WESTERN SYDNEY
UNIVERSITY

FOREIGN DIRECT INVESTMENT IN VIETNAM

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A thesis submitted in fulfilment of the requirements
for the Degree of Doctor of Philosophy

School of Business
Western Sydney University, Australia

2019

STATEMENT OF AUTHENTICATION

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

Ngoc Thao Trang Ho

ACKNOWLEDGEMENT

My PhD journey has been supported, encouraged and inspired by many people, and it would be impossible for me to complete this thesis without them.

First and foremost, I would like to express my sincere gratitude and deep appreciation to my principal supervisor, Associate Professor Anil Mishra for his supervision, guidance, on-going encouragement and constructive feedback in every single stage of my study. His vast knowledge and research experience have been of great value to me. Also, I would like to express my gratitude to my co-supervisor, Associate Professor Craig Ellis for his helpful comments and advice on my research. Anil's and Craig's kindness, patience, and encouragement have been invaluable to me.

I thank all the staff and colleagues at School of Business, Western Sydney University for their assistance during my PhD course. A sincere thank you to Dr Neil Perry, Dr Heath Spong, and Dr Edward Mariyani-Squire for offering me the opportunities to gain my academic experience at the University. Also, I would like to thank all my friends in Vietnam and Australia, who always sympathise, listen to me and take care of me whenever I am stressful, sick or lonely. In addition, a special thanks to Helen Bethune Moore for her diligent proofreading of this thesis.

As well, I greatly appreciate the scholarship award and financial support from the Ministry of Education and Training, Vietnam and Western Sydney University. Thanks to their support, I had a great chance to come to Australia and pursue my research passion.

Lastly, and most importantly, I am very thankful to my dearest family members for their endless love and support**.** My parents, Ho Quang Huy and Lien Ngoc Hien, and my two brothers, Ho Huu Tuong and Ho Huu Toan, have been always by my side, raised me up, taught me, shared all my happiness and encouraged me during the tough times. No words can describe how grateful I am for all the sacrifices that they have made. I dedicate this thesis to them.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ACIC: Asian Common Industrial Classification

AIA: Asian Investment Area

APEC: Asia-Pacific Economic Cooperation

AR (1): Arellano-Bond statistics AR (1)

AR (2): Arellano-Bond statistics AR (2)

ASEAN: Association of Southeast Asian Nations

BCC: Business Cooperation Contract

BOT: Build-Operate-Transfer

BT: Build-Transfer

BTO: Build-Transfer-Operate

DEA: Data Envelopment Analysis

FDI: Foreign Direct Investment

FE: Fixed Effects

FOC: Wholly Foreign-Owned Company

FTAs: Free trade agreements

GDP: Gross Domestic Product

GMM: General Methods of Moment

GSO: General Statistics Office

IMF: International Monetary Fund

IPAP: Investment Promotion Action Plan

OLS: Ordinary Least Squares

Obs: Observations

PCI: Provincial Competitiveness Index

RE: Random Effects

R&D: Research and Development

SAC: Spatial autocorrelation model

SAR: Spatial auto-regression models

SD: Standard deviation

SDM: Durbin-spatial auto-regression model

SEM: Spatial error model

SFA: Stochastic frontier analysis

SMEs: Small and Medium Enterprises

SOEs: State-owned Enterprises

TAF: The Asia Foundation

TC: Technical efficiency change

TFP: Total Factor Productivity

TP: Technological progress

US: United States

USD: United States Dollar

UK: United Kingdom

JVC: Joint Venture Company

MEs: Multinational Enterprises

MLE: Maximum likelihood estimation

OECD: Organisation for Economic Cooperation and Development

VCCI: Vietnam Chamber of Commerce and Industry

VSIC: Vietnamese Standard Industrial Classification

WTO: World Trade Organisation

ABSTRACT

Vietnam is popular for its rich natural resources, an abundant labour force and a stable political situation. However, the phenomenon of foreign direct investment (FDI) into Vietnam only emerges after the introduction of the reform policy – *Doi Moi* in 1986 and the enactment of the Law on Foreign Investment in 1987. These open policies resulted in a strong recovery in economic growth. Although there are few empirical studies that investigate the role of FDI, these studies only focus on some of the features that attract more FDI inflows. There is still a lack of an in-depth empirical analysis of FDI spillover effects on productivity growth in Vietnam. Therefore, this thesis aims to provide an in-depth analysis of FDI spillover effects on productivity growth in Vietnam through a multi-level approach. Particularly, this thesis concentrates on three primary aspects: the influences of FDI spillovers on the productivity of Vietnamese firms; the role of absorptive capacity on FDI spillover productivity; and the impact of spatial FDI spillovers on TFP growth among Vietnamese provinces.

The thesis starts with an in-depth analysis of FDI spillover effects on the productivity of domestic firms in Vietnam. Employing a dataset of all Vietnamese firms over the sample period 2000-2014, the findings show negative signs of FDI horizontal spillovers and positive impacts of FDI backward spillovers on the productivity of local firms. By determining these effects, this thesis supports the continued fiscal and monetary incentives from Vietnamese governments to both foreign investors and domestic firms in the same industry or across industrial sectors.

Absorptive capacity plays an important role in deriving benefits from foreign investments. Using a provincial dataset over the period 2005 to 2014, research in this thesis empirically investigates the absorptive capacity threshold, through the degree of human capital in promoting productivity growth and attracting FDI. Research finds the existence of human capital threshold that impacts FDI productivity spillovers. The determination of a human capital threshold enables local governments to propose a clear target for human capital levels for all Vietnamese provinces and cities. In other words, policymakers need to focus on improving a well-educated workforce for provinces under the threshold level.

Furthermore, this thesis also indicates a heterogeneous FDI productivity spillover distribution across Vietnamese provinces. Therefore, it is essential to retain stable development in the key economic provinces, and focus on improving infrastructures, education and other financial incentives in provinces that receive less FDI spillovers. It is expected that the benefits from FDI spillovers will vary and diversify across the provinces and regions of Vietnam.

Finally, this thesis also offers some general policy implications for the Vietnamese government and local provincial governments to ensure the competitive advantages of local firms and encourage foreign investments across industries and provinces. The policies focus on local infrastructure development, modernising legal and political institutions, the developing government-funded programs and so on. In addition, the development of training centres, vocational colleges and universities are essential to decrease the technology gap between local economies and foreign firms.

Keywords: FDI spillovers, productivity, absorptive capacity, human capital, spatial distribution

CHAPTER 1: INTRODUCTION

1.1 Research Background

Foreign direct investment (FDI) plays an important role in the economic development of recipient countries, especially in South-East Asian developing countries. FDI brings investment capital and the latest technologies to recipient countries and helps them to improve their production processes efficiently and effectively. Furthermore, FDI is also believed to encourage international trade and technology transfer between regions within the host countries. Therefore, the significance of FDI and its impact on the developing host countries are investigated to provide clear evidence of FDI benefits in these countries.

As a market-oriented economy, Vietnam is considered to be a sound investment destination for foreign investors. There are several competitive advantages that make Vietnam popular in attracting foreign investment. Firstly, Vietnam is in South-East Asia and shares its borders with China, Laos, Thailand, and Cambodia. Vietnam's population exceeded 95.5 million at the end of 2017, about 60 per cent of whom are of working age (World Bank, 2017). Vietnam is endowed with a young, fast-learning, and well-educated labour force. Moreover, Vietnam is a country known for its rich natural resources. According to Mirza and Giroud (2004), natural resources are considered to be one of the main factors in attracting FDI into a specific location. Furthermore, Le (2002) states that political and social stability is the strength of Vietnam. Thus, Vietnam is an ideal destination for foreign investors who are looking for locations with low production costs and safe investments.

Although Vietnam is endowed with rich natural resources, abundant human capital and stable political conditions, the main reason for the FDI inflow phenomenon is the economic transition from a centrally planned economy to a market-oriented economy since 1986 (Kokko et al., 2003). The open-door policy, namely the *Doi Moi* reform policy, in 1986, and the promulgation of the Law on Foreign Investment in 1987 have given rise to Vietnam's strong economic recovery, including a significant increase in the economic growth rate and the high level of exports and imports. The implementation of open-door polices also contributes to a very strong inward FDI to Vietnam. Specifically, the registered FDI capital increased more than 16 times, from USD 1,603.5

million in 1988 to USD 26,890.5 million in 2016 (General Statistics Office of Vietnam, 2016). Due to their geographic proximity, the main source of inward FDI in Vietnam comes from other nearby Asian countries.

Although FDI inflows bring many benefits to the domestic economy, such as the increase in tax revenue, and the modernisation of production systems and foreign currency inflows, the challenges posed by FDI management are formidable for the Vietnamese government. Firstly, competitive advantages can be diminished due to differences between the source countries and Vietnam's economy, politics and culture. Secondly, the unbalanced distribution of FDI inflows to various provinces in Vietnam may cause disparate development among them. Thirdly, FDI may stimulate its spillovers on Vietnamese economy and affect productivity growth. Therefore, research in this thesis proposes some significant policy implications to improve the effectiveness of foreign investment, not only in a specific firm or a region but across the Vietnamese economy.

1.2 Research Objectives and Research Questions

This thesis aims to investigate the determinants of FDI spillover and its significance to productivity growth in Vietnam through a multi-level approach. Although several studies examine the influences of FDI on Vietnamese economic growth, these studies only focus on some specific features to design relevant policy to attract more FDI inflows. Pham (2012) states that FDI contributes not only to the increase in capital but also technological capabilities and employees' knowledge in host countries. Research on FDI in Vietnam mostly focuses on the advantages of FDI spillovers on firms' performance and ignores efficiency changes from FDI spillovers. Moreover, the existing literature on FDI in Vietnam often ignores the benefits that FDI spillovers bring to Vietnamese provincial productivity and the reasons for the unbalanced distribution of FDI between those provinces. The absence of such empirical in-depth research on the influences of FDI spillovers possibly undermines government policies to promote FDI. Therefore, this thesis attempts to fill the gap by estimating the impact of FDI spillovers on productivity growth in both Vietnamese firms and provinces.

This thesis answers the following research questions:

1. What are the impacts of FDI spillovers on the productivity of Vietnamese firms?

2. How does human capital affect FDI spillovers and TFP growth in Vietnamese provinces?
3. How do spatial FDI spillovers influence Vietnamese provincial TFP growth?

1.3 Significance of the Research

This research contributes to the existing FDI literature in several ways. Firstly, it is expected that local firms can improve their productivity through technology transfer, knowledge and labour turnover from FDI spillovers. However, the negative side of FDI spillovers is still criticized by some economists. Therefore, research in this thesis provides an in-depth analysis of the effects of FDI spillovers on the productivity of domestic firms in Vietnam. Once the relationship between FDI spillovers and firms' productivity is confirmed, it is relevant to offer continuing fiscal and monetary incentives to maximise benefits from FDI to Vietnamese firms.

Secondly, by estimating a minimum human capital threshold level, this study is the first empirical attempt to examine the effects of human capital on FDI productivity spillovers in Vietnamese provinces. The study demonstrates that FDI is possibly more productive than domestic investment in the presence of the minimum human capital level. This highlights the importance of human capital and proposes the achievement of a clear human capital target for all Vietnamese provinces.

In addition, by employing spatial analysis, research in this thesis provides clear evidence of regional disparity in FDI spillovers among Vietnamese provinces. It is expected that the benefits from FDI spillovers focus not only on the large provinces and cities, but also proximate regions and provinces. The role of the features of proximate provinces should be considered as important as the host provinces' features to encourage foreign investment. Based on the research findings, local governments can propose more effective policies to attract inward FDI across the provinces.

Finally, research in this thesis provides a good opportunity for policy makers to review and re-examine current policies and propose more general policies to improve the business environment in Vietnam. There is also a need for further spending on education and training as well as infrastructure development to help reduce the gap between foreign and domestic

firms in Vietnam. Finally, the findings of this research will provide a reference for foreign investors to make their investment decisions in Vietnam in the future.

1.4 Methodology

Various methods and datasets are employed to address the research questions. Firstly, a number of alternative approaches are used to measure the influence of the existence of foreign firms on local productivity. A common method is to establish a production function, based on the traditional Cobb-Douglas model. In applying the Cobb-Douglas production function model, previous empirical works predominantly exclusively focused on the productivity advantages of FDI spillover through technology transfers. In fact, FDI productivity spillovers include both technological progress and efficiency improvements. Ignorance of efficiency improvements from FDI spillovers is normally due to difficulties in data measurement and data availability (Suyanto and Salim, 2010). In Vietnam, the effects of FDI spillovers on local firms' productivity are widely examined in the existing literature (Le, 2005; Nguyen, 2006; Nguyen et al., 2008; Nguyen and Anwar, 2010; 2013; and Le and Pomfret, 2011). However, these studies ignore the efficiency changes from FDI spillovers. Research in this thesis remedies these shortcomings by adopting the Stochastic Frontier Analysis (SFA) method (Battese and Coelli, 1995). There are several reasons to choose this approach rather than the others for this study. Firstly, this method allows clarification of the two elements of productivity: technological transfer and technical efficiency. As well, the SFA method is preferable because it allows random deviations from the production frontier for factors beyond the control of producers (Seo and Shin, 2011). Thus, the stochastic frontier production function is exploited to test both the production and the efficiency function.

Nkechi and Okezie (2013) state that inward FDI will have smaller influences on economic growth in developing countries if there are 'threshold externalities'. The threshold externalities can be the degree of openness, types of trade regimes or the level of human capital development in a specific host country. Generally, the threshold values can be estimated by using the traditional panel threshold approach of Hansen (1999). However, this method assumes that all explanatory variables must be exogenous. This assumption can cause biased threshold estimations due to the potential endogeneity within variables. Additionally, the relationship between inward FDI and its threshold externalities are

usually dynamic in nature. Therefore, this thesis employs the dynamic threshold analysis developed by Kremer et al. (2013) to measure the threshold level of human capital and examine the impacts of its threshold on TFP growth and FDI spillovers among Vietnamese provinces. The dynamic threshold approach enables to deal with the country-specific fixed effects and the issue of potential endogeneity.

Due to agglomeration impacts, FDI spillovers may be affected by the characteristics of both host regions and alternative ones (Kayam, Yabrokow and Hisarciklilar, 2013). Thus, it is essential to investigate the spatial impacts of FDI spillovers on Vietnamese provincial productivity growth. Research on FDI determinants in Vietnam are well documented (Pham, 2002; Meyer and Nguyen, 2005; Nguyen et al., 2008; Nguyen and Anwar, 2010). However, these studies usually ignore the spatial interaction between proximate regions and provinces except for Hoang and Goujon (2014), Tran, Pham and Barnes (2016), and Esiyok and Ugur (2017). Although these studies employ a spatial econometric approach, they concentrate only on the interaction between bordering provinces, using contiguous matrices. Esiyok and Ugur (2017) consider the physical distance between proximate Vietnamese provinces; however, they do not investigate the spatial FDI spillover effects on TFP growth. Thus, research in this thesis fills a gap by weighing the role of proximate provincial features on FDI spillovers using a distance-based matrix. The model of spatial econometrics used in this thesis includes two factors – spatial lag and spatial error term. While the spatial lag takes into account the impacts of spatially weighted nearby units on the dependent variable, the spatial error structure includes the spatial lag in the error term. To ensure unbiased results and the interdependence between the hosts and proximate provinces, all different spatial model forms are considered in this thesis. They are the spatial auto-regression models (SAR) of LeSage (1999); the spatial error model (SEM) (Coughlin and Segev, 2000); the spatial autocorrelation model (SAC) – the extension of the SAR model, and the Durbin-spatial auto-regression (SDM). The inclusion of all these models helps to explain how the FDI spillover effect has an unequal distribution among provinces.

1.5 Thesis Structure

This thesis is structured into six chapters. This chapter provides the background of the research and outlines the objectives, methodology and significance of the thesis. Chapter 2

provides an overview of foreign direct investment and economic growth in Vietnam, as well as the legal framework for FDI in Vietnam.

Chapter 3 explores the influences of FDI spillovers on productivity in Vietnamese firms through the modern production function model and stochastic frontier analysis. The results indicate the negative spillover effects and the positive backward linkage of FDI on the productivity of Vietnamese domestic firms.

Research in Chapter 4 focuses on the impacts of human capital on FDI spillovers and productivity growth in Vietnamese provinces, using the dynamic threshold panel analysis, over the period 2005-2014. The results illustrate the positive effects of human capital and absorptive capacity on FDI spillovers and total factor productivity in Vietnamese provinces, under their specific threshold value.

Chapter 5 fills in the gap in the existing literature on FDI distribution in Vietnamese provinces and regions by exploring the FDI spillovers to each Vietnamese province, applying the dynamic spatial panel approach.

Finally, Chapter 6 sums up the entire research findings, points out some limitations and contributions of the research, and provides recommendations for further investigation.

CHAPTER 2: FOREIGN DIRECT INVESTMENT IN VIETNAM: AN OVERVIEW

2.1 Introduction

FDI is defined as '*a category of cross-border investment made by a resident in one economy (the direct investor) with the objective of establishing a lasting interest in an enterprise (the direct investment enterprise) that is resident in an economy other than that of the direct investor*' (OECD Benchmark, 2008, p.17). It is considered to be a key factor of economic integration. It not only promotes economic growth and financial stability but also enhances the well-being of societies (Dabour, 2000).

Indeed, FDI brings about benefits to both the direct investor and the recipients. In the view of direct investors – multinational enterprises (MEs), an increase in direct investment flows lays the foundation for the expansion of international production and foreign market share. Further, the relocation into developing economies probably results in a reduction in production costs and export costs due to the availability of a cheaper labour source and other endowments in these countries (Nguyen and Xing, 2008).

The welfare effects of FDI also contribute to the growth of the host economies. Countries receiving FDI can take advantage of latest production technology and seize opportunities to break into international markets through FDI channels. Obtaining better manufacturing technology and innovative capacity are also considered as advantages to domestic firms in the current competitive environment (Pham, 2012).

There are various theoretical studies on FDI in existing academic literature, however, Hymer (1960) and Kindleburger (1969) are two economists who make a significant contribution on FDI theories by considering the expansion of enterprises' activities through capitalising on local firms in the imperfect market. In the early stages, FDI research mainly focused on FDI concepts, international trade and foreign production (Vernon, 1966; McManus, 1972; Buckley and Casson, 1976; Dunning, 1977, 1981). At the beginning of 1990s, Dunning (1988, 1992) published the theory of internalization of the MEs, the eclectic paradigm of international production and macroeconomic theories. These theories became a popular analytical framework for research on FDI and FDI determinants.

2.2 Overview of FDI in Vietnam

2.2.1 Vietnam's Doi Moi Policy

Although Vietnam mostly had an economic relationship within the Soviet bloc after the 1975 War, since the 1980s, Vietnam started opening and encouraging investment from foreign countries. In response to the economic crisis and to abandon the central planning model of socialism, the Vietnamese government took a decisive step by introducing a 'market-oriented socialist economy' that encouraged foreign direct investment into Vietnam (Beresford, 2008). In 1986, the *Doi Moi* policy was launched by the government to transform the market-oriented economy from centralised economy which also concentrated mainly on balancing between state enterprises and private sectors through step-by-step transformation. The *Doi Moi* policy focused on increasing the efficiency and stability of output in agriculture because this was the largest sector with the highest concentration of employees and the poorest people in the economy at that time. In addition, this policy not only reformed the economy from heavy to light industry but also focused on the growth of export-led economic advantages. The basic aim of attracting direct investment was to enhance co-operation with other foreign investors and to encourage external relationships, with flexibility in management as well as exchange and interest rates. In summary, the key areas characterized by *Doi Moi* policy were agricultural reform, price liberalisation, state owned enterprise reform, financial reform, trade liberalisation, and foreign direct investment liberalisation.

The implementation of the *Doi Moi* policy has generated many notable results. Firstly, the GDP increased by 3.9 per cent on average within five years since 1988. Furthermore, the average value of import-export rose by 28 per cent and Vietnam became one of the main destinations of exporting rice in 1988 as well as the third-biggest rice exporter, with 1.5 million tons in 1990. Inflation was controlled, with a significant decrease from 774.7 per cent in 1986 to 67.4 per cent in 1990 (General Statistics Office of Vietnam, 2000). The imposition of the *Doi Moi* policy is also considered to be one of the first steps that helped Vietnam integrate with international economies and globalisation. By the end of 1996, the commercial relationship between Vietnam and more than 120 countries was officially established which helped to increase GDP from foreign trade by more than 20 per cent. Another success from the reform policy was the movement in the fundamental management

mechanism, with 60 per cent of private enterprises, along with support from state-run sectors. In 2007, GDP growth reached 8.4 per cent and continues to increase until 2019 with stronger industrialisation and sharper foreign trade volumes. These results indicate the success of Vietnam's economic transformation from a centrally-planned economy with a bureaucracy and a subsidy form of mechanism to a socialist-oriented market economy (Phan and Ramstetter, 2004).

2.2.2 Legal Framework for FDI in Vietnam

The adoption of the open-door policy brought in many structural transformations, especially the Law on Foreign Investment. This law aims to strengthen the rights of foreign investments as well as minimise the gap between the foreign and domestic investor to attract more FDI to Vietnam. This law has been updated since 1987.

- ***Laws on foreign investment***

The Law on Foreign Investment was first regulated in 1987, which stipulated *"the investment of foreign organizations and individuals in the Socialist Republic of Vietnam"* (Law on Foreign Investment, 1987). However, the law established the initial legal framework to protect the position of domestic enterprise and restrict foreign investors by cooperating with state-owned enterprises (SOEs) only. Although the law had a few shortcomings, it is considered to be the legal foundation for FDI activities in Vietnam, resulted in total registered investment capital of about USD 1,800 million over the period 1988-1990 (General Statistics Office of Vietnam, 2004).

During the period 1990-1995, the law was amended twice, in 1990 and 1992, to remedy some of limitations contained in its first issue, and to "*encourage and create more favourable conditions for foreign organizations and individuals to invest in Vietnam*" (Law on Foreign Investment, 1990; 1993). The revisions included: accepting of business cooperation between foreign organisation and private enterprises directly; expanding joint venture forms; tax and rent land incentives for some FDI projects in some priority areas; and guaranteeing foreign currency balance for FDI projects. The amended law enables private enterprise to build partner relationship with foreign investors in all economic sectors.

The foreign investment law was comprehensively revised in 1996, focusing on the minimisation of complicated administrative procedures and centralising the state management of FDI, as well as licence regulation. FDI enterprises were allowed to select the form of investment[1], the rate of capital contribution and investment location (Law on Foreign Investment, 1996). Policies on industrial zones and export processing zones were more open to encourage FDI enterprises in export-oriented and hi-tech industries (Pham, 1998). Despite the positive changes in the law, the value of inward FDI still decreased because of the 1997 – 1998 Asian financial crisis.

The law was revised a fourth time in 2000 with the inclusion of two new provisions and the revision of twenty old provisions (Pham, 2006; Gillespie, 2007). The law continued to encourage foreign investment in many industries by reducing obstruction and risk in investment, erasing unnecessary interference of government procedures and regulating the right to land use and tax issues (Law on Foreign Investment, 2000). In 2005, a new version of the foreign investment law was brought in to continue to boost foreign investment in Vietnam. The law not only permitted equal partner relationships between foreign and domestic enterprises, but it also ensured the same advantages and disadvantages between foreign investors and local firms (The Investment Law, 2005).

The latest Law on Foreign Investment was promulgated in 2014 with some important changes. They included more open foreign ownership in Vietnamese firms, the reduction of foreign investment approval processes and justification in corporate governance rules to make it closer to international standards. This new law was imposed in July 2015 and its adoption has made Vietnam one of the most exciting emerging markets in South-East Asia (The Investment Law, 2014).

- ***Other legal frameworks and regulations***

Another change made by the Vietnamese government to attract foreign investment was to enact the Enterprise Law, on 1 January 2000. One of the most important points in this Law was that it allowed the registration of a business without waiting for the approval from

[1] Under the *Foreign Investment Law 1996*, there are six different forms of business for foreign investors to choose from in Vietnam. They are *"Business Co-operation Contract (BCC); Joint Venture Company (JVC); Wholly Foreign-Owned Company (FOC); Build-Operate-Transfer (BOT); Build-Transfer-Operate (BTO); and Build-Transfer (BT) (Law on Foreign Investment, 1996)"*.

government. The registration progressing time was then reduced from six months to only one week (The Enterprise Law, 2000). The law is considered a major step in streamlining the investment process and creating more jobs in the labour market.

As well, the Commercial Law was imposed in 2005 to establish a new legal framework for the import and distribution of foreign participation (*Vietnam Commercial Law*, 2005). The law also allowed foreign investors to independently conduct commercial activities in Vietnam. It stated "*Parties have the rights of freedom to reach agreements not in contravention of the provisions of law, fine traditions and customs and social ethics in order to establish their rights and obligations in commercial activities. The State respects and protects such rights*". This Law and its updated version in 2007 were considered to be the legal framework for foreign investors engaging in trading and distribution activities.

The entry into worldwide organisations and signing commercial agreements were milestones that helped Vietnam move forward towards integration and globalisation. In 2007, Vietnam officially became a member of the World Trade Organization (WTO). Participation in the WTO indicated Vietnam's successful transformation into a market-oriented economy and marked its entrance to the global trading market (Bui, 2009; Athukorala and Tran, 2009). In addition, Vietnam has successfully built commercial relationships with more than 160 territories, along with making many important agreements[2]. Vietnam has constantly developed and encouraged investment to improve its amount of exports to the US market and those of other developed countries. In summary, Vietnam has attempted to create a fair and free environment by providing a stable economy and many policies for investment incentives.

2.3 An Overview of FDI Inflows to Vietnam

The reform policies, *Doi Moi*, were launched in 1986, to promote trade liberalisation, attract FDI, and contribute to economic development. The reform has resulted in an annual economic growth rate of around 7 percent during the two decades since its introduction (Hoang, Paitiin and Bangorn, 2010). In addition, the launch of the Foreign Investment Law

[2] The agreements include the Framework agreement on the ASEAN Investment Area (AIA), Asia-Pacific Economic Cooperation forum (APEC) and Asia – Europe Summit included the Investment Promotion Action Plan IPAP.

1987 was an imperative in establishing a legal foundation to attract investors from other countries. The law concentrates mainly on investments made by intensive industries[3], encouraging export-oriented FDI, and obtaining technology transfers from foreign investment (Nguyen and Xing, 2008). Infrastructure facilities were also improved, and important industrial production zones were established to encourage foreign investors (Law on Foreign Investment in Vietnam, 1987).

After the reforms of 1986 and the enactment of the liberal investment law in 1987, the value of FDI inflows achieved a total of registered capital of USD 1,603.5 million, for 211 projects in the first three years, 1988-90. During the period 1991-95, FDI inflows increased significantly with a total registered capital of USD 18,379.1 million. This rapid rise of FDI inflows during this period is considered to be the FDI boom in emerging markets, where low investment costs, cheap labour, and unexplored resources are available. The growth rate of registered FDI was consistently high in 1996, with an increase of approximately 22 per cent in comparison to 1995. However, investment fell rapidly from 1997 (USD 5,955.6 million) to 1999 (USD 2,282.5 million) due to the Asian financial crisis. FDI inflows to Vietnam recovered and achieved a stable increase over the period of 2001-2005. This tendency can be explained by changes to the Law on Foreign Investment, aiming to *"expand economic co-operation with foreign countries"* (Law on Foreign Investment, 2000); the enactment of the Enterprise Law which "*protect lawful rights and interests of investors and reinforce the effectiveness of State administration of business activities*" (The Enterprise Law in Vietnam, 2000), and the free trade agreement between Vietnam and the United States in 2000. This period also witnessed the registration of many large foreign projects such as the Nui Phao Mining and Mineral Processing Joint Venture Company, Thanh Cong Investment and Development Company and Shing Mark Vina Limited Company. The value of FDI inflows into Vietnam fluctuated during the period 2006-2010. FDI inflows reached a peak of USD 71,726 million in 2008, after Vietnam became an official World Trade Organisation (WTO) member in 2007. Nevertheless, the global financial crisis caused a significant decrease in FDI inflows, achieving only USD 23,107 million in 2009 and USD 19,886.8 million in 2010. Although total registered FDI capital decreased to USD 15,589 million in 2011, FDI inflows have gradually recovered and

[3] Intensive industries include some basic sectors such as production of exports, production of import substitution, processing of agricultural produce and processing of raw materials (*Law on Foreign Investment in Vietnam*, 1987)

increased slightly thereafter. Significantly, the value of FDI inflows reached the highest level of FDI disbursement ever (USD 26,890.5 million) in 2016, with an increase of approximately 7 per cent in comparison to 2015 after a series of free trade agreements (FTAs)[4] came into effect (refer to Figure 1).

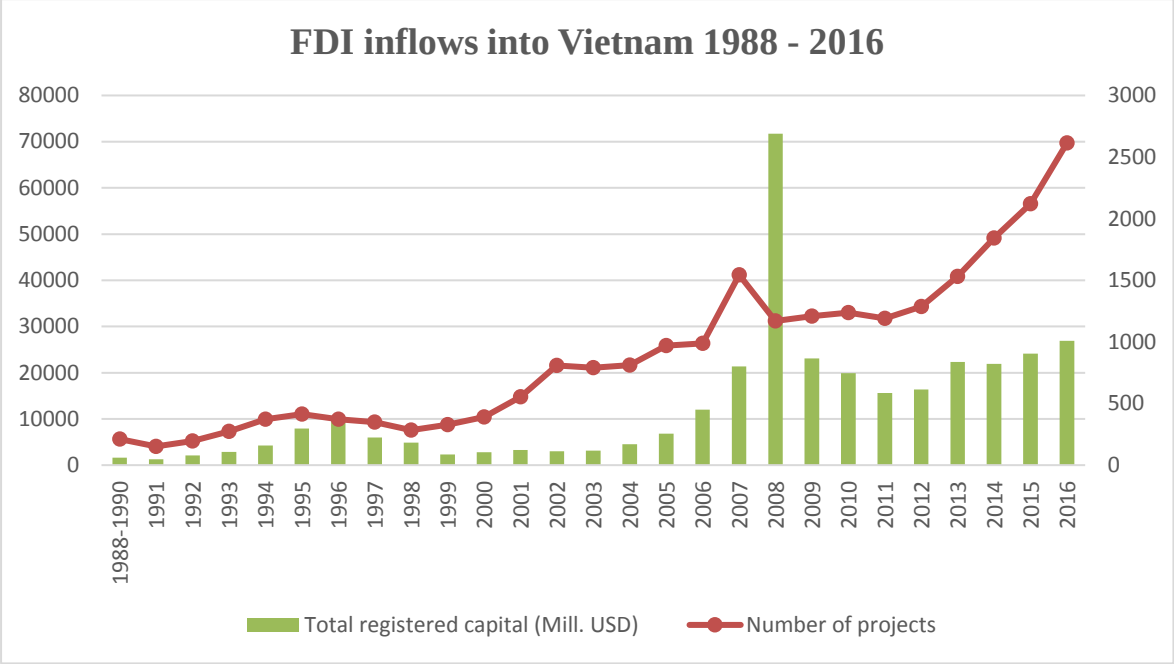


Figure 2. 1: FDI inflows into Vietnam 1988 – 2016

Source: General Statistics Office of Vietnam, 2016

The main sources of FDI in Vietnam are Asian countries. The significant foreign direct investment by Asian countries has been fuelled by their geographic proximity and the large Vietnamese labour force. In 2016, South Korea was the largest foreign direct investor in Vietnam, followed by Japan, with accumulated investment outlays of USD 50,553.5 million and USD 42,433.9 million respectively. Similarly, Singapore, Taiwan, the British Virgin Islands and Hong Kong were also significant sources of FDI in 2016, with accumulative contributions of USD 38,255.4 million, USD 31,885.5 million, USD 20,482.1 million and USD 17,003.1 million respectively.

[4] Free trade agreements (FTAs) are the bilateral agreements which enables to pushing up trade and accelerating Vietnam's integration into the global economy. At the end of 2016, Vietnam is part of 10 regional and bilateral FTAs, including ASEAN members and countries such as China, Korea, Australia and New Zealand (Ministry of Industry and Trade, 2016).

There is a heterogeneous distribution of FDI at the provincial level in Vietnam. The largest cities in the country (Hanoi and Ho Chi Minh City) are the primary destinations for FDI. After admission to the World Trade Organisation (WTO) in 2007, there was a significant change in geographical distribution of FDI to all provinces. This change resulted in a decrease of FDI inflows to the major provinces from 90 per cent to 66 per cent during the period of 2007-2014. The number of specialized economic zones has consistently increased since 2015, implying the expansion of FDI distribution across the country. Hanoi and Ho Chi Minh City are still the main FDI destinations. They achieved 18.24 per cent and 12.24 per cent of the total value of inward FDI in 2016 (General Statistics Office of Vietnam, 2016).

CHAPTER 3: THE EFFECTS OF FDI SPILLOVERS ON VIETNAMESE FIRMS' PRODUCTIVITY

3.1 Introduction

Foreign direct investment (FDI) is believed to be beneficial to receiving countries in terms of providing additional capital, technology and knowledge transfer (Pham, 2012). Due to these advantages, policymakers in many countries have offered a wide range of incentive packages such as tax exemptions, investment allowances, and other benefits to attract more FDI to their countries. The previous chapter provided an overview of FDI inflows and economy in Vietnam; this chapter focuses on in-depth analyses of FDI spillover effects into Vietnam at the firm level. Since the presence of foreign investment means better production technology, knowledge, and human capital, productivity spillover gains are widely found to favour FDI in both the theoretical and empirical literature. The role of FDI in the productivity of local firms in emerging markets has been paid greater attention in the recent existing literature (Zhang et al., 2010).

Despite this appealing argument, previous research fairly provides mixed evidence on the relationship between FDI spillovers and productivity growth of local firms so far. On the one hand, the presence of multinational enterprises provides both increased capital and technological capabilities, resulting in improvements in the productivity of local firms (Caves, 1974; Pham, 2002; Javorcik, 2004: Bitzer and Gorg, 2009; Salim and Bloch, 2009). On the other hand, some studies find negative or even no spillover effects (Aitken and Harrison, 1999; Barry, Gorg and Strobl, 2005; Djankov and Hoekman, 2000). The different research findings are explained by research design, methodologies, data sources, the variables' constructions and econometric estimations. These contradictory results also suggest that the effects of FDI spillovers on the productivity of local firms is not universal. Therefore, there is a need for a further comprehensive study of FDI spillovers and domestic firms' productivity growth nexus.

