, any degree of horizontal FDI agglomeration would reduce local firms' productivity. This can be explained by the competitive relationship rather than the cooperative relationship between foreign and domestic firms reducing domestic firm's productivity. Therefore, the congestion dominates the three types of FDI agglomeration on local firms' productivity. The findings are consistent with the studies such as Henderson (2003b), Carlino et al. (2007), Lin et al. (2011), Rizov et al. (2012), and Hu et al. (2015). However, this study considers the industry agglomeration of foreign firms, unlike previous most studies merely consider the industry agglomeration with the mix of domestic and foreign firms. Furthermore, previous studies merely identify two agglomerations, namely localization and urbanization agglomerations, while this study identifies three types of agglomerations: horizontal, backward, and forward FDI agglomerations. Thus, it is better to understand how the different types of FDI agglomeration impact domestic firms.

Earlier studies such as Fan & Scott (2003), Martin et al. (2011), Cainelli et al. (2018), Cieślik et al. (2018), Ramachandran et al. (2020), and Kim et al. (2021) have mentioned the importance of spatial agglomeration on firm productivity. Nevertheless, few studies introduce a spatial empirical model to explore the effect of spatial agglomeration on firm

productivity, and no studies have further explored the effect of non-linear spatial agglomeration on firm productivity. This study introduces a spatial econometric model to explore further the effect of non-linear spatial agglomeration on firm productivity. As Table 4.4 shows, the values of Pseudo R-squares in Model 2, Model 4, and Model 6 are larger than those in Model 1, Model 3, and Model 5. The proof implies that the non-linear spatial agglomeration can be better to interpret firm productivity than the non-linear agglomeration. Thus, it is crucial to explore the effect of no-linear spatial agglomeration on local firm's productivity. In Models 2, 4 and 6, the evidence shows that the spatial term of horizontal FDI agglomeration is negative with statistical significance and the spatial terms of vertical and forward FDI agglomerations are negative and statistically significant.

Furthermore, the squared spatial term of horizontal FDI agglomeration is negative with statistical significance, while the squared spatial terms of backward and forward FDI agglomerations are positive with statistical significance. The evidence shows a U-shaped relationship between spatial horizontal FDI agglomeration and neighboring firm's productivity and an inverted U-shaped relationship between spatial backward and forward FDI agglomerations and neighboring firm's productivity. Therefore, the congestion effect also dominates backward and forward FDI agglomerations on neighboring firms' productivity.

A U-shaped relationship between spatial horizontal FDI agglomeration and neighboring firms' productivity can be attributed to the nature of competitive relationships between firms. The increase of spatial horizontal FDI agglomeration in a neighboring region would increase competition in the neighboring firms. Thus, the increasing competition forces the neighboring low-productivity firms to crowd out the market and promotes the improvement of the productivity of the neighboring high-productivity firms (Ottaviano, 2012; Forslid et al., 2014). Moreover, competition can be spillovers across regions (Yang & Wong, 2012; Kim et al., 2021). The increasing completion between foreign and neighboring firms would

reduce the overall competition in the neighboring region initially and then reduce the competition with the firms in the local region. However, the overall completion in the neighboring region would increase when the spatial horizontal FDI agglomeration is beyond its threshold value and then improve the firm productivity in the local region.

Based on the regression results in Table 4.4, this study further draws the inverted U-shaped relationship between horizontal, backward, and forward FDI agglomerations and the local firm's productivity, shown in Figure 4.7. The marginal elasticities (the sensitivity to local firms' productivity along with the change of FDI agglomeration's level) between horizontal, backward, and forward FDI agglomerations and local firm's productivity are about 0.002, 0.080 0.094, respectively, which supports Hypothesis 2. Moreover, the threshold values of horizontal, backward, and forward FDI agglomerations are about 0, 1.825, and 1.894, respectively. Foreign firms in horizontal agglomeration are competitive with local firms in the same industry, making local firms geographically alienated from foreign firms. Foreign firms in forward and backward agglomerations cooperate with local upstream and downstream firms, making local upstream and downstream firms geographically close to foreign firms.

Furthermore, the interaction intensity of agglomerated foreign firms with domestic firms is constrained by the geographical distance. Hence, horizontal FDI agglomeration should not be encouraged, and backward and forward FDI agglomerations should keep a reasonable degree for reaping more benefits from FDI. This study also draws the U-shaped relationship between spatial horizontal FDI agglomeration and neighboring firm's productivity and the inverted U-shaped relationship between spatial backward and forward FDI agglomerations and neighboring firms' productivity, shown in Figure 4.8. The marginal elasticities between spatial horizontal, backward, and forward FDI agglomerations and neighboring firm's productivity are about 0.060, 0.078, and 0.158, respectively. Furthermore, the threshold

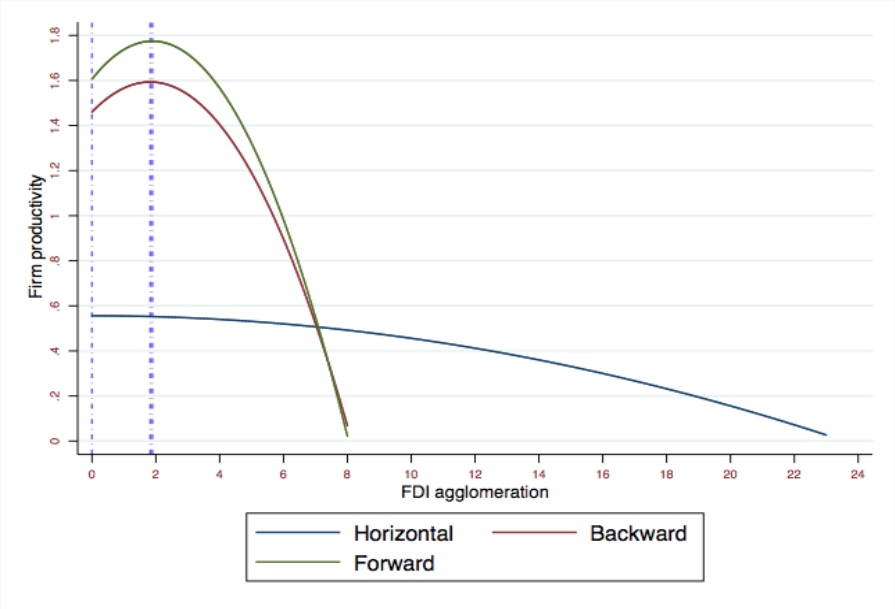
values of horizontal, backward, and forward FDI agglomerations are roughly 1.667, 2.833, and 1.968, respectively.

Table 4.4: Regression results by using the neighbouring weight matrix

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Productivity lag	0.267***	0.276***	0.283***	0.287***	0.290***	0.302***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Firm age	-0.009***	-0.008***	-0.011***	-0.010***	-0.012***	-0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Firm age_2	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	0.258***	0.262***	0.246***	0.249***	0.243***	0.243***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Ownership	0.012	0.004	0.027	0.017	0.030	0.020
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Capital intensity	-0.076***	-0.081***	-0.070***	-0.076***	-0.068***	-0.073***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Export intensity	-0.101***	-0.101***	-0.106***	-0.109***	-0.107***	-0.109***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Real exchange rate	-0.039***	-0.050***	-0.029***	-0.030***	-0.029***	-0.033***
	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)
Human capital	0.010	-0.006	-0.039***	-0.072***	-0.054***	-0.070***
	(0.010)	(0.010)	(0.012)	(0.012)	(0.012)	(0.012)
Infrastructure	-0.215***	-0.173***	-0.127***	-0.031	-0.099***	-0.023
	(0.026)	(0.024)	(0.031)	(0.031)	(0.031)	(0.030)
fdi_agglomeration (awi)	0.001					
	(0.004)					
fdi_agglomeration (awi)_2	-0.001**					
	(0.000)					
fdi_agglomeration (abi)			0.146***			
			(0.008)			
fdi_agglomeration (abi)_2			-0.040***			
			(0.006)			
fdi_agglomeration (afi)					0.178***	
					(0.010)	
fdi_agglomeration (afi)_2					-0.047***	
					(0.007)	
W_export_intensity	0.615***	0.627***	0.076	-0.120	-0.070	-0.445***
	(0.076)	(0.075)	(0.080)	(0.079)	(0.088)	(0.083)
W_human capital	0.189***	0.226***	0.170***	0.209***	0.174***	0.192***
	(0.014)	(0.014)	(0.018)	(0.019)	(0.018)	(0.018)
W_infrastructure	-0.180***	-0.225***	-0.315***	-0.459***	-0.341***	-0.476***
	(0.033)	(0.035)	(0.038)	(0.039)	(0.038)	(0.038)
W_υ	-0.035	0.274***	-0.640***	-0.687***	-0.618***	-0.654***
	(0.048)	(0.045)	(0.053)	(0.048)	(0.053)	(0.043)
W_fdi_agglomeration (awi)		-0.100***				
		(0.023)				
W_fdi_agglomeration (awi)_2		0.030***				
		(0.003)				
W_fdi_agglomeration (abi)				0.221***		
				(0.010)		
W_fdi_agglomeration (abi)_2				-0.039**		
				(0.018)		
W_fdi_agglomeration (afi)						0.311***
						(0.015)
W_fdi_agglomeration (afi)_2						-0.079***
						(0.020)
Constant	0.556***	0.274*	1.460***	1.500***	1.606***	1.744***
	(0.151)	(0.163)	(0.148)	(0.147)	(0.155)	(0.148)
Number of obs.	37,320	37,320	37,320	37,320	37,320	37,320
Pseudo R-square	0.546	0.551	0.564	0.569	0.567	0.581
Log-pseudolikelihood	-25,160	-25,100	-25,060	-24,950	-25,050	-24,930
Wald chi-square	10,914.05	11,374.35	12,110.28	12,767.39	12,230.16	12,919.83
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

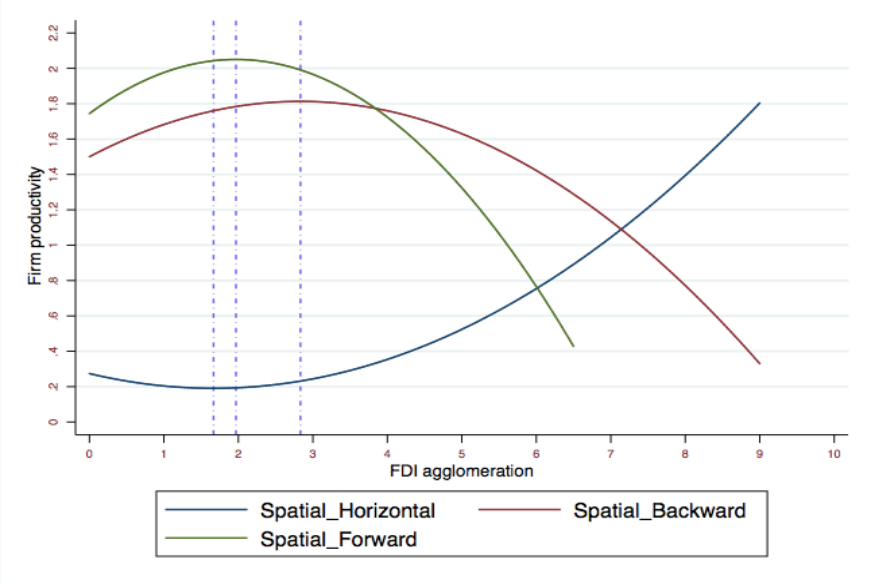
Note: 1. The standard errors and p-values are in the parentheses. 2. ***p<0.01, **p<0.05, *p<0.1 3. The terms of di_agglomeration (awi), fdi_agglomeration (abi) and fdi_agglomeration (afi) and its squared terms are handled by the method of mean-centered processing to reduce the correlation between them.

Figure 4.7: Non-linear relationship between horizontal, backward, and forward FDI agglomerations and local firm's productivity



Note: This study puts the three inverted U-shaped pictures together to compare their elasticities.

Figure 4.8: Non-linear relationship between spatial horizontal, backward, and forward FDI agglomerations and neighboring firm's productivity



Note: This study puts the two inverted U-shaped pictures and one U-shaped picture together to compare their elasticities.

4.5 Conclusions and Implications

This study expands the literature of industry agglomeration to explore the non-linear and spatial effects of the horizontal, backward, and forward FDI agglomerations on domestic firms' productivity based on firm-level data by employing a spatial econometric model with random effect. This study also illustrates the three types of interaction mechanisms, including the main differences in inter-firm relationships, the trade-off between benefits and costs, and interaction intensity. The findings in this study provide some meaningful evidence to trigger an ongoing dialogue between economists, business analysts, and government officers.

This study finds that congestion dominates the three types of FDI agglomerations on local firm's productivity. Furthermore, local firm's productivity is a strong sensitivity to the change of backward and forward FDI agglomerations while weak sensitivity to horizontal FDI agglomeration. By reaping more benefits from FDI, horizontal FDI agglomeration is not encouraged (its threshold value is equal to zero), and backward and forward FDI agglomerations should retain a reasonable degree beyond its threshold value in the local region. The congestion effect seems to have not yet extensively spread. The over-agglomerations are possible to become more and more severe without reasonable intervention. Consequently, it can impede the benefits of FDI agglomerations and even injure domestic firms.

In addition to the congestion effect, this study has also drawn particular attention to the spatial effect. The empirical evidence displays a U-shaped relationship between spatial horizontal agglomeration of foreign firms and neighboring firm's productivity and an

inverted U-shaped relationship between backward and forward agglomerations of foreign firms and neighboring firms' productivity. Furthermore, neighboring firm's productivity is a strong sensitivity to the change of spatial backward and forward FDI agglomerations while weak sensitivity to horizontal FDI agglomeration.

The empirical evidence in this study provides some credible signals for the implications of the region and industry policies that promote firm productivity and economic growth. To reap as much benefit from FDI as possible, local governments should induce the diverse types of FDI agglomeration because of the difference in their interaction mechanisms with domestic firms. Local governments should moderately disperse FDI in some regions and industries with FDI over-agglomeration, and local governments in middle and western regions should implement preferential policies such as duty exemptions and subsidized industry infrastructure to attract FDI. Furthermore, in China, the local governments in different regions usually attract FDI separately and compete. However, it may be better for local governments in different regions to cooperate by developing an integrated policy to promote the positive interactions of FDI agglomeration with domestic firms both in local and neighboring regions. Besides, the local governments, especially in less-developed regions, should also pay attention to the socioeconomic conditions such as human capital and transport infrastructure. These factor endowments are the essential determinants of firm productivity both in local and neighboring regions.

Chapter 5

The Dynamic Effect of Foreign Direct Investment on Export: The Evidence from China

5.1 Introduction

Internationalization can be broadly divided into foreign direct investment (FDI) and trade. Multinational firms generally conduct both activities of FDI and trade at the same time in the international market. Unlike Chapter 3 and Chapter 4 that focus on trade and FDI respectively and link it to firm productivity, this chapter explores the relationship between FDI and trade further, although it does not directly relate to firm productivity. However, it is an indirect linkage to firm productivity.

Globalization provides an excellent opportunity for an individual country, especially developing countries such as China, to participate in international business activities and promotes its domestic economic development. Export and FDI are the two main channels to speed up the globalization process. Figure 5.1 as a whole shows the rapid increase of China's outward FDI stock and flow and export during the period 1999-2017, which reaches 1,482,020.45 millions of U.S. dollars, 124,630 millions of U.S. dollars and 2,263,371.33 millions of U.S. dollars in 2017, respectively (UN Comtrade, 2019; UNCTAD, 2019). Thus, the total amount of China's outward FDI flow and stock occupies about 5.51% and 65.48% of the total amount of its export, respectively. In the short term, FDI may not significantly impact export no matter whether FDI displays or creates export due to its total volumes. However, FDI may play a key role in export in the long term. Table 5.1 shows the top ten target countries of China's outward FDI stock and flow and export in 2017. The rankings include some developed countries (e.g., United States, United Kingdom, and Japan) and developing countries1 (e.g., Russia, India, and Vietnam). Moreover, implementing the " On Belt, One Road" strategy proposed in 2013-2014 continues promoting China's export and outward FDI, especially to African, Asian, and European countries.

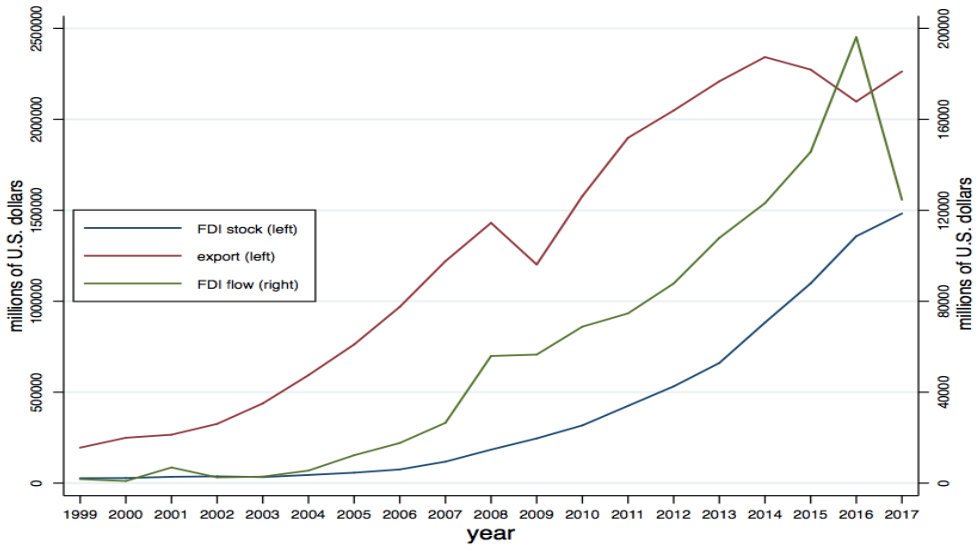
Researchers have tried to investigate the theoretical and empirical studies of whether there is a complementary or substitution effect of FDI on trade for nearly three decades. Moreover, Researchers have tried to investigate the theoretical and empirical studies of whether there is a complementary or substitution effect of FDI on trade for nearly three decades. Moreover, whether FDI displacing or creating trade depends on the type of FDI. Horizontal FDI relates to foreign production and service for the host country's market, while vertical FDI relates to the fragmentation of production between home and host countries, importing immediate goods from the home country (Protsenko, 2004; Bouras & Raggad, 2015). Therefore, horizontal FDI tends to display trade while vertical FDI tends to create trade. However, whether the complementary or substitution effect of FDI on trade is the issue of empirical studies. The simple empirical studies at the aggregated level may lead to misunderstanding the relationship between trade and FDI. Furthermore, the difference in target countries, industries, firms, products Etc. may result in different results in the empirical studies at a disaggregated level.

This study aims to explore the dynamic effect of China's FDI on its export. This study uses the panel data covering 151 target countries to which China exports and conducts FDI during the period 2007-2017, which China's export and FDI stock to these target countries account for 81.1 and 77.5 per cents of its total export and FDI stock in 2017, respectively (Statistical Bulletin of China's Outward Foreign Direct Investment, 2019; National Bureau of Statistics of China, 2019). This study adopts several method tests, including global principal component analysis (PCA), Poisson pseudo-maximum likelihood (PPML), Hausman-Taylor method, Kaiser-Meyer-Olkin (KMO) test, Fisher's permutation test, and variance inflation factor (VIF) test. Thus, this study tries to answer two questions. First, what are the rankings of target countries to which China conducts FDI based on the trade-off between horizontal and vertical FDI motivations? Second, what is the difference in the effect of FDI on export

along with the increasing tendency of horizontal FDI and the decreasing tendency of vertical FDI or the decreasing trend of horizontal FDI and increasing trend of vertical FDI?

