ANALYSIS OF PERFORMANCE OF FOREIGN-INVESTED FIRMS AND THE IMPACTS ON DOMESTIC FIRMS AND INDUSTRIES IN THAILAND

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การวิเคราะห์ผลการดำเนินการของบรรษัทข้ามชาติ และผลกระทบจากบรรษัทข้ามชาติต่อหน่วยธุรกิจและอุตสาหกรรมในประเทศไทย

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาเศรษฐศาสตรดุษฎีบัณฑิต
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ชยานนท์ ภู่เจริญ : การวิเคราะห์ผลการดำเนินการของบรรษัทข้ามชาติ และผลกระทบจากบรรษัทข้ามชาติต่อหน่วยธุรกิจและอุตสาหกรรมในประเทศไทย (ANALYSIS OF PERFORMANCE OF FOREIGN-INVESTED FIRMS AND THE IMPACTS ON DOMESTIC FIRMS AND INDUSTRIES IN THAILAND) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ศ. ดร.ไพฑูรย์ วิบูลชุติกุล, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: ผศ. ดร.บังอร ทับทิมทอง, 232 หน้า.

ในระยะเวลา2ทศวรรษที่ผ่านมามีการศึกษาเรื่องผลกระทบของการลงทุนโดยตรงจากต่างประเทศอย่างแพร่หลาย แต่ผลของการศึกษายังพบข้อสรุปที่ไม่ชัดเจนเกี่ยวกับผลกระทบของการลงทุนโดยตรงจากต่างประเทศต่อการพัฒนาทางเศรษฐกิจในประเทศผู้รับการลงทุน นอกจากนี้การศึกษาด้านผลกระทบของการลงทุนโดยตรงจากต่างประเทศต่อหน่วยธุรกิจในประเทศไทยก็ยังมีจำนวนจำกัด ดังนั้นวิทยานิพนธ์ฉบับนี้มีวัตถุประสงค์เพื่อวัดผลกระทบของการลงทุนโดยตรงจากต่างประเทศต่อผลิตภาพการผลิต และความสามารถในการส่งออกของผู้ประกอบการ โดยใช้ข้อมูลรายผู้ประกอบการจากสำมะโนอุตสาหกรรมรายปี พ.ศ.2550 วิทยานิพนธ์ฉบับนี้ยังได้ทำการศึกษาเปรียบเทียบผลิตภาพการผลิตและความสามารถในการส่งออกระหว่างบรรษัทข้ามชาติกับผู้ประกอบการไทย สำหรับการศึกษาด้านผลิตภาพการผลิตได้ใช้แบบจำลองสมการการผลิตประเภท Translog production function ส่วนการศึกษาด้านความสามารถในการส่งออกได้ใช้แบบจำลองของ Heckman selection method ผลการศึกษาเชิงเปรียบเทียบพบว่า บรรษัทข้ามชาติมีผลิตภาพการผลิตเฉลี่ยสูงกว่าผู้ประกอบการไทยในเพียงบางรายอุตสาหกรรมเท่านั้น แต่บรรษัทข้ามชาติมีความสามารถในการส่งออกมากกว่าผู้ประกอบการไทยในเกือบทุกอุตสาหกรรม ส่วนในการศึกษาด้านผลกระทบภายนอก (Externalities) ของการลงทุนจากต่างประเทศต่อผู้ประกอบการไทย ผลการวิจัยพบผลกระทบในเชิงบวก (Positive externalities) ในภาคอุตสาหกรรมโดยรวม และอุตสาหกรรมย่อย 2อุตสาหกรรม

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CHAYANON PHUCHAROEN: ANALYSIS OF PERFORMANCE OF FOREIGN-INVESTED FIRMS AND THE IMPACTS ON DOMESTIC FIRMS AND INDUSTRIES IN THAILAND. ADVISOR: PROF. PAITOON WIBOONCHUTIKULA, Ph.D., CO-ADVISOR: ASST. PROF. BANGORN TUBTIMTONG, Ph.D., 232 pp.