According to the *World Investment Report* (UNCTAD, 2014), the value of FDI inflows to developing countries has increased significantly from USD 14 billion in 1985 to USD 778 billion in 2014 after the introduction of open policies in favour of FDI in the early

1980s. Similarly, the reform policies, *Doi Moi*[5], were launched in 1986, in an effort to promote trade liberalisation, attract FDI and contribute to economic development in Vietnam. The encouragement of foreign investment to stimulate economic development has resulted in the expansion of the private sector in Vietnam. In 2014, the Manufacturing and Processing sector was the main contributor to the growth of the Vietnamese economy with USD 141,406.7 million of total FDI, followed by the Real Estate sector with USD 48,279.8 million of total FDI. The Administrative and Support Service sector, the Other Services' activities sector and Education and Training sector attracted the lowest FDI capital inflows - approximately USD 211.6 million, USD 754.1 million and USD 819.9 million, respectively (General Statistics Office of Vietnam, 2014). The year 2014 also witnessed the extension of investment and distribution networks by global brands into Vietnam such as Samsung, Microsoft, Nike and Adidas. Manufacturing and Processing sector was consistently a primary attractor of FDI in 2016, with an investment value of USD 172,717.6 million, accounting for 58.8 per cent of the total FDI. Real Estate service sector was also the second FDI inflow distribution with USD 52,203.7 million of total FDI, followed by power production (Electricity, Gas, Steam and Air Conditioning supply) with USD 12,907.6 million of total FDI. While these major sectors in industry witnessed significant growth, other sectors such as Administrative and Support services, Education and Training and Other Services were less attractive to foreign investors in 2016, only achieving USD 495.1 million, USD 741.2 million, and USD 765.3 million of total FDI respectively (General Statistics Office of Vietnam, 2016). In summary, the substantial changes over the years make Vietnam a destination for foreign capital and investment.

[5] The policy *Doi Moi* is an economic renovation policy with the goal of transforming the centrally planned economy into an open market that encourages foreign direct investment. It is considered as a "big-bang" economic liberalisation that transforms a stagnant agricultural economy into a vibrant, market-driven, capitalist system (Freeman 1996).

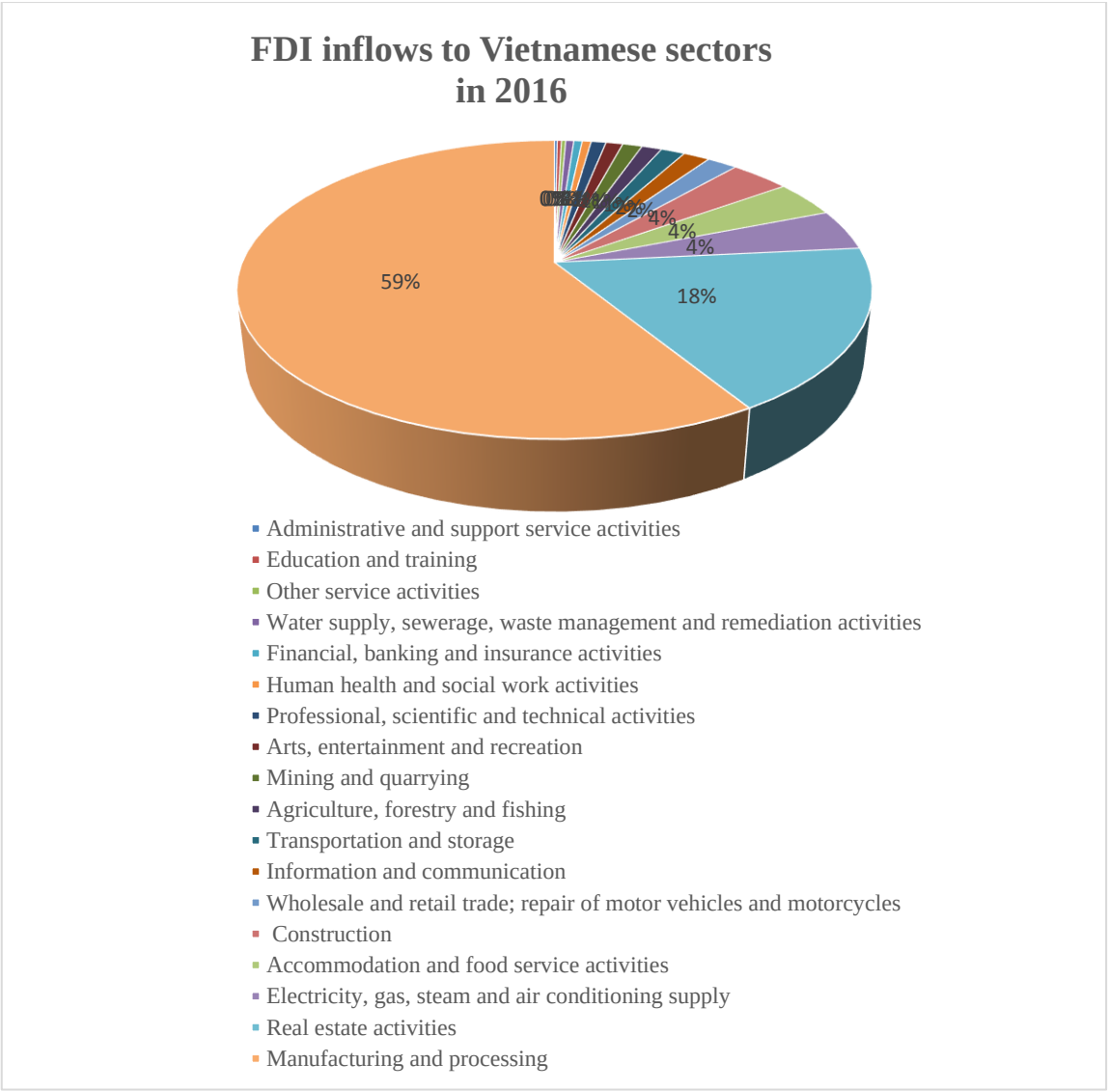


Figure 3. 1: FDI inflows to Vietnamese sectors in 2016

Source: Statistical Yearbook of Vietnam, 2016 (Appendix 3.1)

Productivity growth measures how efficient the production process is, and it commonly encompasses two distinct components: technological change and efficiency changes (Iyer, Alicia and Kam, 2008). According to Nishimizu and Page (1982), technological progress is defined as the change in the best practice production function through process innovation and product innovation which leads to greater output from the same quantity of resources. Those innovations are normally taken from multinational enterprises by product or process knowledge. On the other hand, technical efficiency change is defined as other productivity change, such as learning by doing, diffusion of new technological knowledge, improved managerial practice as well as short-run adjustment to

shocks external to the enterprise. Given that technological progress and efficiency improvement are technically distinct concepts, there is no reason to re-assume that FDI spillovers will have the same impact on each component of productivity. Nevertheless, the existing literature on FDI exclusively focuses on productivity gains from technological progress and rarely concentrates on the efficiency improvements from FDI spillovers. A possible explanation is due to the unavailability of reliable data source and the difficulties in computing productivity gains from technological progress and efficiency improvements. Thus, there is a need for further investigation to clarify the impact of FDI spillovers on the changes of both two elements of productivity - the technology and efficiency changes.

In Vietnam, there are several studies which emphasize the positive spillover from FDI to Vietnamese firms. Le (2005) examines the impact of technological spillover effects of FDI on Vietnamese manufacturing firms' productivity. By employing a Vietnamese provincial panel dataset over the period 1996-2003, Nguyen (2006) finds a two-way linkage between FDI and economic growth. Nguyen and Anwar (2010b, 2013) focus on the impact of FDI spillovers through horizontal and vertical linkages on the productivity of domestic firms from 2000 to 2005, using a dataset of manufacturing firms located in eight regions of Vietnam. Le and Pomfret (2011) investigate the effects of horizontal and backward linkages through FDI on the productivity of domestic firms in Vietnam. However, the majority of these studies on FDI spillovers in Vietnam only focus on the advantages of spillovers on firms' performance and ignore the changes of efficiency from the spillovers. Research in this chapter, is one of the first attempts to bridge those gaps by endorsing the impact of foreign presence on the productivity of local Vietnamese firms, in the form of both technological and efficiency change. With respect to the empirical analysis conducted herein, the research discussed in this chapter employs the stochastic frontier production function approach on firm panel data comprising all Vietnamese firms across sectors to study the influences of FDI spillovers on the productivity of local firms.

This chapter contributes to the literature in several ways. Firstly, it is widely recognised that FDI plays an important role in attracting more capital and technology transfer in developing countries. However, few studies explore the existence and magnitude of FDI spillovers in Vietnam. Thus, research in this chapter provides further investigation to answer the question of whether spillovers exist through FDI and how FDI generates

technological and technical efficiency spillovers to domestic firms. By including all Vietnamese firms across industrial sectors, this study provides the largest, most recent and reliable data for empirical estimation. Furthermore, a further contribution to the literature is made in examining the productivity spillovers by using the parametric approach - stochastic production frontier function, which is unexplored in the context of Vietnam. Finally, the empirical literature on FDI spillovers and firms' productivity is still inconsistent. The results of this research may shed some light on the continuing debate of spillover impacts from FDI in the literature.

In summary, the influences of FDI spillovers on receiving countries rely on the absorptive capacity of those countries and this may vary from country to country and from industry to industry. Therefore, this chapter contributes to the existing literature by examining the relationship between FDI and the efficiency of Vietnamese firms. Using a firm-level panel dataset of industrial sectors in Vietnam[6], this chapter provides more evidence on the continuing debate related to spillover effects from FDI in the empirical literature. The rest of this chapter is structured as below. Section 3.2 reviews the literature related to FDI spillovers. Section 3.3 constructs the hypotheses that are used to examine the FDI spillover effects on the productivity of firms in Vietnam. Section 3.4 discusses the methodology employed to test the hypotheses in this research. Section 3.5 describes the summary of research finding and discusses the empirical results. Finally, section 3.6 presents conclusions and policy implications.

3.2 Literature Review

3.2.1 FDI and Spillover Effects

It is well-established in theoretical literature that foreign investment brings direct and indirect benefits to host countries. The direct benefits include direct capital input, employment and technological advantages (Hymer, 1960) and the indirect advantages include the increase in efficiency and productivity of domestic firms (Blomstrom and Kokko, 1998; Higon and Vasilakos, 2011). Otherwise, spillover effects typically occur

[6] Industrial sectors are engines to drive national economic growth, productivity and competitiveness in Vietnam. They are classified into five levels, based on the Vietnam Standard Industrial Classification 2007 (GSO, 2007).

when the entry of multinational enterprises does not totally internalise productivity gains but instead facilitates and generates productivity gains for domestic firms in the host countries (Javorcik, 2004; 2008).

Existing literature on FDI points out three main channels for productivity spillovers. Firstly, domestic firms may imitate the new knowledge or develop their own innovation to ensure competitive advantages and increase their productivity. This first channel is also known as 'demonstration effects' or the 'learning-by-watching effect' (Das, 1987; Gunther, 2002; Lin and Chuang, 2007). Secondly, domestic firms may absorb and learn new technologies from foreign firms through 'labour turnover' channels between foreign and domestic firms such as when labour from multinational enterprises moves to domestic firms or when they establish their own business (Glass and Saggi, 2002; Pham, 2012). Thirdly, the presence of foreign firms increases competition in product markets, thus forcing domestic firms to strive in a strong competitive environment by exploring resource utilisation more effectively and efficiently.

These three main channels for FDI spillover effects have been the focus of much empirical research in the last two decades. Even though cross-sectional data studies confirm positive evidence of FDI spillovers (Cave, 1974; Driffield, 2001; Dimelis and Lauri, 2002), panel data empirical studies reveal mixed evidences. Blalock and Gertler (2007) and Suyanto, Salim and Bloch (2009) concede that the productivity of Indonesian firms is affected by FDI spillovers. Further, Du, Harrison and Jefferson (2012) reveal the significant effects of vertical spillovers but the weak impact on productivity of Chinese manufacturing firms. In contrast, the negative correlation between FDI spillovers and productivity of Zambian manufacturing firms is found in the study of Bwalya (2006). Haddad and Harrison (1993) and Konings (2001) do not find any evidence of FDI spillovers on productivity of domestic firms.

In Vietnam, the effects of FDI spillover effects on domestic firms are studied by Le (2005), Nguyen (2006), Nguyen et al. (2008), Nguyen and Anwar (2010), and Le and Pomfret (2011). By studying the effects of FDI spillovers on domestic firms, Le and Pomfret (2011) find that the main mechanism of technology transfer from foreign firms to local firms is backward linkages. Anwar and Nguyen (2013) investigate the effects of FDI

spillovers on horizontal and vertical linkages. Based on the traditional Cobb-Douglas model, they find significant impact of FDI spillovers on total factor productivity.

3.2.2 Technology Spillovers from FDI

Theoretically, technological spillovers from FDI to domestic firms are divided into two groups: horizontal/intra-industrial spillovers and vertical/inter-industrial spillovers.

- ***Horizontal spillovers***

Horizontal spillovers from FDI occur when the presence of multinational enterprises cause the increase of domestic firms' productivity within an industry. Teece (1977) claims that FDI spillovers may take place through information transfer from manufacturing firms in one country to manufacturing firms in another. The three main channels of FDI horizontal spillovers, as mentioned in section 3.2.1, are imitation, movement of employees and competition.

Generally, there are two types of empirical studies on horizontal effects. The first type employs industry-level data. Most studies of this type find a significant relationship between FDI and industry productivity. In particular, the positive impact on productivity of domestic firms because of the presence of foreign firms is confirmed through the studies of Cave (1974), Blomstrom and Persson (1983), Blomstrom and Sjoholm (1999) and Liu (2002). The aggregate data at the industry level can, however, create biased results because it has been unable to control for the differences in productivity across industries. This leads to difficulties in determining whether FDI spillovers truly cause the increase in the productivity of domestic firms, or foreign firms are only interested in high productivity industries. Thus, the results of research using industrial data may be endogenous and upward biased.

Otherwise, the impact of FDI spillovers on the productivity of domestic firms is still inconclusive. In a study of Venezuelan firms, Aitken and Harrison (1999) find that productivity of local firms in an industry is negatively influenced if there is an increase in foreign ownership in that industry. They conclude that firms with higher subsidiary shares had lower productivity than those in other industries. Javorcik (2004) investigates the effects of productivity spillovers from FDI using firm-level data from Lithuania and finds

that the domestic firms will benefit from FDI spillovers if they are customers of multinational enterprises. Alternatively, studies on developed countries such as Castellani and Zanfei (2002) for Italy, Harris and Robinson (2003) for the UK, Keller and Yeaple (2003) for the US, Haskel, Pereira and Slaughter (2007) for the UK, find positive evidence of FDI spillovers. In contrast, Girma and Wakelin (2001) find insignificant influences of foreign presence on labour productivity or total factor productivity in the UK firms. Using a dataset of the UK manufacturing firms from 1973 to 1992, Haskel et al. (2002) find positive spillovers from US and French FDI but negative spillovers from Japanese FDI.

- ***Vertical spillovers***

Conversely, vertical spillovers take place between multinational enterprises and domestic enterprises across industries. This happens through both 'backward linkages' and 'forward linkages'. Backward linkages represent the technological transfer by supply chains from foreign-invested firms to domestic suppliers. Foreign firms can directly transfer their technology through training and technical assistance, staff movement or incentives provision to their local supplier (Javorcik, 2004). Alternatively, forward linkages refer to the acknowledgement of new or less costly intermediate inputs of domestic firms from foreign investment in upstream industries. Domestic firms may benefit from better quality products and lower costs, training and sales support as well as infrastructure and business services' improvement from multinational enterprises supplies (Meyer, 2003).

Although there are numerous empirical studies on horizontal spillovers, studies on vertical spillovers are still limited. Studies by MacDuffe and Helper (1997) for the US firms, Driffield, Munday, and Robert (2002) for the UK firms, Blalock and Gertler (2002) for the Indonesian firms, Javorcik (2004) for Lithuanian industries find positive FDI spillovers through backward linkages. Kugler (2001) and Gorodnicjenko, Svejnar, and Terrell (2007) examine both horizontal and vertical spillovers on the efficiency of domestic firms. They find positive backward linkages but negative horizontal spillovers. A study of Hungarian firms by Schoors and Van der Tol (2002) and of Lithuania firms by Javorcik (2004) confirmed the significantly positive influences on backward linkages but the negative effects on forward linkages. In summary, research in this chapter fills a gap by investigating the influences of horizontal and vertical FDI spillovers to the productivity of Vietnamese firms.

3.2.3 FDI Spillovers and Technical Efficiency

The early literature on FDI spillovers concentrate on technology progress because those studies believe knowledge brought by foreign firms come entirely from technology such as product and process knowledge (Das, 1987; Coe and Helpman, 1995; Glass and Saggi, 2002; Javarcik, 2004; Liang, 2007; Le and Pomfret, 2011; and Nguyen and Anwar, 2013). Both growth accounting framework and conventional index number methods have been employed to measure firms' productivity growth for several decades (OECD, 2002). The growth accounting framework was developed by Solow (1957). It introduces a simple way to separate the aggregate production function by assuming that technical change during the research period is neutral on average. A conventional method is adopted by Denison (1962) who postulates a firm's output is produced at full efficiency or capacity function. These two approaches implicitly consider that productivity spillovers are synonymous with technological progress. Consequently, the effects of FDI on domestic firms' productivity are solely examined by employing a standard production function.

As argued by Suyanto and Salim (2010), productivity growth can be separated into two distinct sources: technological progress and efficiency change. Unfortunately, previous research on FDI spillovers usually ignore technical efficiency due to difficulties in its measurement. More recently, it has been possible to separate and focus on both technology and technical efficiency by using more a sophisticated methodological development in productivity literature. The introduction of the Malmquist productivity index[7] (Caves et al., 1982) and stochastic frontier approach[8] (Battese and Coelli, 1995), for instance, are used to investigate the determinants of productivity growth and its decompositions (Suyanto, Salim and Bloch, 2009).

By decomposing output changes into technical, efficiency and input changes, Koop (2001) explores the forces driving output change in six manufacturing industries, using data from 11 countries over 19 years. Dimelis and Lauri (2002) find the positive relationship between FDI spillovers and efficiencies in domestic Greek firms in 1997. By separating

[7] The Malmquist productivity index measures the productivity growth by the radial distance of the observed output and input vectors of two periods relative to a reference technology (Caves et al., 1982).
[8] The stochastic frontier production function is defined by assuming the non-negative technical inefficiency effects as a function of firms-specific variables and time (Battese and Coelli, 1995).

total factor productivity (TFP)[9] growth into efficiency and technology and adopting data envelopment analysis (DEA), Kravtsova and Zenenyuk (2007) find evidence of positive FDI spillovers on both technology and efficiency components. Ghali and Rezgui (2008) examine the contribution of FDI to technical efficiency by employing a panel data of 647 Tunisian manufacturing firms from 1997 to 2001 and find the FDI spillovers positively affect firms' technical efficiency. In a study on 20 OECD countries between 1982 and 2000, Iyer, Rambaldi and Tang (2008) apply a stochastic frontier method to measure the efficiency externalities of trade, FDI, foreign portfolio investment and other foreign investment forms. They find trade and all foreign investment inflows enhance efficiency while outflows of FDI cause inefficiency. Using the Divisia index[10] to divide *TFPgrowth* into technology and scale efficiency, Girma and Gorg (2007) find the significance of FDI productivity spillovers from technology but insignificance on efficiency for the UK manufacturing firms. These studies indicate that the sources of firms' productivity gain from the presence of multinational enterprises are still ambiguous. To contribute to the literature, this chapter aims to investigate FDI spillover effects on each component of productivity growth and solve the controversy of mixed results related to which sources of productivity are obtained by local firms through foreign firms' existence.

3.3 Hypothesis Development on the Relationship between FDI and the Productivity Spillovers in Vietnamese Firms

3.3.1 Foreign Firms' Presence and Productivity Spillovers

The outcomes of research into the relation between FDI spillover and the productivity (or efficiency) of firms is still mixed in the literature. On one hand, it can be argued that the presence of FDI brings negative spillover effects to domestic firms because foreign firms with better techniques, technologies and lower marginal costs can steal market share from domestic firms in the short term. On the other hand, domestic firms which had large fixed costs over a smaller amount of output are under pressure to improve their efficiency.

[9] Total factor productivity (TFP) is one of many indices of productivity – 'a ratio of output to inputs' (Nadiri, 1970). It is identified by 'how efficiently and intensely the inputs are utilized in production' (Comin, 2006).

[10] Divisia index is proposed by Francois Divisia (1926), which is used to construct index number series for continuous-time data on prices and quantities of goods exchanged. In their research, Girma and Grog (2007) construct the Divisia index through decomposing the output growth (TFP growth) into technology and scale efficiency changes.

The negative spillover effects on domestic competitors could be even harsher in highly capital-intensive industries where the fixed costs play a primary role (Aitken and Harrison, 1999). As argued by Javorcik (2004), domestic firms in the same sector have negative effects to FDI spillovers because they are potential competitors of foreign firms (horizontal spillovers).

Otherwise, domestic firms, which supply inputs for foreign firms, are more likely to have positive effects with FDI spillovers (i.e. backward linkages). Rodriguez-Clare (1996) finds that the efficiency improvement of domestic firms is due to a high-quality input requirement and technical training provided by foreign firms to domestic firms' staff. Also, Javorcik (2004) finds the efficiency and productivity of domestic firms increases when domestic suppliers receive training and updated knowledge from foreign buyers.

Le and Pomfret (2011) in a study of Vietnamese manufacturing sectors, find negative productivity spillovers within the same industry (horizontal spillover) but positive and significant backward linkages on domestic firms' productivity. However, the research of Le and Pomfret (2011) only focuses on firms' productivity and ignores the influences of technical efficiency. To illustrate the impact of horizontal spillovers and backward linkages on both Vietnamese firms' productivity and efficiency, the following empirical hypotheses are tested:

Hypothesis 3.1a: There are negative horizontal spillovers from FDI on the productivity of Vietnamese firms

Hypothesis 3.1b: There are positive backward FDI linkages on the productivity of Vietnamese firms

3.3.2 Domestic Firms' Characteristics and Spillover Effects

A firm's size may influence its capacity to acquire benefits from the presence of multinational firms. Aitken and Harrison (1999) confirm that large companies are more likely to handle the 'market stealing' effect of foreign firms. Sinani and Meyer (2004) find that large local firms with higher profitability are more likely to exploit and adopt the latest techniques and technologies introduced by foreign firms than smaller domestic firms. On the other hand, the limited employment and production within small firms may not have

sufficient scale to obtain and imitate technologies from foreign firms. However, Acs and Audretsch (1990) argue that smaller firms are more likely to seize opportunities outside rather than using their own research and development (R&D) and innovation as large firms. Acs and Audretsch (1994) also find small firms earn more comparative advantages by adopting and imitating outside technologies while large firms tend to exploit knowledge created within their own firm. Thus, to clarify the impact of firm size on FDI spillovers, this research hypothesises:

Hypothesis 3.2a: Large firms' size gains more productivity spillovers from FDI than small firms

In terms of ownership structure, it is expected that FDI spillovers bring benefits to different types of firms in Vietnam. According to Perotti, Sun and Zou (1999), the differences in property structures between state-owned enterprises and non-state-owned enterprises lead to different behaviours and performances. On the one hand, state-owned enterprises which are technologically well-equipped, can maximise profit and face competitive labour markets. Furthermore, state-owned enterprises are also prioritised to access output markets, land, and credit sources because they hold a favoured position in Viet Nam's "socialist market economy" (Hakkala and Kokko 2008). On the other hand, Hale and Long (2006) argue that private and other types of firms can attract highly productive workers and gain technology spillovers from FDI. By separately analysing three different type of ownership structures (state-owned, private and collective firms), this chapter examines how FDI spillovers affect each type of institutional settings by proposing the following hypothesis:

Hypothesis 3.2b: The difference in ownership structure of domestic firms has an impact on productivity spillovers from FDI

3.3.3 Productivity and Competition

The earlier section 3.2.1 states that demonstration effects, labour turnover and competition are three main channels of productivity spillovers. Most of the previous studies consider the spillover mechanism as a 'black box' with the assumption that foreign firms' presence automatically create productivity spillovers to domestic firms and ignore the

existence of different channels of productivity spillovers (Gorg and Strobl, 2005). Only a few studies strive to explicitly clarify some of these channels, such as Fosfuri, Motta and Ronde (2001), Gorg and Strobl (2005), Balsvik (2011) and Poole (2013) via labour turnover and Cheung and Lin (2004) via research and development. Due to the unavailability of data of all three channels, research in this chapter is particularly interested in the competition channel. Aitken and Harrison (1999) state that competition results in negative productivity spillovers in the short term and positive spillovers in the long term for domestic firms since the average cost of production for local firms may increase through 'market stealing' by foreign firms, which benefit from a lower marginal cost. This leads to a decrease in the productivity of domestic firms. Nevertheless, the productivity of domestic firms can be likely improved in the long term because all initial costs are settled, and these local firms also adopt foreign firms' knowledge and technologies. Based on the above arguments, the following hypothesis is proposed:

Hypothesis 3.3: There are positive productivity spillovers through competition

3.3.4 FDI Spillover and Source of Productivity Growth

Previous empirical studies merely focus on the degree of FDI spillover effects and assume that productivity benefits from FDI are solely due to technology transfer. Girma and Gorg (2007) argue that decomposing productivity growth into its component parts is usually ignored due to there being little guidance on measuring technical and scale efficiencies separately. By offering a parametric decomposition of productivity growth, Orea (2002) confirms that it is probable to depict the benefits from FDI spillover through each element of productivity growth - technological progress (*TP*), technical efficiency change (*TC*) and scale efficiency change (Scale). Smeets (2008) states that FDI spillover effects should consider not only new technology but also new knowledge. Therefore, this chapter extends the analysis into the productivity growth effect, which includes the productivity index (*TFPgrowth*, *TP*, *TC* and Scale) by proposing the following hypothesis:

Hypothesis 3.4: There are positive FDI spillovers to each element of productivity growth (technological progress, technical efficiency and Scale)

3.4 Research Methodology

3.4.1 Stochastic Frontier Approach

Previous empirical studies have predominantly focused on the productivity advantages of technology transfers through FDI spillovers, based on a traditional production function, i.e. the Cobb-Douglas method. Non-parametric approaches such as Data Envelopment Analysis (DEA) and parametric approaches including Stochastic Frontier Analysis (SFA) are two common methods to measure both efficiencies and productivity in literature. Seo and Shin (2011) state that Stochastic Frontier Analysis is preferred over other approaches because it allows random deviations from the production frontier in case of factors beyond the control of producers. Specifically, the error term in the Stochastic Frontier Analysis is separated into a random noise element (unexplained) and an inefficiency element, that deterministic frontier models are not able to do.

Following Battese and Coelli (1995), a general linear form of a stochastic frontier function can be specified as:

$$y_{it} = f(x_{it};\, \beta) + \varepsilon_{it}, \tag{3.1}$$

$$\varepsilon_{it} = v_{it} - u_{it}, \qquad u_{it} \geq 0, i = 1, 2, \dots, N; t = 1, 2, \dots, T \tag{3.2}$$

where:

y_{it} denotes the production of firm *i* in the period time *t*;

x_{it} implies a (*1* × *k*) vector of known function of production inputs (explanatory variables) used by firm *i* at time *t*;

β is a (*k* × *1*) vector of unknown parameters; and

ε_{it} represents the error term, also known as the composed error term.

The error term includes two components: random error (v_{it}) and technical inefficiency effect (u_{it}). The vector of random errors is assumed to be independently distributed of the technical inefficiency term.

The technical inefficiency effects (u_{it}) can be further expressed as:

$$u_{it} = z_{it}\delta + \omega_{it} \quad (3.3)$$

where:

z_{it} is a ($1 \times j$) vector of non-stochastic explanatory variables affecting technical inefficiency function;

δ describes a ($j \times 1$) vector of unobservable parameters; and

ω_{it}denotes unobservable random variable which is also known as a truncated random variable of normal distribution with zero mean and variance σ^2.

The stochastic frontier and inefficiency function can be estimated simultaneously by applying maximum likelihood estimation (MLE). The likelihood function of the model is derived by the distributional assumptions and estimating the parameters by maximizing the log-likelihood function. Otherwise, firm-specific technical efficiency (TE) illustrates how far a sample lags behind best practice as represented by the frontier function.

$$\widehat{TE_i} = \exp(-\widehat{u_i}),\ i = 1, 2, \ldots, N \quad (3.4)$$

See and Coelli (2012) find that the traditional two-step stochastic frontier method can lead to potential bias due to the lack of consistency in assumptions about the distribution of the inefficiencies. The efficiency score is assumed to be normal, independent and distributed in stage one but not to be distributed in stage two. Furthermore, the omission of the efficiency-changing variables in stage one leads to under-dispersion and this causes bias downwards from the second stage regressions. Consequently, research in this chapter adopts the single-step stochastic frontier model of Battese and Collie (1995) which only allows for the estimation of inefficiency determinants and avoids any problems of inconsistency.

3.4.2 Empirical Models

(a) Stochastic production frontier

This chapter adopts the SFA model of Battese and Coelli (1995) to estimate the relationship between FDI spillovers and firms' productivity through effects on technical efficiency. Assuming the production frontier takes the form of the transcendental logarithm (translog) production function with three input variables, labour, capital and input materials, then Equation (3.1) and Equation (3.2) can be expressed as:

$$lnY_{it} = \beta_0 + \beta_K lnK_{it} + \beta_L lnL_{it} + \beta_M lnM_{it} + \frac{1}{2}(\beta_{KK}[lnK_{it}]^2) + \frac{1}{2}(\beta_{LL}[lnL_{it}]^2) + \frac{1}{2}(\beta_{MM}[lnM_{it}]^2) + \beta_{KL}[lnK_{it} * lnL_{it}] + \beta_{KM}[lnK_{it} * lnM_{it}] + \beta_{LM}[lnL_{it} * lnM_{it}] + \beta_t t + \frac{1}{2}(\beta_{tt} t^2) + \beta_{Kt}[lnK_{it} * t] + \beta_{Lt}[lnL_{it} * t] + \beta_{Mt}[lnM_{it} * t] + v_{it} - u_{it} \quad (3.5)$$

where Y_{it} indicates the output of firm *i* at time *t*, and *K*, *L* and *M* are three input variables: capital, labour and material, respectively.

To measure the FDI spillover effects on firms' productivity in the SFA model, spillover variables (horizontal spillovers and backward linkages) and other exogenous variables (g) influencing technical inefficiency are included in the inefficiency function. Therefore, the model of inefficiency function from Equation (3.3) above can be re-written as:

$$u_{it} = Spillover_{it}\tau + g_{it}\delta + \omega_{it} \quad (3.6)$$

(b) Malmquist productivity decomposition

The Malmquist productivity index was suggested by Caves et al. (1982). This index is defined as a ratio between the Malmquist output and input quantity index (Bjurek, 1996). In this chapter, the Malmquist index is employed in this research to separate total factor productivity growth (*TFPgrowth*) into three components: technical efficiency change (*TC*), technological progress (*TP*) and scale efficiency change (*Scale*).

Following Battese and Coelli (1995) and Suyato, Salim and Bloch (2009), the model is developed as:

$$TFPgrowth_i^{t,t+1} = TC_i^{t,t+1} + TP_i^{t,t+1} + Scale_i^{t,t+1} \quad (3.7)$$

where:

$$TC_i^{t,t+1} = \ln D_o\,(y_{i,t+1},\, x_{i,t+1},\, t+1) - \ln D_o\,(y_{it},\, x_{it},\, t) \quad (3.8)$$

$$TP_i^{t,t+1} = \frac{1}{2}\left[\frac{\delta \ln Do\,(y_{i,t+1}, x_{i,t+1}, t+1)}{\delta(t+1)} + \frac{\delta \ln Do\,(y_{it}, x_{it}, t)}{\delta t}\right] \quad (3.9)$$

$$Scale_i^{t,t+1} = \frac{1}{2}\sum_{n=1}^{N}\left[\frac{\varepsilon_{i,t+1}-1}{\varepsilon_{i,t+1}}\varepsilon_{i,t+1,n} + \frac{\varepsilon_{i,t}-1}{\varepsilon_{i,t}}\varepsilon_{i,t}\right].\ln\left[\frac{x_{i,t+1,n}}{x_{itn}}\right] \quad (3.10)$$

and where:

$TFPgrowth_i^{t,t+1}$ is a generalised output-oriented Malmquist productivity growth index between time period *t* and *t+1*;

y_{it} is the production of firm *i* in the period time *t*;

x_{it} implies a (1 x *k*) vector of explanatory variables;

$D_o\,(y_{it,}, x_{it}, t)$ is a translog output-oriented distance function; and

ε_{it} is the scale elasticity.

To test the impact of FDI spillovers on productivity growth and its components, the research in this chapter follows two steps. In step one, technical efficiency change, technological progress, scale efficiency change, and productivity growth are estimated by using Equations (3.7), (3.8), (3.9) and (3.10) above. In the second step, spillover variables (horizontal spillovers and backward linkages) and other variables (*OV*) contributing to productivity growth are regressed against each source of productivity growth:

$$TFPgrowth_i^{t,t+1} = \alpha_i + Spillover_{it}\beta + OV_{it}\,\delta + \varphi_{it} \quad (3.11)$$

where:

i is firm *i* at period time *t*;

α, β and δ denote parameters and vectors of parameters to be estimated; and

φ is an error term.

3.4.3 Data and Variables

Research in this chapter employs the annual enterprise surveys dataset of the General Statistics Office of Vietnam (GSO). The annual enterprise survey has been implemented by the GSO in 2000. This annual enterprise survey is for both state and non-state enterprises in Vietnam. The main contents of the survey include both financial and nonfinancial information about enterprises. The basic nonfinancial information contains identification code, industrial classification, location and year of establishment; while financial information contains property structure, sales, output, labour, total costs, capital, investment, location, ownership and others.

As argued by Kathuria (2000), using the sample of all firms can estimate the efficiency and inefficiency from a lowest to highest efficient firms. Therefore, this chapter covers the sample of an unbalanced panel data of all industrial sectors from 2000 to 2014 which includes 1,264,765 domestic firms and 51,351 foreign firms.

Following Le and Pomfret (2011), foreign firms are defined as those with foreign ownership greater than zero per cent. These include both joint ventures and 100 per cent foreign-invested firms. Domestic firms comprise state-owned enterprises, collective establishments, private firms and others. Additionally, the industrial sectors are classified to the fourth-digit level of the Vietnamese Standard Industrial Classification (VSIC)[11].

Two sets of variables are used in this chapter to examine the effects of FDI spillovers on Vietnamese firms' productivity.