The structure of this study is organized as follows. After Section 5.1 (Introduction), Section 5.2 briefly reviews the theoretical and empirical literature regarding the effect of FDI on trade. Section 5.3 specifies the analytic methods for panel data and describes the data sources and study sample. Section 5.4 analyzes empirical findings, which is followed by conclusions in Section 5.5.

Figure 5.1: China's outward FDI stock and flow, and export during 1999-2017



Source: UN Comtrade (2019) and UNCTAD (2019)

Table 5.1: The top ten target countries of China's outward FDI stock and flow, and export in 2017

Ranking	FDI stock	FDI flow	Export
1	United States	Switzerland	United States
2	Singapore	United States	Japan
3	Australia	Singapore	Republic of Korea
4	United Kingdom	Australia	Vietnam
5	Netherlands	Germany	Germany
6	Luxembourg	Kazakhstan	India
7	Russia	United Kingdom	Netherlands
8	Germany	Malaysia	United Kingdom
9	Canada	Indonesia	Singapore
10	Indonesia	Russia	Russia

Note: China's Hong Kong and Taiwan are not considered in the ranking.
Source: Statistical Bulletin of China's Outward Foreign Direct Investment (2019) and National Bureau of Statistics of China (2019)

5.2 A Brief Review of the Literature

The theoretical and empirical literature of trade and FDI relates to the substitution effect, complementarity effect, and coexistence. Recent relevant theories argue that whether FDI displacing or creating trade relies on the type of FDI. Horizontal FDI relates to the proximity-concentration theory that explains two-way intra-industry affiliate's production. The earliest theoretical study by Mundell (1957) explores the substitution between international trade and capital flow in the Heckscher-Ohlin model. The differences in factor endowments between two countries can result in the substitution effect even if they have the same production function. Proximity-concentration trade-off theory explores a firm's decision to serve foreign markets in terms of the choices between foreign production and exporting by comparing their added variable costs. Markusen (1984) develops a general equilibrium

model of a multinational enterprise based on economies of multi-plant operation to explore horizontal FDI. The study explains that horizontal FDI can reduce transportation costs, avoid trade barriers, and thus reduce the costs of commodities sold in the local market. With the theory of horizontal FDI, there is no room for strategies that allow firms to lower their overall costs through investing abroad.

Vertical FDI refers to two-way inter-industry affiliate's production and appears because of international factor-price differences (comparative advantage). Helpman (1984) develops the theoretical model of vertical FDI in the Heckscher-Ohlin model, and Barba Navaretti & Venables (2006) perform it. The model's motivation is to answer when a firm would choose to split its production process between several locations and make a vertical FDI. The theories between horizontal and vertical FDI are incompatible and cannot simultaneously interpret their actual coexistence. Markusen (2004) embodies horizontal and vertical FDI into the "knowledge-capital" model. Moreover, the study analyzes that the multinational firm's foreign production pattern relates to country characteristics such as market size, relative factor endowments, and trade and investment barriers.

The literature of empirical studies does not reach a consensus on the relationship between FDI and trade. Some scholars found the substitution effect of FDI on trade. For example, Brainard (1993) focuses on U.S. firm's cross-section of industry-country for 1989 and proved the overall complementary relationship between trade and affiliate sales in part. Helpman et al. (2004) apply the data of U.S. firm's exports and FDI sales for 1994 and confirmed that firms substitute FDI sales for exports. Mitze et al. (2010) explore the nature of German trade-FDI linkages within the EU27 for 1993-2005 and identify the substitutive links between trade and outward FDI. However, some scholars find the complementary effect of FDI on trade. For instance, Lipsey & Weiss (1984) investigate U.S. firms in 14 industries for 1970 and find a positive relationship between a firm's foreign production and export of intermediate and finished products. Aizenman & Noy (2006) analyze 81 countries

for the years 1982-1998 and confirmed the positive feedback between trade and FDI. Anwar & Nguyen (2011) use the data of Vietnam's 19 major trading partners for the period 1990-2007 and reveal a complementary relationship between trade and FDI.

Simply considering the complementary or substitution effect of FDI on trade may not reflect the actual relationship between trade and FDI. In practice, the disaggregated data rather than the aggregated data is used to capture the complementary and substitution effect of FDI on trade. For instance, Blomstrom et al. (1988) employ the data of Sweden and U.S. firm's foreign affiliate production and exports at the most disaggregated industry level for 1982. They find a predominance of positive rather than a negative relationship between U.S. exports and foreign affiliate's net sales. Head & Ries (2001) use the data of Japanese manufacturing firms during 1966-1990 to investigate the effect of FDI on export, which exhibits the net complementary impact of FDI on trade while both complementary and substitution effect of FDI on trade within firm's variation. Chiappini (2016) also uses the data of Japanese manufacturing firms during the period 2005-2011 and finds that the complementary relationship between trade and FDI is dominant for the entire sample while whether FDI creating or displaying trade depends on the type of industries.

The empirical literature of the relationship between trade and FDI mainly relates to the four types of country, industry, firm, and product-level data (Forte & Silva, 2017; Tham et al., 2018). Moreover, more disaggregated data used tend better to understand the dynamic relationship between trade and FDI. Thus, this study accumulates the previous research with an application on the emotional effect of China's outward FDI on its export by using several testing methods.

5.3 Research method

5.3.1 Ranking approach

This study also adopts global PCA to obtain the tendency rankings of target countries to which China conducts horizontal and vertical FDI. Based on the studies of Markusen (2004), Aizenman & Marion (2004), and Grossman et al. (2006), this study considers the target country's market size, factor price, tariff rate, uncertainty, and transport and trade cost as the motivations of China's horizontal and vertical FDI. Market size is measured by the target country's real GDP. The factor price is measured by the target country's real GDP per capita. Tariff rate is measured by the target country's tariff rate. Uncertainty is measured by the standard deviation of real exchange rate. Trade cost is measured by the real cost of the target country's import per container. The use of these variables should keep the direction of their unit measurement consistent based on the trade-off between horizontal and vertical motivations, which the global PCA can be used to rank the target countries between the tendency of horizontal and vertical outward FDI. For instance, Aizenman & Marion (2004) find that uncertainty has a more significant negative impact on vertical FDI than horizontal FDI. Thus, the inverse of uncertainty is used in the analysis of global PCA. Finally, this study uses the global PCA with these variables to obtain the overall scores of target countries. The positive overall scores mean that China is more likely to conduct horizontal FDI than vertical FDI to target countries, while the negative overall scores mean that China is more likely to conduct vertical FDI than horizontal FDI.

This study classifies the study sample into four subgroups based on the scores (rankings) of target countries. The classification of subgroups of S1-47 and S48-151 is according to the threshold values of the positive and negative overall scores shown in Table 5.3 and Table 5.4. This study further uses the global PCA to rank the target countries in the subgroup of

S48-151 and then divide them into two subgroups (Ss1-69 and Ss70-104) based on the threshold values of final positive and negative overall scores (not shown in this study). Thus, the four subgroups of the sample are represented in this study.

5.3.2 Model specification

This study adopts the PPML estimation suggested by Larch et al. (2019). Tinbergen (1962) and Poyhonen (1963) develop the gravity model. Moreover, Anderson & Van Wincoop (2004) indicate that the trade gravity model can explain more than 80 percent of bilateral trade flow if introducing other relevant impact factors into the model. Thus, the augmented trade gravity model used in this study is shown as follows:

$$\begin{aligned}\text{Ln\_real}\_export_{i,t} &= \beta_0 + \beta_1 \text{Ln\_real}\_export_{i,t-1} + \beta_2 Ln\_real\_fdi_{i,t} + \beta_3 Ln\_real\_gdp_{i,t} \\ &+ \beta_4 Ln\_real\_gdp\_per\_capita_{i,t} + \beta_5 Ln\_distance_i \\ &+ \beta_{76}\, \text{Ln\_}trade\_freedom_{i,t} + \beta_7\, \text{Ln\_}investment\_freedom_{i,t} \\ &+ \beta_8 Bilateral\_ER\_change_{i,t} + \beta_9 Bilateral\_ER\_volatility_{i,t} \\ &+ \beta_{10} Multilateral\_REER\_change_{i,t} \\ &+ \beta_{11} Multilateral\_REER\_volatility_{i,t} + \beta_{12} Language_i + \beta_t + \mu_i \\ &+ \varepsilon_{i,t}\end{aligned}$$

"i" and "t" stand for target country and time, respectively. "Ln" stands for log. Ln_real_$export_{i,t}$ and Ln_real_$fdi_{i,t}$ represent the amount of Chine's export and FDI stock to different target countries, respectively. $Ln\_real\_gdp_{i,t}$ and $Ln\_real\_gdp\_per\_capita_{i,t}$ denote the amount of the target country' real gross domestic product (GDP) and real GDP per capita, respectively. $Ln\_distance_i$ stands for the distance between the capitals of China and the target country. ln_$exchange_rate_{i,t}$ stands for the target country's exchange rate. Ln_$trade_freedom_{i,t}$ and Ln_$investmen_freedom_{i,t}$ represent the amount of the target country's trade and investment freedom, respectively.

$Bilateral\_ER\_change_{i,t}$ represents the change of bilateral real exchange rate. The real exchange rate is measured by annual nominal home-to-host (Chinese Yuan to US dollar) currency exchange rate times two countries' consumer price index ratio. $\beta_{10}Bilateral\_ER\_volatility_{i,t}$ represents the volatility of the bilateral real exchange rate and is measured by the 2-year moving average of the standard deviation of the real exchange rate. $Multilateral\_REER\_change_{i,t}$ represents the change of multilateral real effective exchange rate. $Multilateral\_REER\_volatility_{i,t}$ represents the volatility of the multilateral real effective exchange rate and is measured by the 2-year moving average of the standard deviation of multilateral real effective exchange rate. $Language_{i,}$ is measured by "1" if English is the official language of the target country and "0" otherwise. β_t denotes time-specific effect. μ_i denotes time-invariant individual effect. $\varepsilon_{i,t}$ denotes the error term. Finally, β_0-β_{12} denote the corresponding coefficients.

5.3.3 Additional tests

This study also conducts a series of tests to obtain accurate statistics and econometric results. Hausman-Taylor method is applied for robustness check. In terms of the global PCA, this study uses KMO test of correlation between variables. Besides, this study also uses Fisher's permutation test to confirm whether there is a difference in the regression coefficients between two sample groups (Table C.1 in Appendix C) and the VIF test for series correlation of variables.

5.3.4 Data and sample

China's export to target countries is extracted from the National Bureau of Statistics of China. China's outward FDI stock to target countries is extracted from the Statistical Bulletin of China's Outward Foreign Direct Investment. Target countries' exchange rate, GDP, GDP per capita, tariff rate, and costs of import per container are extracted from The World Bank.

Target countries' trade freedom and investment freedom are extracted from The Heritage Foundation. Chinese nominal exchange rate and consumer price index are extracted from the National Bureau of Statistics of China. American consumer price index is extracted from the U.S Bureau of Labor Statistics. The multilateral real effective exchange rate is extracted from International Financial Statistics. Language and distance between the country's capitals are obtained from CEPII. This study finally receives the study sample of 151 countries (Table 5.3 and Table 5.4) during 2007-2017. China's export and FDI stock to these target countries account for 81.1 and 77.5 per cents of its total export and FDI stock in 2017, respectively (Statistical Bulletin of China's Outward Foreign Direct Investment, 2019; National Bureau of Statistics of China, 2019). Thus, the study sample is representative of this study.

5.4 Empirical Findings

Table 5.2 shows the descriptive statistics and correlation matrix of regression variables. In terms of independent and control variables, the correlation between Ln_real_gdp and Ln_real_fdi is 0.5296. The correlation between Ln_real_gdp_per_capita, Ln_real_gdp, Ln_trade_freedom and Ln_investment_freedom is 0.5413, 0.5174 and 0.4504, respectively. The correlation between Multilateral_REER_change, Bilateral_ER_change, and Multilateral_REER_volatility is -0.6098 and 0.6158, respectively. Moreover, the correlation between Ln_trade_freedom and Ln_investment_freedom is 0.4578. The whole evidence reveals a relatively high correlation between these variables. However, the results of the VIF test are all below 10 in the whole regression models shown in Table 5.5, which implies there is no problem of series correlation.

Table 5.3 and Table 5.4 display the rankings of target countries based on horizontal and vertical FDI motivations. The positive and negative overall scores mean above and below its average level, respectively. Moreover, the higher ranking means that China is more likely to conduct horizontal FDI to the target country, while the lower ranking implies that China is more likely to perform vertical FDI to the target country. The target countries with a ranking between 1 and 47 are above the average level, including most developed countries and few developing countries. The target countries with a ranking between 48 and 151 are below the average level, which involves most developing countries and few developed countries. Thus, China tends to conduct horizontal FDI in developed countries while vertical FDI in developing countries. The rankings also provide the basis for dividing the study sample into four subgroups (S1-47, Ss1-69, S48-151, and Ss70-104) used in the regressions shown in Table 5.5 and Table 5.6.

Table 5.2: Descriptive statistics and correlation matrix

Variable	Obs	Mean	Std.Dev	1	2	3	4	5	6	7	8	9	10	11	12
1. Ln_real_export	1,661	11.8597	2.0811	1.0000											
2. Ln_real_fdi	1,661	9.3835	2.3644	0.6114	1.0000										
3. Ln_real_gdp	1,661	24.5119	2.1900	0.8995	0.5296	1.0000									
4. Ln_real_gdp_per_capita	1,661	8.6410	1.4327	0.4018	0.0810	0.5413	1.0000								
5. Ln_distance	1,661	8.9974	0.4747	-0.2808	-0.2252	-0.1949	-0.0148	1.0000							
6. Ln_trade_freedom	1,661	4.3041	0.1585	0.3069	0.0795	0.3747	0.5174	-0.0863	1.0000						
7. Ln_investment_freedom	1,661	3.9269	0.4359	0.2140	0.0077	0.2502	0.4504	0.0920	0.4578	1.0000					
8. Bilateral_ER_change	1,510	-0.0159	0.0385	0.0776	0.2957	0.0326	0.0245	0.0000	0.0827	0.1251	1.0000				
9. Bilateral_ER_volatility	1,661	0.1505	0.1367	-0.0465	-0.1513	-0.0136	-0.0091	0.0000	-0.0391	-0.0438	-0.4512	1.0000			
10. Multilateral_REER_change	1,510	0.0315	0.0433	-0.0179	-0.1341	-0.0153	-0.0111	0.0000	-0.0472	-0.0549	-0.6098	0.1408	1.0000		
11. Multilateral_REER_volatility	1,661	3.7253	1.9873	0.0271	0.0641	0.0093	0.0088	0.0000	0.0046	0.0509	0.0614	0.2555	0.6158	1.0000	
12. Language	1,661	0.3046	0.4604	-0.1647	0.0707	-0.1685	-0.0649	0.2213	-0.0928	-0.0032	0.0000	0.0000	0.0000	0.0000	1.0000

Table 5.3: The rankings of target countries based on the trend of horizontal and vertical FDI

Country Name	Overall Score	Ranking
United States	3.315	1
Luxembourg	1.749	2
Japan	1.411	3
Norway	1.287	4
Switzerland	1.245	5
Germany	1.149	6
France	1.014	7
United Kingdom	1.000	8
Canada	0.944	9
Australia	0.885	10
Qatar	0.843	11
Kuwait	0.828	12
Ireland	0.812	13
Italy	0.785	14
Denmark	0.715	15
Austria	0.713	16
Belgium	0.701	17
Sweden	0.640	18
Finland	0.615	19
Spain	0.584	20
Singapore	0.580	21
Cyprus	0.448	22
Malta	0.430	23
Bahrain	0.334	24
United Arab Emirates	0.330	25
New Zealand	0.313	26
Greece	0.285	27
Brunei	0.284	28
Chad	0.248	29
Oman	0.239	30
Brazil	0.237	31
Bahamas	0.234	32
Slovenia	0.194	33
Korea Republic	0.193	34
Israel	0.186	35
Portugal	0.185	36
Tadzhikistan	0.180	37
Russia	0.161	38
Venezuela	0.112	39
Azerbaijan	0.095	40
Saudi Arabia	0.073	41
Kazakhstan	0.062	42
Congo	0.057	43
Turkey	0.040	44
Uzbekistan	0.025	45
Mexico	0.011	46
Czech	0.006	47
Zambia	-0.006	48
Rwanda	-0.008	49
Slovak	-0.040	50
Zimbabwe	-0.045	51
Nepal	-0.049	52
Botswana	-0.050	53
Iraq	-0.054	54
Poland	-0.058	55
Barbados	-0.072	56
Republic of Palau	-0.081	57
Argentina	-0.082	58
India	-0.083	59
Equatorial Guinea	-0.104	60
Antigua and Barbuda	-0.109	61
Lithuania	-0.113	62
Croatia	-0.115	63
Trinidad and Tobago	-0.121	64
Estonia	-0.129	65
Bulgaria	-0.138	66
Afghanistan	-0.143	67
Jordan	-0.147	68
Hungary	-0.148	69
South Africa	-0.149	70
Panama	-0.153	71
Romania	-0.155	72
Libyan	-0.160	73
Ecuador	-0.172	74

Table 5.4: The rankings of target countries based on the trend of horizontal and vertical FDI (continued)

Country Name	Overall Score	Ranking
Sudan	-0.178	75
Colombia	-0.178	76
Iran	-0.182	77
Mali	-0.185	78
Uruguay	-0.189	79
Uganda	-0.193	80
Angola	-0.197	81
Mongolia	-0.197	82
Gabon	-0.201	83
Granada	-0.203	84
Chile	-0.206	85
Malaysia	-0.214	86
Ukraine	-0.221	87
Georgia	-0.227	88
Namibia	-0.236	89
Dominica	-0.236	90
Serbia	-0.238	91
Micronesia Commonwealth	-0.240	92
Ethiopia	-0.245	93
Armenia	-0.250	94
Seychelles	-0.254	95
Malawi	-0.260	96
Indonesia	-0.260	97
Moldavia	-0.271	98
Costa Rica	-0.271	99
Jamaica	-0.274	100
Surinam	-0.279	101
Lebanon	-0.281	102
Cote d"lvoire	-0.282	103
Thailand	-0.284	104
Byelorussia	-0.287	105
Paraguay	-0.293	106
Kenya	-0.296	107
Peru	-0.300	108
Laos	-0.300	109
Tunisia	-0.301	110
Mauritius	-0.302	111
Algeria	-0.303	112
Nigeria	-0.311	113
Cameroon	-0.313	114
Timor Leste	-0.319	115
Dominica Republic	-0.321	116
Papua New Guinea	-0.322	117
Senegal	-0.327	118
Ghana	-0.327	119
Bolivia	-0.327	120
Guinea-Bissau	-0.332	121
Eritrea	-0.335	122
Fiji	-0.348	123
Tonga	-0.352	124
Philippines	-0.354	125
Republic of Yemen	-0.356	126
Lesotho	-0.360	127
Vanuatu	-0.362	128
Samoa	-0.367	129
Bangladesh	-0.371	130
Morocco	-0.377	131
Tanzania	-0.377	132
Madagascar	-0.380	133
Albania	-0.384	134
Mozambique	-0.384	135
Sri Lanka	-0.394	136
Comoros	-0.394	137
Benin	-0.395	138
Guinea	-0.410	139
Cape Verde	-0.410	140
Sierra Leone	-0.411	141
Guyana	-0.415	142
Vietnam	-0.417	143
Pakistan	-0.420	144
Liberia	-0.428	145
Cambodia	-0.429	146
Myanmar	-0.430	147
Togo	-0.436	148
Djibouti	-0.455	149
Mauritania	-0.456	150
Gambia	-0.476	151

Note: 1. The higher ranking means that China is more likely to conduct horizontal FDI to the target country, while the lower ranking implies that China is more likely to perform vertical FDI to the target country. 2. The value of KMO is 0.842.