Many empirical researches have been dedicated to study the economic impacts of FDI; however, the consensus on whether FDI can accelerate the economic growth is still ambiguous. This dissertation examines another aspect of FDI's impact, the spillover effect on local plants. With the 2007's industrial census, we use micro-level data to examine the effect of FDI on productivity and export performance of locally-operated plants. We first design estimation models to investigate productivity and export performance differentials between foreign-invested and locally-operated plants. Next, we examine the effects of foreign presence on productivity and export performance of locally-operated plants, using Translog production fucntions with both two and four factors of production. The results of our study find that the differences in export performances between foreign and locally operated plants are more convincing than their productivity differentials. There is limited evidence that the foriegn presences in local industries could positively influence the export performances of the locally-operated plants. The study of FDI externalities on locally-operated plants by sector shows that the effects are significant in only a few industries. However, we find that foreign presence in downstream industries has a positive effect not only on the productivity of local plants but also on their export performances in many industries. Our findings reveal that the externalities from the presences of foreign firms on productivity and export performance of locally operated plants (horizontal spillover effect) are detected in only selected industries. In other words, both performance differentials and spillovers effects vary across industries.

Field of Study: Economics	Student's Signature ....
Academic Year: 2014	Advisor's Signature ....
	Co-Advisor's Signature ....

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Introduction

1.1. Rationale

As the same as other developing nations, Thailand has been classified as a net receivers of Foreign Direct Investment, FDI, since 1980. The net inflows of FDI to the nation swiftly increase from the amount of Baht51 billion at beginning of 1990s to Baht224 Billion within a decade. Despite the recent years of political uncertainty in the nation, the following figure reveals that the net inflows of FDI to the nation and to the manufacturing sector still have an increasing trend.

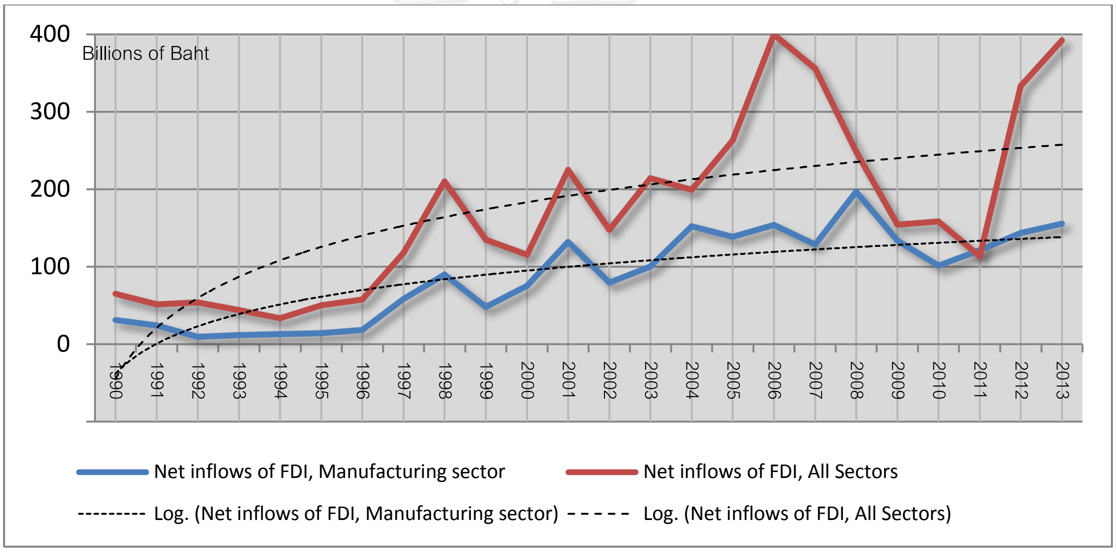
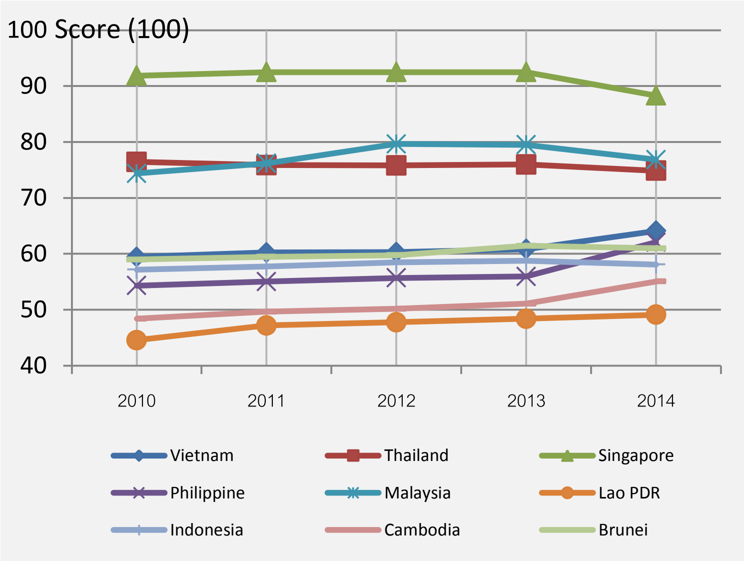