With reference to the translog production function in Equation (3.5) above, there are three inputs and one output. Generally, output value of a firm can be taken directly from the annual surveys of the GSO. However, output values of all firms in all industrial sectors are unavailable to collect for research in this chapter. Thus, the output variable Y_{it} is calculated by the total revenues/sales of firm *i* in period time *t*. Nguyen et al. (2008) and Pham (2012) also employ the sales of firms to measure the output of firms and consider it as a better case when a firm's output comes from not only the manufacturing process but also investment or other business activities. The input variable, L_{it} is represented by the

[11] Vietnam Standard Industrial Classification (VSIC) was built by the General Statistics Office (GSO) on the basis of the International Standard Industrial Classification passed by United Nation Statistical Division and the Draft ASEAN Common Industrial Classification (ACIC). It comprises of five levels, including 21 first-level sectors, 88 second-level sectors, 242 third-level sectors, 437 fourth-level sectors, and 642 fifth-level sectors.

total number of employees. Following Blomstrom and Sjoholm (1999) and Anwar and Nguyen (2013) studies, which consider the book value to calculate the capital stock, this chapter measures capital variable - K_{it} by total book value of fixed assets in firm *i* at the end of the year. Bitzer and Gorg (2009) calculate materials as the difference between gross output and value added. In Suyanto, Bloch and Salim (2012), material inputs are taken directly from the annual survey of the Indonesian Central Board of Statistics. Due to the inadequate data of all expenditures for production, the research in this chapter assumes that total expenditures comprise material and labour payments. The third input variable, M_{it} is measured by total revenues minus total profit, adjusted by total salaries.

The second set of variables includes FDI spillover variables and other control variables as stated in Equation (6.11) above. A horizontal spillover variable indicates the degree of FDI spillovers on domestic firms in the same sector/market. Following from Blalock and Gertler (2008), Grima, Gorg and Pisu (2008) and Wang (2010), horizontal spillover is measured as:

$$h\_spillover_{jt} = \frac{\sum_{\forall i \in j} FO\_dummy_{it} * Y_{it}}{\sum_{\forall i \in j} Y_{it}} \quad (3.12)$$

where:

$h\_spillover_{jt}$ indicates the horizontal spillover in industry *j* at time *t*;

Y_{it} is total sales of firm *i* at time *t*;

FO_dummy is a foreign ownership dummy variable which takes value of 1 if a firm has foreign ownership and is otherwise 0 if a firm is domestic firm;

i and *j* imply *i*th firm in the *j*th industry respectively; and

$\forall i \in j$ illustrates a firm in a given sector.

The vertical backward linkage (*b_spillover)* describes the impact of foreign existence in industry *j* which is supplied by other industries at time *t*. This ratio measures the interaction between foreign firms and their domestic suppliers and it is calculated as:

$$b\_spillover_{jt} = \sum_{\forall i \in j} \alpha_{jrt} * h\_spillover_{rt} \quad (3.13)$$

where α_{jrt} represents the proportion of sector *r*'s output that is supplied to sector *j*, which is taken from input-output table (General Statistics Office of Vietnam, 2012).

The Herfindahl index (*H_index*), measures the level of concentration in an industry *j*. An increase in the Herfindahl index implies a high degree of industry concentration and a decrease in competition. It is computed as:

$$H\_index_{jt} = \sum_{i=1}^{n} \left(\frac{x_{ijt}}{X_{jt}}\right)^2 \quad (i = 1, 2, \dots, n) \tag{3.14}$$

where x_{ijt} denotes the sales of domestic firm *i* in industry *j* at time *t*, and X_{jt} is the total sales of industry *j*. An increase in the Herfindahl index indicates a high degree of industry concentration and this leads to less competition in the industry.

The age of firms can demonstrate their capacity for obtaining the productivity spillovers from foreign presence. Thus, this chapter also includes a firm age variable (*age*), which reflects the age of the firm in the year of the survey. It is calculated by the difference between the year of the survey and the year of establishment.

3.5 Summary Statistics and Correlation Matrix

Table 3.1 below illustrates the summary statistics of the panel dataset over the period 2000 - 2014. The production variables (sales of firm, labour, capital and materials) are computed as the natural logarithm of their original values.

Table 3. 1: Summary statistics of variables

Variable	Obs	Mean	SD	Min	Max
lnY	1,316,116	22.0041	1.9252	17.7858	26.7142
lnK	1,316,116	20.5212	1.8422	16.5236	24.8346
lnL	1,316,116	2.4643	1.2961	0.6931	5.6276
lnM	1,316,116	21.6919	2.1290	16.3004	26.9585
FO_dummy	1,316,116	0.0390	0.1936	0	1
h_spillover	1,316,116	0.1165	0.1858	0	0.7922
b_spillover	1,316,116	0.1075	0.1812	0	0.8002
H_index	1,316,116	0.0390	0.0387	0.0056	0.1212
Age	1,316,116	4.1518	3.8854	0	13

Note: The table reports summary statistics of variables over the period from 2000 to 2014 of all Vietnamese firms. *lnY*, proxy for output of a firm, is measured by the natural log value of total revenue of a firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. The capital intensity, *lnK*, is denoted by the natural value of the total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures, is computed by the natural log value of total sales minus total profit, adjusted by total salaries. Foreign ownership, *FO_dummy*, is a dummy variable which takes value 1 if the share of foreign ownership is greater than zero per cent and zero if otherwise. *h_spillover*, proxy for FDI horizontal spillover, is measured by the share of foreign firms' output over total output of industry. FDI backward linkage, *b_spillover*, is equal to *h_spillover* ratio multiplied by the proportion of the total output of a sector supplied by another sector. *H_index* is a measure of concentration of a sector. Age of firm (*age*) is computed by the difference between year of survey and year of establishment.

The average firm output (natural log of sales) is 22.004, with a standard deviation of 1.925. The average value of capital variable (measured by the natural log of total book value fixed assets of the firm) is 20.521 and the standard deviation is 1.842. The labour variable, which measures the natural log of total number of employees, is low, with an average value of 2.464 and a standard deviation of 1.296. The average value of input materials, which is computed by the natural log of total revenues minus total profit, adjusted by total salaries, is 21.691 and a standard deviation is 2.129, indicating the high expenditures on production function.

The low mean value of the foreign ownership variable (*FO_dummy*), at 0.039 per cent, implies small number of foreign firms in comparison with a significant number of domestic firms. The mean value of FDI horizontal spillover (*h_spillover*) variable (0.117 per cent) is higher than FDI backward linkage (*b_spillover*) variable (nearly 0.108 per cent). The lower mean of backward ratio than horizontal ratio is because of the presence of foreign firms in the role of competitors in the same industries being much larger than the supply chain from foreign invested firms to domestic suppliers. The high mean (4.152 per cent) and standard deviation (3.885) of *age* variable are due to the large difference between old and new establishments.

Table 3.2 below illustrates the correlation matrix of variables. The output of firms (*lnY*) and input materials (*lnM*) are positively related with horizontal (*h_spillover*), backward (*b_spillover*) and the concentration of industry (*H_index*). Labour (*lnL*) and capital (*lnK*)

variables are positively correlated with the *H_index* variable. Firm age (*age*) variable is found to be positively correlated with *FO_dummy*, *h_spillover*, *b_spillover* and *H_index* ratio. The variable *h_spillover* and *b_spillover* have high correlations and therefore they do not appear in the same regression.

Table 3. 2: Correlation matrix of variables

Variable	*lnY*	*lnL*	*lnK*	*lnM*	*FO_dummy*	*h_spillover*	*b_spillover*	*H_index*	*age*
lnY	1.0000								
lnL	0.5354	1.0000							
lnK	0.3230	0.3211	1.0000						
lnM	0.6716	0.5016	0.2881	1.0000					
FO_dummy	0.1883	0.2270	0.2865	0.1744	1.0000				
h_spillover	0.0572	0.1430	0.2776	0.0512	0.3291	1.0000			
b_spillover	0.0844	0.1401	0.2715	0.0773	0.3345	0.9399	1.0000		
H_index	0.0257	0.0460	0.0704	0.0221	0.1073	0.2488	0.2302	1.0000	
age	0.1845	0.1842	0.2662	0.1644	0.0541	0.0450	0.0412	0.0446	1.0000

Note: The table describes the correlation coefficient of variables from 2000 to 2014 of all Vietnamese firms. *lnY*, proxy for output of firm, is measured by the natural log value of total revenue of firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of total number of employees in a firm at the end of the year. The capital intensity, *lnK*, is denoted by the natural value of the total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures, computed by the natural log value of total sales minus total profit, adjusted by total salaries. Foreign ownership, *FO_dummy*, is a dummy variable which takes value 1 if the share of foreign ownership is greater than zero per cent and zero if otherwise. *h_spillover*, proxy for FDI horizontal spillover, is measured by the share of foreign firms' output over the total output of industry. FDI backward linkage, *b_spillover*, is equal to *h_spillover* ratio multiplied by the proportion of the total output of a sector, which is supplied by another sector. *H_index* is a measure of concentration of a sector. Age of firm (*age*) is computed by the difference between year of survey and year of establishment.

3.6 Empirical Results and Discussion

3.6.1 Foreign Firms and Productivity Spillovers

(a) The estimation of horizontal spillovers on productive- efficiency level

This section estimates the impacts of FDI horizontal spillovers on Vietnamese firms' productivity by employing the SFA model of Battese and Collie (1995). The estimation results of different production function forms are reported to find the most appropriate production function form for this chapter. The FDI horizontal spillover variable is included in the inefficiency function and is considered as a contributing factor, together with other specific variables of firms.

Table 3.3 below illustrates the alternative function forms of the translog production function which are tested under a number of null hypotheses. They are Hicks-neutral, no-technological progress, and no-inefficiency production function. The null hypothesis of $\beta_{tK} = \beta_{tL} = \beta_{tM} = 0$ implies that the Hicks neutral technological progress is the main contribution to the production frontier. Otherwise, the null hypothesis of $\beta_{tK} = \beta_{tL} = \beta_{tM} = \beta_t = \beta_{tt} = 0$ indicates there is no technological progress in the production function while the null hypothesis of $\lambda = \delta_0 = \delta_F = \delta_h = \delta_a = 0$ demonstrates the no-inefficiency effect. The results indicate that alternative function models are apparently inadequate to represent the data. In other words, the translog production function is more appropriate than other models. The results also confirm that the inefficiency effects from the explanatory variables are significantly different from zero.

Table 3. 3: Alternative models of stochastic production frontier tests

Test	***Null hypothesis (H_0)***	χ^2	**Conclusion**
Hicks neutral	$\beta_{tK} = \beta_{tL} = \beta_{tM} = 0$	26,900,000	Reject H_0
No-technological progress	$\beta_{tK} = \beta_{tL} = \beta_{tM} = \beta_t = \beta_{tt} = 0$	26,200,000	Reject H_0
No-inefficiency	$\lambda = \delta_0 = \delta_F = \delta_h = \delta_a = 0$	24,200,000	Reject H_0

Table 3.4 below illustrates the estimates of the stochastic frontier production function for Vietnamese firms over the period 2000-2014. Model 1 is a translog production function which is expressed by Equation (5.5) while models 2, 3, and 4 are Hicks-neutral, no-

technological progress and no-inefficiency function respectively[12]. The maximum likelihood time-varying inefficiency effects model 'BC95' (Battese and Collie, 1995) is employed to test the FDI spillovers impact on firm productivity. This model is chosen because it allows for a single stage estimation of each function, i.e. production function and inefficiency function.

In the translog production function reported in Table 3.4 below, the coefficients of capital and input materials are negatively significant while the labour variable is positive and significant. This implies the dominant roles of labour turnover between foreign firms and domestic firms suggesting that a large share of skilled workers contribute to the productivity growth of domestic firms over the full sample period. The coefficient of the interaction between capital and labour variable (*lnKlnL*) is also positive and significant at the 1 per cent level. This is in accordance with Suyanto and Salim (2009) who state that the positive and significant coefficient of the interaction between capital and labour (*lnKlnL*) variable implies substitution effect between these two variables. In contrast, the estimated coefficients of the interaction between capital and input material (*lnKlnM*), and between labour and material (*lnLlnM*) are negatively significant at the 1 per cent level. In a study of Indonesian garment and electronics manufacturing sectors, Suyanto, Bloch and Salim (2012) also find the negative and significant interaction between labour and materials and between capital and materials variables. These negative values indicate a diminishing contribution of the interaction variables between capital and input material and between labour and material to the final output.

[12] Hick-neutral: $lnY_{it} = \beta_0 + \beta_K lnK_{it} + \beta_L lnL_{it} + \beta_M lnM_{it} + 1/2(\beta_{KK}[lnK_{it}]^2) + 1/2(\beta_{LL}[lnL_{it}]^2) + 1/2(\beta_{MM}[lnM_{it}]^2) + \beta_{KL}(lnK_{it} * lnL_{it}) + \beta_{KM}(lnK_{it} * lnM_{it}) + \beta_{LM}(lnL_{it} * lnM_{it}) + \beta_t t + 1/2(\beta_{tt} t^2) + v_{it} - u_{it}$

No-technological progress: $lnY_{it} = \beta_0 + \beta_K lnK_{it} + \beta_L lnL_{it} + \beta_M lnM_{it} + 1/2(\beta_{KK}[lnK_{it}]^2) + 1/2(\beta_{LL}[lnL_{it}]^2 + 1/2(\beta_{MM}[lnM_{it}]^2) + \beta_{KL}(lnK_{it} * lnL_{it}) + \beta_{KM}(lnK_{it} * lnM_{it}) + \beta_{LM}(lnL_{it} * lnM_{it}) + v_{it} - u_{it}$

No-inefficiency function: $lnY_{it} = \beta_0 + \beta_K lnK_{it} + \beta_L lnL_{it} + \beta_M lnM_{it} + v_{it}$

Table 3. 4: Maximum likelihood estimation of stochastic production function (horizontal spillover effects)

Variables	Parameters	Model 1	Model 2	Model 3	Model 4
Production function					
Constant	β_0	11.3684***	12.4482***	12.7399***	2.8743***
		(0.0401)	(0.0400)	(0.0407)	(0.0048)
lnK	β_K	-0.0060*	-0.0341***	-0.0087***	0.0582***
		(0.0032)	(0.0034)	(0.0033)	(0.0002)
lnL	β_L	0.5018***	0.3875***	0.4319***	0.0538***
		(0.0036)	(0.0034)	(0.0034)	(0.0003)
lnM	β_M	-0.0378***	-0.0510***	-0.0895***	0.8440***
		(0.0027)	(0.0027)	(0.0028)	(0.0002)
lnK2	β_{KK}	0.0221***	0.0312***	0.0296***	
		(0.0002)	(0.0002)	(0.0002)	
lnL2	β_{LL}	0.0178***	0.0208***	0.0258***	
		(0.0004)	(0.0004)	(0.0004)	
lnM2	β_{MM}	0.0705***	0.0680***	0.0689***	
		(0.0001)	(0.0002)	(0.0002)	
lnKlnL	β_{KL}	0.0078***	0.0030***	0.0003*	
		(0.0002)	(0.0002)	(0.0002)	
lnKlnM	β_{KM}	-0.0227***	-0.0260***	-0.0250***	
		(0.0001)	(0.0001)	(0.0001)	
lnLlnM	β_{LM}	-0.0289***	-0.0196***	-0.0203***	
		(0.0002)	(0.0002)	(0.0002)	
t	β_t	0.1218***	0.0279***		
		(0.0013)	(0.0005)		
tt	β_{tt}	-0.0006***	-0.0005***		
		(0.0001)	(0.0000)		
tlnK	β_{tK}	0.0065***			
		(0.0001)			
tlnL	β_{tL}	-0.0003***			
		(0.0001)			
tlnM	β_{tM}	-0.0104***			
		(0.0001)			
Inefficiency function					
Constant	δ_0	-9.9724***	-10.4526***	-13.2163***	
		(0.1413)	(0.1736)	(0.1902)	
FO_dummy	δ_F	0.7180***	2.4487***	3.0825***	
		(0.0917)	(0.0782)	(0.0963)	
h_spillover	δ_h	1.6712***	3.3622***	7.0625***	
		(0.0955)	(0.1052)	(0.1502)	
Age	δ_a	-0.1660***	-0.1620***	-0.6052***	
		(0.0061)	(0.0063)	(0.0143)	
Lambda	λ	3.8243***	3.7105***	4.0367***	
		(0.0027)	(0.0107)	(0.0106)	
Log-likelihood		-620,600	-636,600	-660,200	-779,800
Observations		1,316,116	1,316,116	1,316,116	1,316,116

Note: lnY, proxy for output of firm, is measured by the natural log value of the total revenue of firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. The capital intensity, *lnK*, is denoted by the natural value of the total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures, is computed by the natural log value of total sales minus total profit, adjusted by total salaries. Foreign ownership, *FO_dummy*, is a dummy variable which takes value 1 if the share of foreign ownership is greater than zero per cent and zero if otherwise. *h_spillover*, proxy for FDI horizontal spillover, is measured by the share of foreign firms' output over total output of industry. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishment.

Also, in Table 3.4, the coefficient of time (*t*) variable is reported to be significantly positive at 1 per cent level while the square (*tt)* variable is negative. The different sign between *t* and *tt* variables suggests that the output elasticity is declining over the sample period. The movement of the production frontier over time is expressed through the interaction between the time variable and the values of various input variables (labour, capital and others) (Suyanto and Salim, 2009). This movement is positive (technological progress) or negative (technological regress) depending on the values of input variables and *t*. In this study, the interacting variable's coefficient between *t* and labour, and *t* and input materials have negative signs while the interaction between *t* and capital is positive at 1 per cent level. This finding is in accordance with Suyanto, Salim and Bloch (2012) who find positively significant interaction variable *tlnK* and negatively significant interaction variables *tlnL* and *tlnM*. These results indicate that the dominant factor contributing to the technological progress is capital. In other words, capital plays a primary role in the movement of the production frontier over time.

In the inefficiency function, the *FO_dummy* variable is significantly positive at the 1 per cent level, which suggests that the presence of foreign firms is more inefficient than domestic firms (Suyanto and Salim, 2009). Similarly, the *h_spillover* variable is positive and significant, illustrating the inefficient effect of foreign presence on domestic firms within the same industry. This result is consistent with Le and Pomfret (2011) who measure horizontal spillovers to Vietnamese manufacturing sectors using the Cobb-Douglas production function. This negative effect can be explained by the fact that the presence of foreign firms, which possess better technologies and updated knowledge, lead to higher competition effects than local firms. In other words, these advantages allow foreign firms to attract market demand away from local firms. Thus, to protect themselves from 'market

stealing', local firms are forced to increase their average costs through new technology investment, workers' training or changes in production process etc. and this results in a decrease in their productivity. This result is in accordance with the studies of Aitken and Harrison (1999), Djankov and Hoekan (1998), Konings (2001), Haskel et al. (2002), Yudaeva et al (2003), Kosova (2004), Libsey and Sjoholm (2005), Abraham, Konings and Slootmaekers (2006) and Liu (2008) who confirm the negative spillover effects from foreign firms to domestic firms within an industry or sub-sector in developing countries.

The coefficient of the age variable is negative and significant, indicating that older firms achieve lower inefficiency than newer firms. In other words, the older establishments with better financial situation and experiences are more efficient at adopting knowledge and technologies from multinationals than newer firms. This finding is in accordance with Teece (1977), Chen and Tang (1987) and Balcombe et al. (2008). However, the correlation between age and technical efficiency is still ambiguous in the literature. Arrow (1962), Malerba (1992), Salim (2009) and Suyanto, Bloch and Salim (2012) find a positive correlation between older firms and technical efficiency while Teece (1977), Chen and Tang (1987) and Balcombe et al. (2008) confirm a negative relationship. Kathuria (2001) and Jacob (2006) find insignificant effects between age and technical efficiency.

(b) The estimation of backward linkages and productive-efficiency level

This next section examines the relationship between backward linkages and Vietnamese firm productivity. To test a hypothesis of FDI backward linkages on technical efficiency, FDI backward linkage variable is incorporated in the inefficiency function. Le and Pomfret (2011) find that backward linkage is a very important channel of FDI spillovers as foreign firms are willing to share their technology and knowledge to local suppliers. Otherwise, local suppliers may also benefit from the labour turnovers provided by foreign firms. Thus, it is expected that greater amount of backward linkages from foreign presences will increase the productivity of domestic firms in Vietnam.

Table 3. 5: Maximum likelihood estimation of stochastic production function (backward linkage effects)

Variables	Parameters	Model 1	Model 2	Model 3	Model 4
Production function					
Constant	β_0	10.4546***	12.8151***	12.6582***	2.8743***
		(0.0413)	(0.0401)	(0.0407)	(0.0048)
lnK	β_K	-0.1468***	-0.0567***	-0.0180***	-0.0582***
		(0.0034)	(0.0033)	(0.0033)	(0.0002)
lnL	β_L	0.6675***	0.4132***	0.4315***	0.0538***
		(0.0037)	(0.0034)	(0.0034)	(0.0003)
lnM	β_M	0.1471***	0.0651***	0.0739***	0.8440***
		(0.0028)	(0.0027)	(0.0028)	(0.0002)
lnK2	β_{KK}	0.0285***	0.0319***	0.0301***	
		(0.0002)	(0.0002)	(0.0002)	
lnL2	β_{LL}	0.0150***	0.0206***	0.0265***	
		(0.0004)	(0.0004)	(0.0004)	
lnM2	β_{MM}	0.0591***	0.0682***	0.0683***	
		(0.0001)	(0.0002)	(0.0002)	
lnKlnL	β_{KL}	-0.0022***	-0.0021***	-0.0004**	
		(0.0002)	(0.0002)	(0.0002)	
lnKlnM	β_{KM}	-0.0202***	-0.0256***	-0.0250***	
		(0.0001)	(0.0001)	(0.0001)	
lnLlnM	β_{LM}	-0.0268***	-0.0199***	-0.0203***	
		(0.0002)	(0.0002)	(0.0002)	
t	β_t	0.1207***	0.0276***		
		(0.0014)	(0.0005)		
tt	β_{tt}	-0.0036***	-0.0004***		
		(0.0001)	(0.0000)		
tlnK	β_{tK}	0.0061***			
		(0.0001)			
tlnL	β_{tL}	-0.0024***			
		(0.0001)			
tlnM	β_{tM}	-0.0089***			
		(0.0001)			
Inefficiency function					
Constant	δ_0	-4.1478***	-15.8446***	-16.9040***	
		(0.0319)	(0.1550)	(0.2886)	
FO_dummy	δ_F	-6.0058	2.7092***	5.5003***	
		(0.0786)	(0.1250)	(0.1477)	
b_spillover	δ_h	-1.1104***	-1.4609***	-5.0335***	
		(0.0578)	(0.1565)	(0.1821)	
Age	δ_a	-0.2002***	-0.1832***	-0.6093***	
		(0.0041)	(0.0084)	(0.0155)	
Lambda	λ	2.0530***	4.6902***	4.5168***	0.1558
		(0.0038)	(0.0083)	(0.0140)	(0.1530)
Log-likelihood		-648,800	-636,500	-660,600	-779,800
Observations		1,316,116	1,316,116	1,316,116	1,316,116

Note: lnY, proxy for output of firm, is measured by the natural log value of the total revenue of firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. The capital intensity, *lnK*, is denoted by the natural value of the total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures and is computed by the natural log value of total sales minus total profit, adjusted by total salaries. Foreign ownership, *FO_dummy*, is a dummy variable which takes value 1 if the share of foreign ownership is greater than zero per cent and zero if otherwise. FDI backward linkage, *b_spillover*, is equal to *h_spillover* ratio multiplied by the proportion of the total output of a sector which is supplied by another sector. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishment.

Table 3.5 above illustrates the results of the estimates of backward linkage effects on technical efficiency. Interestingly, capital variable is negative and significant at the 1 per cent level, while labour and material are positive and significant at the 1 per cent level, implying that the contribution to productivity growth of domestic suppliers are not only labour but also material inputs. The signs and significance of other remaining variables in the production frontier function are similar to those of horizontal spillovers in Table 3.4 above. The interaction variable between *lnK* and *lnM*, and between *lnL* and *lnM* are significantly negative. The negative signs imply a declined contribution of these interaction variables (Suyanto, Bloch and Salim, 2012). The coefficient of variable time *t* is positive and significant while time square *tt* are negative and statistically significant, indicating a decrease in the output elasticity over time. Finally, the interaction variable between *t* and capital is positively significant at 1 per cent whereas the interaction variable between *t* and labour and between *t* and input materials is negative and significant. These results again indicate the contribution of capital to the movement of the production function over the sample period.

In terms of inefficiency function, *b_spillover* is found to be negative and statistically significant at the 1 per cent level, indicating the positive spillover effects from foreign firms to their local suppliers. This finding is in accordance with the studies of Blalock and Gertler (2002), Javorcik (2004), Bitzer et al. (2008), Le and Pomfret (2001) and Du et al. (2012). This result can be explained as follows: Vietnam is a popular developing market where labour and resources are cheaply available. Thus, Vietnam is usually considered as an ideal destination for multinationals. Moreover, foreign firms can benefit by sharing their knowledge and technologies with local suppliers because of the availability of local intermediate goods supplied. As well, domestic suppliers also achieve technical assistance

from foreign firms to help their supplier increase the quality of products. The age variable is negative and statistically significant, suggesting the considerable positive relation between the age of firms and firm efficiencies. Foreign firms prefer older firms as their local suppliers because of better human capital and infrastructures in those older firms.

As argued by Kathuria (2000), the inclusion of the sample of all firms can help to measure the more accurate inefficiency indices from a distance to the most efficient firms. However, the inclusion of foreign firms may affect the estimation of FDI spillovers because foreign firms are obviously more efficient than local firms. To exclude any biased results that may be caused due to the presence of foreign firms in the panel, this study estimates the stochastic production frontier of only domestic firms. The estimation results are illustrated in Table 3.6 and Table 3.7, respectively. The sign and significance of all variables are similar to those for the sample of all firms in Table 3.4 and Table 3.5. This result is not a surprise since the panel sample set of this research is mostly contributed by domestic firms, reaching nearly 96 per cent (1,264,765 out of 1,316,116 observations). The horizontal spillover variable, *h_spillover* is negatively significant whereas the backward spillover variable, *b_spillover* is found to be positively significant, suggesting the unbiased estimation results given in Table 3.4 and Table 3.5.

Table 3. 6: Maximum likelihood estimation of stochastic production function in domestic firms (horizontal spillover effects)

Variables	**Parameters**	**Coefficient**	**Standard Error**
Production function			
Constant	β_0	12.9252***	0.0417
lnK	β_K	-0.1178***	0.0033
lnL	β_L	0.5499***	0.0038
lnM	β_M	-0.0860***	0.0028
lnK2	β_{KK}	0.0265***	0.0002
lnL2	β_{LL}	0.0188***	0.0004
lnM2	β_{MM}	0.0715***	0.0002
lnKlnL	β_{KL}	0.0065***	0.0002
lnKlnM	β_{KM}	-0.0213***	0.0001
lnLlnM	β_{KL}	-0.0300***	0.0002
t	β_t	0.1338***	0.0014
tt	β_{tt}	-0.0008***	0.0001
tlnK	β_{tK}	0.0060***	0.0001
tlnL	β_{tL}	-0.0004***	0.0001
tlnM	β_{tM}	-0.0104***	0.0001

Inefficiency function			
Constant	δ_0	-9.1871***	0.3719
h_spillover	δ_h	2.7700***	0.1797
Age	δ_a	-0.0958***	0.0065
Lamda	λ	3.7201***	0.0245
Log-likelihood		-582,300	
Observation		1,264,765	

Note: lnY, proxy for output of firm, is measured by the natural log value of the total revenue of firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. The capital intensity, *lnK*, is denoted by the natural value of total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures and is computed by the natural log value of total sales minus total profit, adjusted by total salaries. *h_spillover*, proxy for FDI horizontal spillovers, is measured by the share of foreign firms' output over the total output of industry. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishment.

Table 3. 7: Maximum likelihood estimation of stochastic production function in domestic firms (backward spillover effects)

Variables	**Parameters**	**Coefficient**	**Standard Error**
Production function			
Constant	β_0	12.4616***	0.0415
lnK	β_K	-0.0992***	0.0033
lnL	β_L	0.5423***	0.0038
lnM	β_M	0.0604***	0.0028
lnK2	β_{KK}	0.0263***	0.0002
lnL2	β_{LL}	0.0183***	0.0004
lnM2	β_{MM}	0.0711***	0.0002
lnKlnL	β_{KL}	-0.0067***	0.0002
lnKlnM	β_{KM}	-0.0220***	0.0001
lnLlnM	β_{KL}	-0.0297***	0.0002
t	β_t	0.1343***	0.0014
tt	β_{tt}	-0.0007***	0.0001
tlnK	β_{tK}	0.0061***	0.0001
tlnL	β_{tL}	-0.0005***	0.0001
tlnM	β_{tM}	-0.0105***	0.0001
Inefficiency function			
Constant	δ_0	-12.8979***	0.2182
b_spillover	δ_b	-0.0057***	0.1407
Age	δ_a	-0.1295***	0.0072
Lamda	λ	4.5026***	0.0129
Log-likelihood		-581,100	
Observation		1,264,765	

Note: lnY, proxy for output of firm, is measured by the natural log value of total revenue of firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. The capital intensity, *lnK*, is denoted by the natural value of total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures and is computed by the natural log value of total sales minus total profit, adjusted by total salaries. FDI backward linkage, *b_spillover*, is equal to *h_spillover* ratio multiplied by the proportion of the total output of a sector which is supplied by another sector. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishment.

3.6.2 Characteristics of Domestic Firms and Spillover Impacts

Due to the advantages of labour and capitals, large local firms are better able to absorb the latest technologies brought by foreign firms when compared to small local firms. Thus, the size of domestic firms can affect their capacity for adopting the benefits from the presence of foreign firms. According to the OECD report (2017), small and medium enterprises are independent firms with the limitation of capital and employees but make diverse contributions to economic growth and social well-being by creating jobs, bringing about innovation and reducing poverty. In the context of Vietnam, small and medium enterprises achieve over 90 per cent in total of all enterprises and more than half of all employed Vietnamese citizens work in small and medium enterprises (General Statistics Office of Vietnam, 2014). Thus, this chapter analyses the influence of firm size on FDI horizontal and backward spillovers by two different types of size – large firms and small and medium firms. A large firm is defined as one with a total number of employees of more than 100 persons. A small and medium firm is one with fewer than 100 employees.

The result in Table 3.8 below illustrates the horizontal spillover effects on each scale of firm; large, and small and medium enterprises (SMEs). The sign and significance of variables in production function are in accordance with those of Table 3.4 above. In the inefficiency function, horizontal spillovers for large firms appears to be negative and statistically significant while those for SMEs are positive and significant, implying that large firms benefit due to the presence of foreign firms. This finding is in accordance with the results of Aitken and Harrison (1999) and Sinani and Meyer (2004). Le and Pomfret (2011) find the negative significance of horizontal spillovers for SMEs but insignificant effect of horizontal spillovers for large firms. They argue that the less capacity SMEs possesses, the more significant losses they suffer when competing with foreign firms. This

argument is again confirmed through the result of research in this chapter. However, Le and Pomfret (2011) cannot find the evidence of the significance of horizontal spillover variable on productivity of large firms while the result of this chapter confirms the benefits that large firms earn because of the existence of foreign presence. One explanation for this difference may be due to the difference in sample size in these two studies. Research of Le and Pomfret (2011) focuses only on the manufacturing sector while research in this chapter includes all domestic firms of all industrial sectors which may include important variations in spillover effects of different types of industry.

Table 3. 8: Effects of firm size on horizontal productivity spillovers

Variables	**Parameters**	**Large firms**		**SMEs**	
		Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Production function					
Constant	β_0	11.3603***	0.4282	13.3748***	0.0444
lnK	β_K	-0.1389***	0.0164	-0.1262***	0.0035
lnL	β_L	1.0102***	0.1468	0.5522***	0.0050
lnM	β_M	-0.4817***	0.0148	-0.1354***	0.0029
lnK2	β_{KK}	0.0254***	0.0007	0.0262***	0.0002
lnL2	β_{LL}	0.1685***	0.0281	0.0305***	0.0007
lnM2	β_{MM}	0.0470***	0.0007	0.0731***	0.0002
lnKlnL	β_{KL}	0.0390***	0.002	0.0028***	0.0002
lnKlnM	β_{KM}	-0.0276***	0.0006	-0.0199***	0.0001
lnLlnM	β_{LM}	-0.0174***	0.0022	-0.0297***	0.0002
t	β_t	-0.0085***	0.0057	0.1644***	0.0016
tt	β_{tt}	0.0052***	0.0002	-0.0012***	0.0001
tlnK	β_{tK}	0.0082***	0.0002	0.0054***	0.0001
tlnL	β_{tL}	-0.0224***	0.0009	-0.0032***	0.0001
tlnM	β_{tM}	-0.0038***	0.0002	-0.0115***	0.0001
Inefficiency function					
Constant	δ_0	-12.8729***	1.2061	-13.9131***	0.1810
h_pillover	δ_h	-16.6908***	1.8124	2.3128***	0.1429
Age	δ_a	-0.0019	0.0363	-0.1956***	0.0003
Lambda	λ	3.3053***	0.0569	4.6993	0.0104
Log-likelihood		-40,300		-533,900	
Observations		90,854		1,173,911	

Notes: lnY, proxy for output of firm, is measured by the natural log value of total revenue of firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. The capital intensity, *lnK*, is denoted by the natural value of total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures and is computed by the natural log value of total sales minus total profit, adjusted by total salaries. *h_spillover*,

proxy for FDI horizontal spillover, is measured by the share of foreign firms' output over total output of industry. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishment.

Table 3. 9: Impacts of firm size on backward productivity spillovers

Variables	Parameters	Large firms		SMEs	
		Coefficient	Standard Error	Coefficient	Standard Error
Production function					
Constant	β_0	10.8582	0.4276	13.0130***	0.0442
lnK	β_K	-0.1435***	0.0164	-0.1056***	0.0035
lnL	β_L	0.8083***	0.1466	0.5548***	0.0050
lnM	β_M	0.4842***	0.0148	0.1221***	0.0029
lnK2	β_{KK}	0.0259***	0.0007	0.0255***	0.0002
lnL2	β_{LL}	0.1302***	0.0280	0.0307***	0.0007
lnM2	β_{MM}	0.0474***	0.0007	0.0728***	0.0002
lnKlnL	β_{KL}	-0.0395***	0.0023	-0.0027***	0.0002
lnKlnM	β_{KM}	-0.0280***	0.0006	-0.0202***	0.0001
lnLlnM	β_{LM}	-0.0182***	0.0022	-0.0297***	0.0002
t	β_t	-0.0075***	0.0057	0.1649***	0.0016
tt	β_{tt}	0.0052***	0.0002	-0.0011***	0.0001
tlnK	β_{tK}	0.0082***	0.0002	0.0055***	0.0001
tlnL	β_{tL}	-0.0222**	0.0009	-0.0032***	0.0001
tlnM	β_{tM}	-0.0038***	0.0002	-0.0116***	0.0001
Inefficiency function					
Constant	δ_0	-10.4914***	1.0437	-13.0603***	0.2452
b_pillover	δ_b	-16.0552***	1.8326	-0.7539***	0.1438
Age	δ_a	-0.0099	0.0301	-0.1190***	0.0073
Lambda	λ	2.9981***	0.0550	4.5663***	0.0142
Log-likelihood		-40,300		-534,100	
Observations		90,854		1,173,911	

Note: lnY, proxy for output of firm, is measured by the natural log value of total revenue of a firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. The capital intensity, *lnK*, is denoted by the natural value of total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures and is computed by the natural log value of total sales minus total profit, adjusted by total salaries. FDI backward linkage, *b_spillover*, is equal to *h_spillover* ratio multiplied by the proportion of the total output of a sector which is supplied by another sector. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishment.