Table 5.5 shows the regression results of four subgroups (S1-47, Ss1-69, S48-151, and Ss70-104) and a full group (S1-151) using the PPML estimation. By controlling the export-specific term, import-specific term, bilateral trade cost term, and multilateral resistance term, this study explores the dynamic effect of China's FDI on its export along with the change between horizontal and vertical motivations. The coefficients of Ln_real_fdi are all positive with statistical significance in the whole samples including S1-47 (β=0.0084, ρ=0.0015), S1-151(β=0.0106, ρ=0.0011), Ss1-69(β=0.0112, ρ=0.0013), S48-151(β=0.0134, ρ=0.0013) and Ss70-104 (β=0.0300, ρ=0.0038). The evidence shows that the complementary effect of FDI on export. Therefore, the complementary effect rather than substitution effect is the dominant effect of China's FDI on its export. In other words, China's multinational firms are connecting its domestic firms mainly through backward and forward linkages, which also implies that vertical FDI tends to result in the complementary effect with export. The result is consistent with the findings in the studies of Aizenman & Noy (2006), Anwar & Nguyen (2011), Liu et al. (2016), Singh (2017), and Abamu & Pietrzak (2019). However, these studies do not use continuous disaggregated data to explore this topic. This study applies continuous disaggregated data based on country-level to capture the dynamic effect of FDI on export.

Moreover, the coefficient value is increasing from the sample of S1-47 to the sample of Ss70-104. The evidence reveals that the complementary effect of China's FDI on its export is gradually strong along with the increasing tendency of vertical motivation and the decreasing trend of horizontal motivation, which also meets the theoretical prediction of the effect of horizontal and vertical FDI on export. This study also conducts an additional robustness check using the Hausman-Taylor method shown in Table 5.6. The results are similar to the findings in Table 5.5. Although the effect strength of FDI on export is much more robust in Table 5.6 than in Table 5.5, this study mainly focuses on the dynamic effect

of FDI on export. Furthermore, simple aggregated data such as the whole sample (S1-151) may not capture the relationship between export and FDI. This study uses the disaggregated data by ranking 151 countries based on the motivations of FDI to better understand the dynamic effect between FDI and export. Significantly, this study confirms an emotional impact of FDI on export in the case of China.

Table 5.5: Regression results using the PPML

Variable	S1-47	S1-151	Ss1-69	S48-151	Ss70-104
Ln_real__fdi	0.0084***	0.0106***	0.0112***	0.0134***	0.0300***
	(0.0015)	(0.0011)	(0.0013)	(0.0013)	(0.0038)
Ln_real_gdp	0.0553***	0.0685***	0.0742***	0.0735***	0.0552***
	(0.0019)	(0.0014)	(0.0019)	(0.0016)	(0.0060)
Ln_real_gdp_per_capita	-0.0077*	-0.0150***	-0.0243***	-0.0169***	-0.0051
	(0.0040)	(0.0020)	(0.0041)	(0.0029)	(0.0080)
Ln_distance	-0.0427***	-0.0283***	-0.0112**	-0.0140***	0.0278**
	(0.0049)	(0.0039)	(0.0054)	(0.0049)	(0.0112)
Ln_trade_freedom	0.1279***	-0.0009	0.0316*	-0.0255	-0.1572***
	(0.0325)	(0.0177)	(0.0167)	(0.0189)	(0.0423)
Ln_investment_freedom	-0.0224**	0.0237***	0.0193***	0.0342***	0.0807***
	(0.0092)	(0.0057)	(0.0064)	(0.0065)	(0.0130)
Bilateral_ER_change	0.0150	-0.0867	-0.1501	-0.1527	0.0022
	(0.2823)	(0.2104)	(0.2778)	(0.2650)	(0.5522)
Bilateral_ER_volatility	0.0043	-0.0308	-0.0452	-0.0478	-0.0039
	(0.0463)	(0.0341)	(0.0446)	(0.0426)	(0.0891)
Multilateral_REER_change	0.1893	0.0002	-0.1055	-0.1123	0.1433
	(0.2713)	(0.2018)	(0.2639)	(0.2535)	(0.5326)
Multilateral_REER_volatility	-0.0021	0.0013	0.0030	0.0033	-0.0016
	(0.0050)	(0.0038)	(0.0049)	(0.0048)	(0.0100)
Language	0.0265***	-0.0163***	-0.0487***	-0.0376***	-0.0265**
	(0.0060)	(0.0046)	(0.0064)	(0.0055)	(0.0115)
Contant	1.0227***	0.9826***	0.6532***	0.7915***	0.9692***
	(0.1316)	(0.0774)	(0.0944)	(0.0906)	(0.2038)
Number of obs.	470	1,510	690	1,040	350
Pseudo Log-likelihood	-1048.2218	-3304.9987	-1496.7237	-2251.5038	-751.9750

Note: 1. *** p<0.01, ** p<0.05, * p<0.1 2. Standard errors in the parentheses 3. S1-47 means the sample of target countries from1 to 46 rankings shown in Table 5.3. 4. Ss1-69 means the subsample of target countries from 1 to 69 rankings that are obtained from the sample of target countries from 48 to 151 rankings shown in Table 5.3 and Table 5.4 by using the global PCA

Table 5.6: Additional robustness check using the Hausman-Taylor method

Variable	S1-47	S1-151	Ss1-69	S48-151	Ss71-104
Ln_real_fdi	0.0403***	0.0966***	0.1301***	0.1517***	0.2279***
	(0.0150)	(0.0107)	(0.0146)	(0.0142)	(0.0362)
Ln_real_gdp	1.0506***	1.2198***	0.9515***	1.2038***	1.6636***
	(0.1323)	(0.0912)	(0.0816)	(0.1018)	(0.2591)
Ln_real_gdp_per_capita	-0.0946	0.1029	0.5311***	0.1738	-0.7727**
	(0.1980)	(0.1174)	(0.1327)	(0.1331)	(0.3206)
Ln_distance	-0.8404	-0.067	-0.8419**	-0.1403	0.1735
	(0.5947)	(0.4281)	(0.3681)	(0.4587)	(0.9466)
Ln_trade_freedom	0.0204	0.2365	0.6607***	0.1489	-0.9712***
	(0.3860)	(0.1478)	(0.1836)	(0.1601)	(0.3091)
ln_investment_freedom	-0.1297	0.0799*	0.1243*	0.1188**	0.2184**
	(0.0957)	(0.0477)	(0.0654)	(0.0539)	(0.0949)
Bilateral_ER_change	-0.0312	-0.3981	-0.2725	-0.589	-0.2436
	(1.5960)	(1.0156)	(1.3929)	(1.2436)	(2.3992)
Bilateral_ER_volatility	-0.2011	-0.2451	-0.1683	-0.2235	-0.0875
	(0.2697)	(0.1723)	(0.2348)	(0.2113)	(0.4165)
Multilateral_REER_change	1.498	0.8812	1.072	0.6324	1.3529
	(1.6021)	(1.0167)	(1.3889)	(1.2448)	(2.4376)
Multilateral_REER_volatility	-0.0088	-0.0009	-0.0116	0.0006	-0.0058
	(0.0301)	(0.0191)	(0.0261)	(0.0234)	(0.0462)
Language	0.4707	0.2405	0.0205	0.1954	-0.4645
	(0.5427)	(0.4381)	(0.3900)	(0.4793)	(0.9071)
Contant	-5.9934	-20.6055***	-12.7923***	-19.9411***	-22.3353**
	(6.0758)	(4.4361)	(3.9202)	(4.8342)	(9.7031)
Number of obs.	470	1,510	690	1,040	350
Chi-square	9.714	62.279	18.998	36.367	13.122
P-value	0.0078	0.0000	0.0001	0.0000	0.0014

Note: 1. *** p<0.01, ** p<0.05, * p<0.1 2. Standard errors in the parentheses 3. Chi-square and P-value are from the test results of overidentifying restrictions. 4. Ss1-69 means the sample of target countries from 1to 69rankings that are obtained from the sample of target countries from 1 to 47 rankings shown in Table 3 by using the global PCA

5.5 Conclusions

This study constructs the target country's rankings with the trade-off between horizontal and vertical FDI based on FDI's motivations. China tends to conduct horizontal FDI mainly in developed countries, while vertical FDI mainly in developing countries. With the increasing tendency of horizontal motivation and the decreasing trend of vertical motivation, China's FDI tends to displace its export. In comparison, China's FDI with the decreasing trend of horizontal motivation and the increasing trend of vertical motivation tends to create its export. Moreover, this study confirms that the complementary effect rather than substitution effect is the dominant role in the case of China. Besides, the simple research at an aggregated level may misunderstand the effect of FDI on export. Significantly, the characteristics of target countries such as market size, factor endowment Etc. are regarded as the motivations of the home country's FDI, which significantly impacts the relationship between export and FDI.

The findings in this study provide some room for the Chinese government to implement its macroeconomic policies. China's multinational firms can obtain advanced technology, management skills, low factor costs Etc. through FDI. However, if this is at the cost of export reduction, it seems to be not the Chinese government's desire, especially when export is still the dominant model of international involvement and the fast and convenient way for Chinese firms to participate in the foreign market. Furthermore, this also helps Chinese firms and governments, and other countries better understand how they fit into China's world of international trade. Therefore, non-Chinese governments and multinational firms can better position themselves to improve global business with the largest market in the world.

Chapter 6

Financial Constraints in R&D Investment, Uncertainty and Productivity: The Evidence from British Manufacturing Firms

6.1 Introduction

Manufacturing is vital for the growth of the UK economy, which contributes about 66 % of UK R&D expenditure and about 70% of the UK gross domestic product (GDP) (Office for National Statistics, 2018). The UK is experiencing the impact of Brexit. Irwin (2015) concludes that Brexit can impact the UK through ten channels, including uncertainty, FDI, trade, financial services, liberalization and regulation, immigration, industrial policy, trade policy, budget, and international influence. Latorre et al. (2020) suggest that the UK experiences losses in its wage, average industry productivity, foreign trade, production, wages, and capital remuneration because of Brexit. Furthermore, the financial constraints have an essential impact on the investment in R&D that is the crucial medium of the linkage between financial constraints and firm productivity (Cincera & Ravet,2010; Brown et al., 2012; Hall et al., 2016). Brown & Mason (2014) and Hauge & O'Sullivan (2019) indicate the technical activities such as R&D are essential for the British manufacturing firm's productivity. Therefore, this study investigates the financial constraints of British manufacturing firms in investment R&D and its impact on firm productivity. Furthermore, this study adopts the heterogeneous stochastic frontier analysis (SFA) proposed by Wang (2003) and introduces a flexible translog production function into the regression model. Therefore, this study simultaneously analyzes the effect of external and internal financial constraints on firm productivity and estimates its productivity loss. Furthermore, this study further examines the difference in low, middle, and high-tech industries.

In the presence of market imperfection such as asymmetric information between lenders and borrowers, financial constraints can affect a firm's investment decisions, especially intangible investments such as research and development (R&D) (Cincera & Ravet, 2010). The earlier studies (e.g., Fazzari et al., 1988; Wang, 2003) link the financial constraints to a firm's investment. However, empirical studies on the linkage between the financial factors and firm productivity at the firm lev

el are nascent (Chen & Guariglia, 2013). For instance, Sena (2006) finds that the binding financial constraints can induce debt-constrained firms to enhance their productivity in Italian manufacturing firms. Chen & Guariglia (2013) find that the availability of internal finance strongly constrains the productivity of Chinese manufacturing firms. Ferrando & Ruggieri (2018) estimate the elasticity of productivity with financial constraints of -18% from the evidence of euro area firms.

There are three main contributions of this study: First, this study explores the effect of external and internal financial constraints on firm productivity through the medium of R&D investment. Second, this study constructs a flexible translog production function and introduces it into the heterogeneous SFA proposed by Wang (2003). Third, this study analyzes the loss of British manufacturing firms' productivity and the difference in low, middle, and high-tech industries.

The structure of this study is organized as follows. After Section 1, Section 2 illustrates the heterogeneity SFA model with a flexible translog production function and a summary of the datasets and descriptive statistics. Section 3 analyses empirical findings, which is followed by Section 4 with conclusions.

6.2 Research Method

6.2.1 Theoretical model and estimation

In terms of the SFA with a two-stage approach, the assumption of the inefficient term (u) is independent identically distributed (i.i.d) in the first stage. However, productivity is considered the company's function with characteristic variables, which implies that productivity is not iid and self-contradictory in the first stage (Kumbhakar & Lovell, 2000; Greene, 2005). Moreover, Wang & Schmidt (2002) use the Monte Carlo Simulation and

confirmed that the SFA with a one-stage approach is more accurate than the SFA with a two-stage procedure. In addition, in comparison with the traditional Cobb-Douglas production function, the translog production function proposed by Christensen et al. (1973) is more robust. Because translog production function releases the neutrality of technical progress and the assumption of constant output elasticity and is also better to avoid the estimation bias caused by the setting error of production function. Thus, this study adopts the heterogeneous SFA with the one-stage approach proposed by Wang (2003) and introduces a flexible translog production function into the SFA model. The detailed model setting is shown as follows:

$$LnY_{it} = \alpha_0 + \alpha_1 LnL_{it} + \alpha_2 KnL_{it} + 1/2\alpha_3 (LnL_{it})^2 + 1/2\alpha_4 (LnK_{it})^2 + \alpha_5 LnL_{it} K_{it} + \alpha_6 LnK_{it} T_{it} + \alpha_7 LnL_{it} T_{it} + \alpha_8 T_{it} + 1/2\alpha_9 (T_{it})^2 + \nu_{it} - u_{it} \quad (6.1)$$

Where, "i" and "t" are firm and time, respectively; LnY_{it} is the log of total industrial output; LnK_{it} is the log of capital input; LnL_{it} is the log of labor input; T_{it} is the time trend of measuring technical change; $\nu_{i,t}$ is random error term; the assumption of $\nu_{i,t}$ is i.i.d and normal distribution, namely $\nu_{i,t} \sim i.i.d\, N(0, \sigma_v^2)$; u_{it} is productivity lose ($u_{it} \geq 0$) due to the financial constraints in R&D investment; The assumption of u_{it} is non-negative truncated half normal distribution, namely $u_{it} \sim N^+(\omega_{it}, \sigma_{i,t}^2)$. Finally, α_0 is the constant term, and α_1-α_9 are the elasticity efficiency of corresponding variables.

The heterogenous assumption of u_{it} is shown as follows:

$$\omega_{i,t} = \exp(b_o + \delta_1 rd'_{i,t} + \delta_2 DR'_{i,t} + \delta_3 CR'_{i,t} + \delta_4 rd'_{i,t} * DR'_{i,t} + \delta_5 rd'_{i,t} * CR'_{i,t}) \quad \text{and}$$
$$\sigma_{i,t}^2 = \exp(c_0 + \gamma_1 rd'_{i,t} + \gamma_2 DR'_{i,t} + \gamma_3 CR'_{i,t} + \gamma_4 rd'_{i,t} * DR'_{i,t} + \gamma_5 rd'_{i,t} * CR'_{i,t}) \quad (6.2)$$

Where, b_0 and c_0 both are constant terms; $rd'_{i,t}$ is the vector of R&D investment as the medium between firm productivity and financial constraints; $DR'_{i,t}$(debt ratio) and

$CR'_{i,t}$(cash flow ratio) are the vectors of the financial constraints in R&D investment; δ_1-δ_5 and γ_1-γ_5 are the corresponding coefficient vectors.

The heterogenous SFA with (6.1) and (6.2) can be estimated using the maximum likelihood (ML) method. The ML function is shown as follows:

$$lnML = -0.5\, ln\,(\sigma_v^2 + \sigma_{i,t}^2) + [\,\emptyset((\varepsilon_{i,t} + \omega_{i,t}))/\sqrt{(\sigma_v^2 + \sigma_{i,t}^2)}] - ln\,[\Phi(\omega_{i,t}/\sigma_{i,t})] + ln\,[\Phi(\tilde{\omega}_{i,t}/\tilde{\sigma}_{i,t})] \quad (6.3)$$

Where, $\tilde{\omega}_{i,t} = (\sigma_v^2\omega_{i,t} - \sigma_{i,t}^2\varepsilon_{i,t})/(\sigma_v^2 + \sigma_{i,t}^2)$; $\tilde{\sigma}_{i,t} = (\sigma_v^2\sigma_{i,t}^2)/(\sigma_v^2 + \sigma_{i,t}^2)$; $\emptyset(\cdot)$ and $\Phi(\cdot)$ are density and accumulation functions with standardized normal distribution, respectively.

The deviation degree between a firm's real and optimal productivity ($DP_{i,t}$) is defined as follows:

$$DP_{i,t} = \exp(x'_{i,t}\beta - u_{i,t}) / \exp(x'_{i,t}\beta) = \exp(-u_{i,t}) \quad (6.4)$$

$DP_{i,t}$ is between 0 and 1; $DP_{i,t}$=0 means that firm productivity is the lowest, and its financial constraints in R&D investment are the most serious; $DP_{i,t}$=1 implies the highest level of firm productivity and has no financial constraints in R&D investment. This study further calculates the productivity index using the estimated formula suggested by Battese & Coelli (1988) described as follows:

$$DP_{i,t} = E[\exp(-u_{i,t}|\,\varepsilon_{i,t} = \hat{\varepsilon}_{i,t})] = \exp(-\tilde{\omega}_{i,t} + 0.5\tilde{\sigma}_{i,t})\Phi(\tilde{\omega}_{i,t}/\tilde{\sigma}_{i,t} - \tilde{\sigma}_{i,t})/\Phi(\tilde{\omega}_{i,t}/\tilde{\sigma}_{i,t}) \quad (6.5)$$

Where, $\tilde{\omega}_{i,t}$ and $\tilde{\sigma}_{i,t}$ are the same definitions illustrated above, which are merely the estimated values instead of the whole parameters.

6.2.2 Sample and datasets

This study conducts longitudinal research. The study sample is extracted from Financial Analysis Made Easy (FAME) database. FAME database contains detailed information for the entire population of registered UK firms. The database can be used to research individual companies or analyze a group of companies that fit a specific profile. The report in the database typically includes financial information with 29 profit and loss accounts, 63 balance sheet items, and industry descriptions such as standard industrial classification (SIC) codes, which information is crucial for this study. This study focuses on the UK's manufacturing industry[13] and obtains the sample involving 414 British manufacturing firms during the period 2009-2018.

In terms of data used in this analysis, the output is measured by the log of turnover. Labor is measured by the log of employees. Capital is measured by the log of fixed assets. R&D is transformed into the log of R&D. Debt ratio is measured by liability/total assets. Cash flow ratio is measured by cash flow/ total assets. Debt and cash flow are used to proxy for the external and internal financial constraints, respectively. Furthermore, Table 6.1 provides a summary of the datasets and descriptive statistics.

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[13] This study data extracted from the UK's manufacturing industry in FAME database includes: 10 - Manufacture of food products, 11 - Manufacture of beverages, 12 - Manufacture of tobacco products, 13 - Manufacture of textiles, 14 - Manufacture of wearing apparel, 15 - Manufacture of leather and related products, 16 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials, 17 - Manufacture of paper and paper products, 18 - Printing and reproduction of recorded media, 19 - Manufacture of coke and refined petroleum products, 20 - Manufacture of chemicals and chemical products, 21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations, 22 - Manufacture of rubber and plastic products, 23 - Manufacture of other non-metallic mineral products, 24 - Manufacture of basic metals, 25 - Manufacture of fabricated metal products, except machinery and equipment, 26 - Manufacture of computer, electronic and optical products, 27 - Manufacture of electrical equipment, 28 - Manufacture of machinery and equipment n.e.c., 29 - Manufacture of motor vehicles, trailers and semi-trailers, 30 - Manufacture of other transport equipment, 31 - Manufacture of furniture, 32 - Other manufacturing, 33 - Repair and installation of machinery and equipment.