Figure1.1. Net Inflows of FDI to all sectors and Net inflows of FDI to the Manufacturing sector[1]

In relatively to other FDI's destinations in Asia, Thailand has been classified as in the the list of 2014's top thirty countries with the ease of doing business. In comparison to other ASEAN's member, the line charts in the following page reveals Thailand had been consistently ranked as either the second or third position in this region. Beside these appealing scores, significant amount of investment promotions to attract for FDI have been actively lunched and updated with the optimism for more FDI inflows.

[1] Source: Bank of Thailand Table EC-XT 058 and EC-XT 026



Country	2014 Global ranking
Singapore	1
Malaysia	20
Thailand	28
Vietnam	72
Philippines	86
Brunei	98
Indonesia	117
Cambodia	134
Laos	155

Figure1.2. World Bank's score and ranking on Ease of Doing Business (9 ASEAN members)[2]

A vast number of researches have been conducted to verify the impacts of FDI on host nations. The studies vary in aspects; ranking from their impacts on wages (Libsey 2004) in the host nation to the environmental of host nations, eg. (Mabey 1999), and one of the most soughed after question is whether a net inflows of FDI can promote growth in the host nation. Despite an extensive number of studies, the answer is still relatively ambiguous.

A much less studied aspect is the externalities from their presences to indigenous firms (spillover effects). Since firms incorporated in the Thailand have been playing a pivotal role in nation's gross domestic product; as, the GDP share of industrial and service sector is recorded as high as 91.6% (Thailand 2012). Despite their vital roles in Thai economy, the numbers of empirical works through the firm/plant level data are relatively limited, including this spillover effects from the presence of foreign plants. The attempt to investigate these effects of FDI on the performance of local entities could potentially serve as the passage to solve the puzzle on whether the benefits of FDI to the host nation are only coherent in the conceptual frameworks.

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[2] World Bank Report: Doing Business 2010-2014

In addition, we perceive that the question of whether foreign-controlled firm actually outperform local-operated firms should be addressed prior to the impact study. Hence, a closer examination on performance differentials between foreign and local's firms are also empirically verified in this dissertation.

This dissertation study two distinct types of firm's performance, productivity and export performance of the firm. As, the improvement of plant's productivity and plant's export performances have been consistently focused in the recent national Economic and Social development plans (10^{th} and 11^{th} plan) as the eminent measure to achieve nation's sustainable economic development goal.

1.2. Objectives

With two distinct types of firm performance, productivity & export performance, and two main questions on the performance differentials between foreign-invested and local-operated entities and the performance spillover effects are being examined. The following four dissertation's main objectives have arisen.

1. To investigate whether foreign-controlled plant have higher productivity than local-operated plants.

2. To investigate whether the presences of foreign-controlled plants can statistically affect the productivity of local-operated plants.

3. To compare the export performances between foreign-controlled plant and local-operated plants.

4. To investigate whether the presences of foreign-controlled plant generate any externalities to local plants' export performances.

Chapter three would address the first objective, and the second objective are discussed in the following chapters; while, chapter five verify both third and fourth objectives. Related hypothesis to each objective are respectively shown in each chapter.

1.3. Scope of study

As we can preliminary observe from Table 1.1., the Manufacturing sector plays significantly role in the nation net flows of FDI, half of the foreign direct investment in the nation are attributed to the FDI in this sector[3]. The study from sectoral data by (Alfaro 2003) and (Chakraborty 2008) found the evidences that the positive relationship between nation's growth and FDI in manufacturing sector. In addition, the establishment-level data of service and retailed establishments were not included in the NSO 2007 census (NSO 2007). Hence, the analysis of spillover effects and performance comparison is restricted to manufacturing sector only. To further contribute to the existing literature and enhance the policy implication part, productivity & export performance differentials and spillovers would be verified not only in the aggregate manufacturing sample, but the analysis are also conducted at the industry level.

In order to avoid disproportional in number of foreign and local plants, we scope our analysis to establishments with the size (classified by number of labor) in categories 6 and above, which have total number of workers greater than or equal to 15 workers. Plants which have sales per labor lower tha Baht 10,000, and fixed asset per labor lower than Baht 5,000 per year are not included in this study.