In the inefficiency function in Table 3.9 above, backward linkage is negative and significant for both types of firms. Large firms, which possess better resource knowledge

and a smaller technology gap, can take the advantages from both horizontal spillovers and backward linkages. SMEs, despite the limitation of capital and infrastructures, have an absorptive capacity still positively associated with the presence of foreign firms. This implies that backward linkage is a very essential channel of FDI spillovers to the productivity of local suppliers. In other words, foreign firms prefer sharing their know-how and technologies to their local suppliers where employment and production function are sufficient to adapt their resources. This result is consistent with those of Le and Pomfret (2011), Lenaerts and Merlevede (2015) who confirm that the main role of large firms' size in absorbing technology spillovers.

Table 3.10 below illustrates the effect of ownership structure of domestic firms on FDI horizontal spillovers. Results indicate that horizontal spillover variable is negative and significant for state-owned firms. This indicates that state-owned enterprises receive benefits from the presence of foreign firms. In contrast, results imply that horizontal spillover variable for private firms is negative and significant at the 1 per cent level, whereas the existence of foreign firms does not impact collective firms and others. Private firms, with the limitation of labour, capital and technology, cannot afford to adopt new technology that allows them to compete with the entry of foreign firms in the same industry while state-owned enterprises are likely to possess more skilled workers and technological capacity. Le and Pomfret (2011) also find that the horizontal spillover effect for private firms is significantly negative. However, they do not find the effects of horizontal spillovers in state-owned enterprises, collective and other firms. Using manufacturing sector data, Le and Pomfret (2011) argue that those types of firms have enough skilled workers and technological capacity to compete with foreign firms; thus, the presence of foreign firm does not affect the productivity of those firms. In view of the research which informs all of the industrial sector in this chapter, state-owned enterprises are found to benefit, suggesting that the productivity of state-owned firms are improved due to the presence of foreign competitors.

The results of ownership structure effects of domestic firms on FDI backward linkages are illustrated in Table 3.11. In the inefficiency function, the results show the negative sign and significance of FDI backward linkages, implying that all stated-owned enterprises, private firms, and collectives and other firms benefit from the backward linkages of foreign

presence. This finding is consistent with the result of Le and Pomfret (2011) who confirm that all types of local firms gain benefits from FDI backward linkages.

Table 3. 10: Ownership structure effects of domestic firms on FDI horizontal spillovers

Variables	Parameters	State-owned firms		Private firms		Collective firms and others	
		Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Production function							
Constant	β_0	10.7553***	0.1319	13.0660***	0.0771	12.0289***	0.0531
lnK	β_K	-0.0521***	0.0119	-0.1362***	0.0064	-0.0570***	0.0041
lnL	β_L	0.3888***	0.0134	0.5423***	0.0085	0.5106***	0.0049
lnM	β_M	-0.1277***	0.0093	-0.0824***	0.0051	-0.0702***	0.0035
lnK2	β_{KK}	0.0251***	0.0008	0.0227***	0.0004	0.0253***	0.0002
lnL2	β_{LL}	0.0217***	0.0018	0.0268***	0.0010	0.0193***	0.0006
lnM2	β_{MM}	0.0622***	0.0006	0.0664***	0.0003	0.0730***	0.0002
lnKlnL	β_{KL}	0.1345***	0.0007	0.0017***	0.0004	0.0078***	0.0002
lnKlnM	β_{KM}	-0.0247***	0.0005	-0.0163***	0.0002	-0.0231***	0.0002
lnLlnM	β_{LM}	-0.0259***	0.0007	-0.0255***	0.0004	-0.0300***	0.0002
t	β_t	0.0040***	0.0039	0.1067***	0.0026	0.1669***	0.0019
tt	β_{tt}	-0.0022***	0.0002	-0.0026***	0.0001	-0.0027***	0.0001
tlnK	β_{tK}	0.0077***	0.0002	0.0058***	0.0001	0.0061***	0.0001
tlnL	β_{tL}	-0.0087***	0.0003	-0.0014***	0.0002	-0.0007***	0.0001
tlnM	β_{tM}	-0.0055***	0.0002	-0.0103***	0.0001	-0.0113***	0.0001
Inefficiency function							
Constant	δ_0	-14.9816***	1.4193	-12.6958***	1.2832	-14.5859***	0.2749
h_pillover	δ_h	-1.4739**	0.6499	6.7260***	0.2486	0.1879	0.1727
Age	δ_a	0.1910***	0.0306	0.1443***	0.0158	-0.1158***	0.0095
Lambda	λ	4.2217***	0.0676	3.3582***	0.0097	4.8317***	0.0157
Log-likelihood		-26,030		-79,800		-463,500	
Observations		74,059		270,965		919,741	

Note: lnY, proxy for output of firm, is measured by the natural log value of total revenue of a firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. The capital intensity, *lnK*, is denoted by the natural value of total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures and is computed by the natural log value of total sales minus total profit,

adjusted by total salaries. *h_spillover*, proxy for FDI horizontal spillover, is measured by the share of foreign firms' output over total output of industry. FDI backward linkage, *b_spillover*, is equal to *h_spillover* ratio multiplied by the proportion of the total output of a sector which is supplied by another sector. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishment.

Table 3. 11: Ownership structure effects of domestic firms on FDI backward spillovers

Variables	**Parameters**	**State-owned firms**		**Private firms**		**Collective firms and others**	
		Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Production function							
Constant	β_0	10.7559***	0.1316	12.0447***	0.0779	12.2922***	0.0532
lnK	β_K	-0.0575***	0.0119	-0.0619***	0.0065	-0.0768***	0.0041
lnL	β_L	0.4076***	0.0134	0.5205***	0.0086	0.5183***	0.0049
lnM	β_M	0.1293***	0.0093	-0.0668***	0.0052	-0.0759***	0.0035
lnK2	β_{KK}	0.0261***	0.0008	0.0202***	0.0004	0.0259***	0.0002
lnL2	β_{LL}	0.0199***	0.0018	0.0261***	0.0010	0.0179***	0.0006
lnM2	β_{MM}	0.0622***	0.0006	0.0667***	0.0003	0.0729***	0.0002
lnKlnL	β_{KL}	-0.0117***	0.0007	-0.0025***	0.0004	-0.0077***	0.0002
lnKlnM	β_{KM}	-0.0250***	0.0005	-0.0171***	0.0002	-0.0228***	0.0002
lnLlnM	β_{LM}	-0.0248***	0.0007	-0.0254***	0.0004	-0.0300***	0.0002
t	β_t	0.0041***	0.0039	0.1284***	0.0026	0.1659***	0.0019
tt	β_{tt}	-0.0021***	0.0002	0.0027***	0.0001	-0.0027***	0.0001
tlnK	β_{tK}	0.0074***	0.0002	0.0053***	0.0001	0.0061***	0.0001
tlnL	β_{tL}	-0.0089***	0.0003	-0.0009***	0.0002	-0.0005***	0.0001
tlnM	β_{tM}	-0.0053***	0.0002	-0.0108***	0.0001	-0.0112***	0.0001
Inefficiency function							
Constant	δ_0	-15.1766***	1.0559	-10.0048***	0.8810	-13.2370***	0.3381
b_pillover	δ_b	-1.3716**	0.6058	-1.2312***	0.2968	-2.1589***	0.2146
Age	δ_a	0.1788***	0.0280	0.1755***	0.0102	-0.1206***	0.0093
Lambda	λ	4.1428***	0.0456	3.1467***	0.0075	4.6093***	0.0205
Log-likelihood		-26,020		-79,690		-463,700	
Observations		74,059		270,965		919,741	

Note: lnY, proxy for output of firm, is measured by the natural log value of total revenue of firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. The capital intensity, *lnK*, is denoted by the natural value of total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures and is computed by the natural log value of total sales minus total profit, adjusted by total salaries. FDI backward linkage, *b_spillover*, is equal to *h_spillover* ratio multiplied by the proportion of the total output of a sector which is supplied by another sector. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishments.

3.6.3 Productivity Spillovers and Competition

This section examines the degree of competition through productivity spillovers. The Herfindahl index (*H_index*), as calculated by Equation (3.14) above, is employed to estimate the degree of competition of each Vietnamese industry. Table 3.12 and Table 3.13 below describe the results of the estimates between the Herfindahl index and its interactions with horizontal spillovers and backward linkages, respectively. The spillover variables which do not interact with the Herfindahl index are eliminated to avoid multi-collinearity.

Table 3. 12: Maximum likelihood estimation of stochastic production function (Herfindahl index and its interaction – horizontal spillovers)

Variables	Parameters	Coefficient	Standard Error
Production function			
Constant	β_0	12.4668***	0.0407
lnK	β_K	-0.1348***	0.0033
lnL	β_L	0.4873***	0.0037
lnM	β_M	-0.0203***	0.0027
lnK2	β_{KK}	0.0273***	0.0002
lnL2	β_{LL}	0.0194***	0.0004
lnM2	β_{MM}	0.0697***	0.0002
lnKlnL	β_{KL}	0.0124***	0.0002
lnKlnM	β_{KM}	-0.0221***	0.0001
lnLlnM	β_{KL}	-0.0326***	0.0002
t	β_t	0.1381***	0.0014
tt	β_{tt}	-0.0011***	0.0001
tlnK	β_{tK}	0.0066***	0.0001
tlnL	β_{tL}	-0.0006***	0.0001
tlnM	β_{tM}	-0.0109***	0.0001
Inefficiency function			
Constant	δ_0	-9.7460***	0.0784
FO_dummy	δ_{FO}	2.3106***	0.0372
H_index	δ_{Hi}	4.4621***	0.2279
HH_index	δ_{HHi}	-15.3105***	0.8303
Age	δ_a	-0.9057***	0.0034
Lamda	λ	2.2265***	0.0085
Log-likelihood		-626,400	
Observation		1,316,116	

Note: lnY, proxy for output of firm, is measured by the natural log value of total revenue of firm at the end of the year. *lnL* implies the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. Capital intensity, *lnK*, is denoted by the natural value of the

total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures and is computed by the natural log value of total sales minus total profit, adjusted by total salaries. Foreign ownership, *FO_dummy*, is a dummy variable which takes a value of 1 if the share of foreign ownership is greater than zero per cent and zero if otherwise. *H_index* is a measure of the concentration of a sector. *HH_index* denotes the interaction between the Herfindahl index and horizontal spillover. It is calculated as *H_index* multiplied by *h_spillover*. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishments

Table 3. 13: Maximum likelihood estimation of stochastic production function (Herfindahl index and its interaction – backward linkages)

Variables	Parameters	Coefficient	Standard Error
Production function			
Constant	β_0	12.2001***	0.0408
lnK	β_K	-0.0904***	0.0033
lnL	β_L	0.5212***	0.0037
lnM	β_M	0.0355***	0.0027
lnK2	β_{KK}	0.0253***	0.0002
lnL2	β_{LL}	0.0180***	0.0004
lnM2	β_{MM}	0.0695***	0.0002
lnKlnL	β_{KL}	-0.0074***	0.0002
lnKlnM	β_{KM}	-0.0217***	0.0001
lnLlnM	β_{KL}	-0.0293***	0.0002
t	β_t	0.1174***	0.0014
tt	β_{tt}	-0.0006***	0.0001
tlnK	β_{tK}	0.0065***	0.0001
tlnL	β_{tL}	-0.0005***	0.0001
tlnM	β_{tM}	-0.0101***	0.0001
Inefficiency function			
Constant	δ_0	-4.2843***	0.0834
FO_dummy	δ_{FO}	1.1015***	0.0384
H_index	δ_{Hi}	4.5425***	0.2449
BH_index	δ_{BHi}	-4.7636***	0.6551
Age	δ_a	-0.0746***	0.0030
Lamda	λ	2.5671***	0.0084
Log-likelihood		-623,600	
Observation		1,316,116	

Note: lnY, proxy for output of firm, is measured by the natural log value of total revenue of the firm at the end of the year. *lnL* represents the workforce, which is calculated by the natural log value of the total number of employees in a firm at the end of the year. Capital intensity, *lnK*, is denoted by the natural value of total book value of fixed assets at the end of the year. *lnM* represents the material input expenditures and is computed by the natural log value of total sales minus total profit, adjusted by total salaries. Foreign

ownership, *FO_dummy*, is a dummy variable which takes a value of 1 if the share of foreign ownership is greater than zero per cent and zero if otherwise. *H_index* is a measure of the concentration of a sector. *BH_index* denotes the interaction between the Herfindahl index and backward linkage. This ratio is calculated as *H_index* multiplied by *b_spillover*. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishments

The results in the production function in Table 3.13 have the same sign and statistical significance as those from Model 1 (*translog* production function) in Table 3.4 above. The parameter of coefficient of the Herfindahl index in the inefficiency function is positive and significant. According to Suyanto, Salim and Bloch (2009), higher concentration means an inverse level of less competition, suggesting that high value of the Herfindahl index creates greater inefficiency. The high concentration found between firms also leads to the increase in inefficiency of firms in an industry. In other words, a decline in concentration (or an increase in competition) causes the growth of Vietnamese firms' productivity or efficiency in that industry. These findings are in accordance with previous studies such as those by Le and Pomfret (2011) and Famita (2016), who find a positive relationship between the level of competition and productivity of firms. The interaction variable between concentration and horizontal spillover variables (*HH_index*) and between concentration and backward spillover variables (*BH_index*) is negative and statistically significant at the 1 per cent level. This suggests a positive correlation between the level of concentration and spillover effects. In other words, a high value of concentration will boost larger spillovers from the foreign presence.

3.6.4 The Estimates of FDI Spillover on Sources of Productivity Growth

This section extends the analysis of FDI spillovers by estimating FDI horizontal spillover and backward linkage effects productivity growth and its sources: technical efficiency changes (*TC*), technological progress (*TP*) and scale efficiency changes (*Scale*). The estimations are undertaken on the full sample of all Vietnamese firms and the four productivity indices (*TFPgrowth, TC, TP* and *Scale*) are used interchangeably as a dependent variable to estimate the spillover effects.

The annual average indices of *TFPgrowth*, technical efficiency change, technological change and scale efficiencies are illustrated in Table 3.14 below. The values of *TC* during the first 10 years of the sample period are persistently low, indicating that this element does

not contribute much to the productivity growth of firms. Nevertheless, the variable *TC* exhibits a considerable increase since 2011, which implies the main contribution of 'learning-by-doing' process or knowledge spillovers to the increase of productivity growth in recent years. Technological progress change, *TP*, appears to be relatively stable during the sample period, suggesting the dominant role of capital and technology in firms in Vietnam. Thus, all firms must update their technology to increase their productivity and competitive advantages. In addition, scale efficiency seems to fluctuate until 2009 and then keeps a constant rate during the remaining sample period, suggesting that this component is not the major reason for the increase of firms' productivity. *TFPgrowth* comprises *TC*, *TP* and *Scale* efficiency components. Therefore, improvement in productivity is contributed to steadily by technological progress over the sample period rather than technical efficiency and scale efficiency. This can be explained by the fact that in the presence of foreign firms, Vietnamese firms protect their competitive advantages by adopting foreign technology. Therefore, domestic firms must demonstrate and imitate the technological knowledge through the disclosure of product and process knowledge from foreign firms.

Table 3. 14: Indices of productivity growth and its decompositions (%)

Year	*TC*	*TP*	*Scale*	*TFPgrowth*(*G*)
2001	0.000010	0.05801	0.067734	0.125755
2002	0.000439	1.037249	0.481798	1.519485
2003	0.001733	1.703281	0.240581	1.945596
2004	0.002084	0.91202	1.694573	2.608677
2005	0.009368	1.459764	1.252819	2.721951
2006	0.011793	1.694009	0.321618	1.027420
2007	0.061573	1.421358	0.294012	1.776943
2008	0.138388	1.275225	0.246538	1.660151
2009	0.318802	1.412533	3.079490	4.810824
2010	0.623384	1.203772	2.352163	4.179319
2011	1.895805	1.183077	2.207534	5.287069
2012	3.880976	1.251822	2.146507	7.279308
2013	10.70859	1.284932	2.063410	14.05693

2014	17.29658	1.387088	2.742166	21.42584

Note: TC implies technical efficiency change. *TP* is technological progress change and *Scale* denotes scale efficiency change. *TC, TP* and *Scale* are computed by using Equation (8), (9) and (10) above - refer to Section 6.4.2.b. *TFPgrowth* (*G*) indicates the increase in productivity of firms every year which is calculated by total the sum of *TC, TP* and *Scale*.[13]

According to Liu (2008), an industry with high productivity growth may attract more FDI spillovers to gain greater profits. In addition, Haskel, Peirera and Slaugther (2007) suggest that foreign firms may prefer to invest in a slow-growing industry with highly stable productivity growth to gain greater competitive advantages. Thus, spillover variables can be endogenous due to the causal direction from productivity growth to foreign investment. To deal with the possible endogeneity bias, this research employs the Arellano-Bover/Blundell-Bond Generalised method of moments (GMM) estimator. A framework for efficient instrumental variable estimators of random effects models with information in levels is developed by Arellano and Bover (1995). Based on this framework, Blundell and Bond (1998) propose a system estimator using moment conditions in which lagged differences are employed as instruments for the level equation in addition to the moment conditions of lagged levels as instruments for the differential equation. This estimator is relevant to datasets with many panels and few periods. By using this method, it is assumed that there is no autocorrelation in the idiosyncratic errors and a requirement of the initial condition is that the panel-level effects are uncorrelated with the first difference of the first observation of the dependent variable.

Table 3.15 and Table 3.16 below illustrate the results of Arellano-Bover/Blundell-Bond GMM estimation of FDI horizontal and backward linkages on Vietnamese firms' productivity and their sources over the sample period. This research employs *TFPgrowth*, *TC, TP* and *Scale* interchangeably as a dependent variable in the estimation of spillover effects.

[13] The figures given in Table 6.14 are arithmetic average of annual ratio in per cent

Table 3. 15: Arellano-Bond GMM estimations – horizontal spillovers

	(1)				(2)				(3)			
	TC	*TP*	*Scale*	TFP_growth	*TC*	*TP*	*Scale*	TFP_growth	*TC*	*TP*	*Scale*	TFP_growth
FO_dummy	-0.000***	-0.008***	-0.008***	-0.013***	0.000*	-0.008***	-0.008***	-0.012***	0.000**	-0.008***	-0.008**	-0.012***
h_spillover	-0.000***	0.014***	-0.015***	-0.008***	-0.000***	0.013***	-0.018***	-0.009***	-0.000***	0.015***	-0.015***	-0.011***
age	0.000***	-0.001***	0.001***	0.001***	-0.000***	-0.000***	0.001***	0.001***	0.000***	-0.000***	0.000***	0.001***
H_index					-0.001***	0.006**	0.041***	-0.015*	-0.000***	0.015***	0.022*	-0.023**
HH_index									0.000***	-0.054***	0.118***	0.071**
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.000	0.229	0.489	0.702	0.000	0.252	0.512	0.696	0.000	0.265	0.480	0.683
Wald-χ^2	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000

Note: TFP_growth, *TC, TP* and *Scale* are total factor productivity growth of firms, technical efficiency change, technological progress change and scale efficiency change respectively which are measured by following Equation (7), (8), (9) and (10) above – refer to Section 6.4.2.b. Foreign ownership, *FO_dummy*, is a dummy variable which takes a value of 1 if the share of foreign ownership is greater than zero per cent and zero if otherwise. *h_spillover*, proxy for FDI horizontal spillover, is measured by the share of foreign firms' output over total output of industry. *H_index* is a measure of the concentration of a sector. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishment. *HH_index* denotes the interaction between the Herfindahl index and horizontal spillover. It is calculated as *H_index* multiplied by *h_spillover*.

Table 3. 16: Arellano-Bond GMM estimations –backward spillovers

	(1)				(2)				(3)			
	TC	*TP*	*Scale*	TFP_growth	*TC*	*TP*	*Scale*	TFP_growth	*TC*	*TP*	*Scale*	TFP_growth
FO_dummy	-0.000***	-0.005***	-0.012***	-0.013***	0.000***	-0.005***	-0.011***	-0.013***	-0.000***	-0.004***	-0.012***	-0.014***
b_spillover	0.000***	0.002***	-0.015**	0.012*	0.000***	0.002***	-0.017***	0.015**	0.000***	0.005***	0.009**	0.015***
Age	0.000***	-0.000***	0.001***	0.001***	0.000***	-0.000***	0.000***	0.000**	0.000***	-0.000***	0.000***	0.000***
H_index					-0.000***	0.017***	0.045**	-0.045**	-0.000***	0.022***	0.025***	-0.034***
BH_index									0.000***	-0.036***	-0.146***	0.173**
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.000	0.269	0.496	0.690	0.000	0.317	0.526	0.708	0.000	0.341	0.523	0.706
Wald-χ^2	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000	Prob χ^2 = 0.000

Note: TFP_growth, *TC, TP* and *Scale* are total factor productivity growth of firms, technical efficiency change, technological progress change and scale efficiency change respectively which are measured by following Equation (7), (8), (9) and (10) above – refer to Section 6.4.2.b. Foreign ownership, *FO_dummy*, is a dummy variable which takes a value of 1 if the share of foreign ownership is greater than zero per cent and zero if otherwise. FDI backward linkage, *b_spillover*, is equal to *h_spillover* ratio multiplied by the proportion of the total output of a sector that is supplied by another sector. *H_index* is a measure of the concentration of a sector. Age of firm (*age*) is computed by the difference between the year of the survey and the year of establishment. *BH_index* denotes the interaction between the Herfindahl index and backward linkage. This ratio is calculated as *H_index* multiplied by *b_spillover*.

The variable of *h_spillover* is found to be negative and significant with *TFPgrowth* at the 1 per cent level. This implies the negative relationship between FDI horizontal spillovers and all Vietnamese firms' productivity growth. In terms of *TFPgrowth* decompositions, the outcomes confirm the negative significance of FDI horizontal spillovers and *TC* and *Scale* of firms while *TP* appeared to be positive during the observed period. Thus, to decrease the technology gap between foreign firms and local firms and improve their productivity; local firms must focus on the demonstration of advanced technology from foreign-own firms in the same industry. This means that domestic firms should possess a minimum level of technology and human capital to operate the technology. This is consistent with the argument of Findlay (1978), who finds that local firms must achieve a certain level of technology for themselves to absorb modern technology from multinationals.

The backward linkage (*b_spillover*) variable is positive and significant at the 1 per cent level for *TFPgrowth* of firms, which implies positive linkages between foreign firms and upstream industries. The positive spillovers on productivity growth are mainly contributed by *TC* and *TP*, rather than *Scale* efficiency. This means a foreign presence generates higher technological and technical efficiency for domestic suppliers through training and technology transfer as those foreign firms require high-quality outputs from their suppliers.

The Herfindahl index is negatively significant to the growth of productivity, *TFPgrowth*, both in Table 3.15 and Table 3.16. This means a higher concentration of some dominant firms in an industry and less competition in that industry causes a decrease in productivity for firms. The decrease in competition leads to a decline in any incentive to invest in domestic firms and results in lower productivity for those firms. In terms of *TFPgrowth components*, *TC* is negative and significant while *TP* and *Scale* are found to be positively and significantly related to the Herfindahl index. The main reason causing the negative significance between the level of concentration and productivity growth comes from the negative effect between the Herfindahl index and *TC*. In fact, technical efficiency is transferred from foreign firms to domestic firms through spillover channels (demonstration, labour turnover and competition). The high concentration (the low level of competition) leads to a lack of spillover channels and this causes the decrease in technical efficiency transfer. Moreover, the interacting variables

between the Herfindahl index and *h_spillover* and *b_spillover* are positive and significant, and these results are consistent with the results in Table 3.12 above and Table 3.13 above.

The estimated coefficient of non-spillover variable (*age)* is positive and significantly related to *TFPgrowth*. This implies that the older firms, which possess better capacity and resources are much easier to absorb the efficiency from foreign firms. As regards the sources of *TFPgrowth*, only *TP* is found to be negative to the age of firms. This can be explained by the fact that older domestic firms prefer to gain benefits from the foreign presence through high labour intensity and experiences (technical efficiency) rather than by 'learning-and-doing' processes (technological progress). In the literature, only very few studies measure the impacts of productivity growth and its components to spillover and non-spillover. Kathuria (2000) and Suyanto and Salim (2010) do not find a significant effect between age and the elements of productivity growths.

The above results of the Arellano-Bond GMM estimation are in accordance with the results in SFA estimations. The fixed effect (FE) and random effect (RE) estimation techniques are also employed to test the impacts of FDI spillovers on TFP growth and its decompositions[14]. The horizontal spillovers variable is negative and significant while the backward linkage variable is confirmed to affect the productivity growth and its decompositions positively, both at the 1 per cent level.

[14] Fixed effect and random effect results are not reported due to paucity of space

3.7 Conclusions and Policy Implications

The research in this chapter empirically investigates the FDI spillover effects on the productivity of all Vietnamese firms from 2000 to 2014. Following Battese and Coelli (1995), this research examines the FDI horizontal spillovers and backward linkages to firms' productivity by employing the stochastic frontier production function. In addition, this research also considers the influences of the characteristics of firms and the level of competition on the presence of foreign entities. The TFP growth is separated into technological progress, technical and scale efficiency changes to measure the influences of FDI spillovers on each component of the *TFPgrowth* of firms.

The empirical results indicate a negative relationship between horizontal FDI spillovers and domestic firms' productivity. The negative relationship between horizontal spillovers and firms' productivity implies that the foreign entities induce stronger competitive effects rather than transferring new technology to domestic firms in an industry. Otherwise, backward FDI linkages are found to be positively and significantly related to the productivity of local suppliers. Consequently, domestic suppliers can gain benefits and improve their productivity through technology transfer, human capital turnover and research and development (R&D) supports from foreign firms.

The findings suggest that the degree of FDI spillovers is affected by the size of firms. Due to the advantages of resources, knowledge and a smaller technology gap, larger firms tend to attract foreign investments more than small and medium firms do. This chapter also confirms that state-owned firms receive more benefits from foreign presence rather than other types. This is not a surprise because state-owned enterprises are offered more incentives be the Vietnamese government than are other types of business. For example, some priority sectors in the economy such as electricity, gas, petrol, telecommunications and mining are still monopolised and dominated by state-owned enterprises in Vietnam. State-owned enterprises are also prioritised to obtain loans from banks and financial institutions in comparison to other types of firm. Moreover, the decline in concentration (or the increase in competition) of an industry leads to the growth of a Vietnamese firms' productivity or efficiency in that industry.

Additionally, the effects of FDI horizontal spillovers and backward linkages on TFP productivity growth and its decompositions are again examined by employing Arellano- Bond GMM methods. The results show the negative effect between horizontal FDI spillovers and *TFPgrowth* and their decompositions (*TC* and *Scale*) while backward linkages are found to be positively significant. These results also support previous findings of the SFA estimation.

Several policy implications emerge from the empirical results of this study. Firstly, linkages between foreign firms and Vietnamese domestic firms should be increased to inspire technology spillovers from FDI. Policymakers should consider varying the incentives for FDI across types of business, especially where FDI spillovers result in the efficiency improvements in certain types of business. The incentives could be fiscal incentives (tax and fees incentives, grants and preferential loans etc.) or other incentives such as preferential contracts and the granting of monopoly rights. For those receiving negative spillover effects, policymakers could continuously provide incentives to improve these negative FDI effects and also ensure that these negative influences do not outweigh the overall benefits from FDI.

Foreign firms prefer to provide their technology and knowledge to local firms which are technologically well-equipped and have highly qualified employees (Pham, 2012). Thus, there is a need for further spending on advanced education and training that may help reduce the gap between foreign and local firm in Vietnam. Also, to gain more benefits from the existence of foreign entries, domestic firms are encouraged to invest in R&D and upgrade their human capital to enhance their absorptive capacity. The improvement in human capital could be done through the enhancement of cooperation between local training centres, universities and research institutions.

Finally, more general policies should be pursued in order not only to attract FDI but also benefit local firms through infrastructure development, the modernisation of legal and political institutions, the development of government-funded programs and so on. These improvements would contribute to creating a competitive environment and promote development in all sectors of the country.

CHAPTER 4: HUMAN CAPITAL, FDI SPILLOVERS AND PROVINCIAL TFP GROWTH: A DYNAMIC THRESHOLD PANEL ANALYSIS

4.1 Introduction

Previous studies on the foreign investment of multinationals indicate the primary role of technology diffusion in the process of economic growth (Nelson and Phelps, 1966; Jovanovic and Rob, 1989; Grossman and Helpman, 1991; and Segerstrom, 1991). In contrast to the traditional neoclassical growth theory (Domar, 1947; Harrod, 1948; Solow, 1956) which suggests technological change is an unexplained residual and provided exogenously, the more recent growth literature believes the engine of economic growth is dependent on the state of domestic technological progress (Romer, 1986; Lucas, 1988; Aghion and Howitt, 1992). Endogenous growth theory highlights the importance of using knowledge rather than focusing on capital to increase domestic economic growth rates (Romer, 1986). These growth models therefore promote the intensive investment in human capital formation (education, research and development) and encourage foreign investments in knowledge-intensive industries to create the spillover benefits to domestic firms.

Huang, Liu and Xu (2012) find that technology transfer is never unconditional, and the spillovers are not the certain results of multinationals' presence. Lapan and Bardhan (1973), Conhen and Levinthal (1989), Girma (2005) and Ford et al. (2008) find that the distribution of technology spillovers cannot be utilised unless the labour force possesses the corresponding skills. As a result, local economies must develop their absorptive capacity before benefiting from new technologies provided by foreign investors. By contrast, Findlay (1978), Wang and Blomstrom (1992), Castellani and Zanfie (2003, 2006) and Sawada (2010) confirm that the technology gap between foreign and host regions is positively related to the degree of technology spillovers. This means a recipient country with a greater technology gap will gain more from technology diffusion. In fact, the empirical evidence on the relationship between local absorptive capacity and productivity growth is still controversial in the existing literature. While the previous chapter focused on the effects of FDI productivity spillovers in Vietnamese local firms, research in this chapter will provide a clear description of the impacts of FDI spillovers on Vietnamese provincial productivity growth. Especially, this chapter concentrates

on the role of absorptive capacity and attempts to explore whether the level of productivity growth-absorptive capacity nexus differs across provinces.

Several empirical studies have investigated the relationship between the degree of local absorptive capacity and FDI flows, such as Kokko et al. (1996), Felipe, Calva and Clare (2000), Moran (2001), Kinoshita (2001), Griffith et al. (2002) and so on. However, Kose et al. (2011) find that the threshold effects of some elements appear to affect the degree of FDI inflows to recipient countries. The existing literature indicates several empirical investigations of the threshold effect of technological capabilities on FDI spillovers. Girma (2005) finds a positive relationship between absorptive capacity and the rate of technology spillovers when predicting the nature of absorptive capacity of UK manufacturing firms by applying Hansen's (2000) threshold regression techniques. Based on a dataset of 48 US states from 1978 to 1997, Ford et al. (2008) find that foreign direct investment is more productive than local investment at a minimum human capital threshold. Huang, Liu and Xu (2012) find clear evidence of the threshold effect of regional innovation on productivity spillovers from FDI in a research on Chinese provinces over the period 1985 – 2008. According to Keller (1996) and Borensztein et al. (1998), a certain level of human capital in the recipient countries indicates how local firms in those countries can absorb the potential spillover benefits and determine the potential degree of foreign investment. In other words, a workforce with skilled labourers may lead to an increase in productivity and attract more FDI to that region. Following these arguments, this chapter aims to empirically examine whether a minimum threshold of human capital exists to improve the productivity spillovers in Vietnamese provinces and attract more foreign investment to these provinces.

The primary objective of this chapter is to evaluate the asymmetric linkages between human capital and total factor productivity[15] (TFP) growth in each province of Vietnam. The estimated human capital threshold level then can be used as a benchmark to determine whether the presence of foreign investment creates spillover effects on Vietnamese provincial productivity growth. Generally, the traditional panel threshold approach of Hansen (1999) is

[15] Total factor productivity (TFP) is one of many indices of productivity – 'a ratio of output to inputs' (Nadiri, 1970). It is identified by 'how efficiently and intensely the inputs are utilised in production' (Comin, 2006).

used to estimate the threshold values in a typical threshold model. However, the limitation of Hansen's method is that all regressors are assumed to be exogenous. This may lead to biased threshold estimations since the method ignores endogeneity. To avoid this bias, this study employs a dynamic panel threshold methodology to explore this non-linear relationship between a certain level of human capital and the TFP growth in the context of Vietnamese provinces. The dynamic threshold approach is considered to be an innovative method which allows the estimation of threshold effects of panel data even in case of endogeneity. In this dynamic model, the endogenous regressors are no longer an issue and the estimations are more adequate and flexible than former studies.

The findings of this chapter contribute to the literature in several ways. To the best of our knowledge, this is the first attempt to explore how TFP growth is affected by the human capital threshold in Vietnam. In general, the accumulation of human capital is considered an important element in the process of productivity growth. Using a dynamic panel threshold approach permits us to detect whether a certain level of human capital should be achieved to boost Vietnamese provincial productivity growth and FDI spillovers. In other words, research in this chapter determines a clear human capital target, which then enables the local governments of Vietnamese provinces to propose incentive policies to attract more FDI and increase productivity growth. In addition, the important role of human capital is also emphasised. This makes local governments put more effort into improving education as well as research and development activities.

This chapter is formulated as below. Section 4.2 reviews the former research on the relationship between human capital, FDI spillovers and TFP growth. Section 4.3 discusses the determinant of TFP growth. Section 4.4 illustrates the economic methodology that is used in this chapter. Sections 4.5 and 4.6 describe the summary statistics and discuss the empirical research results. Finally, section 4.7 sums up and presents policy implications.

4.2 Literature Reviews

4.2.1 Endogenous Growth theory, Productivity and Absorptive Capacity

By contrast to the neoclassical growth theory which assumes the exogeneity of technological change in long-term growth (Solow, 1956), endogenous growth theory, introduced in the second half of the 1980s (Romer, 1986; 1987; Lucas 1988; Barro 1990; Helpman, 1991; and Aghion and Howitt, 1992), explains the explicit difference by raising the importance of 'engines of growth' - the technological progress. Nishimizu and Page (1982) define technological progress as the change in the production function through process and product innovation that results in the improvement in long-term productivity growth. Romer (1990) develops the growth model, which demonstrates that productivity growth is driven by technological changes. Similarly, Aghion and Howitt (1992, 1998) introduce the Schum-peterian model in which technological progress occurs in the form of innovations. The investment-based endogenous growth model focuses on externalities such as the accumulation of physical or human capital to generate economic growth (Romer 1986, 1987; Barro, 1990; and Rebelo, 1991).