Table 6.1: A summary of the datasets and descriptive statistics, 2009-2018

Variable	Measurement	Obs	Mean	Std. Dev.	Min	Max
Output (LnY)	The log of turnover	4,140	10.5605	1.6800	7.7115	16.4525
Labour (LnL)	The log of employees	4,140	5.5369	1.5552	2.7726	11.0038
Capital (LnK)	The log of fixed assets	4,140	9.2068	2.2310	4.6052	16.4225
T	Year	4,140	2,013.5000	2.8726	2009	2018
LnR&D	The log of R&D	4,140	5.9839	2.1615	0.6931	11.8225
Debt ratio (DR)	Liability/total assets	4,140	0.1752	0.2164	0.0001	1.2091
Cash flow ratio (CR)	Cash flow/total assets	4,140	0.1021	0.1294	-0.3750	0.5163

6.3 Empirical Findings

Table 6.2 presents the regression results (all sample) that are the corresponding models illustrated in Section 2.1. This study uses LR1[14] and LR2 tests to choose the optimal model among the five regression models shown in Table 6.2. The null hypotheses of LR1 and LR2 tests are the non-existent and existent financial constraints in R&D investment, respectively. The results of LR1 and LR2 tests all show that Model 1 is better than the other four models, which implies that the financial constraints in R&D have an essential impact on firm productivity.

As Model 1 shown, the coefficient of DR (external financing) is 0.3597 at 1% statistical significance, which implies the increase in debt would increase financial constraints and is a consistent finding with Ferrando and Ruggieri (2018). The coefficient of CR (internal financing) is -0.66657 at 1% statistical significance, which means that the increase in cash

[14] Likelihood ratio $(LR) = -2[L(H_0) - L(H_1)]$, where $L(H_0)$ and $L(H_1)$ are the LR function of null and alternative hypotheses; Null hypothesis is $u_{i,t} = 0$, and the alternative hypothesis is $u_{i,t} \neq 0$; LR statistic asymptotically obeys the Chi-squared distribution, and the degrees of freedom is the number of constraints.

flow would reduce financial constraints and is a consistent finding with Chen & Guarigli (2013). Most earlier studies analyze firm's external and internal financing constraints to impact on its productivity directly. However, this study explores a firm's financial constraints, uncertainty, and productivity through the medium of R&D investment. Financial constraints can impact on firm's investment decision in physical capital, R&D, and other activities.

Regarding the financial constraints in R&D investment, the coefficient of LnR&D×DR is 0.0556 at 1% statistical significance. The evidence suggests that the increase in debt (external financing) would enhance the financial constraints in R&D investment and then reduce firm productivity. The coefficient of LnR&D×CR is -0.0540 with statistical insignificance, which implies that cash flow (internal financing) does not impact firm productivity through the financial constraints in R&D investment. Canepa & Stoneman (2008) also confirm that financial factors are a constraint to the innovation of the UK's firms. Firms with financial constraints incline to induce internal financing rather than external financial because it is cheap and readily available (Sena, 2006).

Moreover, Brown et al. (2009) indicate that debt financing is not suitable for R & R&D-intensive firms due to the uncertainty characterized by volatile return, the inherent riskiness of the investment, and the moral hazard of choosing low-risk projects instead of high-risk projects. Regarding financial uncertainty, the coefficient of debt is 0.0826 at statistical insignificance, which shows that debt is not essential in enhancing or reducing a firm's prospective financial uncertainty. The coefficient of cash flow with -3.9949 at 1% statistical significance reveals that the increase in cash flow can primarily reduce a firm's financial uncertainty in the future. The coefficients of lnR&D×DR with 0.4561 at 10% statistical significance suggest that the increase in debt would enhance the firm's financial uncertainty through R&D investments in the future. In addition, the coefficient of LnR&D×CR is

-0.4312 with statistical insignificance, which confirms that the financial constraints of cash flow in R&D investments do not impact on firm's prospective financing uncertainty.

Table 6.3 displays the regression results in low, middle, and high-tech industries. There are considerable differences in the effect of external and internal financings directly or indirectly through the medium of constraints in R&D investment on firm productivity and prospective financial uncertainty among the three industries. In terms of financial constraints, as Table 6.3 shown, the increase in debt would reduce firm productivity in middle and high-tech industries rather than in low-level industry while the increase in cash flow would enhance firm productivity in all sectors. This study mainly focuses on the financial constraints in R&D investment that impact firm productivity. The increase in debt would reduce financial constraints in R&D in the middle-tech industry and enhance financial constraints in R&D in the high-tech industry. In contrast, debt financing is not essential in the low-tech sector. The increase in cash flow would improve the financial constraints in R&D in low and high-tech industries while it would reduce the financial constraints in R&D in the middle-tech industry. Therefore, internal and external financings encounter a large difference in firm productivity when introducing the medium of R&D investment. R&D is more critical in the high-tech industry than middle and low-tech industries (Dabla-Norris et al., 2012).

Moreover, firms with financial constraints are unwilling to invest in high-risk projects, especially in the high-tech industry. Therefore, they cannot choose the optimal capital structure and must forego the most profitable benefits from the investment. As a result, the distortion of resource allocation would contribute to the reduction of firm productivity. Finally, regarding financial uncertainty, the increase in debt would enhance the firm's prospective financial uncertainty in the middle-tech industry while it is not crucial in the low-tech sector, whether directly or indirectly impacting firm productivity. Nevertheless, the increase in cash flow would generally reduce the firm's prospective financial uncertainty in all industries through direct and indirect channels.

Table 6.2: Regression results (all sample)

	Model 1 (unrestricted)	Model 2 (γ=0)	Model 3 (δ=0)	Model 4 ($\omega_{i,t}$=0)	Model 5 ($u_{i,t}$=0)
Production Function					
LnL	0.6147***	0.6218***	0.6507***	0.6229***	0.5977***
	(0.0118)	(0.0113)	(0.0113)	(0.0115)	(0.0142)
LnK	0.2587***	0.2533***	0.2527***	0.2596***	0.2742***
	(0.0080)	(0.0077)	(0.0074)	(0.0077)	(0.0095)
1/2 LnL_2	-0.0113	-0.0113	-0.0101	-0.0041	0.0391**
	(0.0131)	(0.0130)	(0.0136)	(0.0133)	(0.0159)
1/2 LnK_2	0.1025***	0.1023***	0.1010***	0.1053***	0.1275***
	(0.0059)	(0.0058)	(0.0060)	(0.0060)	(0.0080)
LnL×LnK	-0.0417***	-0.0418***	-0.0426***	-0.0470***	-0.0765***
	(0.0071)	(0.0071)	(0.0075)	(0.0073)	(0.0091)
LnK×T	0.0001	0.0004	0.0042*	-0.0002	0.0013
	(0.0025)	(0.0024)	(0.0025)	(0.0025)	(0.0032)
LnL×T	-0.0032	-0.0035	-0.0094***	-0.0032	-0.0080*
	(0.0035)	(0.0035)	(0.0036)	(0.0036)	(0.0045)
T	0.0153***	0.0147***	0.0182***	0.0161***	0.0190***
	(0.0028)	(0.0028)	(0.0029)	(0.0028)	(0.0036)
1/2 T_2	-0.0052**	-0.0054**	-0.0053**	-0.0051**	-0.0053*
	(0.0022)	(0.0022)	(0.0023)	(0.0022)	(0.0028)
Constant	11.4418***	11.2169***	12.7189***	10.7234***	11.1621***
	(0.3870)	(3.2662)	(0.7208)	(0.0237)	(0.0173)
Financial Constraints in R&D Investment					
LnR&D	-0.0440***	-0.0436***			
	(0.0051)	(0.0049)			
DR	0.3597***	0.3407***			
	(0.0418)	(0.0402)			
CR	-0.6657***	-0.6374***			
	(0.0669)	(0.0630)			
LnR&D×DR	0.0556***	0.0446**			
	(0.0206)	(0.0189)			
LnR&D×CR	-0.0540	-0.0576*			
	(0.0353)	(0.0321)			
Constant	0.9746**	0.7475	2.2581***		
	(0.3870)	(3.2662)	(0.7208)		
Financial Uncertainty					
LnR&D	-0.0809		1.3637***	-0.2342***	
	(0.0716)		(0.4300)	(0.0340)	
DR	0.0826		-28.3419**	1.6827***	
	(0.4527)		(11.6324)	(0.2164)	
CR	-3.9949***		13.3785***	-4.0606***	
	(1.2338)		(2.9181)	(0.4558)	
LnR&D×DR	0.4561*		0.0089	0.3262***	
	(0.2553)		(2.5735)	(0.1030)	
LnR&D×CR	-0.4312		-4.4442***	-0.5647***	
	(0.4518)		(0.9374)	(0.1935)	
Constant	-3.2048***	-4.5242	-10.8039***	-2.4334***	
	(0.4404)	(15.3533)	(2.1242)	(0.1750)	
Number of obs.	4,140	4,140	4,140	4,140	4,140
Log likelihood	-3,101.3500	-3,113.4124	-3,230.3455	-3,151.6565	-3,643.1626
LR1	1,100.0000	1,100.0000	825.6342	983.0121	
P-value	0.0000	0.0000	0.0000	0.0000	
LR2		24.1249	257.9910	100.6131	1,100.0000
P-value		0.0002	0.0000	0.0000	0.0000

Note: 1. Standard errors in the parentheses 2. *** p<0.01, ** p<0.05, * p<0.1 3. LR1 and LR2 are the tests for choosing the optimal regression model among Model 1-5. 4. LR= likelihood ratio

Table 6.3: Regression results in the low, middle, and high-tech industries

	Low-tech industry	Middle-tech industry	High-tech industry
Production Function			
LnL	0.3755***	0.7006***	0.5756***
	(0.0481)	(0.0143)	(0.0271)
LnK	0.3663***	0.1961***	0.3170***
	(0.0356)	(0.0103)	(0.0157)
1/2 LnL_2	-0.1031***	0.0665***	0.0038
	(0.0339)	(0.0189)	(0.0264)
1/2 LnK_2	0.0816***	0.1008***	0.0801***
	(0.0173)	(0.0079)	(0.0121)
LnL×LnK	0.0249	-0.0594***	-0.0544***
	(0.0205)	(0.0094)	(0.0149)
LnK×T	-0.0096	-0.0047	0.0078*
	(0.0090)	(0.0030)	(0.0047)
LnL×T	0.0133	0.0030	-0.0193***
	(0.0107)	(0.0045)	(0.0067)
T	0.0113	0.0145***	0.0147**
	(0.0112)	(0.0033)	(0.0057)
1/2 T_2	-0.0063	-0.0058**	-0.0028
	(0.0069)	(0.0025)	(0.0043)
Constant	11.0555***	11.8736***	12.2702***
	(0.0928)	(0.3516)	(1.1686)
Financial Constraints in R&D Investment			
LnR&D	0.1482***	-0.0319***	-0.0788***
	(0.0535)	(0.0063)	(0.0115)
DR	-0.2882	0.4790***	0.5503***
	(0.4492)	(0.0657)	(0.0809)
CR	-2.5237***	-0.6369***	-1.0507***
	(0.4995)	(0.0784)	(0.1640)
LnR&D×DR	-0.0231	0.1306***	-0.1297***
	(0.1770)	(0.0263)	(0.0421)
LnR&D×CR	0.6350***	-0.2058***	0.1396*
	(0.2023)	(0.0441)	(0.0838)
Constant	0.0273	1.4590***	1.8488
	(0.1357)	(0.3509)	(1.1690)
Financial Uncertainty			
LnR&D	-0.5866***	-0.0465	-0.6505***
	(0.1275)	(0.0318)	(0.2188)
DR	-1.6722	0.6999**	-0.7700
	(1.7869)	(0.3276)	(1.4135)
CR	-5.6672**	-3.0307***	-5.8734**
	(2.3846)	(0.8212)	(2.4200)
LnR&D×DR	0.0363	0.3028**	0.5799
	(0.7065)	(0.1508)	(0.8792)
LnR&D×CR	-3.8984***	-1.4041***	-0.7216
	(1.2614)	(0.3691)	(0.8975)
Constant	-1.9923***	-2.3081***	-4.1636***
	(0.5197)	(0.2626)	(0.7573)
Number of obs.	400	2,650	1,090
Log likelihood	-287.9810	-1,769.6701	-822.6477

Note: 1. Standard errors in the parentheses 2. *** p<0.01, ** p<0.05, * p<0.

Figure 6.1 shows the frequency distribution of mean firm productivity during 2009-2018. In Figure 6.1, firm productivity distributes between about 0.7 and 0.9. Thus, the financial constraints in R&D investment can lead to the UK's manufacturing firm productivity loss of about 20%. Figure.6.2 presents the difference in mean firm productivity in low, middle, and high-tech industries during 2009-2018. Compared with the firm productivity in the middle and low-tech sectors, the firm productivity in the high-tech sector presents a steady and upward trend during the ten years.

Moreover, the firm productivity in the middle-tech industry is generally lower than that in high and low-tech industries. Overall, the British firm's productivity in the manufacturing industry presents an upward trend during 2009-2018. Figure 6.3 displays the difference of mean R&D investment in firms in the low, middle, and high-tech industries during the period 2009-2018. R&D is more intensive in the high-tech sector than that in the middle-tech industry. R&D is more intensive in the middle-level sector than in the low-tech sector. Therefore, a higher R&D investment tends to associate with higher firm productivity.

Figure 6.1: The frequency distribution of mean firm productivity (DP) during 2009-2018

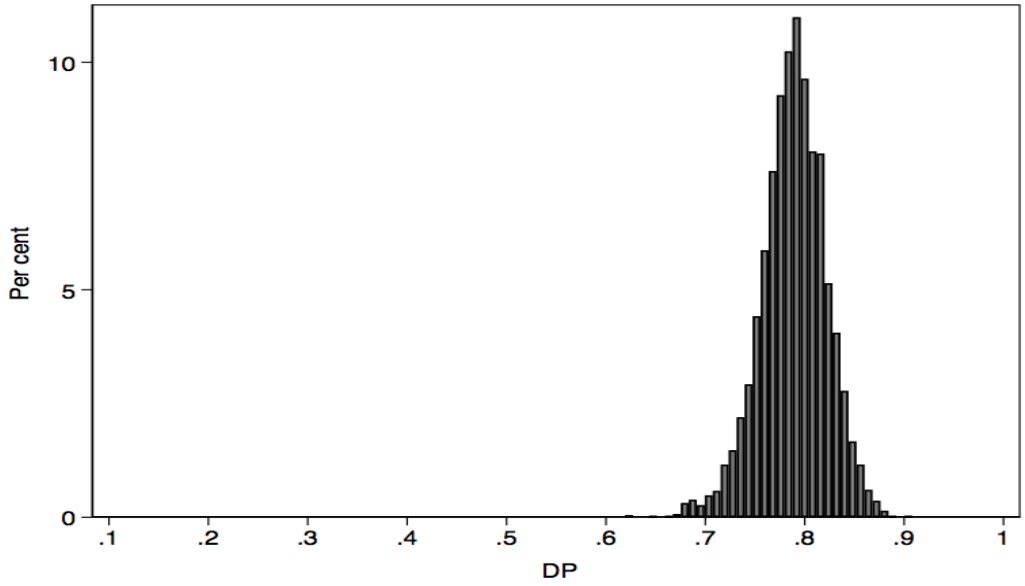


Figure 6.2: The difference of mean firm productivity (DP) in the low, middle, and high-tech industries during 2009-2018

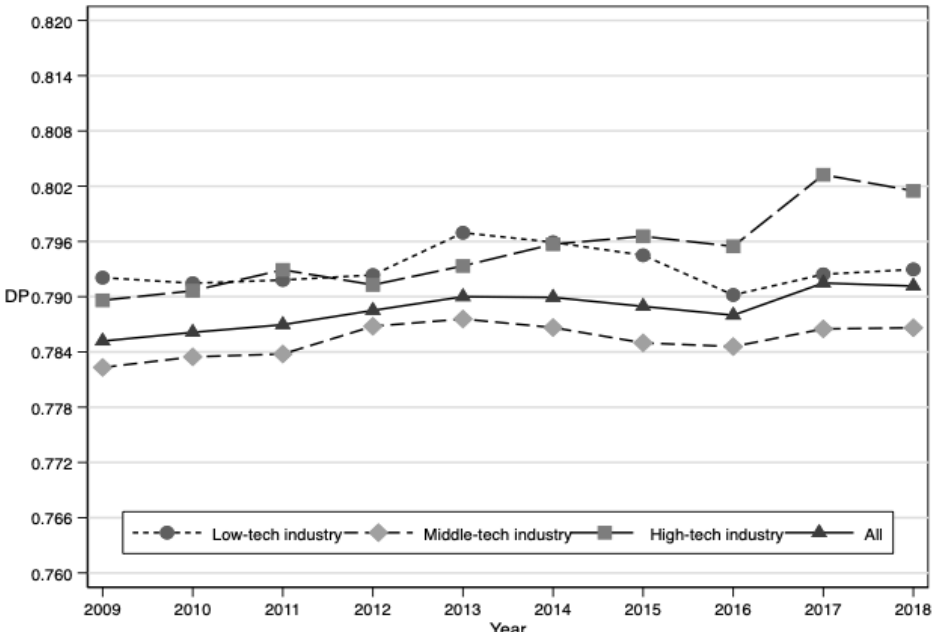
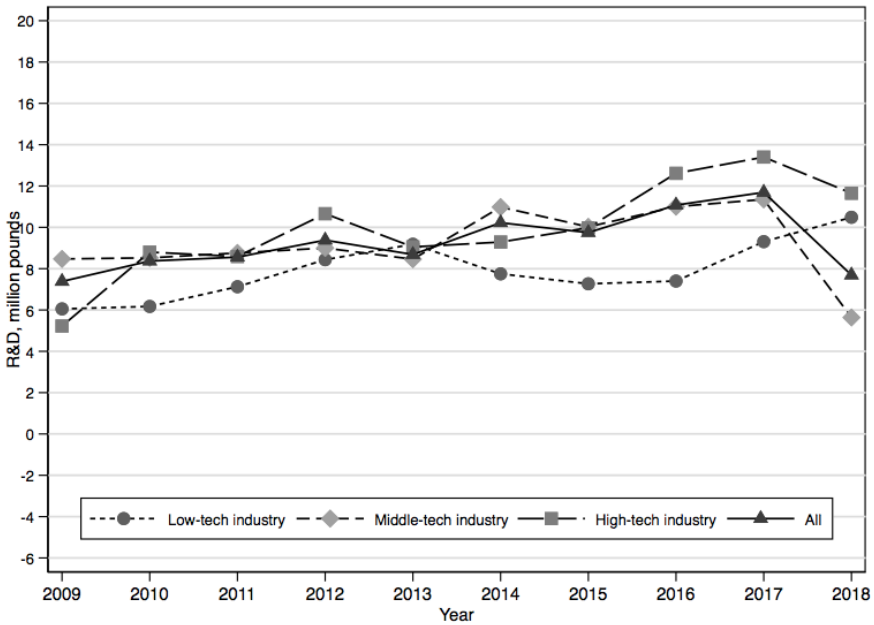


Figure 6.3: The difference of mean R&D investment in the firms in the low, middle, and high-tech industries during 2009-2018



6.4 Conclusions and Implications

This study introduces a flexible translog production function into the heterogeneous SFA to explore the financial constraints in R&D investment, uncertainty, and productivity in British manufacturing firms. Cash flow (external financing) does not impact the financial constraints in R&D investment. Whereas the increase in debt (internal financing) can enhance the financial constraints in R&D investment and then reduce firm productivity. Moreover, there is a significant difference in low, middle, and high-tech industries. The financial constraints in R&D investment lead to the loss of British firm's productivity by about 20%. In addition, firm productivity presents an upward trend during 2009-2018, which implies that the financial market tends to be becoming more conducive to firm productivity.