Since there is small number of foreign controlled plants which could lead to insufficient number of observations in the subsequent tests, we exclude Tobacco [ISIC 16], manufacture of oil and coal product [ISIC 23], other transport equipment [ISIC 35] and other manufacturing (ISIC 3699) industries from all analysis in this dissertation. In addition, Publishing and printing [ISIC 22] and recycling [ISIC 37] are excluded from the analysis because we focus on the plant in manufacturing industries. The detailed descriptive and detailed numbers of sample size are illustrated in each chapter.

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[3] Average from 1990 to 2013, data obtained from Bank of Thailand Table EXCT029 and EXCT058

Prior to the aforementioned studies, another prerequisite is the understanding of multinational corporations. Hence, the theories of MNC, types of FDI are discussed in chapter two. This comprehensive introduction of MNC is part of the explanation to explaian why competitive advantage conceptually prevails in the group of multinational establishments. In addition, this chapter also theoretically explains how technology and knowledge could be transmitted to indigenous units.

Productivity comparison between foreign-invested and local-operated plant are revealed in chatper 3, then the study of FDI externalities is discussed in the following chapter. Export performance comparison and the study of the export spillover effects are integrated in chapter five. Then, the main content of dissertation is concluded with the policy implication and conclusion part.

Although the studies on the impact of FDI have been significantly advanced during the last three decades; however, most of them concentrate on the effect of FDI on the aggregate indices through macro-level data. With the rising of micro-level based data, the studies of FDI externalities have gained an increasing attention from researchers. This dissertation is dedicated to investigate the FDI externalities toward locally operated establishment with the utmost aspiration that the results from this thesis could contribute as the inputs for further development of FDI related policies.

Chapter 2
Review of literatures

To gain an insight of impacts of MNCs on local entity, the theoretical backgrounds of MNCs are necessary; hence, this dissertation firstly discusses the theory of MNCs.

2.1. Theory of MNCs

First, we explore of the traditional theories of multinational enterprise, which cover the original works by (Hymer 1976) and (Dunning 1973). These two theories basically explain why multinational enterprise exists. Then we further look at the model which could not only explain why we foreign-invested firms exists but also what type of multinational enterprises the entrepreneur would pursue, and the conclusion section.

2.1.1 OLI: Ownership, Location, and Internalization

(Dunning 1977) developed the OLI electric paradigm to explain why we have the cross boarder direct investment, the origin of his development derived from (Hymer 1976) dissertation. As his attempt to explain the international capital movement which could not explained by interest rate differential which is suggested by international portfolio theory, the theory of multinational enterprise, which fundamentally explain why firm directly invest abroad. At the center of his suggested framework, there is a firm-specific advantage hypothesis, which indicates MNCs must possess some specific advantage; such as, superior technology or lower cost due to scale economies, which allow MNCs to overcome the disadvantage of doing business abroad.; however, (Hymer 1976) work could not explain why firm does not concentrate their utilization of advantage at home and export the products to abroad markets, or why firm does not use the licensing mode of entry rather than internalize their operation in abroad.

(Dunning 1977) further add that the *firm specific advantage is necessary but not sufficient condition* for firm to directly invest abroad (MNEs), then the OLI framework was developed. To invest abroad, firms must simultaneously possess two advantages and one motive, which are the ownership advantage, location advantage, and internalization motive. The following advantages and motive explains why firms investing abroad instead of keeping the operation and penetrate the host market to exporting.

Ownership advantage: Firm must have a product, or proprietary asset, or manufacturing /operation process which could not be accessible by the local firms and it would give this type of firm with some market power or cost advantage over the host country's firm. In his early work, (Dunning 1973) stated the specific advantage which had been purposed in the initial work of (Hymer 1976) are in four aspects[4].

Location advantage: is the benefit which attracts the foreign firms to set the operation abroad rather than exporting, the rational of setting a new operation abroad must be outweighed the benefit from concentrating the operation in home and exporting to host nation.

Internalization motive: is the condition which implies that the MNCs prefer to transfer their proprietary asset within the firms; direct investment rather licensing, to host countries. (Bremish 1986) further augmented the transaction cost theory to enhance the explanation of internalization motive of foreign-invested firms. Obstacles to trade, transportation cost, non-tariff / tariff barriers exist in the imperfect market; hence, there is a transaction cost for MNE to overcome this barrier to trades. As a result, it is more efficient for the firm to use internal structure rather than exporting or market intermediaries to serve the host market.