The important role of the recipient countries' absorptive capacity, which is measured by the research and development (R&D) and human capital in those countries, in driving productivity growth is confirmed by Romer (1990) and Aghion and Howitt (1992). Cohen and Levinthal (1989, 1990) state that research activities and human capital are two primary factors of absorptive capacity in the literature. According to these studies, the degree of technological progress depends on how much capacity it has to absorb the outside knowledge. Similarly, Borensztein, Gregorio and Lee (1998) confirm the primary role of human capital in absorbing technology spillovers of foreign firms and improving productivity. Xu (2000) finds that the higher productivity of FDI spillovers is only achieved by reaching the minimum stock of human capital at 1.9 years of male secondary school attainment. According to Griffith, Redding and Van Reenen (2003), TFP growth is affected by R&D-induced innovation, R&D-based absorptive capacity and technology transfer. Apart from R&D and human capital in the host country, the degree of openness is also considered as another driver of absorptive capacity.

4.2.2 Human Capital Threshold and Productivity Growth

Although endogenous growth theory implies the importance of technological investment through knowledge and innovation spillovers, there are few empirical studies which consider human capital as a primary driver of technology spillovers and productivity growth in the existing literature. Benhabib and Spiegel (1994) find that human capital stock has a positive effect on TFP by examining 78 countries from 1965 to 1985. By employing data on 12 OECD countries over the period 1974 – 1990, Griffith, Redding and Van Reenen (2004) find strong evidence of the relationship between human capital and productivity growth. Islam (2009) finds that research intensity and distance to the productivity frontier positively affect productivity growth. By utilising data of 21 OECD countries over the period 1960-1990, Fuente (2011) confirms that human capital is positively significant to productivity. According to Gehringer, Martinez-Zarzoso and Nowak-Lehmann (2014), the main determinants of TFP growth are rationalisation, human capital endowment and investment in information and communication technologies. However, they do not find evidence for the linkage between FDI, R&D and openness and TFP growth.

However, there is some ambiguous evidence on the relationship between human capital and TFP growth in the existing literature. Cameron, Proudman and Redding (2005) do not find any evidence on the effects of labour quality on productivity growth. They argue that labour quality directly affects the production output through private rates of return rather than TFP. Fuente and Domenech (2006) confirm that the weak empirical performance of human capital indicators to economic growth is due to data deficiencies. This chapter proposes human capital variable, as a determinant of technology spillovers to investigate whether the absorptive capabilities of a local economy affect the degree of TFP growth and attract more inward FDI.

4.2.3 Human Capital as a Driver of FDI Technology Spillovers

Research indicates two common approaches to estimate how technological absorptive capacity influences the role of FDI on local economic growth. The first approach divides a whole sample into sub-samples, and then FDI spillovers effects are compared from the sub-samples. By dividing British electronics enterprises into subsamples based on a proxy of the

size and share of skilled employees, Girma and Wakelin (2001) find that small size and low ratio of skilled workers' enterprises do not have enough absorptive capacity to benefit from FDI spillovers. Haskel el al. (2007) do not find the differences of absorptive capacity in splitting their sample into three different groups based on their performance measurements (industry-year employment, total factor productivity and skill intensity). The other approach is to estimate a linear or non-linear relationship between FDI spillovers and a proxy of absorptive capacity in an empirical growth model. By adding a linear cross-term of human capital and FDI variables, Xu (2000) finds that technical spillovers from multinational enterprises are affected by a level of human capital stock. Specifically, human capital stock in the host country must achieve beyond the threshold level of 1.9 if they want to benefit from American multinational enterprises. Li and Lu (2005) find a strongly positive association between human capital and economic growth in developing countries. Huang et al. (2007) also find a technical threshold effect associated with the level of FDI technological spillovers.

The above research indicates the presence of threshold effects which affect the FDI technology diffusion to local economic growth. However, there are only a few studies which explore a level of threshold of technological or absorptive capabilities to benefit from FDI spillovers in the existing literature. According to Borensztein et al. (1998), FDI spillover will be available in the host country if there is a certain threshold level of human capital. By measuring the number of years in secondary school, they find that the presence of minimum level of human capital makes FDI more productive than domestic investment. Further, the secondary school enrollment ratio is deemed a crucial factor of intra-firm technology transfer in the study of Urata and Kawai (2000). Bloomstrom and Kokko (2002) find that tertiary education contributes to the expansion of multinationals in an economy due to the availability of highly-skilled graduates and labour. Girma (2005) applies the threshold model of Hansen (2000) to assess the extent of FDI impacts on some critical values of absorptive capacity among UK manufacturing firms. Ford et al. (2008) confirm the relationship between FDI and per-capita output growth in the presence of a minimum human capital threshold. Employing the threshold method of Hansen (1999), Li and Fu (2009) investigate human capital as a determinant of FDI technology spillovers in the Chinese provinces. They find that FDI

productivity spillovers is negative when the quality of labour force is below the threshold and vice versa. Hwang et al. (2012) provide evidence of the correlation between FDI spillovers and regional innovation by employing the threshold approach of Hansen (2000). Wang et al. (2016) explore the threshold effect of FDI technology spillovers through the technology gap between different regional Chinese industrial factors. By using data on equipment manufacturing industry in China, Wang, Huiwen and Zhang (2107) find the threshold effect of human capital level on FDI spillovers. These studies indicate the apparent impact of human capital threshold on FDI spillovers. In Vietnam, there has not been an empirical study which investigates the threshold effects on FDI productivity spillovers. Therefore, research in this chapter fills the gap in the existing literature by employing the dynamic panel threshold methodology to estimate the impact of human capital to FDI spillovers in terms of TFP growth in the Vietnamese provinces.

4.3 Determinants of the Speed of TFP Growth

This chapter attempts to contribute to the literature by examining the nonlinear relationship between the human capital threshold and TFP growth of each Vietnamese province. Apparently, there are various factors that can determine the speed of TFP growth in theoretical and empirical studies. They can be human capital, the degree of FDI spillovers, the openness, the infrastructure development, the scale of population, the labour cost, the change of market structure and the unemployment rate.

4.3.1 Human Capital (HC)

According to Fleisher, Li and Zhao (2008), human capital is believed to play a fundamental role in economic growth, especially in developing countries. According to Bresnahan et al. (1999), a well-educated and highly-trained labour force helps to adapt technology investment easily, thus leading to improvement in long-term economic growth. Bassanini and Scarpetta (2001) find the positive effects of human capital on growth across a selected group of OECD countries. Chen and Fleisher (1996, 1997) and Demurger (2001) find that education at the secondary and college level enable us to explain the inequality of provincial growth rate in China. Griffith, Redding and Van Reenen (2004) confirm the significant linkage between

human capital and productivity growth in 12 OECD countries over the period 1974 – 1990. Liu (2007) finds significant effects of human capital on productivity in rural and urban Chinese areas. By employing data of 55 developed and developing countries, Islam (2009) finds that human capital and R&D driven absorptive capacity accelerates productivity growth. According to Khadaroo and Seetanah (2010), the higher level of human capital indicates the availability of skilled workers and an educated labour force. Gehringer, Mertinez-Zarzoro and Nowak-Lehmann (2014) find that human capital is one of main drivers of TFP growth in 17 European Union countries over the period 1995-2007. Similarly, Kadri, Hein and Ruubel (2018) find a positive relationship between human capital endowment and TFP growth when employing data of 99 regions from 31 European countries over the period 2000-2013. However, Fleisher, Li and Zhao (2008) find that the influence of human capital on economic growth can vary widely across countries due to the differences in the labour market and education quality. Following the above arguments, this chapter includes human capital as a threshold variable to investigate its impacts on TFP growth and FDI spillovers in Vietnamese provinces.

4.3.2 Foreign Direct Investment Spillovers (FDI_spillovers)

Because of the direct and indirect benefits of foreign investment, policymakers in several countries have proposed economic incentives and competition policies to attract FDI to their countries. By employing data from 40 countries over the period 1966-1994, Xu (2000) finds that technology transfers from FDI contributes to the productivity growth in those countries. Lee (2006) confirms that the productivity spillovers through FDI are significant and robust. However, Cohen (2007) finds that the spillover effects on local productivity are mixed. Azman-Saini, Baharumshah and Law (2010) do not find any spillover effects of FDI on productivity growth. Suyanto, Bloch and Salim (2012) state that the spillover effects of FDI on productivity growth may depend on industry-specific characteristics. They find positive spillovers in the garment industry and negative spillover effects in the electronics industry. Liu, Agbola and Dzator (2016) examine the influence of FDI spillovers on TFP growth using Chinese firm-level data over the period 2003-2008 and find that FDI-related employment has

a negative impact on TFP growth. Thus, research in this chapter examines the impact of FDI spillovers on TFP growth in Vietnamese provinces.

4.3.3 Trade Openness (OPEN)

The openness-economic growth nexus has been the subject of many empirical studies. Grossman and Helpman (1991) state that the higher the degree of openness, the more opportunities to imitate and learn from outside. Edwards (1992, 1998) also finds that the market size will expand faster that country is more open. Using a panel data of 83 developed and developing countries; Miller and Upadhyay (2000) confirm a positive relationship between trade openness and total factor productivity. Alcala and Ciccone (2004) find that trade openness has a significant and robust effect on labour productivity. Wong (2004) finds that trade openness and technology spillovers are two important channels for TFP growth. Lai, Peng and Bao (2006) find that the degree of openness in the host country is also another key variable of absorptive capacity that helps to improve TFP growth and FDI spillovers. The positive relationship between openness and productivity spillovers is also reinforced by Boer et al. (2001) and Comin and Hobijn (2004), Schiff and Wang (2008), Seck (2012) and Liargovas and Skandalis (2012). Using a dataset of 16 Middle East and North Africa countries over the period 1987-2008, Rogmans and Ebbers (2013) find that openness to trade is positively associated with the value of FDI inflows. Blonigen and Piger (2014) confirm the positive relationship between trade openness and the bilateral FDI stocks when examining the FDI determinants in OECD countries. Bresnahan et al. (2016) investigate the impact of trade on productivity growth, using firm level data from Ghana, Kenya and Tanzania. They find mixed evidence between exports and TFP growth. The inconsistent results may be due to lower external tariffs' policy in these countries. Seim (2009) finds that a local economy with high degree of openness, few restrictions and low trade costs boosts the level of exports rather than improving economic growth and attracting FDI. Research in this chapter includes the trade openness variable to investigate whether the more open the economy, the higher the TFP growth in Vietnamese provinces.

4.3.4 Infrastructures (P)

Wei (2000) states that a location with good infrastructure is more attractive than others. Straub (2008) states that physical infrastructure may include various elements such as transportation, paved roads, telecommunication, electricity supply and other tangible infrastructure that provide cost-effective access to market. Aschauer (1989) investigates the impact of public infrastructure on productivity growth in the United States from the 1950s to the 1980s. He finds that the return to public investment is negatively correlated with infrastructure and productivity. Munnell (1992) finds a positive correlation between productivity and infrastructure. However, this positive relationship depends on other macro factors, such as the management and financing of infrastructures and inflation, among others. Using a panel of 28 developing countries over the period from 1981 to 1991, Dessus and Herrera (2000) find that infrastructure is positively significant to an increase in long-term GDP growth. Straub (2008) finds a positive impact of infrastructure stock on economic growth in a study of 140 countries over the period 1989 – 2007. The positive relationship between the degree of infrastructure and TFP growth is confirmed by Bronzini and Piselli (2009) for Italian regions over the period 1980 – 2001. Calderon and Serven (2010, 2012, 2014) confirm the positive effects of infrastructure on growth. Lucke and Eichler (2016) find the importance of infrastructure in attracting FDI inflows to host countries when examining the determinant of bilateral FDI stock of 29 source and 65 host countries over the period 1995 – 2009. Using a dataset of 65 countries for the period 1985 – 2011, Kim and Loayza (2017) find that physical infrastructure is one of the important determinants of productivity growth.

While many studies find a positive effect of infrastructure on TFP growth, others report a negative effect or insignificant effect. Holtz-Eakin (1994) and Garcia-Mila et al. (1996) find that public capital does not have a significant effect on productivity or output. Boarnet (1998) finds a negative impact of infrastructure on the output of California counties. Calderon et al. (2003) find that the reduction of public infrastructure investment contributes to the increase in economic growth in Argentina, Brazil and Mexico. Canning and Pedroni (2008) argue that the effect of infrastructure on growth may vary due to the substantial variation across countries.

Consequently, this chapter employs infrastructure variable and hypothesises that a high level of infrastructure leads to an increase in FDI productivity spillovers.

4.3.5 Other Determinants

- ***Market Reforms (M)***

According to Campos and Kinoshita (2008), foreign investment decisions are affected by local economic and political risks. In other words, the more liberal the local market is, the fewer trade barriers foreign investors will face. They also suggest that the implementation of structural reforms in host countries can reduce investment risk, and this is a positive signal to foreign investors. Economic and structural reforms include changes in tax laws, trade liberalisation, privatisation, domestic financial reform and other incentives' packages to remove barriers to international capital flows (Biglaiser and Derouen, 2006).

Sachs and Warner (1995) use the index of trade openness ratio as an economic regime indicator to investigate the economic convergence in 80 developed and developing countries from 1960 to 1992. Using data from 92 countries from 1960 to 2000, Chen and Dahlman (2004) find that productivity growth is affected by local economic and institutional reforms. Zheng (2005) confirms that one of the most striking changes in China is the introduction of a market mechanism. Thus, the increase in the ratio of non-state-owned share of the economy is depicted as a proportion of market reform. Biglaiser and Derouen (2006) investigate the effects of economic reform to FDI inflows in Latin America. They find that their implementation is not always more likely to attract FDI inflows. Campos and Kinoshita (2008) examine the role of structural reforms in attracting FDI inflows in 19 Latin American and 25 Eastern European countries from 1989 to 2004. They find that financial liberalisation and privatisation in local countries have strong effects on FDI. Similarly, Trevino et al. (2010) also confirm the relationship between market reform and foreign investment when re-examining this linkage using a dataset of Latin American countries from 1988 – 1992. Employing the transitional growth model, Song et al. (2011) find that China's 1992 reform led to significant growth acceleration. Fu and Li (2009) employ the ratio of non-state-owned employees to investigate the impact of the marker reform on the productivity spillovers. According to Su (2015), the

differences in market size and structure of government expenditures directly affects economic growth in China and Japan. Using data from China's state and private sectors from 1992 to 2007, Curtis (2016) examines the influence of economic reform on China's growth in terms of TFP. The author finds that the reallocation of resources after the reform makes up 21.5 per cent of TFP growth during the research period.

In Vietnam, the *Doi Moi* reform policy has led to the improvement in non-state sectors' performance and reduced the degree of central government control in many areas. Research in this chapter seeks to contribute to the existing literature by providing an investigation of nonlinear relationship between the pace of market reform and the productivity growth in Vietnamese provinces.

- ***Population Growth (POPG)***

Population growth is believed to cause a decrease in productivity growth. Malthus (1992) finds that the greater the population, the fewer the resources available. Caldwell (1998) also confirms a constant tension between population and available resources; thus, large populations are not expected to witness any economic growth. Nagarajan (2007) finds that a large population causes a slower increase in production because of the scarcity of labour and resources. Moreover, a higher population growth leads to a greater use of finite resources, and thus a declining long-term potential growth (Linden, 2017).

However, Riley (2003) argues that a large population will increase its political strength and provide enough labour for its economic development. Baker, Delong and Krugman (2005) find a positive relationship between population growth and economic growth. They also predict that lower economic growth in high-income countries will mean slower population growth in the forthcoming years. Gupta and Wang (2009) find that the large scale of the population in China and India generates quantity and quality in the labour force and thus, causes improvement in economic growth. Aziz and Makkawi (2012) propose that a large population will make a larger investment environment because they believe a large population will offer a large product market and labour force. Maestas, Mullen and Power (2016) find that an increase in population age causes a decrease in the economic growth rate because of the slower

growth in labour productivity. Peterson (2017) asserts that the growth of population directly influences the workforce size and economic growth. Based on these arguments, this chapter hypothesises that the increase in population growth rate will have direct and indirect impacts on the Vietnamese provincial productivity growth.

- ***Labour Costs (WAGE)***

According to Coughlin and Segev (2000), higher productivity normally leads to higher level of employee compensation. However, there are only few empirical studies which emphasise the importance of labour costs on productivity growth, and the results are still mixed. Friedman et al. (1992) find that the level of wages is a positive determinant for foreign plant location. Basile et al. (2008) and Casi and Resmini (2010) find positive impacts of productivity spillovers on the level of wages in European regions. However, Coughlin and Segev (2000), Kang and Lee (2007) and Kawai (2009) find negative effects of productivity spillovers and wage levels in Chinese provinces. By contrast, Hilber and Voicu (2010) do not find any evidence of the influences of FDI spillovers on wage levels in Romania. This chapter employs the wage level to examine how this factor impacts on productivity spillovers in each Vietnamese province over the sample period.

- ***Unemployment Rate (UNEMP)***

Unemployment has several socio-economic consequences on the labour market and this can adversely affect TFP growth. However, empirical evidence of the unemployment effect on TFP growth is inconclusive in the existing literature. Using data from the US and Europe during the period from 1979 to 1994, Gordon (1997) finds that a higher rate of unemployment is positively correlated to a greater productivity growth in these countries. By contrast, Alexander (1993) and Wakeford (2004) argue that an increase in productivity as the main reason for an increase in labour demand leads to a reduction in the unemployment rate. Meyer (2001) and Mankiw Reis (2003) find that an increase in productivity can reduce the unemployment rate in the long term. Thomas (2006) finds a negative impact of unemployment rate on productivity growth in Germany and Sweden. Using European regional data, Basile and Benedictis (2008) find that the relationship between the regional unemployment rate and

productivity is negative under a certain level of productivity threshold. Mun, Lin and Man (2008) and Mpanju (2012) find that FDI productivity spillover has a strong impact on the pattern of employment opportunities. Akinlo and Adejumo (2016) also confirm the negative impact of the unemployment rate on TFP. Following these arguments, research in this chapter proposes that productivity spillovers may reduce the unemployment rate in Vietnamese provinces.

- ***Vietnamese Provincial Competitiveness index (PCI)***

This research also includes the Vietnamese provincial competitiveness index (PCI). This index, constructed by the Asia Foundation (TAF) and the Vietnam Chamber of Commerce and Industry (VCCI), is a regulatory framework to measure the competitiveness between Vietnamese provinces. It is used to explain the performance of each Vietnamese province and compare the dynamics of private sector, job creation and economic growth between provinces. The ratio was first formulated in 2005 using data surveyed from local firms in different provinces. Information on the PCI estimation is extracted from Malesky (2005). This index has been updated annually since 2005 on the PCI website[16].

This ratio is normally used as an institutional control variable to investigate the economic growth between Vietnamese provinces. Le and Nguyen (2014) use the PCI index as the institutional quality ratio to examine the relationship between economic performance and institutional quality among Vietnamese provinces and cities. Tran, Pham and Barnes (2016) explore the spatial spillover effects from FDI in Vietnam. They find that the PCI is positively correlated with TFP growth in the host provinces. Bai et al. (2017) find a negative relationship between firms' growth and corruption by employing the PCI as a governance control variable. This chapter includes this variable to control for estimation of the human capital threshold and TFP growth among Vietnamese provinces.

[16] The provincial competitiveness index (PCI) index can be taken from its official website: http://eng.pcivietnam.org/

4.4 Econometric Methodology

4.4.1 Dynamic Panel Threshold Approach

Research in this chapter aims to explore the non-linear relationship between the human capital threshold and TFP growth. To test the threshold effect, Hansen (1999) introduces a non-dynamic panel threshold model. In this threshold regression model, individual observations can be separated into different levels based on the value of an observed variable. The advantage of this approach is that the number of regimes of variable is tested and both threshold levels and the marginal impact of this variable are estimated. This method, however, is restricted to regression models with the assumption that all explanatory variables must be exogenous. This assumption may cause the potential endogeneity bias between dependent and independent variables.

To account for the non-linearity and to deal with endogeneity problem, Caner and Hansen (2004) extend Hansen (1999)'s model and develop a threshold dynamic model using generalised methods of moments (GMM) type estimators. However, Caner and Hansen (2004)'s approach is only designed to apply for cross-sectional data. To consider the threshold effect in a panel regression, this study employs a dynamic panel threshold approach proposed by Kremer et al. (2013). They introduce this method for an analysis of the inflation impact on economic growth of 124 industrialised and non-industrialised countries. In their work, the authors apply the forward orthogonal deviations transformation, developed by Arellano and Bover (1995). The characteristic of this transformation is that it eliminates the serial correlation of the transform error terms and maintains the un-correlation of the error terms. Then, this transformation is combined with both the estimation of Caner and Hansen (2004)'s threshold model and the traditional method of Hansen (1999) to deal with the country's specific fixed effects. Consequently, the potential endogeneity of regressors is no longer an issue.

4.4.2 Empirical models

Following Kremer et al. (2013), the dynamic panel threshold model investigates the human capital and TFP growth nexus in the Vietnamese provinces. The dynamic panel threshold model is as follows:

$$Y_{it} = \mu_i + \gamma Y_{i,t-1} + \alpha X_{it} + \beta_1 H_{it} I(H_{it} \leq \lambda) + \beta_2 H_{it} I(H_{it} > \lambda) + \varepsilon_{it} \qquad (4.1)$$

where:

Y_{it} is the dependent variable, which is calculated by the provincial TFP growth;

$Y_{i,t-1}$ is the lagged value of dependent variable which is also used as the instrument variable;

μ_i denotes the individual fixed effects which are taken from forward orthogonal transformation;

X_{it} represents vectors of explanatory regressors where slope coefficients are assumed to be regime independent. It consists of partly endogenous variables and exogenous variables such as FDI spilloves, trade openness, infrastructures, the pace of market reforms, the population growth rate, labour costs, the unemployment rate and the PCI;

The human capital (H_{it}) is both the threshold variable and the regime-dependent variable utilised to split the sample into different regimes;

β_1 and β_2 are the two regression slopes assuming that this model has two regimes;

$I(.)$ denotes an indicator function which has a value of 1 if the value of the threshold variable H is below a specific threshold value λ and 0 otherwise;

ε_{it} is the error term;

$i = 1, 2, \ldots, N$ represents Vietnamese provinces;

$t = 1, \ldots, T$ is time variable.

To estimate the dynamic threshold model, this chapter follows a three-step procedure. The first step is to estimate a reduced form of regression for endogenous variables, as a function of instruments. The endogenous variables are then replaced by predicted values in the structural equation. In second stage, the threshold value is estimated by using Hansen (1999)'s method where the endogenous variables are replaced by their predicted values taken from the first step regression. The sum of squared residual result is denoted by $S(\lambda)$. This stage is repeated for a strict subset of the support of the threshold value H. In the final stage, the estimated threshold value λ is chosen as the one associated with the minimisation of the sum of squared residuals. Once the estimated threshold value is determined, the slope coefficient of the equation (1) is estimated by using the GMM method.

4.4.3 Data and Variables

- ***Sample selection***

The sample consists of a balanced panel data of 63 Vietnamese provinces over the period from 2005 to 2014[17]. The data is from the official publication of the Statistical Year Book of the General Statistics Office of Vietnam and Ministry of Labour of Vietnam website. The choice of Vietnamese provinces as the unit of analysis is due to the diversities between Vietnamese provinces in terms of inward FDI flows, social and economic growth as well as international trade. Each Vietnamese province is also allowed to formulate their own polices to improve its economic and social development as well as attract more foreign investment.

- ***Measurement of variables***

With reference to the dynamic threshold panel model given in equation (1), there is one output variable and a set of input variables in the model.

The output variable, $\boldsymbol{Y_{it}}$, is the value of provincial TFP growth of each Vietnamese province. This variable is constructed by firstly estimating the TFP growth at the firms' level and then

[17] Ha Tay province merged into Hanoi city since 2008 and thus will not be considered in this sample due to the lack of data.

aggregating it to provincial level. Following Orea (2002) and Suyanto, Salim and Bloch (2009), TFP growth is decomposed into technical efficiency change, technological progress and scale efficiency change by employing a generalised Malmquist index. Thus, the TFP growth variable can be represented as follows:

$$Y_i^{t,t+1} = TC_i^{t,t+1} + TP_i^{t,t+1} + Scale_i^{t,t+1} \quad (4.2)$$

where:

$Y_i^{t,t+1}$ is a generalised output-oriented Malmquist productivity growth index of firm *i* between time *t* and *t+1*;

$TC_i^{t,t+1}$ implies the technical efficiency change of firm *i* between periods *t* and *t+1*;

$TP_i^{t,t+1}$ is the technological progress change of firm *i* between periods *t* and *t+1*;

$Scale_i^{t,t+1}$ is the scale elasticity change of firm *i* between periods *t* and *t+1*;

According to Lin and Kwan (2016; 2017), the provincial TFP growth can be further expressed as:

$$Y_{jt} = \frac{lny_{ijt}}{\sum_{i \in j} lny_{ijt}} Y_{ijt} \quad (4.3)$$

where:

Y_{jt} is the TFP growth of province *j* in year *t*;

lny_{ijt} denotes the natural logarithm value of firm *i*'s revenue, located in province *j* at year *t*[18];

Y_{ijt} implies the value of TFP growth of firm *i* in province *j* at year *t;*

[18] In their research, Lin and Kwan (2017) use value-added of a firm to construct the weight of the firm underlying county in each year. Due to the lack of value-added data for the research period, this chapter employs the revenue of firms instead, following Nguyen et al. (2008) and Pham (2012)

Tran, Pham and Barnes (2016) employ the firm level data to estimate the sectoral total factor productivity of local firms under the spatial spillover effects of foreign firms. Lin and Kwan (2017) construct county-level total factor productivity by the average weights of TFP growth at firm level. In their research, the weights are the value-added shares of each firm in that county. Following the above studies, this chapter computes the value of TFP growth by using the data from the annual enterprise surveys dataset of the General Statistics Office of Vietnam (GSO) over the period 2004 – 2014. Overall, the dispersion of TFP growth among Vietnamese provinces over the sample period is quite symmetric and in line with normal distribution, with the values ranged from -0.05 to 0.121 (details in Appendix 4.2).

The set of explanatory variables include human capital, FDI spillovers, trade openness, the development of the Vietnamese provinces' infrastructure, the pace of market reform, the unemployment ratio, the rate of population growth, the labour costs and the competitive ratio (PCI) in each province.

A number of ways have been used to measure the value of human capital variable in the existing literature. Ford, Rock and Elmslie (2008) consider the percentage of the population with at least a college degree as a human capital variable. Huang, Liu and Xu (2010) estimate the level of human capital by the average educational level of residents in 29 Chinese provinces in their study of the threshold effect of regional innovation and FDI spillovers in China. In this research, the threshold variable – human capital, $\boldsymbol{H_{jt}}$, is represented by the ratio of skilled workers[19] to population in each Vietnamese province from 2005 to 2014, following the research of Kang and Kee (2007), Manca (2009), Hoang and Goujon (2014), Murphy and Robert (2016) and Anderson (2017). The distribution of human capital human is more left-skewed than the normal distribution, indicating that the ratio of skilled workers is quite small among the provinces. Its value varies between 0.081 to 0.254 over the period 2005-2014 (details in Appendix 4.3).

[19] According the General Statistics Office of Vietnam, skilled workers/trained workers are defined as those who graduated from a technical training school with an equivalent degree or a tertiary education level in the national education system (with a specific and recognised certificate of training)

The FDI spillovers (***FDI_spillover***$_{jt}$) is another explanatory variable. Hoang, Paitiin and Bangorn (2010) use the ratio of FDI inflows to GDP of each Vietnamese province to investigate the relationship between FDI and economic growth in Vietnamese provinces. Nguyen, Giang and Tran (2012) employ FDI inflows variables to measure the effect of FDI on Vietnamese provincial economic growth after the WTO accession in 2007. These studies use the ratio of FDI inflows to Vietnamese provinces due to the unavailability of data at firm level and the lack of a sophisticated method to estimate the degree of FDI spillovers. Aitken and Harrison (1999) estimate the foreign investment at sectoral level by the average foreign equity over all plants in each sector, weighted by the employment share of each plant in that sector, using dataset from Venezuela's national statistical bureau.

In this chapter, FDI spillovers (***FDI_spillover***$_{jt}$) into each Vietnamese province is computed by the weighted average of FDI spillovers in each firm. This variable is measured as the fixed capital share with the weights being the value of the employment share of foreign firms in each Vietnamese province. Following Aitken and Harrison (1999), Tran, Pham and Barnes (2016) and Lin and Kwan (2017), the annual FDI spillover variable for a given representative firm *i* in province *j* at year *t* is calculated as follows:

$$FDI\_spillover_{jt} = \frac{\sum_i K_j L_{ijr}}{\sum_i L_{ijr}} \qquad (4.4)$$

where:

$FDI\_spillover_{jt}$ represents the value of FDI spillovers into each province *j* in year *t*;

K_j is total book value of fixed asset of FDI firms in province *j* at year *t*;

L_{ijr} implies the workforce, calculated by total number of employees annually in a foreign firm *i* in sector *j* at province *r*.

As argued by Grossman and Helpman (1991), regions with higher degree of openness have more chance to learn from outside. Furthermore, openness is considered as one of key variables of absorptive capacity (Lai, Peng and Bao, 2006). Thus, openness to trade is expected to be

associated with a high level of FDI spillovers and productivity growth. Following Kremer et al. (2013), the openness ($\boldsymbol{OPEN_{jt}}$) variable is computed by the ratio of total imports plus total exports over the total GDP of each province.

Local infrastructures variable is one of the important determinants of productivity as it offers leverage for all economic activities (Bogdan, 2016). Thus, to measure the value of local infrastructures ($\boldsymbol{P_{jt}}$) in each Vietnamese province, this chapter uses the total of fixed and post-paid phone registration per ten thousand of population, following the research of Loree and Guisinger (1995), Zhao and Zhu (2000), Kang and Lee (2007) and Hoang and Goujon (2104).

Peterson (2017) states that the growth of population can directly or indirectly affect the workforce size, economic growth and foreign investment. Considering the advantages of a large population, this chapter includes the annual growth rate of population in a province ($\boldsymbol{POPG_{jt}}$) to examine how the population size impacts the provincial productivity growth in Vietnam. This measurement is consistent with research of Aziz and Makkawi, 2012; Kremer et al., 2013.

Campos and Kinoshita (2008) state that local economic and political risks directly affect foreign investment and structural reforms can help to reduce these risks. In Vietnam, the *Doi Moi* reform policies help to improve the performance of non-state sectors and cut down the degree of central government control. To compute the pace of market reform ($\boldsymbol{M_{jt}}$), this chapter uses the ratio of non-state employees to total labour force (Zheng, 2005; Fu and Li, 2009).

The high degree of productivity may generate a higher level of employee compensation (Coughlin and Segev, 2000). Following Hoang and Goujon (2104), this chapter calculates the labour cost variable ($\boldsymbol{WAGE_{jt}}$) by annual income per employee in the firm sector in each Vietnamese province. This variable is used to investigate how the cost of wages affects productivity growth in Vietnamese provinces.

Wakeford (2004) states that an increase in productivity creates an increase in labour demand, thus leading to a decrease in the unemployment rate. Thus, this chapter also includes

the unemployment rate (***UNEMP***$_{it}$), to control for the impact of human capital on the TFP growth in Vietnamese provinces over the sample period.

The PCI index represents the economic performance of each Vietnamese province and the competitive capacity between provinces. It is expected that a higher level of PCI index positively affects the high level of productivity growth. Thus, the competitive index (***PCI***$_{jt}$) is included in this chapter to examine its impact on productivity spillovers in each Vietnamese province.

4.5 Summary Statistics and Correlation Matrix

Table 4. 1: Summary statistics of variables

Variable	Min	25%quantile	Median	75%quantile	Max
Y	-0.0543	-0.0030	.04249	0.0686	0.1210
H	0.0810	0.1090	0.1380	0.1690	0.2540
FDI_spillover	6.9188	7.7983	9.7711	11.2974	12.1769
UNEMP	0.7500	2.0000	2.6900	4.0300	6.4200
M	0.9039	0.9345	0.9480	0.9580	0.9693
WAGE	16.7546	17.1367	17.3125	17.4667	17.9572
PCI	0.4102	0.5266	0.5704	0.6043	0.6647
OPEN	0.1043	0.2116	0.4075	0.8099	1.6535
POPG	0.1100	0.3800	0.7100	1.2900	2.5300
P	0.3750	1.9836	2.7439	3.3258	4.2845

Notes: The table reports summary statistics of variables from 2005 to 2014 of all Vietnamese provinces. The value of ***Y***, proxy for output of each Vietnamese province, is defined by the TFP growth in each Vietnamese province. ***H*** implies the human capital ratio, which is calculated by the ratio of skilled workers to population. The FDI spillovers variable, ***FDI_spillover***, is the value of FDI spillovers into each Vietnamese province. ***UNEMP*** indicates the unemployment rate of the labour market in each Vietnamese province. The pace of market reform, ***M***, is indexed by a ratio of non-state employees to the total employed labour force. Labour costs, ***WAGE***, is the natural log value of annual incomes per employee in the firm sector in each province, deflated by the domestic price index. The provincial competitive index (***PCI***) denotes the performance of each Vietnamese province and compares that province with other provinces. This index is taken directly from the annual PCI report. ***OPEN*** represents economic openness, which is measured by the share of exports plus imports in the total

GDP. ***POPG*** is the population growth rate of each province, which is taken directly from GSO website. Infrastructures, ***P***, is computed by the natural log value of the ratio of total telephones registration per ten thousand of population.