The findings in this study suggest that firms should combine internal and external financing to reduce the financial constraints in R&D investment and uncertainty. Moreover, there are significant differences in the firms between low, middle, and high-tech industries. The investment in R&D is costly and high risk for firms, especially firms in the high-tech sector. A suitable combination of internal and external financing can better transform the R&D investment into higher firm productivity. In addition, it worth noting that a good financial market is crucial for reducing a firm's financial constraints, especially in R&D investment, and then improving firm productivity (Chen & Guariglia, 2013; Satpathy et al., 2017).

Chapter 7

Investigating the Efficiency of British Listed Manufacturing Firms: What Is a Matter in the "Black Box"?

7.1 Introduction

The manufacturing industry plays a vital role in the development of the British economy. Along with the globalization process, the UK is going through decriminalization and deindustrializes the most among industrialized countries (Hauge & O'Sullivan, 2019). Moreover, the UK is experiencing the impact of Brexit. Irwin (2015) concludes that Brexit can affect the UK through ten channels: uncertainty, FDI, trade, financial services, liberalization and regulation, immigration, industrial policy, trade policy, budget, and international influence. Latorre et al. (2020) suggest that the UK experiences losses in its wage, average industry productivity, foreign trade, production, wages, and capital remuneration because of Brexit. Therefore, based on the current background of the UK, it is meaningful to explore what is a matter in the "black box" about the British listed firm's efficiency in the manufacturing industry. This study tries to uncover the double "black boxes". First, this study decomposes firm efficiency into five dimensions: technical, pure technical, scale, profitability, and operational efficiencies. Second, this study decomposes the external business environment into eight dimensions, including the exchange rate fluctuation, trade openness, business freedom, financial freedom, education level, market size, factor price, and road infrastructure.

Some earlier studies have explored firm efficiency in the manufacturing industry. Chandra et al. (1998) adopt the data envelopment analysis (DEA) to evaluate 29 Canadian textile companies in 1994 and find that most do not perform well. Roudaut (2006) employs a stochastic frontier approach (SFA) to investigate the technical efficiency of Cote D'ivoire's 205 manufacturing firms in 1994 and 1995 and confirms that formal firms are more technically efficient than informal firms, and the efficiency gap between them is mainly from the result of a disadvantageous business environment. Huang (2018) uses the two-stage DEA to analyze the overall efficiency of Taiwanese 64 medical manufacturing firms in 2014 and confirms that many of them perform higher on the profitability efficiency than the

marketability efficiency. de la Fuente-Mella et al. (2020) apply econometric and stochastic frontier analyses to explore the productivity and technical efficiency of 87 industry categories for the 1995-2010 period in the Chilean manufacturing industry and find that the Chilean manufacturing sector experiences a downward trend in technical efficiency during the 16 years. However, no studies have investigated the efficiency of British listed firms in the manufacturing industry by linking to both its internal and external factors. Moreover, this study combines the methods of two-stage DEA suggested by Coelli (1998) and three-stage DEA proposed by Fried et al. (2002). Thus, the findings have important implications for the self-checking of firm efficiency and the implementation of government policy.

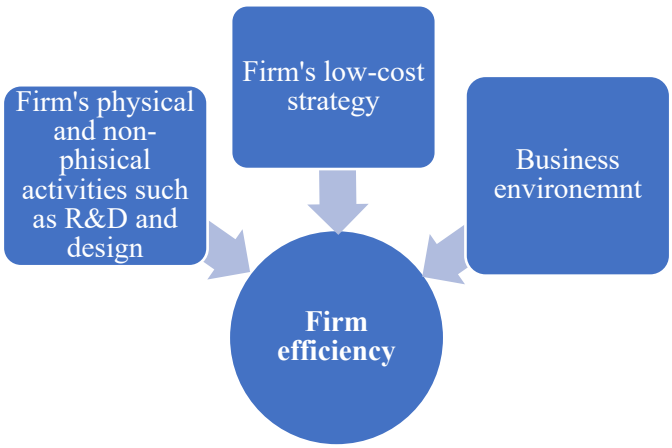
This study is organized as follows. After Section 1, Section 2 discusses a conceptual framework for firm efficiency. Section 3 describes analytical specifications and datasets summary. Section 4 analyzes empirical findings, followed by conclusions in Section 5.

7.2 A Brief Conceptual Framework

This study develops an explorative conceptual framework by integrating the low-cost strategy, the firm's physical and non-physical activities (e.g., R&D and design), and the business environment. As one of Porter's "generic" strategies, the low-cost strategy emphasizes efficiency and rigorously pursues the cost reduction from all possible resources (Kotha & Swamidass, 2000). Firms can generate a competitive advantage by minimizing production costs and becoming the most efficient producers in an industry (Porter, 1980). Moreover, the maximization of efficiency makes firms rely on simplification and standardization through high-volume production and low product variety in the manufacturing industry (Porter, 1985). Manufacturing firms' physical and non-physical activities relate to R&D, design, manufacturing, marking, and retail in the smile curve. From the value chain perspective, service segments are becoming more profitable while

manufacturing segments are becoming less profitable. Furthermore, R&D as non-physical activity represents a significant component of the advanced manufacturing of the 21st century (Hauge & O'Sullivan,2019). R&D is intricately linking to the manufacturing process and plays a vital role in innovation. Besides, the business environment as an external factor also has an essential impact on firm efficiency. Firms are environmental dependent and environment serving, depending on the environment for resource inputs and producing goods or service for consumption by the environment (Kariuki et al., 2011). Business environment can be considered the three layers: macro-environment, industry environment, and micro-operational environment, which is included in the PESTEL framework[15] and Porter's five force framework[16] (Kariuki et al., 2011). Roudaut (2006) shows that the business environment (e.g., market condition and infrastructure) exert a crucial impact on Cote D'ivoire's manufacturing firms. Therefore, low-cost strategy, firm's physical and non-physical activities, and business environment are integrated into the explorative framework shown as follows:

Figure 7.1: Conceptual framework for firm efficiency



[15] PESTEL= political, economic, social, technological, environmental, and legal
[16] Porter's five forces relate to potential entrants, bargaining power of buyers, threat of substitutes, bargaining power of suppliers, and competitive rivalry.

7.3 Research Method

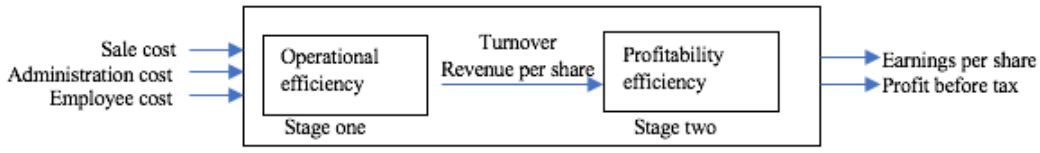
7.3.1 Analytic specification

This study combines the two-stage (DEA-Tobit) approach suggested by Coelli (1998) and the three-stage (DEA-SFA) approach proposed by Fried et al. (2002) to conduct the following three logical steps:

Step One:

This study conducts the DEA without intermediate inputs to obtain technical efficiency (TE). TE can be further decomposed into pure technical efficiency (PTE) and scale efficiency (SE), in which the calculation formula is $TE = SE \times PTE$. This study further uses network DEA to explore the operational efficiency in stage one (OE_ONE) and profitability efficiency in stage two (PE_TWO). The process of network DEA is described as:

Figure 7.2: The process of network DEA



Step Two:

This study combines the DEA and SFA to obtain the adjusted TE, PTE, and SE efficiency in stages one and two removing the impact of environmental and random factors. The adjusted efficiency can objectively reflect the efficiency of each decision-making unit (DMU). SFA model is shown as follows:

$$s_{mi} = f(E_i;\ \beta_m) + \nu_{mi} + \mu_{mi};\ \ i = 1, 2, 3 \cdots, I; m = 1, 2, 3 \cdots, M.$$

The footnotes "m" and "i" are m[th] DMU and i[th] input, respectively. S_{mi} is a slack variable. E_i is an environmental variable. ν_{mi} is a random error term. μ_{mi} is the management inefficiency.

SFA model can further remove the impact of environmental and random factors on efficiency measurement using the adjusted formula described as follows:

$$X_{mi}^{A} = X_{mi} + \left[\max\left(f\left(E_i;\hat{\beta}_m\right)\right) - f\left(E_i;\hat{\beta}_m\right)\right] + [\max(\upsilon_{mi}) - \upsilon_{mi}]\ ;\ \ i = 1, 2, 3 \cdots, I; m = 1, 2, 3 \cdots, M.$$

Where, X_{mi}^{A} is the adjusted input; X_{mi} is the original input. $\left[\max\left(f\left(E_i;\hat{\beta}_m\right)\right) - f\left(E_i;\hat{\beta}_m\right)\right]$and $[\max(\upsilon_{mi}) - \upsilon_{mi}]$ denotes the DMUs in the same environmental condition.

This study uses the adjusted inputs to repeat Step One and then obtains the adjusted TE, PTE, SE, OE_ONE, and PE_TWO.

Step Three:

This study adopts a Tobit model to estimate the impact of environmental factors on firm efficiency. Tobit model can competently deal with the limited dependent variable that the value is between 0.8 and 1 in this study. The regression model is shown as follows:

$$UTE_{it} = \beta_0 + \beta_1 LER_{i,t} + \beta_2 RDI_{i,t} + \beta_3 ln\_FA_{i,t} + \beta_4 CI_{i,t} + \beta_4 INN_{i,t} + \beta_5 lR_{i,t} + \beta_6 TO_{i,t} + \beta_7 ln\_BF_{it} + \beta_8 \ln\_FF_{it} + \beta_9 PR_{i,t} + \beta_{10} MS_{it} + \beta_{11} FP_{it} + \beta_{13} ln\_RI_{it} + \mu_i + \epsilon_{it}$$

The footnotes of "i" and "t" are firm and time, respectively. In terms of the dependent variable, UTE_{it} is unadjusted technical efficiency. In terms of control variables, $LER_{i,t}$ is leverage rate; $RDI_{i,t}$ is R&D intensity; ln $\_FA_{i,t}$ is the log of firm age; $CI_{i,t}$ is capital intensity; $INN_{i,t}$ is firm internationalization. In terms of independent variables, $lR_{i,t}$ is inflation rate; $TO_{i,t}$ is trade openness; ln_BF_{it} is the log of business freedom; ln$_FF_{it}$ is the log of financial freedom; $PR_{i,t}$ is education level; MS_{it} is the log of market size; FP_{it} is the log of factor price; ln_RI is road infrastructure; μ_i is the random effect. ϵ_{it} is the error term; Finally, β_0-β_{13} are corresponding coefficients.

This study also uses the likelihood ratio (LR) test and the Hausman test to choose the optimal model.

7.3.2 Sample and data

This study sample consists of panel data with 123 British-listed manufacturing firms during 2006-2018. A summary of the detailed datasets, including data sources, measurement, and processing, and where to use are presented in Table 7.1.

Table 7.1: Summary of main datasets, 2006-2018

Variable	Source	Measurement and processing	Where to use
Sale cost	FAME	Standardized, (0.1-1)*	DEA
Administration cost	FAME	Standardized, (0.1-1)	DEA
Employee cost	FAME	Standardized, (0.1-1)	DEA
Turnover	FAME	Standardized, (0.1-1)	DEA
Revenue per share	FAME	Standardized, (0.1-1)	DEA
Earnings per share	FAME	Standardized, (0.1-1)	DEA
Profit before tax	FAME	Standardized, (0.1-1)	DEA
UTE	Obtained from DEA	(0 -1)	Tobit model
LER	FAME	Long-debt/total assets	Tobit model
RDI	FAME	Expenditure on R&D/revenue	Tobit model
Ln_FA	FAME	Log of the years since firm incorporation	Tobit model
CI	FAME	Fixed investment/total assets	Tobit model
INN	FAME	"1" for firm internationalization and "0" otherwise	Tobit model
IR	World Development Indicators	Inflation rate	Tobit model, SFA
TO	World Development Indicators	(Export+import)/GDP	Tobit model, SFA
Ln_BF	The Heritage Foundation	The log of score (0 - 100)	Tobit model, SFA
Ln_MS	World Development Indicators	The log of GDP	Tobit model, SFA
Ln_FF	The Heritage Foundation	The log of score (0 - 100)	Tobit model, SFA
PR	Department of Education	Participation rate in higher education	Tobit model, SFA
Ln_FP	World Development Indicators	The log of GDP per capita	Tobit model, SFA
Ln_RI	Department for Transport Statistics	The log of mileages of road freight	Tobit model, SFA

Note: * means that these variables are standardized because the DEA requires non-negative values.

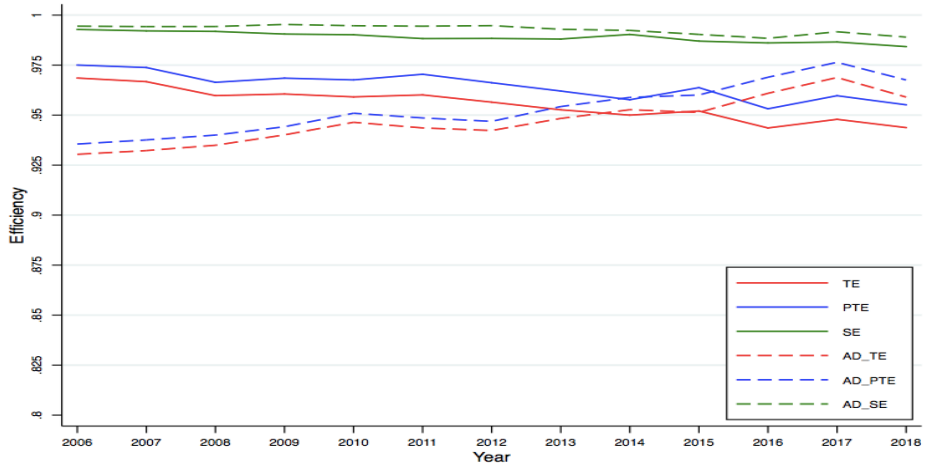
7.4 Findings

In Figure 7.3, TE, PTE, and SE all reach a relatively high level (above 0.95) and display a slight decline during 2006-2018. However, adjusted TE and PTE show a slight increase and surpass TE and PTE since 2015. Adjusted SE shows a slight decrease and is above SE during the 13years. Moreover, TE is mainly impacted by PTE. In Figure 7.4, OE_ONE displays a slight decline from 0.9 in 2006 to 0.85 in 2018, while PE_TWO shows a slight increase from 0.67 in 2006 to 0.69 in 2018. Adjusted OE_ONE is above OE_ONE during the 13 years. Adjusted PE_TWO surpasses PE_TWO since 2015. As Figure 7.5 shown, the technical, pure technical, scale, and profitability efficiencies are lower in the low-tech industry than in the

middle and high-tech industries, while operational efficiency is higher in the low-tech industry than in the middle and high-tech industries during the 13 years. The evidence also reveals that the firm's technical, pure technical, scale and profitability efficiencies commonly show a slight decrease and reach a relatively high level, while the firm's operational efficiency shows a slight increase.

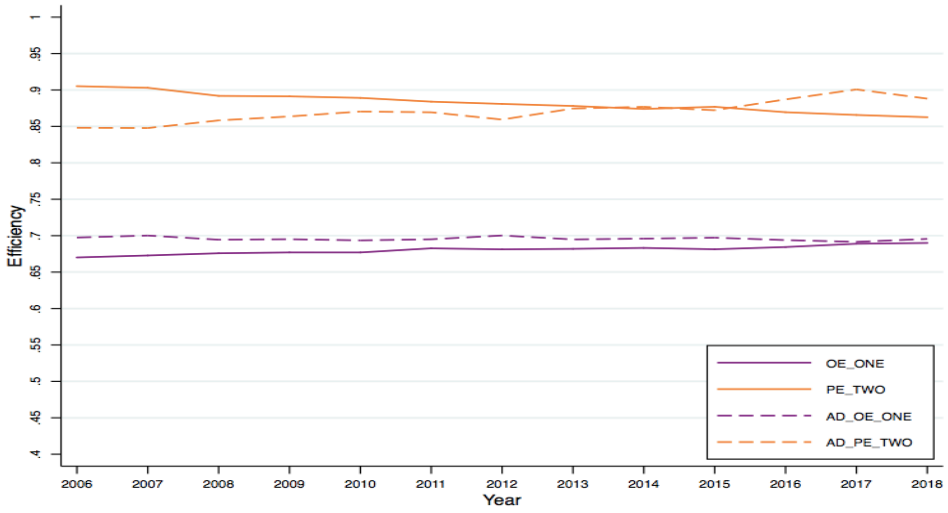
The efficiencies of British listed manufacturing firms reach a relatively high level, except its operation efficiency still has a large room to improve. Moreover, technical efficiency is mainly impacted by scale efficiency. In addition, the overall environment gradually deteriorates, especially since 2015. Unlike manufacturing firms in developing countries, the firm's technical efficiency is generally low and has a large room to improve (See Le et al., 2018; de la Fuente-Mella et al., 2020; Al-Durgham & Adeinat, 2020). Moreover, this study explores various firm's efficiencies by considering environmental factors and confirms the critical impact of ecological factors on firm's efficiencies. This also gives the reason for conducting the following regression analysis about the effect of environmental factors on firm's technical efficiency.

Figure 7.3: Unadjusted and adjusted firm TE, PTE, and SE during 2006-2018



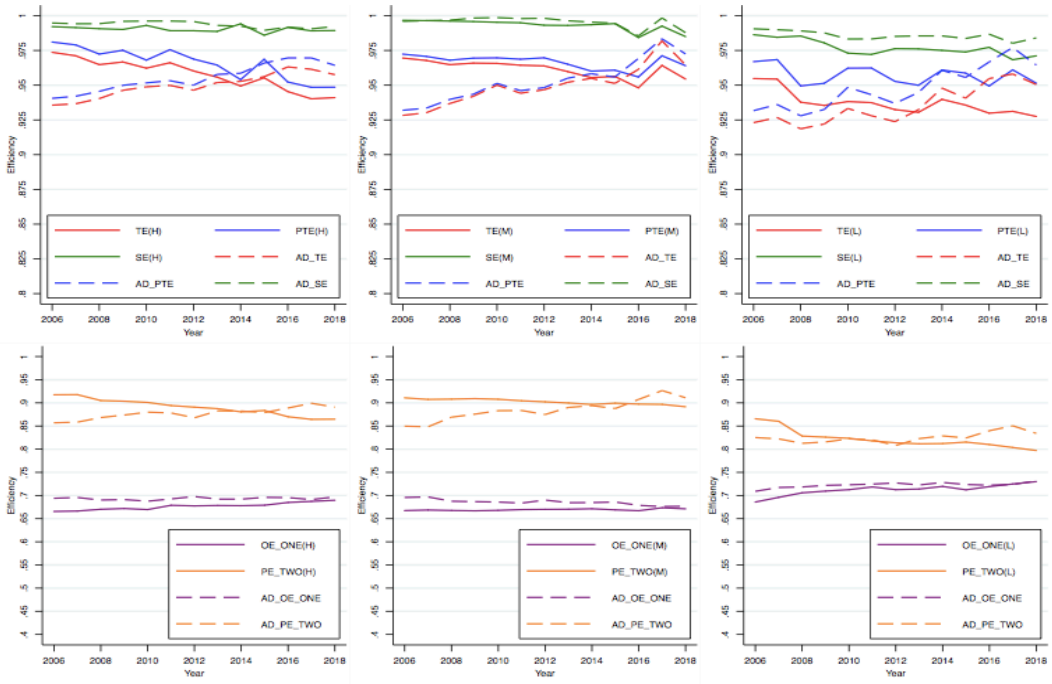
Note: AD means the adjusted mean value.