There are two initiatives of internalization; strategies of vertical integration and horizontal diversification. Due to the failure to consistently obtain the intermediate goods, MNCs could select the vertical integration strategies. While the market failure in intangible asset market; for example, management know-how, and proprietary technology, could lead MNCs to horizontally internalize their operation.

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[4] Foreign firms can access or gain better access at cheaper cost to knowledge and information, factor input, better access to market (ex... brand name), vertically integration than the local counterpart.

The OLI framework has been widely referred in the multinational enterprise's related topics in performance comparison and investigation of spillovers from FDI. While, the transaction cost theory has been utilized as the referred theoretical concept in researching for the optimal choice of entry modes; for example, joint venture versus wholly owned subsidies.

To conclude this section, FDI incurs when the particular firm simultaneously possess their ownership advantage, aim to protect their proprietary asset (internalization motive), and location advantage of setting its subsidies in host nation (for example, competitive prices for important factors of production). If one of these elements is missing, that particular firm would likely to pursue their exportation to host nation instead of conducting their direct investment in host nation.

However the international direct investment has been rapidly expanded during the last 3 decades. (Markusen 2004)'s initiative was laid on the belief that the basic conceptual framework which focus on the, firm specific advantage, resource seeking, or internalization purpose are no longer sufficient to validate the emerging types of direct investment. For example, the OLI theory could not explain the investment in fragmented international production. Nonetheless, the traditional framework could not effectively explain the recent empirical findings; for instant, the significant of MNE in the industries with high intangible asset, small but skill labor abundant (for example, Switzerland, Sweden) *nations are the home to many multinational firms.* Hence, the development of new theoretical explanation to explain the multinational firms' new behavior deserved the attention. In next section, I would present the conceptual frameworks which have been employed in (Markusen 2004) to explain the international direct investment. The enhancement which the knowledge capital model augmented to the OLI conceptual framework is the explanation of how the multinational activity is related to country characteristics (i.e….trading cost, difference in market size). *To be more specifically, firm characteristic interact with country characteristic in determining what type of multinational enterprise firm would intake to penetrate host market in Knowledge Capital Model.*

2.1.2. Introduction to Markusen's conceptual framework

Markusen adjusted the OLI electric paradigm of Dunning as followed and as his path to depart for the knowledge capital model. The following alteration is made to Dunning framework.

Ownership advantage: the ownership advantage of the firms should be presented in term of knowledge capital, which includes human capital, patents, technical blueprints, process or other proprietary knowledge *rather than the physical capital*, which implies that MNCs are the firms which intensively use knowledge capital not broadly classified as capital because

[A].The knowledge capital could be easily transferred to the foreign operation (for example, engineers or managers are sent to the subsidy), while the transfer of physical capitals involves relatively large cost.

[B].Knowledge capital goods are skilled labor intensive, and the most of the MNCs' headquarters are incorporated in skilled labor abundant nation. (Markusen 2004) perceive that by specifying the capital as knowledge capital in the setting could enhance the analysis of the emerging of new multinational firms.

Location advantage: would vary across to the purpose of investment, specific host nation property could encourage or discourage specific type of direct investment. Market size of host countries and the substantial trade cost would stimulate firm to serve the host market through their own subsidiaries rather than exporting from home. While the low trade cost between home and host nation (rather than high) influence firms to set plant in the host nation. With consideration of market size of host nation and trade cost, we can generally conclude that for horizontal MNCs. Location advantage would arise in the case that when trade cost are moderate or high, and the market size is large. However, vertical MNCs would be optimal when trade costs are low, factor of production intensity vary in each stage of production, and the differences in factor endowments of two nations are significant.

Internalization motive: which is closely link to the public good characteristics of knowledge capital, multinational firms could undertake their direct investment (internalize) this knowledge for the use in order to retain their knowledge within the firm.

In next section, we analyzes the horizontal type MNE with respect to domestic firm, the model for vertical MNE, and the extension analysis of vertical type of multinational firms.

2.1.3. Model of Horizontal Multinationals: A general equilibrium oligopolistic competition

We referred to the horizontal and vertical type of multinational firms definition given in (Markusen 1995)'s paper.

Horizontal direct investment/MNE is defined as the direct investment in the foreign production/operation of products and services which is roughly similar to those products in which they produce in home. They have plants in both host and home country and one headquarter in home nation, each market would be served by its own plant.

Vertical direct investment/MNE is the direct investment in foreign production/operation of products or services in which their production is geographically fragmented through different stage of production. They have a single plant in host country and one headquarter in home nation, a single plant in host country would not only serve host market but also home market through re-export.