Table 4.1 illustrates the summary statistics of the panel dataset over the period 2005 – 2014. The output variable, ***Y***, is the value of TFP growth in each Vietnamese province. The median value of variable ***Y*** is 0.04249, with a 25th percentile of -0.0030 and a 75th percentile of 0.0686. The difference between these values is not significant, indicating the small and stable growth rate of productivity between provinces over the sample period. The median value of human capital variable ***H***, proxy for threshold variable, which is measured by the ratio of total skilled workers over the population in each Vietnamese province, is 0.1380. The 25th percentile and 75th percentile values are 0.1090 and 0.1690 respectively, indicating that there are 25 per cent of the data are below the value of 0.1090, and 25 per cent of data sample achieve upwards of 0.1690. Although these values are still small in the total population, there is a considerable increase during the sample period, suggesting an improvement in the number of skilled workers over time. The median value of provincial ***FDI_spillover*** variable is 9.7711. The large difference between the minimum and maximum value of this variable indicates the heterogeneous distribution ratio of FDI inflows into the Vietnamese provinces. The median value of unemployment rate (***UNEMP***) is quite low at 2.69 per cent, with the 25th percentile at 2 per cent and the 75th percentile at 4.03 per cent. This ratio indicates that the percentage of unemployed workers in the total labour force among Vietnamese provinces is comparatively small over the sample period. The value pace of market reform – ***M*** (calculated by the proportion of non-state employees to the total employed labour force) is high, with a median of 0.9480, implying significant changes in labour turnover from state-owned enterprises to non-state-owned firms in the Vietnamese provinces. The median labour costs (***WAGE***), which is represented by the log value of annual average incomes per employee, is 17.3125, while the 25th percentile value is 17.1367 and 75th percentile is 17.4667. There are no significant differences in the wage rates, indicating a consistency in labour cost rates among the provinces. The median value of ***PCI*** variable is 0.5704. The difference between the minimum and maximum value of this index is comparatively small, suggesting less competitive performances among Vietnamese provinces. The median value of trade openness of market

(***OPEN***), which is calculated by the share of imports plus exports in the total GDP, is 0.4075, a 25th percentile at 0.2116 and a 75th percentile at 0.8099. The large difference in the degree of openness reflects the diversity in open-door policies in the provinces in attracting foreign investment and improving their productivity. The low median value of the population growth rate of each province (***POPG***), at 0.7100 and the large differences between the 25th percentile and 75th percentile at 0.3800 and 1.2900 correspondingly. This suggests the slight increase in the scale of population in provinces over the sample period. Finally, the median value of infrastructure variable (***P***), measured by the natural logarithm of a ratio of total telephone registration per ten thousand of population, is 2.7439 and the 25th percentile and 75th percentile are 1.9836 and 3.3258 respectively. The high and stable increase values imply the significant investment in infrastructure development across the Vietnamese provinces over time.

Table 4.2 illustrates the correlation matrix of all variables. The dependent variable, ***Y***, is found to be positively correlated with the pace of market reform (***M***) and the population growth rate (***POPG***) whereas it is negatively correlated with the openness (***OPEN***) and the degree of provincial competitiveness (***PCI)***. The FDI spillovers (***FDI_spillover***) are positively correlated with the degree of infrastructures (***P***) and the labour costs (***WAGE***). The variables exhibit a low correlation.

Table 4. 2: Correlation matrix of variables

Variable	***Y***	***H***	***FDI_spillover***	***UNEMP***	***M***	***WAGE***	***PCI***	***OPEN***	***POPG***	***P***
Y	1.0000									
H	-0.4078	1.0000								
FDI_spillover	0.1696	0.2390	1.0000							
UNEMP	0.6393	-0.2273	0.3084	1.0000						
M	0.0125	-0.2965	0.1052	0.1224	1.0000					
WAGE	-0.4959	0.5061	0.0828	-0.3254	-0.1311	1.0000				
PCI	-0.2761	0.2313	0.1017	-0.0781	0.1888	0.3981	1.0000			
OPEN	-0.1559	0.4301	0.3921	0.0346	0.1885	0.4858	0.3307	1.0000		
POPG	0.0182	0.2129	0.1269	-0.0711	-0.3505	0.3684	-0.0470	0.2149	1.0000	
P	-0.6755	0.5790	0.0320	-0.5197	0.0032	0.6899	0.4781	0.4772	0.1250	1.0000

Notes: The table reports the correlation matrix of variables over the period from 2005 to 2014 of all Vietnamese provinces. The value of ***Y***, proxy for output of each Vietnamese province, is defined by the TFP growth in each Vietnamese province. ***H*** implies the human capital ratio, which is calculated by the ratio of skilled worker over population. The FDI spillovers variable, ***FDI_spillover***, is the value of FDI spillovers in each Vietnamese province. ***UNEMP*** indicates the unemployment rate of the labour market in each Vietnamese province. The pace of market reform, ***M***, is indexed by a ratio of non-state employees to total employed labour force. Labour costs, ***WAGE***, is the natural log value of annual incomes per employee in the firm sector in each province, deflated by the domestic price index. The provincial competitive index (***PCI***) denotes the performance of each Vietnamese province and compares that province with other provinces. This is taken directly from the annual PCI report. ***OPEN*** represents the economic openness, which is measured by the share of exports plus imports in the total GDP. ***POPG*** is the population growth rate of each province, which is taken directly from the GSO website. Infrastructures, ***P***, are computed by the natural log value of the ratio of total telephone registrations per ten thousand of population.

4.6 Empirical Results and Discussion

4.6.1 Dynamic Panel Threshold Analysis

Table 4.3 illustrates the threshold effect of human capital on the TFP growth in 63 Vietnamese provinces from 2005 to 2014, using the dynamic panel threshold model.

Table 4. 3: Human capital and TFP growth: Dynamic panel threshold regression

A. Threshold estimates		
$\hat{\gamma}$	0.1213	
95% confidence interval	[0.1151 – 0.1219]	
Impact of H	Coefficient	Standard Error
$\widehat{\beta_1}$	-0.1333***	0.0826
$\widehat{\beta_2}$	0.1883 *	0.1370
B. Impact of covariates		
FDI_spillovers	-0.0821***	0.0043
UNEMP	-0.0029***	0.0006
M	-0.0056***	0.0015
WAGE	-0.4631**	0.2102
PCI	0.0213***	0.0088
OPEN	0.1202***	0.0257
POPG	0.0153**	0.0066
P	0.0062*	0.0041
$\widehat{\boldsymbol{\delta_1}}$	0.0497	0.0341
Obs	630	

Notes: The value of ***Y***, proxy for output of each Vietnamese province, is defined by the TFP growth in each Vietnamese province. ***H*** implies the human capital ratio, which is calculated by the ratio of skilled workers to population. The FDI spillovers variable, ***FDI_spillover***, is the value of FDI spillovers into each Vietnamese province. ***UNEMP*** indicates the unemployment rate of the labour market in each Vietnamese province. The pace of market reform, ***M***, is indexed by a ratio of non-state employees to the total employed labour force. Labour costs, ***WAGE***, is the natural log value of annual incomes per employee in the firm sector in each province, deflated by the domestic price index. The provincial competitive index (***PCI***) denotes the performance of each Vietnamese province and compares that province with other provinces, taken directly from the annual PCI report.

OPEN represents economic openness, which is measured by the share of exports plus imports in the total GDP. ***POPG*** is the population growth rate of each province, which is taken directly from GSO website. Infrastructures, ***P***, is computed by the natural log value of the ratio of the total telephone registrations per ten thousand of population.

The estimated threshold human capital value is 0.1213. The point estimate of the threshold is significant since it is in the 95 per cent confidence interval value ([0.1151 – 0.1219]). Once the threshold value is obtained, the relationship between human capital and TFP growth ratio can be considered. The estimated value threshold splits our sample into two regimes: the 'low threshold value' regime and the 'high threshold value' regime. The first regime consists of 521 observations below the threshold value of 1.1213, implying the low level of human capital in these observations. The coefficient in the first regime ($\widehat{\beta_1}$= -0.1333) is found to be negative and significant indicating that there is a negative relationship between the level of human capital and TFP growth under a certain level of a threshold. On the other side, the second regime contains 109 observations with a high level of human capital. In the second regime, the coefficient is 0.1883, which is positive and significant, implying that a marginal increase in human capital will significantly improve the amount of TFP growth. In summary, human capital is negatively correlated with the rate of TFP growth if it is less than the threshold value, whereas the opposite is true for a higher level of human capital. In other words, provinces that offer a higher level of a well-trained workforce will take advantage of the high TFP growth rate. This empirical finding is consistent with previous studies on the impact of human capital on productivity growth such as: Islam (2009); Chen and Luoh (2010); Khadaroo and Seetanah (2010); Gehringer, Mertinez-Zarzoro and Nowak-Lehmann (2014); and Islam, Ang and Madsen (2014). In the context of Vietnam, the research in this chapter is the first attempt to investigate the relationship between human capital and TFP growth by employing the dynamic panel threshold technique

The pull and push factors of the dependent variable, TFP growth, are estimated using GMM procedures and the results are reported in section B of Table 4.3.

Firstly, the FDI spillovers (***FDI_spillover***) are negative and significant with the TFP growth, implying that the presence of foreign firms may cause a decrease in local firms'

productivity in the Vietnamese provinces. This finding is in accordance with former research (Aitken and Harrison 1999; Konings, 2001; Haskel et al., 2002; Le and Pomfret, 2011, Suyanto, Bloch and Salim (2012), Bruhn and Calegario, 2014; and Liu, Agbola and Dzator, 2016). These studies confirm that inward FDI does not always have positive effects but also negative ones to arise. Bruhn and Calegario (2014) find that the productivity spillovers do not happen equally across all industries in Brazil. In particular, the existence of foreign firms leads to negative effects in labour-intensive industries. Aitken and Harrison (1999) also confirm the negative effects of foreign ownership on the productivity of local firms in the same industry.

The unemployment rate (***UNEMP***) is found to be negative and significant to TFP growth under the threshold, indicating that the productivity spillovers produce more jobs in the labour market, thus helping improve the ratio of unskilled or unexperienced labourers. Hamidah et al. (2016) find that hiring unskilled and inexperienced workers will help firms to reduce the cost of wages. Thus, the presence of foreign firms results in a decline in the unemployment rate in Vietnam. Next, the coefficient sign of market reforms (***M***) is negative and significant, suggesting that the increase in market reforms ratio responds to a decrease in the productivity growth in Vietnamese provinces. Zhang (2001) finds that market reforms are not the driver of domestic output growth. Jones and Ruffin (2008) find that the productivity spillovers are negatively affected by marketisation. Fu and Li (2009) state that market reforms mainly focus on efficiency improvement instead of pure technical progress. Thus, they argue that marketisation is significantly negative to productivity growth because productivity growth is more dependent on technical progress than on efficiency. Labour costs (***WAGE***), are found to be negative and significant, suggesting that higher level of employee compensation will deter the productivity growth in Vietnamese provinces. This finding is in accordance with the results of: Friedman et al. (1992); Coughlin and Sagev (2000); Kang and Lee (2007); Kawai (2009); and Ping (2011). The provincial competitiveness index (***PCI***) is found to be positive and significant to TFP growth, which implies that the higher productivity growth, the more competitive capacity in these Vietnamese provinces. According to World Economic Forum (2010), the competitiveness index at the national level can be considered as a set of 'institutions, policies and factors that determine the level of productivity growth'. Korez-Vide

and Polona (2016) find a positive relationship between the global competitive index and the economic growth in Central and Eastern European countries. Tran, Pham and Barnes (2016) also include the provincial competitiveness index to investigate the spatial spillover effect from FDI in Vietnamese provinces. They also confirm the positive effects of the competitive index and the productivity spillovers. Openness (***OPEN***) is positive and significant with productivity spillovers, suggesting that the more open the provinces, the more the improvement in productivity growth. This finding is in accordance with the research of Boer et al. (2001) and Comin and Hobijn (2004) and Liargovas and Skandalis (2012), who find that openness is one of the determinants of productivity spillovers. Jones and Ruffin (2008) also confirm the importance of openness in attracting inward FDI, along the lines of Asiedu (2002), Forbes and Warnock (2012) and Kurul (2017). The population growth rate (***POPG***) has a positive and significant impact on TFP growth, suggesting that a large population increases its political strength and provides enough labour to market, thus improving productivity growth. This finding is in accordance with Riley (2003), Baker, Delong and Krugman (2005), Gupta and Wang (2009) and Aziz and Makkawi (2012). The infrastructures variable (***P***) is found to be positive and significant, implying that infrastructure development is a primary domestic driver of TFP growth and the increase in the level of domestic infrastructures will improve productivity growth in Vietnam's provinces. The positive relationship between the degree of infrastructures and TFP growth is in accordance with Bronzini and Piselli (2009) for Italian regions for the period 1980 – 2001 and Fleisher et al. (2010) for Chinese provinces.

4.6.2 Robustness Tests

Kremer et al. (2013) state that the choice of instruments may lead to biased coefficient estimates. Research in this chapter reduces the number of instruments count to 1 to prevent an overfit of instrument variables. Table 4.4 illustrates the results for this change in the choice of instruments. The results of human capital threshold on provincial TFP growth are still robust when reducing the instrument variables. In other words, the selection of instruments has no important effect on the results in this chapter.

Table 4. 4: Human capital and TFP growth: Dynamic panel threshold regression (01 instrument variable)

A. Threshold estimates		
$\hat{\gamma}$	0.1208	
95% confidence interval	[0.1088 – 0.1219]	
Impact of H	Coefficient	Standard Error
$\widehat{\beta_1}$	-0.3449***	0.0953
$\widehat{\beta_2}$	0.1944 *	0.1303
B. Impact of covariates		
FDI_spillovers	-0.0764***	0.0068
UNEMP	-0.0026***	0.0007
M	-0.0056***	0.0019
WAGE	-0.5361**	0.2337
PCI	0.0232**	0.0106
OPEN	0.1210***	0.0285
POPG	0.0164**	0.0086
P	0.0066*	0.0044
$\widehat{\boldsymbol{\delta_1}}$	0.0541*	0.0341
Obs	630	

Notes: The value of ***Y***, proxy for output of each Vietnamese province, is defined by the TFP growth in each Vietnamese province. ***H*** implies the human capital ratio, which is calculated by the ratio of skilled worker over population. The FDI spillovers variable, ***FDI_spillover***, is the value of FDI spillovers into each Vietnamese province. ***UNEMP*** indicates the unemployment rate of the labour market in each Vietnamese province. The pace of market reform, ***M***, is indexed by a ratio of non-state employees to the total employed labour force. Labour costs, ***WAGE***, is the natural log value of annual incomes per employee in the firm sector in each province, deflated by the domestic price index. The provincial competitive index (***PCI***) denotes the performance of each Vietnamese province and compares that province with other provinces and is taken directly from the annual PCI report. ***OPEN*** represents the economic openness, which is measured by the share of exports plus imports in the total GDP. ***POPG*** is the population growth rate of each province, taken directly from GSO website. Infrastructures, ***P***, is computed by the natural log value of the ratio of total telephone registrations per ten thousand of population.

Following Chao et al. (2017), this section also performs the robustness test to check the sensitivity of the finding results in Table 4.3 by using alternative method. To compare the performance of the dynamic panel threshold model, research in this chapter employs the traditional threshold estimation, introduced by Hansen (1999). The Hansen (1999) threshold regression results are illustrated in Appendix Table A4.1. The sign and significance of the control variables are almost like those from Table 4.3. The only notable exception refers to the value of estimated threshold. In the Hansen method, the estimated threshold is 0.0860 while the dynamic threshold value is 0.1213. This difference indicates that the Hansen method estimation is less efficient than the dynamic panel threshold estimation. In other words, ignoring the potential endogeneity may lead to bias increases and precision decreases for the threshold estimation. Therefore, the dynamic threshold approach is unbiased and preferable to the original Hansen (1999) methodology.

4.7 Conclusion and Policy Implications

Based on a dataset of 63 Vietnamese provinces over the sample period from 2005 to 2014, this research empirically investigates the influences of human capital threshold on productivity growth by employing the Kremer et al. (2013) dynamic panel threshold model. This approach is chosen because it allows the estimation of threshold effects even in case of endogeneity. Therefore, the estimation effects of the human capital threshold on the TFP growth are more suitable and flexible than former methods.

The empirical results indicate that a threshold value does exists in the human capital – the TFP growth nexus, at a value of 1.1213. This implies that the improvement in the productivity growth in Vietnamese provinces is not unconditional and depends on the level of human capital. TFP growth is positive and significant with human capital if it is higher than the threshold value while the opposite side is true, when the degree of human capital is under its threshold. The results also indicate that the productivity growth is affected by the competitiveness between provinces, the openness, the scale of population and infrastructure development of each Vietnamese province. Obviously, foreign investors pay more attention to regions with a highly competitive capacity and are more open. Moreover, a large population provides a sufficient labour market and a better infrastructure to contribute to a stable increase in the productivity growth of local regions. Other remaining control variables, the spillovers of inward FDI, unemployment rate, market reforms and labour costs are negatively correlated with the improvement of productivity.

The research findings also suggest some important policy implications. Firstly, this study emphasises the importance of human capital in improving the TFP growth in Vietnamese provinces and proposes the achievement of a clear level of human capital targets for all Vietnamese provinces. For those provinces that are under the threshold level, it is essential to pay more attention to knowledge transfer, improve their human capital and increase their R&D activities to enhance their absorptive capacity, to boost the productivity growth and to attract more FDI inflows. Moreover, this study demonstrates a need to promote the growth of well-educated workforce in all Vietnamese provinces and cities. The development of training

centres, vocational colleges and universities are required to decrease the technology gap between provinces and between local economies and foreign investors. Additionally, this research also depicts the importance of stable economic growth, the improvement in infrastructures and the openness of local economies. Therefore, more general policies and incentives packages to support the development of infrastructures and economic growth, as well as encourage foreign investments, should be issued and followed to ensure stable economic development and more benefit from inward FDI to Vietnamese provinces in the future.

CHAPTER 5: IMPACTS OF FDI SPILLOVERS ON PROVINCIAL TFP GROWTH: A SPATIAL APPROACH

5.1 Introduction

The role of foreign direct investment (FDI) on economic development has been confirmed at both the macro and micro level in the existing literature. At the country level, FDI contributes to national tax revenue, employment, capital, international trade, and national economic growth rate of recipient countries (Ledyaeva, 2009; Blonigen and Piger, 2014). Apart from the macroeconomic level, FDI is expected to affect indigenous firms through different spillover effects (Blomstrom and Kokko, 1998). Since foreign firms possess advanced technologies and superior knowledge capital, their existence can benefit nearby local firms through labour turnover, demonstration or competition spillover effect (Gunther, 2002; Glass and Saggi, 2002; Lin and Chuang, 2007; and Pham, 2012). Various studies provide evidence of FDI spillovers at both firm and industry levels (Suyanto, Salim and Bloch, 2009; Lin, Liu and Zhang, 2009; Zhang el al., 2010; Hale and Long, 2011; Nguyen and Anwar, 2013; Merlevede, Schoors and Spatareanu, 2014). Thus, the presence of foreign firms has had a significant impact on the world economy and been the focus of considerable attention.

To lower transaction costs and exploit external resources, firms tend to agglomerate in a specific location. This is in accordance with Marshallian notion (Marshall, 1920) that the concentration of production in an area creates external benefits for firms in that area and specialized suppliers nearby. Tobler (1970) asserts that 'everything is related to everything else, but near things are more related than distant things'. These arguments indicate the importance of the location decision and proximity distance of firms. It is well documented that the distance between countries is a primary determinant of bilateral international trade and foreign investment (Frankel and Rose, 2002; Baltagi, Song and Koh, 2003; Blonigen et al., 2007; Hall and Petroulas, 2008). Nevertheless, most of these empirical studies on FDI location implicitly assume that proximate locations have no impact on foreign firms' decision-making. In the existing literature, little work has been done on how the existence of FDI location

influences the aggregate productivity of indigenous firms in the spatial dimension (Hong and Sun, 2011; Tran, Pham and Barnes, 2016; Lin and Kwan, 2016; 2017).

Kayam, Yabrokov and Hisarciklilar (2013) state that an investment decision may not only be affected by the characteristics in a region but also in alternative ones by agglomeration impacts. Blanc-Brude et al. (2014) confirm that ignorance of the impact of alternative locations or the exclusion of spatial dependence may cause various estimation and inference problems. Therefore, the investigation of interaction among regions is essential to avoid any bias in an econometric estimation. Moreover, Lin and Kwan (2011) find that the location of foreign firms illustrates the self-reinforcing pattern not only through geographical proximity but also along the industrial and sectoral spatial dimensions. While the previous chapter concentrated on the role of human capital as a determinant of FDI spillovers and productivity growth, research in this chapter aims to provide further empirical evidence showing the geographic extent of FDI spillovers, using province-level data in Vietnam.

In the context of Vietnam, the determinants of FDI among provinces are widely examined by Pham (2002), Meyer and Nguyen (2005), Nguyen and Anwar (2010) and Hoang and Goujon (2014). Nevertheless, these studies do not account for the spatial interaction between proximate regions and provinces, except for those by Hoang and Goujon (2014); Tran, Pham and Barnes (2016); and Esiyok and Ugur (2017). In their research, Hoang and Goujon (2014) employ spatial econometric approach to test the significance of FDI between Vietnamese provinces over the sample period 2000 – 2010. Their study only concentrates on the interaction between bordering provinces, using the contiguous matrices. This may cause biased results due to the exclusion of all the proximate remaining provinces. Kayam, Yabrukov and Hisarciklilar (2013) argue that the inclusion of only host regions' characteristics is not sufficient to explain the FDI locational choice. In fact, proximate provinces may have more interaction than some bordering provinces. Thus, the elimination of other proximate provinces affects the evaluation of FDI determinants and generates biased outcomes. Tran, Pham and Barnes (2016) employ contiguous matrix to re-investigate the spatial spillover effect through productivity growth of local firms from 2000 to 2005. Similar to the research by Hoang and Goujon (2014), the contiguous weight matrix used by Tran, Pham and Barnes (2016) only

concentrates on the interaction among bordering provinces. Research over the period from 2006 to 2009 by Esiyok and Ugur (2017) focuses on the physical distance between Vietnamese provinces. However, they ignore the FDI spillover effects on local firms. Based on these arguments, this chapter remedies their shortcomings by weighing the provincial features through the distance between town centres of each province. This method is suggested by Anselin (1999), followed by Baltagi et al., (2007), Kayam, Yabrokov and Hisarciklilar, (2013) and Lin and Kwan (2016, 2017). The advantage of using a distance-based matrix is because of its exogeneity with respect to FDI spillover (Anselin and Bera, 1998). Moreover, the dataset used in this chapter is updated and more detailed than former research.

This chapter contributes to existing literature in different ways. It supports the argument of the role that location and distance play in decision-making by foreign investors. In other words, the determinants of foreign investment to a host region not only depend on location-specific attributes but also rely on the proximity to alternative locations. This chapter also employs different specifications of distance to different models. Using a panel dataset for 63 provinces in Vietnam over the period 2005 – 2014, research in this chapter firstly estimates a 'non-spatial' model of provincial FDI location using local market determinants. Then, several spatial econometric models are included to control for spatial dependence and improve the explanatory power of research models. By employing different spatial models, this chapter highlights the importance of proximate provinces in which these provinces are not just rivals for FDI inflows, but also directly affect the likelihood of a foreign investment decision in a specific province. Although the research in this chapter is not the first investigation of the spatial impact on Vietnamese provinces, this study also provides the important implication for the effectiveness of expenditures to promote FDI inflows and improve the productivity spillovers in local provinces.

This chapter is structured as follows. Section 5.2 briefly demonstrates the FDI distribution in the Vietnamese provinces. Section 5.3 reviews the literature on FDI location choice. Section 5.4 describes the econometric methodology used in this chapter. Section 5.5 and 5.6 illustrate the summary statistics and discuss the empirical results. The final section sums up and offers policy implications.

5.2 Geographical Distribution of FDI Inflows to Vietnamese Provinces

In Vietnam, the number of foreign investment projects increased significantly after the *Doi Moi* reform policy in 1986 and the promulgation of a liberal foreign investment law in 1987. These policies have resulted in a significant increase of registered FDI capital in Vietnam from USD 1,603.5 million in 1988 to USD 26,890.5 million in 2016 (General Statistics Office of Vietnam, 2016). The fluctuated increase of FDI inflows into Vietnam during this period is due to several special circumstances. Firstly, the value of FDI inflows fell rapidly during the period 1995 – 1999 due to the impact of the Asian financial crisis of 1997 – 1998. The FDI flows in Vietnam recovered during 2000s. This achievement can be credited to the changes of the Foreign Investment Law, the enactment of Law on Enterprises, and the free trade agreement between Vietnam and the United States in 2000. FDI inflows reached a peak of USD 71,726 million in 2008 after Vietnam became an official World Trade Organisation (WTO) member in 2007. However, FDI inflows decreased to USD 23,107 million in 2009 due to the influences of the global financial crisis. FDI inflows have gradually recovered thereafter.

The fluctuation of total registered FDI inflows during this period results in an uneven distribution between Vietnamese provinces. Hanoi (located in the north) and Ho Chi Minh City (located in the south) are the two key cities that attract major FDI inflows. According to the General Statistics Office of Vietnam in 2006, over 90 per cent of total FDI inflows are concentrated in 19 key provinces, with Hanoi (24 per cent) and Ho Chi Minh City (45 per cent) during the period of 2001 – 2006. After acceptance to the WTO in 2007, the percentage of FDI inflows into Hanoi and Ho Chi Minh City increased to approximately 25 per cent and 53 per cent respectively. The WTO membership has led to significant changes in geographical distribution of FDI to other provinces and has resulted in the decrease of FDI inflows from 90 per cent to 66 per cent during the period 2007 – 2014. As in previous periods, foreign investment was continually drawn to major Vietnamese provinces during 2015 and 2016. Hanoi and Ho Chi Minh City are still the main destinations for FDI, which achieved 18.24 per cent and 12.24 per cent of the total value of inward FDI (General Statistics Office of Vietnam, 2015; 2016). This is because these two cities offer more infrastructure and agglomeration advantages. The presence of foreign investors may also depend on the location of Vietnam's

specialised economic zones, which are throughout the country. Other major destinations for FDI are in the Southwest Vietnam provinces, including Long An, Can Tho and Kien Giang (General Statistics Office of Vietnam, 2016).

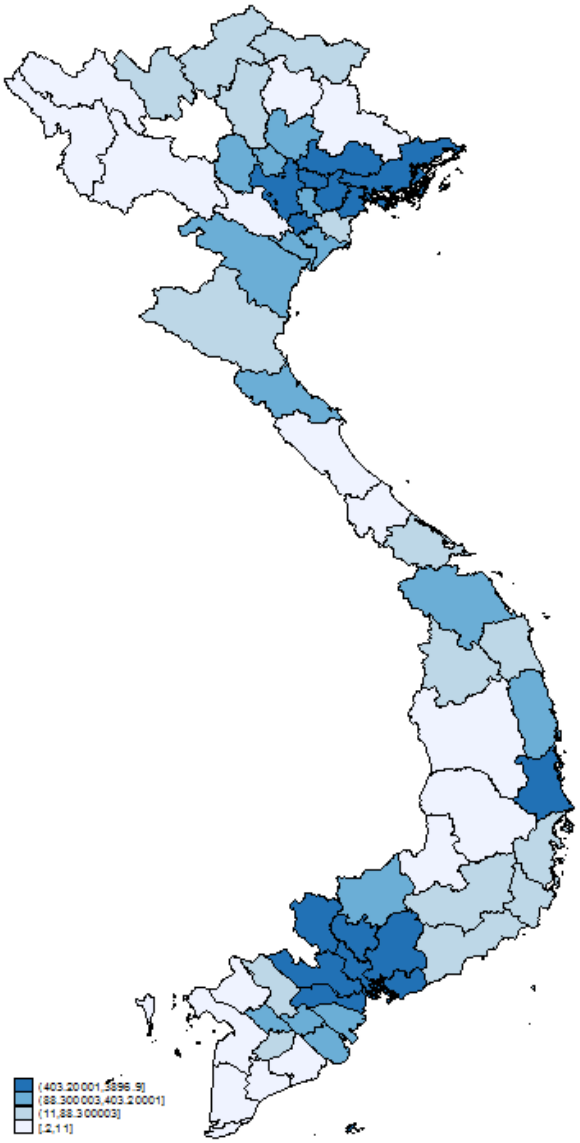


Figure 5. 1: The value of FDI inflows to Vietnamese provinces in 2016

Source: General Statistics Office of Vietnam, 2016

5.3 Literature Review

5.3.1 Theoretical Background of Spatial Relationship in FDI

Previous research indicates that the enhancement or impediment of FDI flows into a specific location is affected by various factors. In the literature, there are four fundamental methods of FDI research: horizontal FDI; vertical FDI; export-platforms FDI; and vertical specialisation with agglomeration.

The first two groups of studies apply traditional theories on FDI such as Cushman (1987), Helpman (1984), Coughlin et al. (1991), Broadman and Sun (1997) and Sun et al. (2002). These studies focus mainly on market-seeking production and generating competition between recipient countries. They argue that multinationals find advantages only in their destination of investment. Moreover, the impact of the third countries and the spatial interaction between different host countries are ignored in these studies.

In contrast, the third group, export-platforms FDI considers the role of the third countries which could be one of the determinants of foreign investment decision-making. Yeaple (2003) includes the effects of third countries in his research first. The model of export-platforms FDI is adequately developed by Ekholm et al. (2007). It is defined as 'investment and production in a host country where the output is largely sold in third markets, not the parents or host-country markets'. In other words, this model emphasises the roles of neighbouring market to trade and transport instead of host-country markets. This group concentrates on 'spatial auto-regression' which includes two spatial lag variables (spatial lag-dependent variable and a market potential variable) into a standard regression analysis on FDI distribution.

Finally, the fourth motive – vertical specialisation with agglomeration, is introduced by Blonigen et al. (2005; 2007). By applying this framework, multinational enterprises (MEs) will gain agglomerations and reduce production costs by separating the production process into specific geographic regions. However, Blonigen et al. (2007) state that empirical analysis of this motive only captures net effects. Thus, it is difficult to tease out from country-level and industrial-level data.

Table 5.1 below summarises the expected signs and spatially lagged FDI and potential neighbouring markets on FDI for various of FDI forms.

Table 5. 1: Hypothesised spatial lag and market potential variables, by forms of FDI

FDI motivation	Sign of spatial lag variable	Sign of market potential variable
Pure horizontal	0	0
Pure vertical	-	0
Export platform	-	+
Vertical specialisation with agglomeration	+	+

Source: Blonigen et al. (2007, p.1308) and Ledyaeve (2009)

This chapter employs inter-provincial data and this requires some adaption of these analysis. Hoang and Goujon (2014) argue that the scale of provincial markets in Vietnam is quite small and the trade barriers between provinces are low in comparison to international barriers. Thus, the target market can be regional, which includes both the host and proximity markets. In addition, all Vietnamese provinces are subject to the national trade policy. Consequently, the regional-trade platform type is adopted in place of the export platform of FDI motive in this chapter (Ledyaeda, 2009; Hoang and Goujon, 2014). Following Ledyaeda (2009), the theoretical basis for the regional-trade platform is assumed to be analogous to export-platform FDI in general. It is expected that FDI inflows in one region are positively correlated with foreign investment in neighbouring regions due to agglomeration impacts.

5.3.2 Empirical Research in the Geographical Distribution of FDI

The existing literature provides little evidence of spatial relationship in FDI and most of these studies focus on the spatial distribution of FDI in developed countries. Head et al. (1995) firstly investigate the role of agglomeration effects by estimating the determinants of Japanese FDI in the US. They find a significant agglomeration impacts between bordering states. This is one of the initial attempts in identifying the FDI location by taking account of spatial

interdependence. Yeaple (2003) finds that the value of FDI inflows in the host country is attracted by the policies and characteristics of bordering countries when extending the standard models of FDI and considering the possibility of complex integration. Head and Mayer (2004) examine the distribution of Japanese FDI in the European Union. They find that the high level of FDI inflows is positively correlated with the more developed regions. Baltagi et al. (2007) include a data set of US industries and host countries over the 1989 – 1999 period to investigate the determinants of spatially weighted third countries on FDI inflows. They confirm a strong evidence of spatial interaction but cannot determine whether the dominant type of FDI is an export-platform FDI or a complex vertical FDI motive. Employing data of US-outward FDI flows to 35 host countries from 1983 to 1998, Blonigen et al. (2007) find that the FDI distribution depends on the location of countries, suggesting the role of spatial interdependence between neighbouring countries. Hall and Petroulas (2008) find a significant impact of a third country presence when examining the real stock of FDI for 476 countries over the period 1994 – 2004. Basile, Castellani and Zanfei (2008) explore the locational choices of multinational firms in Europe over the period 1991 – 1999. They find that MNs are attracted by agglomeration economies where structural and cohesion funds are allocated. Using data for American states from 1977 to 2003, Bode, Nunnenkamp and Waldkirch (2012) confirm a positive impact of spatial proximity on FDI inflows to those states.

There are fewer spatial studies in developing economies. Coughlin and Segev (2000) conduct a comprehensive spatial econometric study in China. Using data of US FDI inflows to 29 Chinese provinces during the period 1990 – 1997, they estimate a spatially correlated errors' model and find that FDI in one province has a positive impact on FDI in neighbour province. However, this study uses a very simple definition of neighbour, as sharing a common border between two provinces, and assumes an equal weighting of every neighbour. Estimating the spatial weight matrix by a simple inverse distance between the Russian regions, Ledyaeva (2009) confirms weak evidence of spatial dependence across Russian regions over the period 1996-2005. Kayam, Yabrukov and Hisarciklilar (2013) re-examine the spatial effects of FDI inflows in 64 Russian regions for the period between 1995 and 2003. Using different spatial models, the authors find that FDI inflows to the host regions are affected by spatial market size

and the endowment of natural resources rather than FDI levels in proximate regions. Blanc-Brude et al. (2014) investigate how spatial distance affects FDI location decisions in 244 Chinese cities from 2004 to 2007. This research confirms strong evidence of spatial dependence between cities but weak evidence of administrative distance.

In Vietnam, there are only three studies which examine the significance of the spatial distribution and inward FDI. Nguyen and Nguyen (2007) simply provide an overview of spatial FDI distribution across Vietnamese provinces. Hoang and Goujon (2014) investigate the determinants of FDI distribution among bordering Vietnamese provinces by applying a spatial econometric model. The limitation of Hoang and Goujon's study is that it only focuses on bordering provinces and neglects other provinces. This exclusion possibly causes biased results because some proximate provinces may have more interaction than some other neighbours. Using a dataset of 62 Vietnamese provinces from 2006 to 2009, Esiyok and Ugur (2017) examine the locational determinants of FDI inflows through the distance-based weight matrix. They find that neighbouring regions' characteristics have indirect effects on FDI inflows and the existing regional disparity of FDI distribution can be due to agglomeration dynamics. However, their research does not consider the spillover effects of FDI among Vietnamese provinces.

5.3.3 Geographical Proximity and FDI Spillover

According to Gertler (2003), knowledge diffusion from FDI is extremely sensitive to geographical distance and this can generate knowledge spillovers between regions. In the existing literature, the positive relationship between knowledge diffusion from FDI and geographical distance is confirmed by Boschma and Frenken (2010); Broekel and Boschma (2012); and Cassi and Plunket (2014). However, Gorg and Strobl (2005) argue that knowledge diffusion can also bring negative spillovers effects to indigenous firms as agglomeration can push up the local costs such as land, labour, and public goods and creates negative pecuniary externalities on firms. Thus, in the context of firm agglomeration, the knowledge spillover effects are still inconclusive.