Figure 7.4: Unadjusted and adjusted firm efficiency in stage one and two during 2006-2018



Note: AD means the adjusted mean value.

Figure 7.5: Unadjusted and adjusted firm efficiency in the low, middle, and high-tech industries during 2006-2018



Note：1. AD means the adjusted mean value 2. H, M, and L in the parentheses mean high, middle, and low-tech industries, respectively.

This study uses the LR test and Hausman test to choose the optimal model. The result of the LR test shows the rejection of the null hypothesis (pooled model) at 1% significance, which means the fixed model should be a better fit than the pooled model. Furthermore, the result of the Hausman test displays the acceptance of the null hypothesis (random model), which implies that a random model is a better fit than a fixed model. Therefore, the Tobit model with random effect is the optimal estimation. In Table 7.2, the results using the random model in column (3) show that Ln_BF, Ln_FF, Ln_MS, and Ln_RI have a positive impact on firm efficiency, and Ln_FP has a negative impact on firm efficiency. Whereas IR, TO, and PR do not affect firm efficiency. Therefore, environmental factors exert different effects on firm efficiency. However, earlier studies such as Roudaut (2006) and Kariuki et al. (2011) emphasize the importance of the business environment. However, no studies have systematically explored what inside of the business environment. Therefore, this study decomposes it into several detailed environmental factors and captures their different effect on firm efficiency.

This study further conducts regressions in low, middle, and high-tech industries. In Table 7.3, the whole environmental variables do not impact firm efficiency in the low-tech sector. However, Ln_BF, Ln_FF, and Ln_RI positively impact firm efficiency in the middle industry. Ln_RI and Ln_BF positively impact firm efficiency, and Ln_FP harms firm efficiency in the high-tech sector. The evidence suggests that the overall environment has a more critical impact on firm efficiency in middle and high-tech industries than in low-tech industries. In other words, low-tech firms are less environmentally dependent, and the environment is serving than firms in the middle and high-tech industries.

Table 7.2: Regression results (all sample)

Variable	(1) Pooled model	(2) Fixed model	(3) Random model
LER	-0.145***	-0.02	-0.009*
	(0.012)	(0.014)	(0.005)
RDI	0.020***	-0.002	-0.003
	(0.005)	(0.002)	(0.002)
Ln_FA	-0.002**	-0.003	0.000
	(0.001)	(0.005)	(0.001)
CI	-0.152***	0.037	0.000
	(0.035)	(0.047)	(0.015)
INN	-0.002	0.001	0.001
	(0.003)	(0.003)	(0.001)
IR	-0.123	-0.114	-0.116
	(0.387)	(0.135)	(0.096)
TO	-0.076	-0.036	-0.002
	(0.270)	(0.095)	(0.067)
Ln_BF	0.086	0.062*	0.049*
	(0.116)	(0.036)	(0.029)
Ln_FF	0.053	0.048	0.037*
	(0.089)	(0.032)	(0.022)
PR	0.084	-0.005	-0.003
	(0.091)	(0.021)	(0.023)
Ln_MS	-0.004	0.028**	0.015*
	(0.032)	(0.013)	(0.008)
Ln_FP	-0.024	-0.169***	-0.088***
	(0.096)	(0.058)	(0.024)
Ln_RI	0.028	0.036**	0.023***
	(0.032)	(0.018)	(0.008)
Constant	0.387		1.032***
	(1.198)		(0.299)
Number of obs.	1,599	1,599	1,599
Chi-squared	199.52	28.56	193.66
P-value	0.000	0.008	0.000
LR test (pooled v.s fixed)	4587.33		
P-value	0.000		
Hausman test (fixed v.s random)		1.22	
P-value		0.875	

Note: 1. Standard errors in the parentheses 2. *** p<0.01, ** p<0.05, * p<0.1 3. Dependent variable is the unadjusted TE 3. The Tobit model with fixed effect (two-side truncation) and the Hausman test adopt the method suggested by Honoré (1992).

Table 7.3: Regression results in the low, middle, and high-tech industries

Variable	(4) Low-tech industry	(5) Middle-tech industry	(6) High-tech industry
LER	0.090**	0.017	-0.116***
	(0.042)	(0.038)	(0.041)
RDI	0.008	-0.004	-0.010
	(0.018)	(0.015)	(0.022)
Ln_FA	-0.013**	0.017***	-0.009
	(0.005)	(0.006)	(0.009)
CI	-0.229**	0.207	0.154
	(0.091)	(0.140)	(0.133)
INN	0.010	-0.029**	0.004
	(0.007)	(0.013)	(0.010)
IR	0.564	-0.630	-1.075
	(0.732)	(0.650)	(0.866)
TO	-0.677	0.154	0.243
	(0.529)	(0.472)	(0.619)
Ln_BF	0.017	0.372**	0.376*
	(0.206)	(0.177)	(0.227)
Ln_FF	-0.057	0.294*	0.230
	(0.169)	(0.153)	(0.192)
PR	-0.013	-0.01	0.136
	(0.169)	(0.143)	(0.189)
Ln_MS	0.045	-0.049	0.062
	(0.060)	(0.051)	(0.066)
Ln_FP	-0.046	-0.131	-0.454**
	(0.173)	(0.147)	(0.193)
Ln_RI	0.004	0.101*	0.184***
	(0.060)	(0.053)	(0.069)
Constant	1.205	-0.846	0.267
	(2.143)	(1.868)	(2.322)
Number of obs.	299	624	676
Chi-squared	46.6	85.84	67.76
P-value	0.000	0.000	0.000

Note: 1. Standard errors in the parentheses 2. *** p<0.01, ** p<0.05, * p<0.1 3. Dependent variable is the unadjusted TE.

7.5 Conclusions

Firm's technical, pure technical, and scale efficiencies reach a relatively high level, while its profitability and operational efficiencies have a large room to improve. The overall environment gradually deteriorates, especially since 2015. Business freedom, financial freedom, market size, and road infrastructure positively impact firm efficiency. In contrast,

factor price hurts firm efficiency. Moreover, the overall environment has a more significant impact on firm efficiency in the middle and high-tech industries than in the low-tech industry. Thus, the findings provide the channels for firms and local government to improve firm efficiency, enabling firms to make more profits and better compete both in domestic and foreign markets.

Chapter 8

Conclusions

8.1 Concluding Remarks and Implications

This thesis theoretically and empirically explores firm performance, primarily when firms conduct international operations, by linking the internal, external, direct, and indirect impact factors. These factors relate to country components, export behaviors based on productivity cut-off, horizontal, backward, and forward FDI agglomerations, the dynamic effect between FDI and trade, financial constraints in R&D investment, and the "black box" of firm efficiency. The significant findings have been identified, providing important implications for government policies and a firm's domestic and foreign operations.

In terms of Chapter 2, this study combines the resource, institution, and competitiveness-based views to find five-country components, namely advanced factor (human capital), institution, market competition, cluster development, and market size that moderate the I-P relationship. The MRA with VWLS is employed rather than a simple empirical study to analyze the mediating effect. Moreover, the sample used in this Chapter involves 99,398 firms and 34 economies (32 countries and 2 regions) covering 1969-2017. Furthermore, this study further conducts a horizontal and vertical comparison between developing and developed countries. Therefore, this study is powerful and meaningful. The main findings that the country components except market size exert a positive mediating effect on the I-P relationship. Furthermore, the five-country components positively mediate the I-P relationship in developed countries while negatively affecting the I-P relationship in developing countries. In terms of the essential priorities of the five-country components, advanced factor and market competition have a more crucial mediating effect on the I-P relationship than the other three country components in developed countries. In contrast, cluster development and market competition have a more critical mediating effect on the I-P relationship than the other three country components in developing countries. The insight findings provide important implications for government policies both in developing and developed countries. Thus, governments should maximize the advantageous country factors to improve a firm's capabilities and competitiveness or minimize the disadvantageous

country factors to constrain its capabilities and competitiveness. Governments, especially in developing countries, should build a good home country's environment for firms. So that they need to establish a good institution, cultivate, and attract innovative talents, construct a perfect mechanism of market completion, promote cluster development, and improve the economic level.

Regarding Chapter 3, this study combines self-selection, learning-by-exporting, knowledge-based view, and organizational learning theory to theoretically illustrate the four types of export behaviors, including export propensity, export intensity, irregular export, and regular export. This study further explores the effect of productivity cut-off on firm behaviors by employing the Heckman two-stage procedure with Probit and Tobit models. The Heckman two-stage procedure is employed to correct the sample selection bias because firms with more profitability tend to conduct the international operation. This study uses the data of 208,424 Chinese firms during the period 2005-2007, in which exporting is the dominant mode of international involvement in Chinese firms. The main findings are that productivity is likely to impact a firm's export propensity and irregular export positively. It exerts a negative effect on the firm's export intensity and does not impact the firm's regular export. Enhancing productivity cut-off is not conducive to the firm's export propensity and regular export while it does not affect the firm's export intensity and irregular export. Productivity cut-off tends to impact the firm export decision rather than export scale. Moreover, firms with regular export are more sensitive to productivity cut-off than firms with irregular export. Therefore, firms can better integrate different resources and consist of their comparative advantage and adjust their behaviors with matching their comparative advantage. So that firms can better compete in the domestic and foreign market. The local government should encourage firm's innovation, reduce firm's trade costs, and promote industry updating.

Chapter 4 expands the literature on industry agglomeration to explore the non-linear and spatial effect of horizontal, backward, and forward FDI agglomerations on firm productivity by employing a spatial econometric model based on the data of 12,240 Chinese firms covering the period 2010-2013. This study theoretically illustrates the interaction

mechanisms of horizontal, backward, and forward FDI agglomerations on firm productivity, including the main differences in terms of inter-firm relationships, the trade-off between benefits and costs, and interaction intensity. This study also creates the three new indices of horizontal, backward, and forward FDI agglomerations. The new indices can well capture the three types of FDI agglomeration and overcome the measurement bias due to the difference in absolute economy scale of different regions in China. This study finds that the congestion effect (inverted U-shape relationship) dominates the three types of FDI agglomerations on local firm productivity. This study also finds that the spatial congestion effect dominates backward and forward FDI agglomerations on neighboring firm productivity while a U-shaped relationship between spatial horizontal FDI agglomeration and neighboring firm productivity. Moreover, both local and neighboring firms' productivity is stronger than the level change of foreign firms' backward and forward FDI agglomeration, while it is weaker than that of foreign firms' horizontal agglomeration. Therefore, the Chinese local governments should induce different types of FDI agglomeration because of the difference in their interaction mechanisms with domestic firms. They should also moderately disperse FDI in some regions and industries with FDI over-agglomeration and implement preferential policies such as duty exemptions and subsidized industry infrastructure to attract FDI in less-developed middle and western areas. Furthermore, the Chinese local government in different regions should co-operate rather than compete by developing an integrated policy to promote the positive interactions of FDI agglomeration with domestic firms in local and neighboring areas.

In Chapter 5, this study explores the dynamic effect of FDI on export by using the PPML estimation based on the panel data of China's 151 target countries during 2007-2017. This study adopts the global PCA to obtain the tendency rankings of target countries to which China conducts horizontal and vertical FDI by using the data of target countries' market size, factor price, tariff rate, uncertainty, and transport and trade costs that are as the motivations of China's horizontal and vertical FDI. The results display that China's FDI with the increasing tendency of horizontal motivation and the decreasing trend of vertical motivation

tends to displace its export. In contrast, China's FDI with the decreasing trend of horizontal motivation and the increasing trend of vertical motivation tends to create its export. Export is still the dominant model of international involvement and the fast and convenient way for Chinese firms to participate in the foreign market. If China's FDI is at the cost of its export reduction, it is not the Chinese government's desire. Thus, the Chinese government can induce its FDI and export. Moreover, the Chinese firms and government and helping other nations better understand how they fit into China's world of international trade. Therefore, non-Chinese governments and multinational firms can better position themselves to improve global business with the largest market in the world.

Concerning Chapter 6, this study investigates internal and external financial constraints in R&D investment, uncertainty, and productivity in 414 British manufacturing firms during 2009-2018 by using the heterogeneity SFA with a one-stage approach with flexible translog production. This study conducts theoretical derivation that links financial constraints to firm productivity through the channel of R&D investment and its future financing uncertainty. The empirical findings show that Cash flow (external financing) does not impact the financial constraints in R&D investment. Whereas the increase in debt (internal financing) can enhance the financial constraints in R&D investment and then reduce firm productivity. Furthermore, there are significant differences in low, middle, and high-tech industries. The financial constraints in R&D investment can lead to British manufacturing firms' loss of about 20%. In addition, firm productivity presents an upward trend during 2009-2018, which implies that the financial market is becoming more conducive to firm productivity. Therefore, firms should combine internal and external financing to reduce the financial constraints in R&D investment and uncertainty. Moreover, the UK's government also needs to help and provide more financing channels for firms, especially firms in the high-tech industry.

Chapter 7, as the final core chapter, tries to uncover the "black box" of the efficiency of 123 British listed manufacturing firms during the period 2006-2018. This study estimates the values of operation efficiency, profitability efficiency, technology efficiency, pure technical efficiency, and scale efficiency and considers the difference when the environmental factors

are removed by using the three-stage (DEA-SFA) model. Furthermore, this study explores the impact of the ecological factors on firm efficiency using the two-stage (DEA-Tobit) model. The findings show that a firm's technology efficiency, pure technical efficiency, and scale efficiency reach a relatively high level (between 0.93 and 1). In contrast, its profitability efficiency (between 0.85 and 0.9) and operational efficiency (between 0.65 and 0.7) have a large room to improve without deleting the impact of environmental factors. The overall environment gradually deteriorates, especially since 2015. Business freedom, financial freedom, market size, and road infrastructure positively impact firm efficiency. In comparison, factor price harms firm efficiency. Moreover, the overall environment has a more significant impact on firm efficiency in the middle and high-tech industries than in the low-tech sector. Thus, the findings provide the channels for firms and local government to improve firm efficiency, enabling firms to make more profits and better compete both in domestic and foreign markets.

8.2 Limitations and Future Directions

Chapter 2:

The country components exert a positive or negative mediating effect on internationalization by improving or constraining the firm's different capabilities, such as absorptive and innovative capabilities. According to Griffith & Harvey (2001) and Zollo & Winter (2002), the literature suggests that dynamic capabilities could promote internationalization and improve a firm superior performance. There is no consensus about the definition of the dimensions of dynamic capabilities (Wang & Ahmed, 2007; Zahra et al., 2006). Teece et al. (1997) define dynamic capability as a firm's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments. Wang & Ahmed (2007) and Wang et al. (2015) indicate that dynamic capabilities are associated with absorptive, adaptive, innovative, and transformative capabilities. Dynamic capability is the critical source of a firm's competitive advantage during an international expansion (Luo,

2000; Depperu & Cerrato, 2005). However, this meta-analytic study is not possible to measure the variable.

Future research can conduct an individual study and combine the quantitative and qualitative methods to explore the mediating effect of country components on the I-P relationship through the dynamic capability by using the structural equation modeling (SEM) approach. Moreover, the increasing meta-analytic studies have explored the area of firm performance and internationalization. Therefore, meta-meta-analysis can also be considered in future research.

Chapter 4:

This study uses random effect and needs to assume that the random terms are orthogonal to all the independent variables. It may not be tenable in the model. This study can include time-province fixed effect and cluster appropriately. Moreover, this study combines the ideas of the RCA index suggested by Balassa (1965) and horizontal and vertical (forward and backward) indices proposed by Javorcik (2004) to construct three new indices of horizontal, backward, and forward FDI agglomerations. Whether the new indices can well capture the three types of FDI agglomeration and overcome the measurement bias due to the difference in the absolute economy scale of different regions in China, need to conduct further validation. How to measure the agglomeration index would broadly impact the empirical results.

Chapter 5:

Whether the relationship between FDI and trade is substitution or complementation is closely related to FDI motivation. To what extent we can trust the reliability of the ranking by using the global PCA to identify the tendency score among all the target countries. Other alternatives rather than the global PCA can be considered to test the reliability. Besides, it is perhaps rough to use country-level aggregate FDI and trade data to study this topic. Most previous empirical studies and this study merely explore the effect of outward FDI on

quantitative trade. However, few empirical studies have investigated the impact of outward FDI on qualitative trade. The investigation of the effect of outward FDI on quantitative and qualitative trade at the disaggregated level, such as product-level, can provide more meaningful implications for a country's micro and macroeconomic policies, especially China, which currently needs to speed up its growth industry updating.

Charter 7:

This study ignores the level of technology and shadow prices. Andersson & Johansson (2018) revealed the high importance of using technology as an input factor to measure its efficiency. Also, in a certain sense, such most favorable prices may be interpreted as shadow prices that support cost-efficient behavior. Shadow prices help exclude unrealistic input prices, especially since this study selects a sample of multinational firms that require price stabilization (see Cherchye et al., 2013). Moreover, Asmild et al. (2009) explain the advantages of using multi-directional efficiency analysis (MEA) instead of data envelopment analysis (DEA). Therefore, future research can consider these factors and methods to expand this topic.

This study may consider adopting co-creation value in Payne et al. (2008) but from an operational management perspective. It may develop a conceptual framework for value co-creation in the manufacturing industry by including several economic factors. Also, this study may consider adding a low-cost strategy (one of Porter's differentiation strategies) as the theoretical framework. The framework can help to answer the highly possible questions from readers. For example, what is the motive of studying efficiencies? According to Porter, a low-cost strategy is beneficial to help firms generating competitive advantage by becoming the lowest cost producers compare to other similar manufacturers. Many articles discuss cost leadership strategies in the manufacturing industry (see Kotha & Swamidass, 2000).

8.3 Outputs Beyond Academic Research

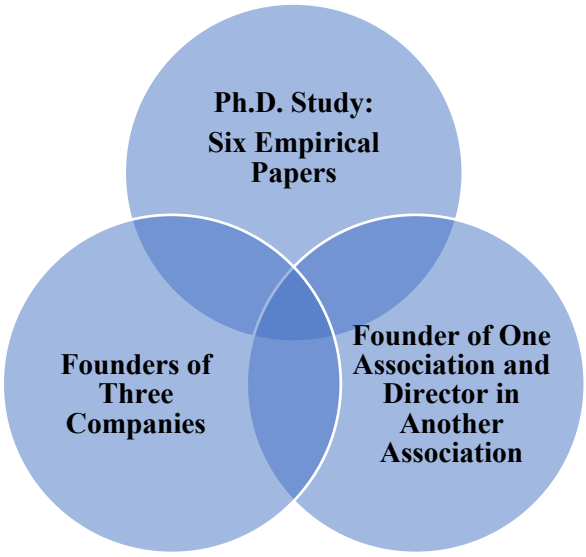
During my Ph.D. study, I have produced six empirical papers (Charter 2-7). I also have presented these papers in several academic conferences shown as follows:

•2017 SPRU Ph.D. Forum at the University of Sussex
• The Second Corporate Governance Early Career Researchers Conference-2017 at the University of Nottingham
•BAM 2017 Doctoral Symposium at the University of Warwick
•2018 Copenhagen Business School, Denmark (absent)
•IRCMA 2018 conference at Wuhan University
•BAM2018 Doctoral Symposium at the University of the West of England
•Paper Development Workshop-2018 in King's College
•BAM2019 Conference at the University of Birmingham
•BAM2019 Conference at Aston University
•46th AIB UK and Ireland Chapter Conference-2019 at the University of Sussex
•AIB-US West 2020 Conference at San Diego State University (absent)
•AIB Miami 2020 Conference at Florida International Business University

During my Ph.D. study, I set up three companies and an association. I have also been appointed as a director in another association. Due to privacy, I do not report the information here and merely report the academic outputs. Figure 8.1 shows the overview of the outcomes during my Ph.D. study. Finally, I have constructed a strong network with academic researchers, government officers, and businessmen in China and overseas, especially in the UK.