The profit (π) of any type of firm could be basically presented as.

$$\pi^k = Sale - TVC - operating\ cost$$

Where superscript k represents type of firm (in this case type d and type h), TVC is total variable cost With free entry condition, which implies *non positive profit* status, and let assume that firm has single market, p as price, vc is variable cost per each unit of X and X as quantity sold then the above equation could be written as

$$\pi^k : p\left[\frac{(p - vc)}{p}\right]X - operating\ cost \leq 0$$

If we illustrate (m) as the mark up revenue portion over the price [(p-vc)/p] the above free entry profit equation could be rewritten as.

$$\pi^k: p(m)X - operating\ cost \leq 0$$

Given with two types of operating cost, G and F, where G is the plant specific operating cost, and F is firm specific operating cost, and two different market i and j, two different final product price (p_i and p_j), and two different markup portion (m_i and m_j) for each markets we can elaborate the above simple free entry profit inequality could be set for each categories of firms

For Type d_i firm: $p_i(m_{ii}^d)X_{ii}^d + p_j(m_{ij}^d)X_{ij}^d \leq z_i(G+F)$ 2-1

For Type d_j firm: $p_j(m_{jj}^d)X_{jj}^d + p_i(m_{ji}^d)X_{ji}^d \leq z_j(G+F)$ 2-2

For Type h_i firm: $p_i(m_{ii}^h)X_{ii}^h + p_j(m_{ij}^h)X_{ij}^h \leq z_i(G+F) + z_jG$ 2-3

For Type h_j firm: $p_j(m_{jj}^h)X_{jj}^h + p_i(m_{ji}^h)X_{ji}^h \leq z_j(G+F) + z_iG$ 2-4

Where p_i, p_j are the price of goods X in country i and j respectively, X_{ii}^d and X_{ij}^d are goods x sold in country i, and export to country j respectively by domestic firm incorporated in country i, while X_{ii}^h is goods X offered in country i by horizontal multinational firm from head quarter in country i, X_{ij}^h is goods X offered in country j by subsidiaries of horizontal multinational firm headquartered in country i Where m_{ij}^h ; for example, is its mark up of the nation i horizontal firm's product in market j (the first subscript of X and m term represents the nation/head quarter of the firm, while the superscript represents type of firm [which in this case domestic or horizontal MNE]). z_i and z_j are the wage for skilled labor in country i and country j respectively.

In word, the above inequalities prevails that each firm's markup revenue (revenue after variable cost) should be less than the operating fixed cost of firm in order to comply with free entry condition. The interpretation and implication is presented in the following table, with the condition in which the entrepreneur is selecting the entry mode to country j.

First, we study the change of variables in profit inequalities of each type of firm.

Case	Ex Port	H MNE	Intuition	Policy implication for the recipient nation
1.World income rises (an equal increase in M_i and M_j)			H MNEs has lower variable cost than exporting domestic firms and as X in both markets increase, Mark up rev. of MNE would increase faster than exporting choice.	Stimulate/retain the economic growth at the world growth rate
2.Trade cost increases (increase in t)			Since they have both plants in both nations, they would serve their markets through their foreign operation	Impose higher tariff/non-tariff barriers.
3. Home's skilled wage drop, host's skilled wage increases. (z_i drops and z_j increases)			Exp. firm's **total** VC and **total** operating cost drops, while only a **portion** of operating cost of MNE drops (only VC and Operating cost of home plant would drop) then it is better to concentrate the production.	Increase human capital to retain the competitiveness of their nation in attracting the foreign investor
4. Host's skilled wage drop, home skilled wage increases (z_i inc. and z_j)			MNE can enjoy this dropping cost in host nation, **since they also have the production plant** in host nation, while the exp. Firm whose production is concentrated in home nation could not enjoy this drop.	Increase human capital through the improvement of education and trainings. Support the knowledge spillover activities

Table2.1. A summary on Effects of Markusen's [1st case to 4th case]

The choice of horizontal investment in host nation is more attractive when total world income has increase, increasing trade cost and the host nation is endowed with more human capital; however concentration of production in home and export to host received more popularity when the home nation is endowed with more skilled labor since their cost and operating cost would entirely decline since their only plant is located in home nation, while MNE with horizontal type of investment in host country would partially benefit from this decline in home since they have the production facilities in both nations. We have extended the analysis from the previous model and construct the following table which further explains the country characteristics.