Madariaga and Poncet (2007) state that spatial dependence can be an important force in the process of productivity growth. Unfortunately, it is normally ignored. Furthermore, the FDI spillover effects can occur not only in a particular location but also intra- and inter-regions (Lin and Kwan, 2017). However, there has been little work on how the existence of FDI location influences the aggregate productivity of indigenous firms in the spatial dimension (Hong and Sun, 2011; Tran, Pham and Barnes, 2016; Lin and Kwan, 2016; 2017). Using a dataset of Chinese provinces over the period 1980 – 2005; Hong and Sun (2011) find that FDI externalities positively impact Chinese TFP within and across regions. Lin and Kwan (2016) adopt a spatial temporal autoregressive panel model to investigate the direct and indirect effects of FDI spillovers on spatial diffusion. They find that FDI existence from neighbour regions can generate knowledge spillovers and benefit domestic firms in the host region. Lin and Kwan (2017) re-investigate the FDI spatial spillover effects, using data at county level from 1998 to 2007. They confirm the negative spillover effects of FDI and domestic private firms in the same county. Tran, Pham and Barnes (2016) undertake the first investigation of FDI spatial spillover effects in Vietnamese firms from 2000 – 2005. However, this study is limited by using only one spatial model and using a contiguity matrix. Kayam, Yabrukov and Hisarciklilar (2013) and Esiyok and Ugur (2017) state that some proximate regions may have more interaction than some neighbours. To avoid the bias caused by the exclusion of proximate regions, this chapter employs an inverse distance matrix and different type of spatial models to investigate the FDI spillovers into Vietnamese provinces over the period 2005 – 2014. By establishing a rationale for different spatial lags and weight matrices, research in this chapter provides a clearer understanding of the role of neighbouring regions on FDI spillovers.

5.4 Econometric Methodology

5.4.1 Theoretical Spatial Models

Spatial econometrics is a set of techniques that deals with the spatial linkages of both cross-sectional and panel data analysis (Pealinck and Klaassen, 1979; Anselin, 1988). A standard spatial regression model includes two main factors: the spatial lag term and the spatial error structure. The spatial lag element indicates the impacts of spatially weighted nearby units on

the dependent variable whereas the spatial error structure includes the spatial lag in the error term (Yesilyurt and Elhorst, 2017). A general spatial nesting model is constructed as follows:

$$Y_{it} = \rho W Y_{it} + X_{it}\beta + W X_{it}\theta + \mu_{it} \quad (5.1)$$
$$\mu_{it} = \lambda W \mu_{it} + \varepsilon_{it}$$

where:

Y_{it} is N x 1 vector of dependent variables in the period time t; X_{it} denotes an N x K matrix of exogenous explanatory variables correlated with the K x 1 vector β at time t; W is an N x N non-negative spatial weight matrix; WY_{it} indicates the endogenous spatial lag at time t; WX_{it} is the exogenous spatial lag in the period time t; and $W\mu_{it}$ represents the spatial lag among the error terms over the period time t; scalar ρ is spatial dependence parameter; λ is spatial autocorrelation parameter; and K x 1 vector θ denote the strength of the above spatial lags; and ε_{it} is error term.

If WX_{it} and $W\mu_{it}$ are equal to zero, Equation 4.1 turns into a spatial autoregressive model (SAR) (LeSage, 1999). In the SAR models, WY_{it} indicates the spatially weighted dependent variable and the strength of spatial dependence depends on explicitly spatial relationship between dependent variables (Kayam, Yabrukov and Hisarciklilar, 2013). A typical SAR model is represented as follows:

$$Y_{it} = \rho W Y_{it} + X_{it}\beta + \varepsilon_{it} \quad (5.2)$$

Otherwise, WY_{it} and WX_{it} are equal to zero, a spatial error model (SEM) is generated (Equation 5.3). According to Yesilyurt and Elhorst (2017), a SEM model can be relevant when regions share similar unobserved characteristics. In this model, the error term differs from the SAR specification as it includes a spatially autocorrelated error term.

$$Y_{it} = X_{it}\beta + \mu_{it} \quad (5.3)$$
$$\mu_{it} = \lambda W \mu_{it} + \varepsilon_{it}$$

Additionally, a spatial autocorrelation model (SAC) can be constructed if WX_{it} is equal to zero. This model, in fact, is an extension of the SAR model, allowing for a spatially autocorrelated error. Its form is as follows:

$$Y_{it} = \rho WY_{it} + X_{it}\beta + + \mu_{it} \quad (5.4)$$
$$\mu_{it} = \lambda W\mu_{it} + \varepsilon_{it}$$

Kayam, Yabrukov and Hisarciklilar (2013) state that the consideration of only host regions' features is not adequate because the characteristics of proximate regions also play a primary role in the locational choice of foreign investors. Therefore, two extensions of SAR and SEM are introduced to consider all characteristics of alternative locations. The first extension from SAR model, namely Durbin spatial autoregressive model (SDM), consists of spatially weighted explanatory variables. In this model, the error term does not include the spatial autocorrelation error term ($W\mu_{it} = 0$) and the form of SDM is as follows:

$$Y_{it} = \rho WY_{it} + X_{it}\beta + WX_{it}\theta + \varepsilon_{it} \quad (5.5)$$

To investigate the relationship between host and proximate regions based on the above models, it is essential to determine the weighting matrix (W). It is constructed by positioning all proximate regions as elements of a symmetric matrix, and these regions are represented in rows and column (Kayam, Yabrukov and Hisarciklilar, 2013). In spatial econometrics analysis, there are different ways to construct a weighting matrix. Coughlin and Sagev (2000) address only the neighbourhood impact by assigning 1 to all the neighbours and zero to non-neighbour regions. However, the limitation is that the weight matrix only concentrates on the interaction among bordering provinces. The elimination of other proximate provinces can generate biased outcomes. In fact, proximate provinces may have more interaction than some bordering provinces. To include proximate regions; Blonigen el al. (2007) construct the weighting matrix by defining an impact frontier and the weight is determined by distance from the target regions. Kayam, Yabrukov and Hisarciklilar (2013) argue that it is hard to identify the impact frontier. Therefore, for the research discussed in this chapter, the alternative method is employed, which was suggested by Anselin (1999), followed by Baltagi et al. (2007), Kayam, Yabrukov and Hisarciklilar (2013), Lin and Kwan (2016; 2017). Spatial interaction is

constructed by an inverse distance-weight matrix, based on the distances between Vietnamese provinces. By considering all Vietnamese provinces, FDI spatial spillovers is analysed to clarify the geographic proximity of all feasible alternatives.

5.4.2 Empirical Econometric Estimation

To investigate the spatial effect of FDI spillovers on TFP growth among Vietnamese provinces, the research in this chapter estimates different forms of spatial models (SAR, SAC, SEM, and SDM). Following Yesilyurt and Elhorst (2017), the spatial nesting model for research in this chapter is as follows:

$$\boldsymbol{TFP_{jt} = \rho WTFP_{jt} + X_{jt}\beta + \varphi WFDI\_spillover_{jt} + WX_{jt}\theta + \mu_{jt}} \qquad (5.6)$$

$$\boldsymbol{\mu_{jt} = \lambda W\mu_{jt} + \varepsilon_{jt}}$$

where:

the dependent variable, provincial TFP_{jt} is a weighted average of TFP growth value at firm level, then aggregated at the provincial level.

$\boldsymbol{W}$ is a N x N non-negative spatial weight matrix; where $W_{ij} = \begin{bmatrix} (d_{ij})^{-1} & if\ i \neq j \\ 0 & if\ i = j \end{bmatrix}$

$\boldsymbol{X_{jt}}$ denotes an N x K matrix of exogenous control variables correlated with the K x 1 vector β at time t;

$\boldsymbol{FDI\_spillover_{jt}}$ denotes the spillover effects of foreign firms in each Vietnamese province. It is measured by the weighted average of FDI spillovers in each firm;

The scalar ρ is spatial dependence parameter; φ indicates spatial independent parameter; λ is spatial autocorrelation parameter; and K x 1 vector θ denote the strength of the above spatial lags;

$\boldsymbol{\varepsilon_{jt}}$ is error term.

This chapter initially estimates the spatial auto-regression models (SAR) of LeSage (1999) and the spatial error model (SEM) (Coughlin and Segev, 2000) and the extension of the SAR model – spatial autocorrelation model (SAC) to describe spatial interaction among the Vietnamese provinces. To ensure unbiased results and interdependence between alternative hosts and proximate provinces, this chapter then adopts another extensive model, Durbin-spatial auto-regression (SDM), with the inclusion of both spatially weighted independent and explanatory variables. The inclusion of all these models enables observation of how FDI spillovers have intra-regional and inter-regional impacts on productivity growth among the provinces.

5.4.3 Data and the Variables

- ***Data selection***

For the research discussed in this chapter, a dataset of 63 provinces and cities in Vietnam[20] is employed. The data is obtained from the official publication of Statistical Year Book of General Statistics Office of Vietnam from 2005 to 2014. Data is also obtained from the Foreign Investment Department (Ministry of Planning and Investment) and the Ministry of Labour of Vietnam websites. Research in this chapter concentrates on the provincial level for several reasons. Firstly, the information on geographical distance is only available at the provincial level and the estimation at firm-level is not feasible due to limitations in computation. The diversity in foreign investment, social and economic features among Vietnamese provinces is another reason. Additionally, each Vietnamese province can propose its own incentives to push up foreign investment and improve its economic and social growth. Therefore, the selection of provincial level data is appropriate as the unit of spatial analysis.

- ***The dependent and explanatory variables***

The provincial TFP growth ($\boldsymbol{Y_{jt}}$) of each Vietnamese province is denoted by the dependent variable, $\boldsymbol{Y_{it}}$**.** Following Lin and Kwan (2016; 2017), this variable is constructed as:

[20] Ha Tay province is merged into Hanoi city in 2008 and will not be included in this sample due to the unavailable data.

$$\boldsymbol{Y_{jt}} = \frac{\boldsymbol{lny_{ijt}}}{\sum_{i \in j} \boldsymbol{lny_{ijt}}} \boldsymbol{Y_{ijt}} \quad (5.7)$$

where:

$\boldsymbol{Y_{jt}}$ represents the TFP growth of province *j* in year *t*;

$\boldsymbol{lny_{ijt}}$ implies the natural logarithm value of firm *i*'s revenue, located in province *j* at year *t*;

$\boldsymbol{Y_{ijt}}$ is the value of TFP growth of firm *i* in province *j* at year *t;*

The estimation of provincial TFP growth includes two steps. Firm-level productivity is first estimated and then aggregated to be the provincial value. In fact, measurement of TFP growth and its components are the subject of investigation in many empirical studies (Jorgenson, 1995; Orea, 2002; and Suyanto, Salim and Bloch, 2009). According to Kumbhakar, Wang and Horncastle (2015), the decomposition of TFP growth into its sources is essential. These components include technical efficiency change, technological progress and scale efficiency change. The TFP growth model is as follows:

$$\boldsymbol{Y_i^{t,t+1}} = \boldsymbol{TC_i^{t,t+1}} + \boldsymbol{TP_i^{t,t+1}} + \boldsymbol{Scale_i^{t,t+1}} \quad (5.8)$$

where:

$\boldsymbol{Y_i^{t,t+1}}$ is a generalised output-oriented Malmquist productivity growth index of firm *i* between time *t* and *t+1*;

$\boldsymbol{TC_i^{t,t+1}}$ implies the technical efficiency change of firm *i* between periods *t* and *t+1*;

$\boldsymbol{TP_i^{t,t+1}}$ is the technological progress change of firm *i* between periods *t* and *t+1*;

$\boldsymbol{Scale_i^{t,t+1}}$ is the scale elasticity change of firm *i* between periods *t* and *t+1*;

Once the firm-level TFP growth is computed, the provincial-level TFP growth among provinces is constructed by using the weighted average of TFP growth at firm level. Lin and

Kwan (2016; 2017) employ the value-added shares of each firm within a county to count for the average weights. Due to non-availability of data on value-added shares, research in this chapter use the share of revenues in each province to measure the weights (Nguyen et al., 2008; Pham, 2012). Data using to estimate the firm-level productivity and the average weights are taken from the annual enterprise surveys dataset of the General Statistics Office of Vietnam (GSO) over the period 2004 – 2014 (Figure 5.2).

The spatial weight matrix (***W***) indicates the spatial relationship among Vietnamese provinces. The level of spatial dependence is modelled to reduce when distance increases. Thus, the nearer neighbours achieve heavier weights than more distant provinces (Esiyok and Ugur, 2017). In the spatial model, each diagonal element is the spatial weighting matrix of cross-section units. The off-diagonal elements are zero because a region cannot be its own neighbour (Drukker, Peng and Prucha, 2013). In this chapter, the geographical distance matrix is the inverse distance matrix $N_{(63x63)}$, where the weights are inversely related to the distances (d_{ij}) between the provinces[21].

This chapter consists of several explanatory variables to control for the FDI productivity spillovers. They are FDI spillover, human capital, openness, the provincial competitive index (PCI), infrastructure, labour costs, the agglomeration ratio, domestic investment, the industrialisation ratio and the pace of institutional market reform.

The spillover effects of foreign presence among provinces is represented by the FDI spillover variable (***FDI_spillover***$_{jt}$). Previous studies on FDI location mainly use the value of FDI inflows to investigate FDI distribution to Vietnamese provinces. Hoang and Goujon (2014) include the cumulative FDI inflows as a dependent variable to investigate FDI determinants in Vietnamese provinces using a spatial approach. Similarly, Esiyok and Ugur (2017) employ the per-capita register FDI capital to examine the locational factors that impact FDI inflows in Vietnamese provinces over the period 2006 – 2009. Lin and Kwan (2017) argue that the spillover effect may occur through the presence of foreign firms. Using dataset from

[21] $W = 1/d_{ij}^2$, where d_{ij} is the distance [km] between the main town of province i and j.

Venezuela's national statistical bureau, Aitken and Harrison (1999) compute sectoral foreign investment spillovers by the average foreign equity over all plants in each sector, weighted by the employment share of each plant within the sector. Tran, Pham and Barnes (2016) estimate the sectoral FDI spillovers by the share of fixed capital of FDI firms being weighted by the share of the labour force of foreign firms. Following Aitken and Harrison (1999), Tran, Pham and Barnes (2016) and Lin and Kwan (2017), the FDI spillover variable is computed by the shares of fixed capital and the average weight is the value of the employment share of foreign firms in each Vietnamese province (Figure 5.3). This variable is constructed as:

$$\boldsymbol{FDI\_spillover_{jt}} = \frac{\sum_i \boldsymbol{K_j L_{ijr}}}{\sum_i \boldsymbol{L_{ijr}}} \qquad (5.9)$$

where:

$\boldsymbol{FDI\_spillover_{jt}}$ implies the value of FDI spillovers into each province *j* in year *t*;

$\boldsymbol{K_j}$ is the total book value of fixed asset of FDI firms in province *j* at year *t*;

$\boldsymbol{L_{ijr}}$ denotes the total number of employees in a foreign firm *i* in sector *j* at province *r* every year.

Human capital plays an important role in the improvement of local economic growth (Fleisher, Li and Zhao, 2010). The high level of illiteracy is found to be negative to FDI inflows in Chinese provinces (Coughlin and Segev, 2000). Kang and Lee (2007) investigate the determinants of locational choice of South Korean affiliates in China. They find that the higher the level of human capital in Chinese provinces, the more South Korean FDI inflows into these provinces. Fallon and Cook (2009) find a positive relationship between human capital and FDI inflows in the United Kingdom. Human capital is considered as one of main drivers of TFP growth in European Union countries (Gehringer, Mertinez-Zarzoro and Nowak-Lehmann, 2014). In the context of Vietnam, Pham (2002) measures the index of human capital as the number of students at secondary school per capita. Meyer and Nguyen (2005) find that the high number of university professors per 1000 inhabitants, account for the ratio of human capital, and positively affect FDI inflows in Vietnam. Esiyok and Ugur (2017) use the ratio of

lower secondary school enrolment per 1000 inhabitants as the human capital variable when investigating locational determinants of FDI in Vietnamese provinces over the period 2006 – 2009. Hoang and Goujon (2014) argue that labour can switch firm-by-firm and location-to-location, resulting in labour – turnover among regions. Investors, then, may take skilled workers into account not only in the host region, but also in neighbouring regions. Therefore, research in this chapter includes the ratio of skilled labour over the population as human capital ($\boldsymbol{H_{jt}}$) between Vietnamese provinces. It is expected that human capital positively affects FDI productivity spillovers both in host and proximate Vietnamese provinces.

According to Lai, Peng and Bao (2006), the higher degree of openness in the host country can help to improve TFP growth and FDI spillovers. Thus, the relationship between openness and productivity growth are well documented in the existing literature (Wong, 2004; Schiff and Wang, 2008; Seck, 2012; Liargovas and Skandalis, 2012; and Bresnahan et al., 2016). However, research on the spatial impacts of openness on proximate regions' FDI productivity spillovers are still limited. Using data of US countries between 1969 and 2003, Pede, Florax, and Groot (2006) find that human capital has a strong effect on economic growth among US counties through the spatially neoclassical growth model, but fewer impacts in an endogenous setting. Mishra, Parhi and Diebolt (2008) examine the relationship between human capital accumulation and spatial TFP growth interdependence using a dataset of 15 Asian countries between 1970 and 2000. They find that age-structured human capital accumulation is spatially correlated to TFP growth among these countries. Blanc-Brude et al. (2014) find that human capital is one of the key factors of FDI in making a location decision in Chinese provinces and cities. Using a panel of 533 Brazilian regions over the period 1970 – 2010, Lima and Neto (2015) find that physical and human capital are essential for the growth of the Brazilian regional economies. Following Esiyok and Ugur (2017), this chapter hypothesises that the more open the provincial economy, the higher the productivity growth for both host and neighbouring provinces. The openness ratio ($\boldsymbol{OPEN_{jt}}$) is the percentage of exports and imports share in provincial GDP.

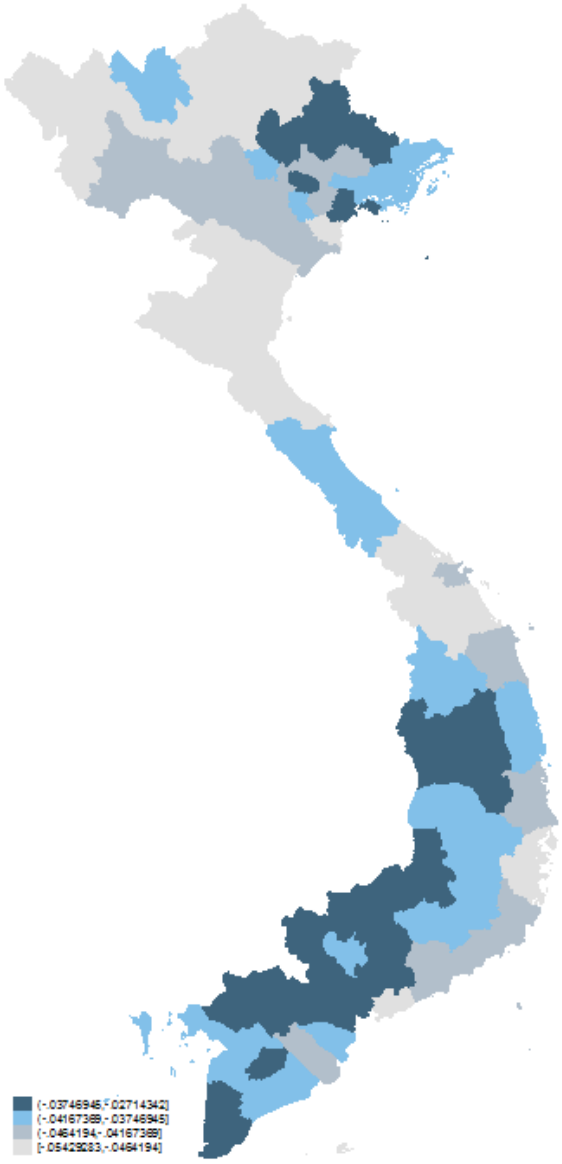


Figure 5. 2: TFP spatial distribution across Vietnamese province in 2014

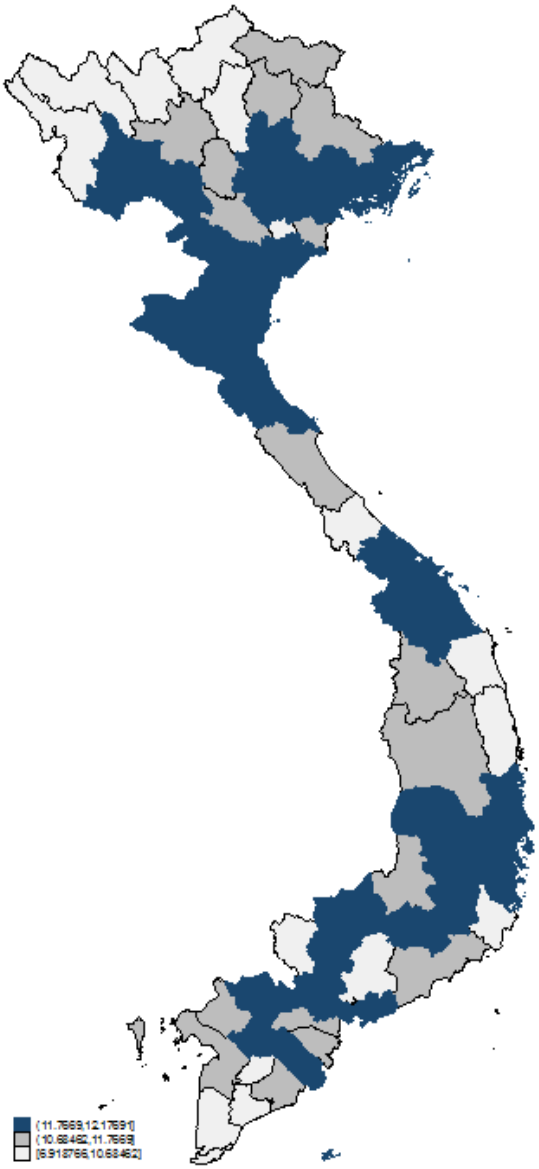


Figure 5. 3: FDI spillovers spatial distribution across Vietnamese province in 2014

Source: Author's calculation

Infrastructure is found to play a key role in promoting economic growth and attracting foreign investments in studies on TFP growth determinants in Straub and Warlters (2008), Calderón and Servén (2010, 2014), Lucke and Eichler (2016) and Kim and Loayza (2017). At the regional level, Kang and Lee (2007) find a positive influence of infrastructure on the determinants of locational choice for South Korean investors in China. Bronzini and Piselli (2009) find a positive impact of infrastructure on TFP growth of the Italian regions over the period 1980 – 2001. Ping (2011) also confirms the positive relationship between FDI inflows and infrastructure in the Chinese provinces. In Vietnam, Pham (2002), Nguyen (2006) and Anwar and Nguyen (2010) find that the degree of FDI inflows is correlated with the average number of phones per capita and the volume of passengers in transport. Following Hoang and Goujon (2014); research in this chapter employs the total of fixed and post-paid phone registrations per ten thousand of population to proxy for infrastructures ($\boldsymbol{P_{jt}}$) in each Vietnamese province.

FDI locational decisions may depend on labour costs in local regions. Coughlin and Segev (2000) state that high productivity is normally correlated with a higher level of labour compensation. However, empirical evidence on the importance of labour costs is still unclear. Basile et al. (2008) and Casi and Resmini (2010) find a positive relationship between the wage level and FDI inflows in European regions. On the other hand, Coughlin and Segev (2000), Kang and Lee (2007), Kawai (2009) and Ping (2011) find a negative relationship between productivity spillovers and the cost of wages. The impact of labour costs on FDI's locations in the Vietnamese provinces is investigated by Meyer and Nguyen (2005) and Hoang and Goujon (2014). Myer and Nguyen (2005) do not find any evidence of labour-cost effects on FDI inflows. Hoang and Goujon (2014) find a negative relationship between labour costs and the distribution of FDI among Vietnamese provinces. Based on these arguments, research in this chapter investigates the labour costs – FDI productivity nexus in Vietnamese provinces. Thus, the labour costs variable ($\boldsymbol{WAGE_{jt}}$) is employed. It is measured by annual income per employee in the firm sector in each Vietnamese province, deflated by the domestic price index.

Lin and Kwan (2017) argue that firms tend to agglomerate in a specific location to reduce transaction costs and to exploit external resources. Consequently, foreign firms prefer to locate

in a region where firms already exist. According to Hoang and Goujon (2014), the advantages of agglomeration are technology and knowledge spillovers, and the labour turnover among firms. Moreover, as information on the investment environment is quite limited, agglomeration is considered a positive signal for a sound investment environment for investors to make their investment decisions. The positive impact of agglomeration on FDI inflows is found in the research of Head et al. (1999), Head and Myer (2004), Cheng (2007), Casi and Resmini (2010, Hiber and Voicu (2010). However, Aitken and Harrison (1999) assert that 'market stealing' may occur due to the presence of foreign firms; thus, resulting in a decrease in the productivity of domestic firms. Le and Pomfret (2011) state that the decline in concentration of an industry helps to improve firms' productivity in that industry. Based on these arguments, this chapter hypothesises that agglomeration directly affects FDI productivity spillovers among Vietnamese provinces. To measure the agglomeration, this chapter includes two variables: the concentration ($\boldsymbol{CONCEN_{jt}}$) and the provincial domestic investment ($\boldsymbol{DI_{jt}}$) indices. The level of concentration in each province is measured by the total output of province j per km^2, following Tran, Pham and Barnes (2016). The provincial domestic investment ratio is computed by the domestic investment scaled by provincial population (Esiyok and Ugur, 2017).

Other regional characteristic variables are included. The first control variable is the provincial competitiveness index ($\boldsymbol{PCI_{jt}}$). The ratio was first formulated in 2005 by using the survey data of local firms in different provinces to measure the competitiveness between Vietnamese provinces. This ratio is used as an institutional quality ratio in investigating the relationship between economic performance and institutional quality among Vietnamese provinces and cities (Le and Nguyen, 2014). Tran, Pham and Barnes (2016) find positive relationship between PIC ratio and spatial FDI spillovers over the period 2000 – 2005. Bai et al. (2016) consider this ratio as a governance control variable when examining the firm growth and corruption nexus in Vietnam. Thus, this ratio[22] is included as an element to investigate the spatial FDI spillovers among Vietnamese provinces. Furthermore, this chapter also comprises the ratio of urban population for each province ($\boldsymbol{URBAN_{jt}}$). According to Lu (1997), Yu and

[22] The data on provincial competitiveness index (PCI) index is from http://eng.pcivietnam.org/

Mao (1999), Wei and Fan (2000), and Yu and Wei (2003), regional development in China may be affected by spatial agglomeration, especially in the urban-rural divisions. Ye and Wei (2005) state that urbanisation stimulates regional development as urban areas tend to be more developed than their rural peers. Ledyaeva (2009) includes a dummy industrialisation variable, measured by Russian regions with populations exceeding one million, to determine FDI determinants in Russian regions. Tran, Pham and Barnes (2016) argue that industrial activities in Vietnam accumulate mostly in urban and sub-urban areas; thus, the greater the urban population, the higher degree of industrialisation in Vietnam. As the industrialisation and urbanisation indices are closely corelated, the ratio of urban population to control for industrialisation in each Vietnamese province is employed. This ratio is calculated by the share of urban population over the total provincial population in each province. Finally, the ratio of the pace of market reforms ($\boldsymbol{M_{jt}}$) is employed to investigate the role of market reforms on FDI productivity spillovers among the provinces. Campos and Kinoshita (2008) state that local economic and political risks directly affect foreign investment decisions. Using a panel of Latin American countries over the period 1988 – 1992, Trevino et al. (2010) find a positive correlation between market reform and foreign investment. The ratio of non-state-owned employees is used to investigate the impact of market reform on productivity spillovers in Chinese provinces (Fu and Li, 2009; Curtis, 2016). In the context of Vietnam, the *Doi Moi* reform policy helps to improve the performance of non-state sectors and decrease the degree of central government control. In other words, the local market is more liberal and foreign investors face fewer trade barriers. Thus, foreign investors prefer to invest in provinces with a high pace of market reforms. Following Zheng (2005) and Fu and Li (2009), the pace of market reform is measured by the ratio of non-state employees to total labour force.

All regressors in this chapter are spatially lagged one-year of original terms from the cumulative period of the dependent variable. This is consistent with the assumption that foreign investors make their investment decision by observing the values of variables in the previous year (Coughlin and Segev, 2000; Iwasaki and Suganuma, 2005; Ledyaeve, 2009; and Tran, Pham and Barnes, 2016). Moreover, Ledyaeva (2009) states that the possible

endogeneity can be solved if all the explanatory variables are taken in original terms one-year lagged.

5.5 Summary Statistics and Correlation Matrix

Table 5. 2: Summary statistics of variables

Variable	Min	25%quantile	Median	75%quantile	Max
Y	-0.0543	-0.0030	.04249	0.0686	0.1210
FDI_spillover	6.9188	7.7983	9.7711	11.2974	12.1769
H	0.0810	0.1090	0.1380	0.1690	0.2540
OPEN	0.1043	0.2116	0.4075	0.8099	1.6535
P	0.3750	1.9836	2.7439	3.3258	4.2845
WAGE	16.7546	17.1367	17.3125	17.4667	17.9572
CONCEN	16.3747	20.2131	21.8073	23.2538	27.1724
DI	7.5024	8.4761	8.8423	9.1607	9.9216
PCI	0.4102	0.5266	0.5704	0.6043	0.6647
URBAN	0.1009	0.1502	0.1913	0.2993	0.5209
M	0.9039	0.9345	0.9480	0.9580	0.9693

Notes: This table reports summary statistics of variables over the period from 2005 to 2014 of all the Vietnamese provinces. The value of ***Y***, proxy for output of each Vietnamese province, is defined by the TFP growth in each Vietnamese province. The FDI spillovers variable, ***FDI_spillover***, implies the value of FDI spillovers into each Vietnamese province. ***H*** indicates the human capital ratio, which is calculated by the ratio of skilled worker over population. ***OPEN*** represents economic openness, which is measured by the share of exports plus imports in the total GDP. Infrastructures, ***P***, is computed by the natural log value of the ratio of total telephone registrations per ten thousand of population. ***WAGE*** indicates the labour costs variable, which is calculated by the natural log value of annual incomes per employee in the firm sector in each province, deflated by domestic price index. The agglomeration indicator includes two variables: the concentration (***CONCEN***), measured by the total industrial output of each province per km^2; and the provincial domestic investment (***DI***), is computed by the domestic investment scaled by provincial population. The provincial competitive index (***PCI***) denotes the performance of each Vietnamese province and compares that province with other provinces. This data is taken directly from the annual PCI report. The ratio of urban population of each province (**URBAN**) is indexed by the share of urban population over the total provincial population in each Vietnamese province. Lastly, the pace of market reform, ***M***, is defined as a ratio of non-state employees to total employed labour force.

Table 5.2 shows the summary statistics of the dataset during the sample period 2005 – 2014. The small difference between the percentile values of the output variable – TFP growth (***Y***), with a 25th percentile of -0.0030 and a 75th percentile of 0.0686, implies the steady productivity growth among provinces over the sample period. The FDI spillover variable (***FDI_spillover***) indicates the value of FDI spillovers into each Vietnamese province. The 25th percentile, the median and the 75th percentile values of this variable are quite large, achieving 7.7982; 9.7711 and 11.2974 respectively. These figures suggest the diversified and unbalanced distribution of FDI into the provinces during the sample period. The values of median, the 25th percentile and 75th percentile of human capital variable (***H***) in the above table indicate that there are 50 per cent of the data is below the value of 0.1380; 25 per cent of the data is below the value of 0.1090; and only 25 per cent of data sample achieves above 0.1690. Despite the low value of skilled labourers in the population, this ratio has improved over the sample period, suggesting an improvement in labour quality over that time. The median of trade openness (***OPEN***), calculated by the portion of total imports and exports in the total GDP, is 0.4075. The 25th percentile and 75th percentile values are 0.2116 and 0.8099 respectively, reflecting the diversity in open-door policies among the Vietnamese provinces. The value infrastructure variable (***P***), measured by the natural logarithm of a ratio of total telephone registrations per ten thousand of population, is quite high and stable, with a median of 2.7439; the 25th percentile of 1.9836 and 75th percentile of 3.3258 correspondingly. These values indicate a significant improvement in infrastructure investment and development across Vietnamese provinces. The median value of labour costs, represented by the log value of annual average incomes per employee, deflated by domestic price index, is 17.3125, while the 25th percentile value is 17.1367 and the 75th percentile is 17.4667. The very small different between these values indicates the consistency in labour cost rates between provinces over the sample period. The median of the concentration ratio (***CONCEN***), measured by the total industrial output of each province per km^2, is 21.8073, with the 25th percentile of 20.2131 and the 75th percentile of 27.1724. The significant difference between these values reflects the improvement in provincial industrial performance over the past decade. The median value of provincial domestic investment ratio (***DI***), measured by the share of domestic investment over the population, is 8.8423, while the 25th percentile value is 8.4761 and the 75th percentile is

9.1607. There are no significant changes in the domestic investment rates, indicating the stable rate of domestic investment among the provinces. The median value of ***PCI*** – the provincial competitiveness index is 0.5704, with the 25th percentile of 0.5266 and the 75th percentile of 0.6043. The small difference between minimum and maximum value of this index suggests less competitive performance between the Vietnamese provinces. The median of urban population ratio of each province (**URBAN**), indexed by the share of urban population over the total provincial population in each Vietnamese province, is still comparatively low at 0.1913, with the 25th percentile of 0.1502 and the 75th percentile of 0.2993. This implies the slow movement of population structures from rural to urban areas. Finally, the median value of the pace of market reform – ***M***, computed by the proportion of non-state employees to total employed labour force, is high, with a median of 0.9480, suggesting considerable changes in labour turnover from state-owned enterprises to non-state-owned firms in the Vietnamese provinces.

Table 5.3 illustrates the correlation matrix of all above variables. The dependent variable, ***Y***, is found to be positively correlated with human capital (***H***), the domestic investment (***DI***), the provincial competitiveness index (***PCI***), the urban population ratio (***URBAN***) and the pace of market reform (***M***). ***Y*** is negatively correlated with the FDI spillovers (***FDI_spillover***), openness (***OPEN***), infrastructure (***P***), the labour costs (***WAGE***) and concentration (***CONCEN***). Overall, the correlation matrix does not indicate any major concerns.