Besides, I got married to my wife and personally decorated my own houses both in China and UK during my Ph.D. study. I also obtained China's driving license ten years ago and would get the UK's driving license (I passed the theoretical test, finished the driving training, and am waiting for the final driving test due to the coronavirus pandemic). All of these I have done during my Ph.D. study lay a good foundation for my future life and career success.

Figure 8.1: The overview of outputs during my Ph.D. study



Appendix A

Supplement to Chapter 2

Appendix A.1 (Table A.1): Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
1. Fisher's Z	237	0.256	0.321	0	3.435
2. Market competition	237	5.684	0.371	4.24	6.22
3. Market size	237	8,803.524	7,242.474	4.24	16,962.6
4. Cluster development	237	5.028	0.466	3.5	5.5
5. Institution	237	0.032	0.993	-2.722	2.198
6. Advanced factor	237	0.006	1.000	-3.025	1.183
7. Structure index	237	0.236	0.426	0	1
8. Financial index	237	0.633	0.483	0	1
9. Composite index	237	0.122	0.328	0	1
10. Accounting index	237	0.755	0.431	0	1
11. Market index	237	0.156	0.364	0	1
12. Operational index	237	0.017	0.129	0	1
13. OLS	237	0.498	0.501	0	1
14. 2 and 3SLS	237	0.059	0.236	0	1
15. GLS	237	0.160	0.368	0	1
16. GMM	237	0.021	0.144	0	1
17. Endogeneity	237	0.173	0.379	0	1
18. Fixed effect	237	0.131	0.338	0	1
19. Random effect	237	0.110	0.313	0	1
20. Advertising intensity	237	0.173	0.379	0	1
21. Leverage ratio	237	0.316	0.466	0	1
22. Firm age	237	0.295	0.457	0	1
23. Firm size	237	0.772	0.420	0	1
24. Capital intensity	237	0.118	0.323	0	1
25. International experience	237	0.114	0.318	0	1
26. Ownership	237	0.080	0.272	0	1
27. R&D	237	0.304	0.461	0	1
28. Firm risk	237	0.055	0.228	0	1
29. Firm growth	237	0.101	0.302	0	1
30. Industry growth	237	0.021	0.144	0	1
31. Product diversification	237	0.177	0.383	0	1
32. Business group	237	0.068	0.251	0	1
33. Industry concentration	237	0.025	0.157	0	1
34. Lagged performance	237	0.068	0.251	0	1
35. Industry control	237	0.333	0.472	0	1
36. Year control	237	0.152	0.360	0	1

Appendix A.2 (Table A.2): Correlation matrix (left side)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Effect size	1.000																	
2. Market competition	0.070	1.000																
3. Market size	0.070	0.142	1.000															
4. Cluster development	0.049	0.699	0.280	1.000														
5. Institution	0.023	0.685	0.064	0.567	1.000													
6. Advanced factor	0.020	0.766	0.232	0.817	0.689	1.000												
7. Structure index	0.126	0.007	0.006	0.007	0.081	0.064	1.000											
8. Financial index	0.095	0.050	0.017	0.082	0.034	0.109	0.730	1.000										
9. Composite index	0.026	0.105	0.030	0.146	0.163	0.116	0.208	0.490	1.000									
10. Accounting index	0.057	0.082	0.085	0.021	0.059	0.055	0.053	0.055	0.003	1.000								
11. Market index	0.064	0.190	0.154	0.155	0.079	0.172	0.117	0.131	0.017	0.756	1.000							
12. Operational index	0.061	0.012	0.071	0.026	0.004	0.051	0.081	0.036	0.049	0.230	0.056	1.000						
13. OLS	0.055	0.064	0.026	0.051	0.035	0.011	0.002	0.093	0.114	0.076	0.103	0.001	1.000					
14. 2 and 3SLS	0.039	0.053	0.134	0.002	0.043	0.024	0.071	0.143	0.125	0.107	0.139	0.033	0.250	1.000				
15. GLS	0.007	0.076	0.175	0.036	0.006	0.053	0.001	0.049	0.083	0.062	0.034	0.057	0.435	0.110	1.000			
16. GMM	0.055	0.009	0.156	0.005	0.032	0.013	0.013	0.010	0.035	0.053	0.063	0.437	0.146	0.037	0.064	1.000		
17. Endogeneity	0.103	0.102	0.037	0.131	0.134	0.167	0.113	0.161	0.068	0.155	0.111	0.200	0.210	0.359	0.104	0.166	1.000	
18. Fixed effect	0.076	0.096	0.030	0.099	0.135	0.127	0.079	0.042	0.030	0.017	0.040	0.046	0.014	0.062	0.103	0.117	0.187	1.000
19. Random effect	0.033	0.027	0.128	0.075	0.035	0.137	0.005	0.041	0.075	0.020	0.109	0.046	0.242	0.027	0.435	0.052	0.054	0.136
20. Advertising intensity	0.042	0.186	0.005	0.050	0.074	0.113	0.018	0.094	0.103	0.025	0.080	0.060	0.035	0.067	0.013	0.011	0.027	0.021
21. Leverage ratio	0.108	0.132	0.059	0.158	0.016	0.143	0.134	0.065	0.060	0.077	0.257	0.089	0.024	0.022	0.123	0.026	0.025	0.193
22. Firm age	0.037	0.317	0.152	0.320	0.261	0.376	0.099	0.071	0.012	0.132	0.151	0.013	0.108	0.005	0.246	0.098	0.169	0.188
23. Firm size	0.167	0.066	0.154	0.087	0.036	0.103	0.136	0.101	0.012	0.075	0.095	0.085	0.123	0.093	0.128	0.080	0.169	0.121
24. Capital intensity	0.118	0.119	0.071	0.045	0.062	0.081	0.043	0.020	0.017	0.217	0.203	0.054	0.051	0.036	0.089	0.037	0.029	0.129
25. International experience	0.060	0.036	0.047	0.052	0.040	0.052	0.019	0.030	0.028	0.043	0.081	0.047	0.171	0.136	0.084	0.053	0.047	0.060
26. Ownership	0.084	0.041	0.005	0.061	0.017	0.132	0.019	0.001	0.015	0.049	0.087	0.039	0.045	0.008	0.083	0.043	0.112	0.024
27. R&D	0.161	0.238	0.060	0.123	0.103	0.186	0.065	0.065	0.005	0.008	0.120	0.087	0.107	0.010	0.211	0.095	0.086	0.098
28. Firm risk	0.005	0.100	0.068	0.101	0.064	0.119	0.041	0.086	0.080	0.122	0.203	0.032	0.129	0.018	0.147	0.094	0.037	0.017
29. Firm growth	0.001	0.111	0.001	0.076	0.097	0.111	0.055	0.053	0.003	0.061	0.029	0.044	0.055	0.025	0.070	0.049	0.006	0.089
30. Industry growth	0.056	0.098	0.116	0.092	0.054	0.100	0.057	0.010	0.055	0.015	0.018	0.019	0.029	0.088	0.016	0.022	0.088	0.030
31. Product diversification	0.098	0.116	0.144	0.127	0.041	0.127	0.128	0.124	0.005	0.136	0.047	0.061	0.046	0.024	0.008	0.068	0.066	0.115
32. Business group	0.051	0.169	0.044	0.161	0.191	0.251	0.031	0.031	0.002	0.036	0.023	0.035	0.066	0.004	0.157	0.040	0.144	0.055
33. Industry concentration	0.000	0.114	0.083	0.094	0.086	0.106	0.037	0.044	0.022	0.033	0.069	0.187	0.054	0.074	0.003	0.024	0.068	0.017
34. Lagged performance	0.053	0.015	0.197	0.033	0.037	0.022	0.048	0.039	0.002	0.082	0.070	0.226	0.133	0.004	0.066	0.546	0.188	0.145
35. Industry control	0.113	0.007	0.044	0.033	0.092	0.003	0.049	0.037	0.100	0.118	0.164	0.023	0.006	0.051	0.033	0.083	0.150	0.124
36. Year control	0.103	0.080	0.029	0.003	0.005	0.077	0.097	0.044	0.050	0.197	0.239	0.127	0.002	0.093	0.039	0.020	0.117	0.185

Appendix A.3 (Table A.3): Correlation matrix (continued, right side)

Variable	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1. Effect size																		
2. Market competition																		
3. Market size																		
4. Cluster development																		
5. Institution																		
6. Advanced factor																		
7. Structure index																		
8. Financial index																		
9. Composite index																		
10. Accounting index																		
11. Market index																		
12. Operational index																		
13. OLS																		
14. 2 and 3SLS																		
15. GLS																		
16. GMM																		
17. Endogeneity																		
18. Fixed effect																		
19. Random effect	1.000																	
20. Advertising intensity	0.018	1.000																
21. Leverage ratio	0.168	0.145	1.000															
22. Firm age	0.158	0.003	0.023	1.000														
23. Firm size	0.191	0.062	0.110	0.197	1.000													
24. Capital intensity	0.081	0.109	0.116	0.008	0.105	1.000												
25. International experience	0.002	0.012	0.130	0.088	0.100	0.049	1.000											
26. Ownership	0.145	0.094	0.100	0.081	0.049	0.133	0.041	1.000										
27. R&D	0.091	0.523	0.202	0.115	0.053	0.071	0.006	0.094	1.000									
28. Firm risk	0.034	0.086	0.235	0.047	0.043	0.256	0.086	0.134	0.042	1.000								
29. Firm growth	0.073	0.105	0.102	0.125	0.118	0.007	0.120	0.055	0.009	0.103	1.000							
30. Industry growth	0.052	0.067	0.090	0.095	0.060	0.054	0.053	0.065	0.031	0.035	0.048	1.000						
31. Product diversification	0.022	0.109	0.136	0.034	0.064	0.001	0.027	0.026	0.102	0.034	0.064	0.163	1.000					
32. Business group	0.282	0.099	0.106	0.194	0.106	0.006	0.097	0.168	0.115	0.009	0.021	0.040	0.037	1.000				
33. Industry concentration	0.029	0.068	0.052	0.046	0.169	0.024	0.058	0.048	0.069	0.039	0.054	0.163	0.005	0.064	1.000			
34. Lagged performance	0.041	0.099	0.038	0.084	0.146	0.006	0.062	0.018	0.188	0.083	0.035	0.040	0.051	0.005	0.043	1.000		
35. Industry control	0.096	0.126	0.135	0.131	0.171	0.019	0.085	0.055	0.156	0.066	0.030	0.104	0.000	0.024	0.114	0.060	1.000	
36. Year control	0.190	0.024	0.142	0.010	0.006	0.137	0.107	0.092	0.155	0.053	0.064	0.062	0.019	0.020	0.007	0.074	0.449	1.000

Appendix A.4 (Table A.4): Standard errors in regressions (all sample)

Variable	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Structure index	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Financial index	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Composite index	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Accounting index	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Market index	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Operational index	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
OLS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2 and 3SLS	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
GLS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GMM	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Endogeneity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fixed effect	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Random effect	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Advertising intensity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Leverage ratio	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Firm age	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Firm size	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Capital intensity	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
International experience	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Ownership	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R&D	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Firm risk	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Firm growth	0.000	0.001	0.001	0.000	0.000	0.001	0.001	0.000	0.000	0.001	0.001
Industry growth	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Product diversification	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Business group	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Industry concentration	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Lagged performance	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Industry control	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Year control	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AD	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002
Market competition		0.001	0.002								
Market competition×AD			0.002								
Market size				0.000	0.000						
Market size×AD					0.000						
Cluster development						0.000	0.002				
Cluster development×AD							0.002				
Institution								0.000	0.001		
Institution×AD									0.001		
Advanced factor										0.000	0.001
Advanced factor×AD											0.001
Constant	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

Appendix A.5 (Table A.5): Standard errors in regressions (developing countries)

Variable	Model 0	Model 1	Model 3	Model 5	Model 7	Model 9
Structure index	0.002	0.002	0.002	0.002	0.002	0.003
Composite index	0.005	0.005	0.005	0.005	0.005	0.005
Accounting index	0.004	0.004	0.004	0.004	0.004	0.004
Market index	0.004	0.005	0.004	0.005	0.004	0.005
Operational index	0.006	0.007	0.006	0.006	0.006	0.007
OLS	0.002	0.002	0.002	0.002	0.002	0.003
2 and 3SLS	0.004	0.004	0.005	0.004	0.004	0.004
GLS	0.003	0.003	0.003	0.003	0.003	0.003
Endogeneity	0.002	0.003	0.003	0.002	0.002	0.003
Fixed effect	0.002	0.002	0.002	0.002	0.002	0.002
Random effect	0.004	0.004	0.004	0.004	0.004	0.004
Advertising intensity	0.005	0.005	0.005	0.005	0.005	0.005
Leverage ratio	0.002	0.002	0.002	0.002	0.002	0.003
Firm age	0.001	0.002	0.002	0.001	0.002	0.002
Firm size	0.002	0.002	0.002	0.002	0.002	0.002
Capital intensity	0.002	0.002	0.003	0.003	0.003	0.003
International experience	0.004	0.004	0.004	0.004	0.004	0.004
Ownership	0.002	0.002	0.002	0.002	0.002	0.003
R&D	0.004	0.004	0.004	0.004	0.004	0.004
Firm risk	0.005	0.005	0.005	0.006	0.005	0.006
Firm growth	0.010	0.010	0.010	0.010	0.010	0.010
Product diversification	0.003	0.003	0.003	0.003	0.003	0.003
Business group	0.003	0.003	0.004	0.003	0.003	0.004
Lagged performance	0.004	0.004	0.005	0.004	0.004	0.004
Industry control	0.002	0.002	0.002	0.002	0.002	0.002
Year control	0.002	0.002	0.002	0.002	0.002	0.002
Market competition		0.004				
Market size			0.000			
Cluster development				0.003		
Institution					0.001	
Advanced factor						0.003
Constant	0.004	0.016	0.004	0.012	0.005	0.007

Appendix A.6 (Table A.6): Standard errors in regressions (developed countries)

Variable	Model 0	Model 1	Model 3	Model 5	Model 7	Model 9
Structure index	0.000	0.000	0.001	0.000	0.000	0.000
Composite index	0.001	0.001	0.001	0.001	0.001	0.001
Accounting index	0.002	0.002	0.002	0.002	0.002	0.002
Market index	0.002	0.002	0.002	0.002	0.002	0.002
Operational index	0.003	0.003	0.003	0.003	0.003	0.003
OLS	0.000	0.000	0.000	0.000	0.000	0.000
2 and 3SLS	0.001	0.001	0.001	0.001	0.001	0.001
GLS	0.000	0.000	0.000	0.000	0.000	0.000
Endogeneity	0.000	0.001	0.000	0.000	0.000	0.001
Fixed effect	0.001	0.001	0.001	0.001	0.001	0.001
Random effect	0.000	0.000	0.000	0.000	0.000	0.000
Advertising intensity	0.000	0.000	0.000	0.000	0.000	0.000
Leverage ratio	0.000	0.000	0.000	0.000	0.000	0.000
Firm age	0.000	0.001	0.000	0.001	0.001	0.001
Firm size	0.000	0.000	0.000	0.000	0.000	0.000
Capital intensity	0.000	0.000	0.000	0.000	0.000	0.000
International experience	0.001	0.001	0.001	0.001	0.001	0.001
Ownership	0.001	0.001	0.001	0.001	0.001	0.001
R&D	0.000	0.000	0.000	0.000	0.000	0.000
Firm risk	0.001	0.001	0.001	0.001	0.001	0.001
Firm growth	0.000	0.000	0.000	0.001	0.000	0.001
Product diversification	0.000	0.000	0.000	0.000	0.000	0.000
Business group	0.001	0.001	0.001	0.001	0.001	0.001
Lagged performance	0.001	0.001	0.001	0.001	0.001	0.001
Industry control	0.000	0.000	0.000	0.000	0.000	0.000
Year control	0.000	0.000	0.000	0.000	0.001	0.000
Market competition		0.001				
Market size			0.000			
Cluster development				0.001		
Institution					0.000	
Advanced factor						0.000
Constant	0.002	0.005	0.002	0.003	0.002	0.002

Appendix A.7 (Table A.7): Papers in Meta-analysis

Author (s) and publish year	Journal name	Country name	Country category*
Miller (1969)	The Journal of Industrial Economics	USA	1
Severn & Laurence (1974)	Journal of Financial and Quantitative Analysis	USA	1
Rhoades (1974)	The Review of Economics and Statistics	USA	1
Hughes et al. (1975)	Journal of Financial and Quantitative Analysis	USA	1
Miller & Pras (1980)	Southern Economic Journal	USA	1
Lall & Siddharthan (1982)	The Economic Journal	USA	1
Ravenscraft (1983)	The Review of Economics and Statistics	USA	1
Singh Kumar. (1984)	Journal of Economic Studies	UK	1
Hitt & Ireland (1985)	Human Relations	USA	1
Kim & Lyn (1986)	Journal of International Business Studies	German	1
Bühner (1987)	Strategic Management Journal	German	1
Grant (1987)	Journal of International Business Studies	UK	1
Johnson & Thomas (1987)	Strategic Management Journal	UK	1
Grant et al. (1988)	Academy of Management Journal	UK	1
Geringer et al. (1989)	Strategic Management Journal	USA	1
Jung (1991)	Journal of Business Research	USA	1
Morck & Yeung (1991)	Journal of Business	USA	1
Ramaswamy (1993)	Academy of Management Proceedings	USA	1
Kim et al. (1993)	Strategic Management Journal	USA	1
Roth & Ricks (1994)	Strategic Management Journal	Japan	1
Naidu & Prasad (1994)	Journal of Business Research	USA	1
Colombo (1995)	International Journal of the Economics of Business	Japan	1
Sambharya (1995)	Management International Review	USA	1
Siegel et al. (1995)	Managerial Finance	USA	1
Riahi-Belkaoui (1996)	International Business Review	France	1
Tallman & Li (1996)	Academy of Management journal	USA	1
Allen & Pantzalis (1996)	Journal of International Business Studies	USA	1
Simmonds & Lamont (1996)	The International Journal of Organizational Analysis	USA	1
Hitt et al. (1997)	Academy of Management journal	USA	1
Gomez-Mejia & Palich (1997)	Journal of International Business Studies	USA	1
Wan (1998)	Asia Pacific Journal of Management	Hong Kong	1
Riahi-Belkaoui (1998)	International Business Review	USA	1
Mishra & Gobeli (1998)	Journal of International Business Studies	USA	1
Gedajlovic & Shapiro (1998)	Strategic Management Journal	USA	1
Gomes & Ramaswamy (1999)	Journal of international business studies	USA	1
Doukas et al. (1999)	Journal of International Financial Management & Accounting	USA	1
Autio et al. (2000)	Academy of Management Journal	Finland	1
Geringer et al. (2000)	Strategic Management Journal	Japan	1
Chiao et al. (2008)	International Marketing Review	Taiwan	1
Zahra & Garvis (2000)	Journal of Business Venturing	USA	1
Elango (2000)	American Business Review	USA	1
Palich et al. (2000)	Journal of Business Research	USA	1
Zahra et al. (2000)	Academy of Management Journal	USA	1
Mathur et al. (2001)	The Quarterly Review of Economics and Finance	Canada	1
Lu & Beamish (2001)	Strategic Management Journal	Japan	1
Balabanis (2001)	British Journal of Management	UK	1
Mauri & Sambharya (2001)	International Business Review	USA	1
Martinez (2002)	Managerial Finance	France	1
Narasimhan & Kim (2002)	Journal of Operations Management	Korea	1
Vermeulen & Barkema (2002)	Strategic Management Journal	Netherlands	1
Qian & Li (2002)	Journal of Business Research	USA	1
Qian (2002)	Journal of Business Venturing	USA	1
Carpenter (2002)	Strategic Management Journal	USA	1
Dhanaraj & Beamish (2003)	Journal of Small Business Management	Canada	1
Jeong (2003)	International Marketing Review	China	0
Ruigrok & Wagner (2003)	Management International Review	German	1