Case	Ex port	H MNE	Intuition	Policy implication for the recipient nation
5.Host nation is large market (large M_j)			H MNEs has lower variable cost in host nation market since it variable cost does not include trading cost.	Stimulate economic growth
6. Home nation is large market (large M_i)			H MNE might not prove to be profitable because the company main market is already in home. Since H investment would lead to the incurring burden of operating fixed cost abroad.	Economic growth policy
7. Factor endowment gap is large (home is skilled, host is unskilled)			Concentration in home and export to host could allow the company to fully enjoy the benefit of cheap skilled labor at home.	Increase competitiveness of our nation through increasing human capital stock.
8. Factor endowment gap is large (home is unskilled, host is skilled)			MNE could mainly base their production in host nation, where they can recruit cheap skilled labor, while domestic firm in home is not able to diversify their production to cheap skilled labor source	Increase human capital through the improvement of education and trainings. Support the knowledge spillover activities

Table2.2.. Host country's characteristic and decision to FDI [Markusen's 5^{th} case to 8^{th} case]

As we can observe in the main analysis and from table 2.2 if the difference between two countries in factors endowment, and assume that the home nation is skilled labor abundant nation, and host nation is unskilled labor abundant nations, concentrating the production only at home would be optimal choice; however the result would be opposite if the home nation is unskilled labor abundant nation, and host is skilled labor abundant nation. In addition if the host nation is large market, then the motive to pursue the horizontal direct investment in host nation increases.

To conclude this model, choice of multinational firm is superior to domestic operation choice when transportation costs are high, the market size is large, and when the difference of nation factor endowment increases. Domestic firms in *unskilled labor abundant nation* (case 8) has the motive to invest abroad in order to obtain skill workers with competitive wage. While, firms in the skilled labor abundant nation with the exportation to unskilled labor abundant nations would be benefited more than doing FDI in host nation. In next section we add the vertical multinational into the analysis, and this model is later named by (Markusen 2004) as knowledge capital model.

2.1.4. Knowledge capital model

Horizontal Multinational Corporation has been discussed in the previous section, but we haven't discussed the vertical corporation which assumed to have the single plant in one country and headquarter in other country for this model.

Three characteristics, which are related to the knowledge based asset which is the main input of this model, should be preliminarily discussed.

1. Fragmentation: Production of final goods could be separated from the knowledge based activities, and with the fragmentation, firm could fragment their production of final goods to foreign plant through technology transfer while maintain their knowledge based activities in headquarter.

2. Skilled labor intensity: Knowledge based assets is constructed from skilled-labor intensive activities relative to final production.

3. Jointness: Services of knowledge based assets are joint inputs into multiple production facilities. Hence added cost of second plant is small compared to the cost of establishing a firm with a local plant.

The fragmentation and skilled labor intensive of knowledge based activities motivate the firm to vertically plan their production abroad, and their country choice would depend on market size and factor endowment of destination. Jointness increases the motive for conducting a horizontal multinational. (Markusen 2004) assume that both jointness and fragmentation persist hence the firm fixed cost is characterized by relatively low costs of geographically fragmenting headquarter and firm production with shared firm fixed cost across multiple plant (Jointness feature).

In conclusion, this model prevail the same result as the previous model with the more comprehensive feature of the model to include the vertical type of MNEs. The horizontal MNEs have the highest markup revenue, and their advantage over other type would increase if the trade cost increases; however horizontal MNE also has the highest operating fixed cost. As the host market size expand, firm would likely to become multinational in order to fully capture the favorable change of host nation market by avoiding the trade cost from exporting final goods from home. As the host nation (i) becomes more skilled labor abundant nation, the motive of setting up vertical investment in specified host country to sort for skilled labor input would increase.

Only when the home nation becomes more skilled labor abundant nation, concentration of production in home and export to host nation [type d_i], the condition for entrepreneur to undertake horizontal multinational direct investment is when world income is large, host market is expanding, and trade cost is high or increasing. Vertical Multinational choice would prevail when host nation skilled labor endowment is increased. Next section, we reviewed the model in which the vertical MNE produce the intermediates goods at one location while produce the final goods in another location. With this adjustment, the fragmentation of the MNE production in the reality could be more captured from theoretical sense.

The interpretation is the production of x is profitable under particular range (shaded area) in which the operating fixed cost is less than the mark up revenue. As the host nation j is too skilled labor scarcity nation (high z_j low w_j), which is shown by in upper left of the operating fixed cost line. it is also not profitable to pursue the direct investment in nation j, when nation J is becoming too skilled labor abundant (low z_j, high w_j) which is presented in lower right corner of the figure, then the operating fixed cost of this vertical MNC would overcome the operating markup revenue mainly due to the high cost of unskilled labor in nation j which is required in the production of goods x in nation j.