Table 5. 3: Correlation matrix of variables

Variable	***Y***	***FDI_spillover***	***H***	***OPEN***	***P***	***WAGE***	***CONCEN***	***DI***	***PCI***	***URBAN***	***M***
Y	1.0000										
FDI_spillover	-0.6007	1.0000									
H	0.4055	0.0033	1.0000								
OPEN	-0.0494	0.4597	0.2908	1.0000							
P	-0.6755	0.6396	-0.1235	0.3854	1.0000						
WAGE	-0.4959	0.5465	0.0431	0.4285	0.6899	1.0000					
CONCEN	-0.2607	0.6529	0.1983	0.6564	0.5745	0.4720	1.0000				
DI	0.3862	-0.1318	0.4025	0.2454	-0.1458	0.0660	0.1231	1.0000			
PCI	0.6597	-0.1731	0.3757	0.1895	-0.3576	-0.1794	0.2441	0.3737	1.0000		
URBAN	0.6693	-0.4381	0.4031	-0.0877	-0.5841	-0.4342	-0.2103	0.2424	0.4276	1.0000	
M	0.0125	0.1594	-0.2947	0.1794	0.0032	-0.1311	0.4216	-0.1344	0.1909	-0.0257	1.0000

Notes: The table reports the correlation matrix of variables over the period from 2005 to 2014 of all Vietnamese provinces. The value of ***Y***, proxy for output of each Vietnamese province, is defined by the TFP growth in each Vietnamese province. The FDI spillovers variable, ***FDI_spillover***, implies the value of FDI spillovers into each Vietnamese province. ***H*** indicates the human capital ratio, which is calculated by the ratio of skilled worker over population. ***OPEN*** represents economic openness, which is measured by the share of exports plus imports in the total GDP. Infrastructures, ***P***, is computed by the natural log value of the ratio of total telephone registrations per ten thousand of population. ***WAGE*** indicates the labour cost, which is calculated by the natural log value of annual incomes per employee in the firm sector in each province, deflated by domestic price index. The agglomeration indicator includes two variables: the concentration (***CONCEN***), measured by the total industrial output of each province per km^2; and the provincial domestic investment (***DI***), is computed by domestic investment scaled by provincial population. The provincial competitive index (***PCI***) denotes the performance of each Vietnamese province and compares that province with other provinces. This data is taken directly from the annual PCI report. The ratio of urban population of each province (**URBAN**) is indexed by the share of urban population over the total provincial population in each Vietnamese province. Lastly, the pace of market reform, ***M***, is defined as a ratio of non-state employees to the total employed labour force.

5.6 Empirical Results and Discussion

Table 5.4 illustrates the estimation results of spatial FDI productivity spillovers across the Vietnamese provinces over the sample period from 2005 to 2014. Model (1) describes the OLS estimation results without including spatially-lagged variables. Overall, the signs and significance in the OLS model are consistent with results in Chapter 4[23]. However, the inclusion of only an OLS model would be insufficient to explain the spatial effects among the provinces. In other words, using only an OLS estimation would be biased due to the omission of the spatially-lag form in the model. Thus, research in this chapter includes SAR, SEM, SAC and SDM models to take into account the role of the attributes of proximate provinces.

The estimation results are divided into two sections. The first section considers the effect of the characteristics of host provinces and ignores the impact of the alternative host region features (SAR, SEM and SAC), while the second group identifies the impacts of proximate-region characteristics on TFP growth (SDM). All these features consist of an average weight of alternative provinces; the weight changes inversely to the distance between provinces. Two main factors of spatial models (the spatial lag term and the spatial error structure) are included in both groups of estimations. In the first section, the ***FDI_spillovers*** variable is negative and significant to TFP growth across different model specifications. This implies that the presence of foreign firms causes a decrease in productivity of domestic firms in the Vietnamese provinces. The negative significance can also be explained by the market-stealing impact from the existence of foreign firms. This finding is consistent with earlier research on the spatial FDI spillovers in Lin and Kwan (2016; 2017); and Tran, Pham and Barnes (2016). The negative impact of FDI spillovers on local productivity is also confirmed in firm-level data studies of Aitken and Harrison (1999); Konings, (2001); Haskel et al. (2002); Le and Pomfret (2011); Suyanto, Bloch and Salim (2012); Bruhn and Calegario (2014); and Liu, Agbola and Dzator, (2016). The human capital variable (***H***) is positive but insignificant with TFP growth in the host provinces, suggesting that the FDI productivity spillover distribution is not

[23] Chapter 4 investigates the impact of the human capital threshold on TFP growth in Vietnamese provinces. The investigation in this chapter finds that human capital (H_{jt}) is positive with TFP growth under a specific threshold. ***FDI_spillovers, UNEMP, M*** and ***WAGE*** are negative with TFP growth while ***PCI, OPEN, POPG*** and ***P*** have positive impacts on provincial TFP growth.

impacted by skilled labour in Vietnamese provinces. This is in accordance with the findings in Chapter 4; that human capital only affects TFP growth under a certain level of threshold. Fleisher, Li and Zhao (2010) also point out that the impact of human capital can vary due to the diversity in labour and education quality between regions. The relationship between openness (***OPEN***) and provincial TFP growth is positive and significant in the host provinces, indicating that a higher degree of openness is associated with more FDI productivity spillovers. Esiyok and Ugur (2017) find that a high level of openness to trade in a province not only attracts FDI into that location, but also into its neighbours. Thus, this research finding is consistent with earlier studies that confirm a positive relationship between openness and FDI productivity growth (Comin and Hobijn, 2004; Schiff and Wang, 2008; Seck, 2012; Liargovas and Skandalis, 2012; and Blonigen and Piger, 2014). The infrastructure development (***P***) is found to contributes to FDI spillovers and improves provincial productivity growth, reinforcing the empirical findings of Bronzini and Piselli (2009), Calderon and Serven (2010, 2014), and Lucke and Eichler (2016). In the context of Vietnam, Meyer and Nguyen (2005), Hoang and Goujon (2014) and Esiyok and Ugur (2017) also confirm infrastructure as one of primary factors in attracting FDI inflows into Vietnamese provinces. Employing different spatial models, the labour cost (***WAGE***) is negative and insignificant to the TFP growth of the host provinces, suggesting that a higher level of employee compensation may deter productivity growth, but this variable is not the key element to generate FDI productivity spillovers in the host provinces. The concentration variable (***CONCEN***), one element of agglomeration ratio, is negative and insignificant to the TFP growth of the host provinces. Another component of agglomeration, domestic investment (***DI***) is positive and insignificant to TFP growth. Although research by Hoang and Goujon (2014) and Esiyok and Ugur (2017) confirm the positive relationship between agglomeration and FDI inflows, these research findings do not find evidence of significant agglomeration on productivity growth in the host provinces. This difference can be explained by the difference in the measurement of variables as well as the sample sizes of these studies. The coefficient of provincial competitiveness index (***PCI***) is positively correlated with FDI productivity spillovers, implying that the more competitive capacity in the host provinces, the more attractive it is to foreign investors, and the higher productivity growth. This finding is supported by Tran, Pham and Barnes (2016)

and Korez-Vide and Polona (2016), who find positive relationships between the global competitive index and economic growth. Unfortunately, the research discussed in this chapter does not find any evidence of the correlation between the urban ratio (***URBAN***) and FDI productivity spillovers. This can be argued to be caused by very high land costs in urban areas. Zhao and Zhu (2000) and Cheng (2006, 2007) also find that land costs negatively affects the FDI location choices in China. Finally, the market reform (***M***) is negatively significant to the FDI productivity spillovers, indicating that an increase in pace of market reforms results in a decrease in productivity growth and FDI spillovers in the host provinces. This finding is reinforced by research of Zhang (2001), Jones and Ruffin (2008) and Fu and Li (2009).

In the second section, all features of proximate provinces are included to consider the interdependence between alternative hosts and proximate regions. The ***FDI_spillovers*** variable in the proximate provinces is positively correlated with the TFP growth in the host province. This implies local firms located in neighbouring provinces can benefit from FDI spillovers which diffuse beyond borders. This finding is in accordance with previous studies by Nguyen et al. (2006), Tran, Pham and Barnes (2016), and Lin and Kwan (2016), who confirm that the market stealing inversely affects domestic firms because of geographical distance. Furthermore, the level of human capital (***H***) in neighbouring provinces is positive to the host provincial TFP growth, suggesting that the role of labour turnover is due to the FDI spillover effects between Vietnamese provinces. Labour cost (***WAGE***) in proximate provinces is negatively significant to productivity growth in the host province, indicating the higher the level of employee compensation in nearby provinces, the lower degree of FDI productivity spillovers in the host province. This finding is consistent with the research of Coughlin and Sagev (2000), Kang and Lee (2007), Kawai (2009) and Ping (2011) who also find a negative relationship between wage levels and inward FDI among regions. The agglomeration indices, concentration (***CONCEN***) and domestic investment (***DI***) are found to be positive and significant to the host TFP growth, indicating that the more the agglomeration in proximate regions, the greater the productivity and attractivity to the host province. Esiyok and Ugur (2017) argue that neighbouring provinces can be either the markets for products/services or additional sources of labour and resources. Thus, concentration and investment in proximate

regions contribute to FDI productivity spillovers overall. All other remaining variables (openness, infrastructure, PCI ratio, urban ratio and market reforms) have the same signs and significance as in the factors in host provinces. Specifically, the higher openness (***OPEN***) in proximate provinces can generate positive FDI effects and improve the host's provincial TFP growth. This finding is similar to the results of Esiyok and Ugur (2017) who find a positive correlation between openness and FDI inflows to neighbouring regions. Similarly, the infrastructure development (***P***) and the provincial competitiveness index (***PCI***) in nearby provinces also contribute to positive FDI spillovers and result in the improvement of locally provincial TFP growth. These positive relationships are confirmed by the research of Hoang and Goujon (2014), Tran, Pham and Barnes (2016) and Esiyok and Ugur (2017). The urban index (***URBAN***), however, is uncorrelated with FDI productivity spillovers, implying that urban population intensity in nearby provinces does not affect the degree of FDI productivity spillovers. Finally, the high degree of market reform (***M***) in neighbouring provinces causes a decrease in the host provincial FDI productivity spillovers, suggesting a negative relationship between the pace market reform and the FDI spillovers. This finding is in accordance with research of Jones and Ruffin (2008) and Fu and Li (2009).

In summary, the research findings discussed in this chapter indicate that provincial productivity is not only improved by the distribution of FDI spillovers and specific characteristics in the host province but also affected by other features in the proximate provinces.

As a robustness check, the research in this chapter also employs the dynamic SDM spatial spillover model to test FDI spatial effects. This method also employs the inverse distance matrix, measured by the physical distance between the provincial capitals and cities. Appendix Table 5.1 illustrates the results of the dynamic SDM estimation over the sample period. The results show that, like the previous SDM estimation results in Table 5.3, the ***FDI_spillovers*** variable is negative to TFP growth in the host provinces and positively correlated with TFP in the neighbouring provinces. Human capital, openness, infrastructure development and the provincial competitive index are positive both in the host regions and proximate provinces. On the other hand, the labour costs and market reforms are negatively correlated with the TFP

growth of the host provinces. Finally, the concentration ratio has a positive effect on the productivity growth, while the urban ratio does not have any impact on TFP growth. These research findings suggest that the discussion in this chapter are robust.

Table 5. 4: FDI spatial spillover effects in Vietnamese provinces over the period 2005-2014

	(1)	(2)	(3)	(4)	(5)
Y	**OLS**	**SAR**	**SEM**	**SAC**	**SDM**
Host province					
FDI_spillover	-0.0040***	-0.0020***	-0.0020***	-0.0014***	-0.0010**
	(0.0007)	(0.0008)	(0.0007)	(0.0005)	(0.0005)
H	0.1435***	0.0120	0.0112	0.0380	0.0534
	(0.0214)	(0.0484)	(0.0430)	(0.0390)	(0.0392)
OPEN	0.0136***	0.0135***	0.0103**	0.0069**	0.0103***
	(0.0020)	(0.0038)	(0.0047)	(0.0030)	(0.0033)
P	0.0214***	0.0068***	0.0199***	0.0106***	0.0090***
	(0.0018)	(0.0022)	(0.0032)	(0.0020)	(0.0017)
WAGE	-0.0042	0.0049	-0.0177	-0.0051	-0.0043
	(0.0040)	(0.0041)	(0.0053)	(0.0041)	(0.0040)
CONCEN	-0.0031***	-0.0056	-0.0014	-0.0049	-0.0049
	(0.0008)	(0.0040)	(0.0019)	(0.0035)	(0.0034)
DI	0.0063***	0.0034	0.0049	0.0020	0.0034
	(0.0015)	(0.0035)	(0.0032)	(0.0029)	(0.0028)
PCI	0.2455***	0.1713***	0.1738***	0.1174***	0.1138***
	(0.0160)	(0.0255)	(0.0366)	(0.0218)	(0.0228)
URBAN	0.0420***	0.0054	0.0092	0.0065	0.0069
	(0.0083)	(0.0066)	(0.0089)	(0.0057)	(0.0066)
M	-0.1883***	-0.4351**	-0.3335*	-0.4294***	-0.4458***
	(0.0722)	(0.1710)	(0.1729)	(0.1318)	(0.1353)
Alternative provinces					
FDI_spillover					0.0288***
					(0.0104)
H					1.9487***
					(0.7196)
OPEN					0.4677***
					(0.0641)
P					0.1219***
					(0.0216)

WAGE					-0.2067***
					(0.0430)
CONCEN					-0.1305***
					(0.0385)
DI					0.1583***
					(0.0434)
PCI					0.2649*
					(0.1511)
URBAN					-0.1886
					(0.1003)
M					-7.2284***
					(2. 7661)
Spatial dependence (ρ)		2.5052***	5.5586***	3.4816***	3.1453***
		(0.1694)	(0.0190)	(0.2220)	(0.1321)
Spatial autocorrelation (λ)				3.8257***	
				(0.1100)	
Number of obs	630	630	630	630	630
Pseudo R^2(variance ratio)	0.84	0.94	0.91	0.87	0.95
Log-likelikehood		2131.62	1899.81	2247.77	2276.33

Notes: The value of ***Y***, proxy for output of each Vietnamese province, is defined by the TFP growth in each Vietnamese province. The FDI spillovers variable, ***FDI_spillover***, implies the value of FDI spillovers into each Vietnamese province. ***H*** indicates the human capital ratio, which is calculated by the ratio of skilled worker over population. ***OPEN*** represents economic openness, which is measured by the share of exports plus imports in the total GDP. Infrastructures, ***P***, is computed by the natural log value of the ratio of total telephone registrations per ten thousand of population. ***WAGE*** indicates the labour costs, which is calculated by the natural log value of annual incomes per employee in the firm sector in each province, deflated by the domestic price index. The agglomeration indicator includes two variables: the concentration (***CONCEN***), measured by the total industrial output of each province per km^2; and the provincial domestic investment (***DI***), computed by the domestic investment scaled by provincial population. The provincial competitive index (***PCI***) denotes the performance of each Vietnamese province and compares that province with other provinces. This data is taken directly from the annual PCI report. The ratio of urban population in each province (**URBAN**) is indexed by the share of urban population over the total provincial population in each Vietnamese province. Lastly, the pace of market reform, ***M***, is defined as a ratio of non-state employees to the total employed labour force.

5.7 Conclusion and Policy Implications

Different spatial econometric models are employed in this chapter to investigate the determinant of FDI locational choice across Vietnamese provinces over the sample period from 2005 to 2014. The choice of multiple spatial models enables consideration of the spatial interdependence and interaction both in the host province and proximate regions.

The empirical results point out that FDI spillover effects are negatively significant with local TFP growth, but positively significant with its neighbouring provinces, suggesting that a market-stealing impact is more severe locally. There is mixed evidence of human capital influence in the host province, but the high level of skilled workers in proximate regions can contribute to FDI productivity spillovers in the host region, due to the labour turnover. Openness, infrastructure, and the provincial competitive index are positively correlated with both local and neighbouring TFP growth. The pace of market reform is negatively significant to TFP growth, both in the host and proximate provinces, suggesting that this factor is not the driver of TFP growth. Labour costs in the host province are found to have an insignificant impact on TFP growth in that province; however, this factor negatively affects the FDI productivity spillovers in proximate provinces. In other words, a low level of productivity growth in one province may occur due to the high degree of employee compensation in nearby provinces. Agglomeration in neighbouring provinces, represented by concentration and domestic investment, is positively correlated with the productivity in the host province. Finally, from research conducted in this chapter, no evidence of urbanisation on FDI productivity spillovers among Vietnamese provinces was found.

The research findings also suggest some important policy implications. Firstly, it is impossible to transfer natural resources from one province to others. Thus, the development of open economic zones and national ports are relevant in attracting more FDI. Due to the heterogeneous distribution of FDI, it is essential to focus on improvement in infrastructure both in the local and the proximate provinces to encourage foreign investment. Local government also might consider additional expenditure on education and training on an ongoing basis to improve the degree of human capital and attract inward FDI. The role of characteristics of proximate provinces and the improvement in transport connections between nearby regions should be noted. Moreover, it is essential for the Vietnamese government to control unhealthy fiscal competition between provinces by closely

monitoring local policies. It is desirable that the benefits from FDI spillovers do not only focus on the large provinces and cities but diversify into proximate regions and provinces.

CHAPTER 6: CONCLUSIONS AND POLICY IMPLICATIONS

6.1 Concluding Remarks

The primary objective of this research is to investigate the significance of FDI spillovers to productivity growth and its determinants in Vietnam through a multi-level approach. The research conducted in this thesis is not the first attempt to examine the role of FDI in Vietnam, but it contributes to the existing literature by providing extensive and in-depth evidence on FDI distribution in Vietnam. This thesis focuses on the spillover effects of FDI on productivity growth at both the micro and macro levels over the different sample periods. This thesis firstly investigates how the presence of foreign investors impacts the productivity of local Vietnamese firms. Secondly, the role of human capital threshold in attracting FDI and improving productivity are examined across the Vietnamese provinces. This thesis also takes into account the reasons for FDI spillover disparities among the Vietnamese regions, and how the spatial FDI spillovers affect provincial productivity growth. Following these arguments, this thesis aims to answer these following empirical research questions: How do FDI spillovers affect the productivity of Vietnamese firms? How does human capital impact FDI productivity spillovers among the Vietnamese regions? And, how do the spatial FDI spillovers influence Vietnamese provincial TFP growth?

Chapter 2 provides an overview of FDI, the distribution of FDI inflows into Vietnam as well as the legal frameworks imposed by the Vietnamese government on the rights and responsibilities of foreign investors when making investment decisions in Vietnam. FDI is confirmed to be present in Vietnam since the early nineteenth century but its amount is only improved after the implementation of the *Doi Moi* economic reform in 1986, and the enactment of the Law on Foreign Investment in 1987. These policies are considered as a foundation to promote trade liberalisation, attract FDI and improve the economic growth rate in Vietnam. Moreover, this chapter also describes the heterogeneous distribution of FDI across the country after the reform policies, which may imply the different impact of FDI spillovers on productivity growth in local firms in different locations of Vietnam.

Chapter 3 empirically investigates the FDI spillover effects on the productivity of Vietnamese firms over the period 2000 – 2014. The research undertaken in this chapter

provides clear empirical evidence on the two-way linkage between FDI spillovers (horizontal and backward linkage) and the productivity growth of indigenous firms, using the stochastic frontier production function. In particular, the horizontal FDI spillover is found to be negative and significant to the productivity of local firms in the same industry. Otherwise, local suppliers can improve their productivity through FDI spillover effects from foreign firms as positive relationships between FDI backward linkage are confirmed. The research results also confirm that the larger the firm, the greater the advantages are from FDI spillovers and state-owned enterprises receive the most benefits from FDI spillovers. The research in this chapter also suggests an increase in the competition level of an industry results in an improvement in the productivity of domestic firms in that industry. The TFP growth is also decomposed into three different elements (technical efficiency change, technological progress change, scale efficiency) to re-examine their relationships and FDI spillover effects. The research results are still robust with positive backward relationships and negative horizontal linkages between these decompositions.

Chapter 4 empirically determines the threshold value of absorptive capacity, which is represented by human capital ratio, and its effects on FDI productivity spillovers, using a data sample of 63 provinces over the period from 2005 to 2014. The empirical result indicates the existence of a human capital threshold (at value of 1.1213). This implies the importance of a high level of human capital (over the threshold value) in improving and increasing TFP growth among the Vietnamese provinces. The FDI spillover is negative to TFP growth under the human capital threshold, as the presence of foreign firms creates stealing-market effects. The findings also highlight the role of degree of openness, the scale of population and infrastructure development in promoting TFP growth, while other remaining factors (unemployment rate, market reforms and labour costs) are negatively correlated with the improvement of productivity across provinces.

Chapter 5 extends the analysis of FDI spillovers by exploring the reasons for FDI spillover disparities among 63 the Vietnamese provinces over the sample period from 2005 to 2014. By employing different spatial economic models and an inversed distance matrix, research in this chapter considers the spatial interdependence and interaction both in the host and neighbouring provinces. The empirical research results imply that the market-stealing effect is more severe locally because the FDI spillover effects are negatively

significant with local TFP growth, but positively significant with its neighbouring provinces. Human capital, openness, and infrastructure development are confirmed to contribute to FDI productivity spillovers in proximate regions while the high degree of labour costs and market reforms results in a decrease in FDI productivity spillovers both in the host and neighbouring provinces. The concentration of firms is found to be one of driving factors of productivity in the host provinces but otherwise the ratio of urbanisation does not have any impact on FDI productivity spillovers across the Vietnamese provinces.

6.2 Policy Implications

The empirical research findings in this thesis have important implications for both central and local government.

As a positive relationship between FDI backward spillovers and the productivity growth of local firms is confirmed, the Vietnamese government should consider the continuing fiscal (tax and fee incentives, interest loan incentives etc.) and investment incentives (monopoly rights, investment grants etc.) to promote linkages between foreign firms and local suppliers. For those that receive negative spillover effects; Vietnamese government may continuously provide incentives to improve the negative effects but also ensure the competitiveness advantages of local firm in the same industry. The policymakers should also assist different types of firms, especially small and medium-sized firms to derive more benefits from horizontal and backward FDI spillovers. It is also essential to focus on advanced education and training, which may help reduce the gap between foreign and local firms in Vietnam. Particularly, local firms are encouraged to invest in R&D and upgrade their human capital to enhance the absorptive capacity and benefit from FDI spillover effects.

This thesis also emphasises the importance of human capital in promoting FDI spillovers and improving provincial productivity growth rate in Vietnam. Thus, it is relevant to set a clear target for human capital to be achieved in all Vietnamese provinces and cities. There is particularly a need to promote the growth of a well-educated workforce in provinces that are under the threshold level. The improvement in human capital can be done through enhancing cooperation among local training centres, universities and research institutions. Thus, the development of training centres, vocational colleges and universities are

necessary to decrease the technology gap between local economies and foreign firms. For provinces above the human capital threshold level, local government should constantly propose more incentive packages to support the development of infrastructure, maintain stable economic growth as well as offer more open policies to encourage foreign investments in their area.

Research in this thesis also confirms an unbalanced distribution of FDI spillovers across the provinces in Vietnam. Thus, it is essential to provide incentive policies to encourage agglomeration between local and foreign firms across the provinces. In particular, local government should retain high standards in education, R&D activities, technology and financial development in the key economic regions where many foreign firms are located. In poorer provinces, the policymakers should focus on improving infrastructure, transportation, and the education system, as well as offer more financial incentives. These policies would enable them to improve their local administrative, management systems and business environment, reduce the gap in spillover effects and attract more foreign investment. Moreover, it would be appropriate to encourage connections among provinces because the significant role of neighbouring provinces is confirmed by the research in this thesis. A connection strategy could be developing inter-training centres or institutions at the regional rather than provincial level. Furthermore, the central government should closely monitor and control the local policies to prevent unhealthy fiscal competition between provinces.

Finally, more general policies could be implemented. These policies should be imposed to ensure the competitive advantages for local firms and encourage foreign investment across industries and provinces. The policies should concentrate on local infrastructure development, the modernisation of legal and political institutions, the development of government-funded programs and so on. It is anticipated that the benefits from FDI spillovers could vary and diversify across provinces and regions of Vietnam.

6.3 Limitations and Recommendations for Future Research

Although this thesis contributes to the existing FDI literature by providing a comprehensive and deep insight into FDI spillovers in Vietnam, there are a few limitations. Because of lack of data, the research in this thesis has not taken into account the forward

linkages between FDI spillovers and TFP growths of domestic firms. Furthermore, since the annual enterprise survey in Vietnam was first undertaken in 2000, it is impossible to consider the impact of FDI spillovers on the growth of productivity of local firms in Vietnam before that time. Nguyen (2008) states that insufficient data is a common issue in most developing countries. Such data would improve the interpretation of results and make the research contributions stronger.

Based on the above research findings and some limitations, the thesis proposes future research. Firstly, more detailed research on backward linkages would be done to investigate the impacts of FDI forward spillovers on the productivity of local up-stream firms across the industries. It is expected that local firms would switch from importing inputs to procure locally. Moreover, source investment country characteristics can be considered as FDI determinants to improve productivity growth. This analysis would be useful to attract foreign direct investment to Vietnam and make it one of great investment destinations in Asia.

APPENDIXES

Appendix 3.1: Number of approved FDI projects and total registered capital in Vietnam in 2016

	Number of projects	Total registered capital (mil. USD)	%
Administrative and support service activities	236	495.1	0.17
Education and training	316	741.2	0.25
Other service activities	157	765.3	0.26
Water supply, sewerage, waste management and remediation activities	56	1451.1	0.49
Financial, banking and insurance activities	87	1485.3	0.51
Human health and social work activities	122	1602	0.55
Professional, scientific and technical activities	2193	2643.9	0.90
Arts, entertainment and recreation	135	3029.7	1.03
Mining and quarrying	104	3497.9	1.19
Agriculture, forestry and fishing	522	3573.8	1.22
Transportation and storage	607	4280.9	1.46
Information and communication	1477	4718.7	1.61
Wholesale and retail trade; repair of motor vehicles and motorcycles	2248	5433.2	1.85
Construction	1384	10658.7	3.63
Accommodation and food service activities	545	11494.7	3.91
Electricity, gas, steam and air conditioning supply	108	12907.6	4.39
Real estate activities	581	52203.7	17.77
Manufacturing and processing	11716	172717.6	58.81
TOTAL	**22594**	**293700.4**	**100**

Source: Statistical Yearbook of Vietnam, 2016

Appendix 4.1: Hansen's threshold method (1999) estimation

Table A4. 1: Estimated threshold values and their confidence intervals

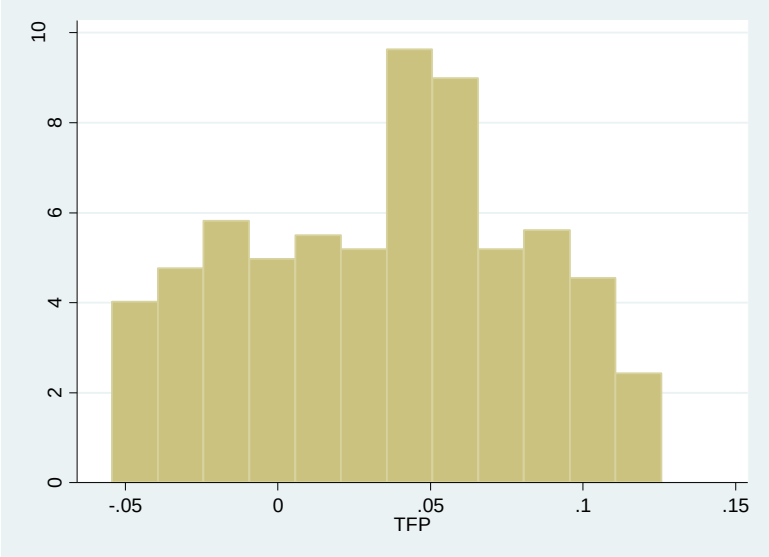
Threshold	Estimated value	95% confidence interval
η_1	0.0860	[0.0830 – 0.0870]

Table A4. 2: Estimated parameters for single threshold

Variable	Coefficient	Standard Errors
FDI_spillovers	-0.0022***	0.0005
UNEMP	-0.0059***	0.0008
M	-0.5092***	0.1486
WAGE	-0.0332***	0.0062
PCI	0.0567***	0.0169
OPEN	0.0160***	0.0052
POPG	0.0097***	0.0028
P	0.0407***	0.0019

Notes: The value of ***Y***, proxy for output of each Vietnamese province, is defined by the TFP growth in each Vietnamese province. ***H*** implies the human capital ratio, which is calculated by the ratio of skilled worker over population. The FDI spillovers variable, ***FDI_spillover***, is the value of FDI spillovers into each Vietnamese province. ***UNEMP*** indicates the unemployment rate of labour market in each Vietnamese province. The pace of market reform, ***M***, is indexed by a ratio of non-state employees to the total employed labour force. Labour costs, ***WAGE***, is the natural log value of annual incomes per employee in the firm sector in each province, deflated by the domestic price index. The provincial competitive index (***PCI***) denotes the performance of each Vietnamese province and compares that province with other provinces. This is taken directly from the annual PCI report. ***OPEN*** represents economic openness, which is measured by the share of exports plus imports in the total GDP. ***POPG*** is the population growth rate of each province, taken directly from GSO website. Infrastructures, ***P***, is computed by the natural log value of the ratio of total telephone registrations per ten thousand of population.

Appendix 4.2: Distribution of TFP growth over the sample period 2005-2014

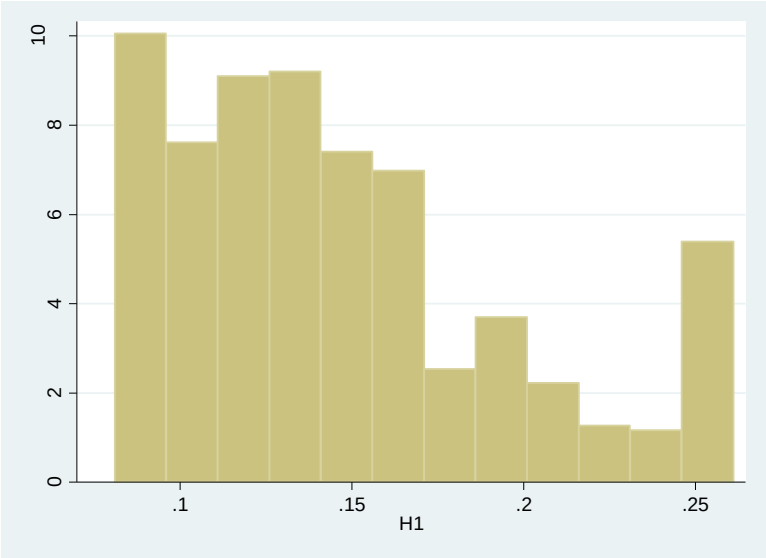


Variable: TFP growth

Observation: 630

Mean	0.035
Median	0.042
Maximum	0.121
Minimum	-0.054
Std. Dev	0.046
Skewness	-0.126
Kurtosis	2.039

Appendix 4.3: Distribution of human capital variable over the sample period 2005-2014



Variable: HUMAN CAPITAL

Observation: 630

Mean	0.146
Median	0.138
Maximum	0.254
Minimum	0.081
Std. Dev	0.049
Skewness	0.753
Kurtosis	2.752

Appendix 5.1: Dynamic SDM spatial estimation

Table A5. 1: The dynamic SDM spatial spillover effects in Vietnamese provinces

			Short-run effects			Long-run effects		
	Host province	**Alternative province**	**Direct effect**	**Indirect effect**	**Total effect**	**Direct effect**	**Indirect effect**	**Total effect**
FDI_spillover	-0.0011***	0.2878**	-0.0005***	0.0273**	0.0268*	-0.0008**	0.0157**	0.0149**
	(0.0003)	(0.0111)	(0.0000)	(0.0139)	(0.0142)	(0.0004)	(0.0070)	(0.0071)
H	0.0713***	2.0938***	0.1263***	2.4623**	2.5886**	0.0995***	1.3457***	1.4452***
	(0.0236)	(0.7326)	(0.0338)	(1.0163)	(0.0142)	(0.0257)	(0.4689)	(0.4824)
OPEN	0.0096***	0.5176***	0.0221***	0.5874***	0.6096***	0.0158***	0.3224***	0.3381***
	(0.0017)	(0.0508)	(0.0044)	(0.1742)	(0.1783)	(0.0023)	(0.0550)	(0.0565)
P	0.0075***	0.0973***	0.0058***	0.0762***	0.0704***	0.0066***	0.0454***	0.0388***
	(0.0011)	(0.0185)	(0.0012)	(0.0242)	(0.0246)	(0.0011)	(0.0108)	(0.0110)
WAGE	-0.0013	-0.2323***	0.0040	-0.2405***	-0.2445***	0.0014	-0.1348***	-0.1362***
	(0.0026)	(0.0398)	(0.0031)	(0.0670)	(0.0688)	(0.0027)	(0.0255)	(0.0264)
CONCEN	-0.0045***	0.1494***	-0.0081***	-0.1716***	-0.1798***	-0.0063***	-0.0944***	-0.1007***
	(0.0012)	(0.0280)	(0.0015)	(0.0441)	(0.0450)	(0.0013)	(0.0172)	(0.0175)
DI	0.0040**	0.1195**	0.0069***	0.1401**	0.1470**	0.0054***	0.0765**	0.0819***
	(0.0016)	(0.0464)	(0.0023)	(0.0646)	(0.0663)	(0.0018)	(0.0302)	(0.0312)
PCI	0.0959***	0.7052***	0.1198***	1.0824***	1.2022***	0.1075***	0.5663***	0.6738***
	(0.0129)	(0.1912)	(0.0142)	(0.3353)	(0.3418)	(0.0127)	(0.1253)	(0.1270)
URBAN	0.0037	-0.2487	-0.0016	-0.2446	-0.2461	-0.0010	-0.1380*	-0.1370*

	(0.0047)	(0.1306)	(0.0067)	(0.1550)	(0.1600)	(0.0055)	(0.0798)	(0.0831)
M	-0.3596***	-6.0934***	-0.5338***	-7.9718**	-8.5056**	-0.4449***	-4.2342***	-4.6791***
	(0.0689)	(2.2421)	(0.1094)	(3.8376)	(3.9250)	(0.0748)	(1.5907)	(1.6259)
Spatial lag	3.2652***							
	(0.2017)							
Time lag	-0.6287**							
	(0.2692)							
Pseudo R^2	0.94							
Log-likelihood	2077.95							

Notes: The value of ***Y***, proxy for output of each Vietnamese province, is defined by the TFP growth in each Vietnamese province. The FDI spillovers variable, ***FDI_spillover***, implies the value of FDI spillovers into each Vietnamese province. ***H*** indicates the human capital ratio, which is calculated by the ratio of skilled workers over population. ***OPEN*** represents economic openness, which is measured by the share of exports plus imports in the total GDP. Infrastructures, ***P***, is computed by the natural log value of the ratio of total telephone registrations per ten thousand of population. ***WAGE*** indicates the labour cost, which is calculated by the natural log value of annual incomes per employee in the firm sector in each province, deflated by domestic price index. The agglomeration indicator includes two variables: the concentration (***CONCEN***), measured by the total industrial output of each province per km^2; and the provincial domestic investment (***DI***), computed by the domestic investment scaled by provincial population. The provincial competitive index (***PCI***) denotes the performance of each Vietnamese province and compares that province with other provinces. This data is taken directly from the annual PCI report. The ratio of urban population of each province (**URBAN**) is indexed by the share of urban population over the total provincial population in each Vietnamese province. Lastly, the pace of market reform, ***M***, is defined as a ratio of non-state employees to the total employed labour force.

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