Appendix A.8 (Table A.8): Papers in Meta-analysis (continued)

Author (s) and publish year	Journal name	Country name	Country category*
Capar & Kotabe (2003)	Journal of International Business Studies	German	1
Claessens et al. (2003)	Pacific-Basin Finance Journal	Hong Kong	1
Claessens et al. (2003)	Pacific-Basin Finance Journal	Indonesia	0
Majocchi & Zucchella (2003)	International Small Business Journal	Italy	1
Goerzen & Beamish (2003)	Strategic Management Journal	Japan	1
Claessens et al. (2003)	Pacific-Basin Finance Journal	Philippines	0
Claessens et al. (2003)	Pacific-Basin Finance Journal	Thailand	0
Lee et al. (2003)	International Journal of Commerce and Management	USA	1
Riahi-Belkaoui (2003)	Journal of Intellectual capital	USA	1
Kotabe et al. (2002)	Journal of International Business Studies	USA	1
Contractor et al. (2003)	Journal of International Business Studies	USA	1
Wagner (2004)	International Business Review	German	1
Tallman et al. (2004)	Management International Review	Japan	1
Ahn, Fukao, & Kwon (2004)	Seoul Journal of Economics	Japan	1
Lu & Beamish (2004)	Academy of Management Journal	Japan	1
Kim et al. (2004)	Strategic Management Journal	Japan	1
Carpenter & Sanders (2004)	Journal of Management	USA	1
Thomas & Eden (2004)	Multinational Business Review	USA	1
Luo et al. (2005)	Journal of Business Research	China	0
Tongli et al. (2005)	Asia Pacific Journal of Management	Singapore	1
Li & Qian (2005)	Journal of Global Marketing	USA	1
Kor & Leblebici (2005)	Strategic Management Journal	USA	1
Goerzen & Beamish (2005)	Strategic Management Journal	USA	1
Rieck et al.(2005)	Working Paper	USA	1
Lu & Beamish (2006)	Journal of International Entrepreneurship	Japan	1
Thomas (2006)	Journal of Business Research	Mexico	0
Chiao et al. (2006)	Small Business Economics	Taiwan	1
Ural & Acaravc (2006)	Problems and Perspectives in Management	Turky	0
Hitt et al. (2006)	Academy of Management Journal	USA	1
Liu et al. (2006)	International Conference	USA	1
Wolff & Pett (2006)	Journal of Small Business Management	USA	1
Wilkinson& Brouthers (2006)	International Business Review	USA	1
Doukas & Kan (2006)	Journal of International Business Studies	USA	1
Zhou et al. (2007)	Journal of International Business Studies	China	0
Contractor et al. (2007)	Journal of World Business	India	0
Ruigrok et al. (2007)	Management International Review	Switzerland	1
Li et al. (2007)	Journal of Global Marketing,	USA	1
Chang & Wang (2007)	Journal of World Business	USA	1
Chari et al. (2007)	Journal of World Business	USA	1
Bowen & Wiersema (2007)	Working Paper	USA	1
Jang & Tang (2007)	Working Paper	USA	1
Liu & Feng (2008)	International Conference	China	0
Radulovich (2008)	Working Paper	India	0
Kumar & Singh (2008)	Thunderbird International Business Review	India	0
Wan et al. (2008)	Journal of International Business Studies	Japan	1
Pangarkar (2008)	Journal of World Business	Singapore	1
Hsu & Liu (2008)	?Asia Pacific Management Review	Taiwan	1
Driffield et al. (2008)	Journal of Productivity Analysis	UK	1

Appendix A.9 (Table A.9): Papers in Meta-analysis (continued)

Author (s) and publish year	Journal name	Country name	Country category*
Kim & Mathur (2008)	International Review of Financial Analysis	USA	1
Santalo & Becerra (2008)	The Journal of Finance	USA	1
Qian et al. (2008)	Journal of International Business Studies	USA	1
Hsu & Pereira (2008)	Omega	USA	1
Lavie & Miller (2008)	Organization Science	USA	1
Pangarkar & Yuan (2009)	Multinational Business Review	China	0
Chittoor et al. (2009)	Organization Science	India	0
Gaur & Kumar (2009)	British Journal of Management	India	0
Jung (2009)	Management International Review	Japan	1
Johnson et al. (2009)	Journal of International marketing	Taiwan	1
Dastidar (2009)	Journal of International Business	USA	1
Ravichandran et al. (2009)	Journal of Management Information Systems	USA	1
Musteen et al. (2010)	Journal of World Business	Czech	1
Singh et al. (2010)	Management International Review	German	1
Eckert et al. (2010)	International Business Review	German	1
Kim et al. (2010)	Journal of International Business Studies	Korea	1
Chelliah et al. (2010)	International Journal of Business and Management	Malaysia	0
Papadopoulos & Martin (2010)	International Business Review	Singapore	1
Nielsen (2010)	Management International Review	Switzerland	1
Pan et al. (2010)	African Journal of Business Management	Taiwan	1
Shih (2010)	The Service Industries Journal	Taiwan	1
Lee et al. (2010)	Review of Accounting, Banking and Finance	Taiwan	1
Chen & Hsu (2010)	Industrial Marketing Management	Taiwan	1
Nath et al. (2010)	Industrial Marketing Management	UK	1
Beleska-Spasova & Glaister (2010)	Management International Review	UK	1
Fernhaber & Li (2010)	Entrepreneurship Theory and Practice	USA	1
Qian et al (2010)	Strategic Management Journal	USA	1
Xuemei (2011)	International Conference	China	0
Jiang & Xu (2011)	International Conference	China	0
Shen et al. (2011)	African Journal of Business Management	China	0
He & Wei (2011)	International Business Review	China	0
Abor (2011)	Thunderbird International Business Review	Ghana	0
Chang & Rhee (2011)	Journal of International Business Studies	Korea	1
Lin et al. (2011)	Journal of International Management	Taiwan	1
Tsai et al. (2011)	Review of Quantitative Finance and Accounting	Taiwan	1
Ho et al. (2011)	Actual Problems of Economics	Taiwan	1
Chiao & Yang (2011)	African Journal of Business Management	Taiwan	1
Elango (2011)	European Business Review	USA	1
Zaheer & Hernandez (2011)	Global Strategy Journal	USA	1
Deng et al. (2012)	Chinese Management Studies	China	0
Wu et al. (2012)	Chinese Management Studies	China	0
Pangarkar & Wu (2012)	International Business Review	China	0
Chen & Tan (2012)	Journal of World Business	China	0
Fisch (2012)	Global Strategy Journal	German	1
George & Kabir (2012)	Journal of Business Research	India	0
Ahangar et al. (2012)	African Journal of Business Management	Iran	0
Lee & Rugman (2012)	Journal of International Management	Korea	1

Appendix A.10 (Table A.10): Papers in Meta-analysis (continued)

Author (s) and publish year	Journal name	Country name	Country category*
Lee et al. (2012)	Emerging Markets Review	Malaysia	0
Wei-Hwa & Wei-Chun (2012)	International Journal of Business and Social Science	Taiwan	1
Tsao & Chen (2012)	Asia Pacific Journal of Management	Taiwan	1
Mudambi et al. (2012)	Applied Financial Economics	UK	1
Beleska-Spasova et al. (2012)	Journal of World business	UK	1
Oh & Contractor (2012)	Global Strategy Journal	USA	1
Li et al. (2012)	International Business Review	USA	1
Qian & Rugman (2013)	Journal of International Business Studies	Canada	1
Singla & George (2013)	Journal of Business Research	India	0
Hajela & Akbar (2007)	Working Paper	India	0
Song (2013)	Management International Review	Korea	1
Nielsen & Nielsen (2013)	Strategic Management Journal	Switzerland	1
Hsu et al. (2013)	Journal of World Business	Taiwan	1
Shiau et al. (2013)	Emerging Markets Finance and Trade	Taiwan	1
Hsu (2013)	Journal of World Business	Taiwan	1
Lien & Tsao (2013)	Management International Review	Taiwan	1
Elango et al. (2013)	Decision Sciences	USA	1
Pangarkar & Hussain (2013)	International Studies of Management & Organization	Singapore	1
Ma et al. (2014)	Journal of World Business	China	0
Chen et al. (2014)	Management Decision	China	0
Zhou & Wu (2014)	Journal of World Business	China	0
O'Brien et al. (2014)	Strategic Management Journal	Japan	1
Yeoh (2014)	Thunderbird International Business Review	Malaysia	0
Casey & Hamilton (2014)	Journal of International Entrepreneurship	New Zealand	1
Bolaji & Chris (2014)	Journal of Management Studies	Nigeria	0
Almodóvar & Rugman (2014)	British Journal of Management	Spain	1
Hilmersson (2014)	International Small Business Journal	Sweden	1
Lin et al. (2014)	Baltic Journal of Management	Taiwan	1
Tsai (2014)	Journal of Business Research	Taiwan	1
Oh & Contracto (2014)	British Journal of Management	USA	1
Rhou & Koh (2014)	International Journal of Hospitality Management	USA	1
Kang & Lee (2014)	International Journal of Hospitality Management	USA	1
Powell (2014)	Journal of International Business Studies	USA	1
Lee et al. (2014)	International Journal of Contemporary Hospitality Management	USA	1
Faroque & Takahashi (2015)	Asia Pacific Journal of Marketing and Logistics	Bangladesh	0
Wu & Voss (2015)	International Business Review	China	0
Zhang et al. (2015)	Journal of International Business Studies	China	0
Chen et al. (2015)	Management Decision	China	0
Cozza et al. (2015)	China Economic Review	China	0
Gaur & Delios (2015)	Management International Review	India	0
Karthik et al. (2015)	Working Paper	India	0
Hashai (2015)	Strategic Management Journal	Israel	1
Majocchi et al. (2015)	Journal of Business Economics and Management	Italy	1
Cerrato & Piva (2015)	Management International Review	Italy	1
De Noni & Apa (2015)	Journal of International Entrepreneurship	Italy	1
Urban & Sefalafala (2015)	South African Journal of Economic and Management Sciences	South Africa	0
Fernandez Olmos & Díez-Vial (2015)	European Journal of Marketing	Spain	1
Díaz-Fernández et al. (2015)	European Management Journal	Spain	1
Rodríguez-Gutiérrez et al. (2015)	Journal of Organizational Change Management	Spain	1

Appendix A.11 (Table A.11): Papers in Meta-analysis (continued)

Author (s) and publish year	Journal name	Country name	Country category*
Jiménez-Jiménez et al. (2015)	The TQM Journal	Spain	1
Celo & Chacar (2015)	Journal of International Business Studies	USA	1
Memili et al. (2015)	Management Decision	USA	1
Kang & Lee (2015)	Tourism Economics	USA	1
Kovach et al. (2015)	Journal of Operations Management	USA	1
Boehe et al. (2016)	Industrial Marketing Management	Brazil	0
Boehe & Jiménez (2016)	International Business Review	Brazil	0
He et al. (2016)	European Journal of Marketing	China	0
Nguyen et al. (2016)	Journal of Business Research	China	0
Li et al. (2016)	Sustainability	China	0
Clegg et al. (2016)	International Business Review	China	0
Dittfeld (2017)	Management International Review	German	1
Jain & Prakash (2016)	International Studies of Management & Organization	India	0
Kirca et al. (2016)	Journal of World Business	India	0
Altaf & Shah (2016)	Pacific Science Review B: Humanities and Social Sciences	India	0
Delbufalo et al. (2016)	Journal of Management Development	Italy	1
Giachetti (2016)	Management International Review	Italy	1
Miller et al. (2016)	International Business Review	Japan	1
Yang et al. (2016)	Long Range Planning	Japan	1
Boermans & Roelfsema (2016)	International Economics and Economic Policy	Netherlands	1
Benito et al. (2016)	Global Strategy Journal	Norway	1
Fernández-Olmos et al. (2016)	Business Research Quarterly	Spain	1
Benito-Osorio et al. (2016)	International Business Review	Spain	1
Brida et al. (2016)	Tourism Management Perspectives	Spain	1
Hilmersson & Johanson (2016)	Management International Review	Sweden	1
Chen & Lin (2016)	International Business Review	Taiwan	1
Cole & Karl (2016)	Applied Economics	USA	1
Vithessonthi & Racela (2016)	Journal of Multinational Financial Management	USA	1
Jung et al. (2016)	Journal of Contemporary Hospitality Management	USA	1
Ogasavara et al. (2016)	International Marketing Review	Brazil	0
Zheng et al. (2017)	World Development	China	0
Popli et al. (2017)	Global Strategy Journal	India	0
Ganvir et al. (2017)	International Journal of Emerging Markets	India	0
Upadhyayula et al. (2017)	Journal of International Management	India	0
Shin et al. (2017)	International Business Review	Spain	1
García-García et al. (2017)	Journal of World Business	Spain	1
Song et al. (2017)	International Journal of Hospitality Management	USA	1

Note: * means that the country category (“1”, developed countries; “0”, developing countries) is according to the definitions of the International Monetary Fund.

Appendix A.12: Fisher's Z

The calculation formulas of Fisher's Z coefficient are illustrated as follows:

Partial correlation coefficient:

$$r = \frac{t}{\sqrt{t^2 + df}}$$

Where:

"t" is the T-statistic of the regression coefficient.

"df" is the degree of freedom.

Fisher's z-transform:

$$Z = \frac{1}{2} Ln(\frac{1+r}{1-r})$$

Appendix A.13: FAT-PET-PEESE approach

This study employs the FAT-PET-PEESE approach proposed by Stanley (2005), Stanley (2008), Doucouliagos & Stanley (2009), and Stanley & Doucouliagos (2012).

FAT-PET MRA:

$$t_i = \beta_1 + \beta_0 \left(\frac{1}{SE_i}\right) + v_i \quad \text{(A.13.1)}$$

Where:

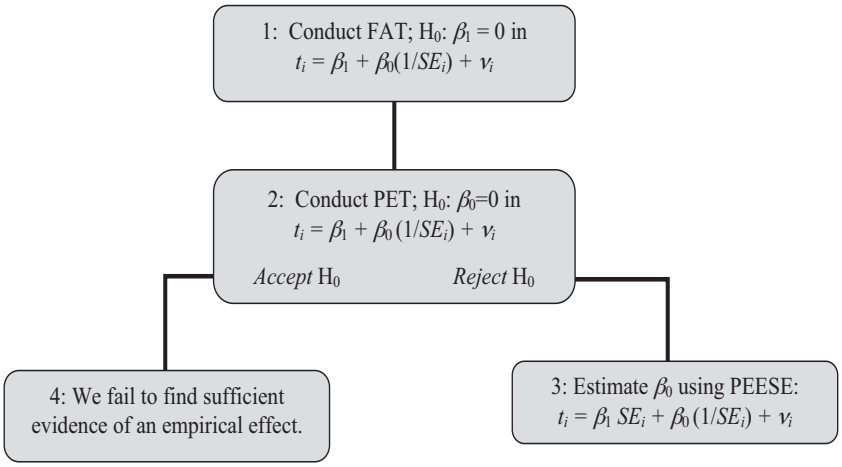
t_i: Reported estimate's T-statistic value
SE_i: Reported estimate's standard error
v_i: Error term

PEESE MRA:

$$t_i = \beta_1 SE_i + \beta_0 \left(\frac{1}{SE_i}\right) + v_i \quad \text{(A.13.2)}$$

FAT-PET-MAR model (A.13.1) test for publication bias and the presence of a genuine effect beyond publication selection, respectively. PEESE model (A.13.2) estimates the actual empirical impact corrected for publication bias. In summary, Figure A.1 displays the schema (model A.13.1 and model A.13.2) for investigating and correcting publication bias.

Appendix A.14 (Figure A.1): The Schema (model A.13.1 and model A.13.2) for investigating and correcting publication bias.



Source: Stanley & Doucouliagos (2012)

Appendix B

Supplement to Chapter 4

Appendix B.1: Relevant indices

Revealed comparative advantage (RCA) suggested by Balassa (1965):

$$RCA_{ij} = (X_{ij} / \sum_j X_{ij}) / (\sum_i X_{ij} / \sum_{ij} X_{ij})$$

Where X_{ij} denotes exports in the sector "i" from country "j". The numerator and denominator denote. The percentage share of a given sector "i" in national exports and the percentage share of the same sector in the world exports, respectively.

Horizontal and vertical indices proposed by Javorcik (2004):

$$Horizontal_{jt} = \frac{\sum_{i \in j} Foreign\ share_{it} \times Y_{it}}{\sum_{i \in j} Y_{it}}$$

Where $Foreign\ share_{it}$ stands for the share of firm i's total equity owned by foreign investors. Y_{it} stands for the output of firm "i" in industry "j".

$$Backward_{jt} = \sum_{k \neq j} \theta_{jk}\, Horizontal_{kt}$$

Where, θ_{jk} stands for the percentage of industry j's total intermediate use purchased by industry "k".

$$Forward_{jt} = \sum_{m \neq j} \rho_{jm} \frac{\sum_{i \in m} Foreign\ share_{it} \times (Y_{it} - EX_{it})}{\sum_{i \in m} (Y_{it} - EX_{it})}$$

Where, ρ_{jm} stands for the percentage of industry j's total intermediate input that is supplied by industry "m". EX_{it} represents the exports of each firm "i" in industry "m".

Appendix C

Supplement to Chapter 5

Appendix C.1 (Table C.1): Fisher's permutation test of regressions in Table 5.5

Variable	b0-b1	Freq	P-value
Ln_fdi (S1-46 and S47-151)	0.083	1,000	0.000
Ln_fdi (Ss1-45 and Ss46-105)	-0.008	1,000	0.000

Note: b0-b1 means the difference in the coefficient of Ln_fdi between two samples.

Appendix D

Supplement to Chapter 7

Appendix D (Table D.1): Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. UTE	1,599	0.967	0.055	0.809	0.999	1.000													
2. LER	1,599	0.142	0.110	0.001	0.359	0.295	1.000												
3. RDI	1,599	0.145	0.280	0.001	1.077	0.111	0.034	1.000											
4. ln_FA	1,599	2.713	1.373	0	4.644	0.099	0.002	0.241	1.000										
5. CI	1,599	0.040	0.037	0.002	0.127	0.093	0.020	0.094	0.019	1.000									
6. INN	1,599	0.677	0.468	0	1	0.042	0.057	0.178	0.347	0.060	1.000								
7. IR	1,599	0.023	0.009	0.004	0.038	0.029	0.015	0.062	0.100	0.024	0.062	1.000							
8. TO	1,599	0.282	0.017	0.249	0.304	0.052	0.016	0.084	0.157	0.035	0.132	0.211	1.000						
9. ln_BF	1,599	4.518	0.026	4.454	4.553	0.030	0.051	0.153	0.059	0.022	0.018	0.479	0.326	1.000					
10. ln_MS	1,599	4.418	0.054	4.382	4.500	0.059	0.020	0.041	0.190	0.040	0.154	0.258	0.822	0.226	1.000				
11. ln_FF	1,599	0.465	0.028	0.417	0.498	0.065	0.029	0.142	0.191	0.048	0.118	0.301	0.485	0.366	0.610	1.000			
12. PR	1,599	14.984	0.065	14.845	15.068	0.001	0.007	0.009	0.007	0.033	0.009	0.069	0.085	0.069	0.010	0.041	1.000		
13. ln_FP	1,599	10.276	0.032	10.224	10.329	0.054	0.053	0.116	0.144	0.061	0.061	0.374	0.153	0.566	0.251	0.511	0.479	1.000	
14. ln_RI	1,599	9.853	0.075	9.735	9.994	0.045	0.015	0.070	0.147	0.030	0.121	0.347	0.520	0.162	0.656	0.484	0.150	0.058	1.000

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