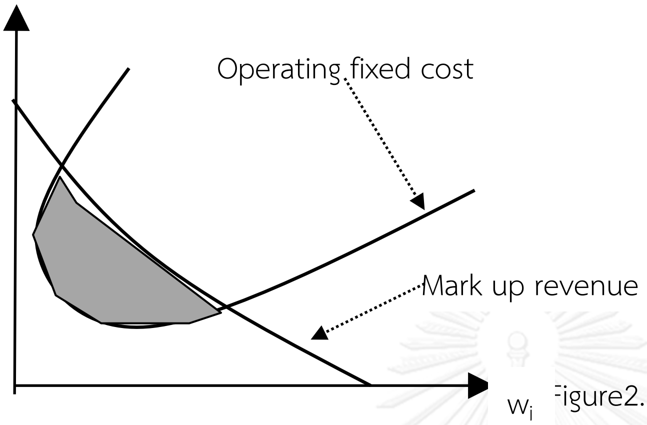

Figure2.1.Partial equilibrium of vertical MNCs

As the extension of the vertical MNEs in the knowledge capital model, we can further add a caution to the previous model conclusion (last row of table 1.3) on the motive of vertical direct investment undertaken by multinational firms. As host nation is more endowed with skilled labor, the attractiveness of vertical investment in that nation would increase as the company could sort for cheaper skilled wage in their production; but it should not be too skilled labor abundant nation, otherwise the unskilled wage is too high which would increase in the cost of product assembly in host nation. Hence the policy aimed to promote the human capital stock through education would not be sufficient because the unskilled labor wage would increase as nation has becoming more relatively skilled labor abundant. Authority should also design their policy to prevent this increased in unskilled labor wage through adopt unskilled labor migration from unskilled labor abundant nation.

The original works on firm specific advantage, location advantage and internalization motive could basically explain why multinational enterprise exists; motives for foreign direct investment had been discussed in those original works. However, they could not determine the type of multinational enterprise; hence, the Knowledge capital model is reviewed in this paper to enhance the theoretical understanding of multinational activities

To conclude, we can observe throughout this section, MNCs, either horizontal or vertical, possessed the flexibility to optimize their productions. However, a domestic firm, by its nature, is relatively rigid in their production network to adapt themselves to the change in factor prices. As host nation is becoming more skilled labor endowment, the attractiveness of the vertical investment is most enhanced as its sole production is located in the nation with less expensive human capital stock, which is the factor of production of firm's product. Then authority in host nation should increase their human capital stock through formal education or training. If the subsidies of vertical MNCs are established in the host nation for the assembly of final goods, not for the complete production of final goods; then, a caution should be made on policy of transforming the nation to skilled labor abundant nations, since it would automatically increase the wage of unskilled labor which would distress the profit of vertical MNC's subsidiaries as their assembly process requires unskilled labor as well. Trading cost in final goods would encourage firm to become Multinational enterprise, hence tariff or non-tariff barriers are widely imposed in order to attract the foreign direct investment in the FDI recipient countries. However, the imposed barriers should be restricted to final goods only. As FDI in recipient nation economy is expanding at greater rate than expansion in home market, this would automatically induce the presence of MNE (either horizontal or vertical) in the host nations. In the next section, the theoretical literatures on performance differential between MNCs and local plants are discussed.

2.2. Comparative performance between MNCs and local firms: Productivity

In this section, we illustrate the conceptual frameworks which discuss the performance of foreign-invested plants, first we revisit the OLI paradigm then we discuss the heterogeneity productivity model.

2.2.1. Ownership advantage

In order to overcome the new foreign market which it does not familiar with, MNE must possesses some advantage which local firm does not has. This advantage is generally called firm specific advantage which has been long developed in wellknown in (Hymer 1976) and (Dunning 1977) work. As discussed in the section 2.1.1. The discussion of the OLI electric paradigm in linkage to recent empirical literatures is addressed in the chapter three.

Based on the empirical work by (Bellak 2001), in which he concluded that the heterogeneity of the productivity across the firms is the firm/plant level phenomenon rather than industry phenomenon. Majority of the existing empirical literature support productivity supremacy of the foreign-invested companies, their result would be discussed in the third section.

First we shall clarify the productivity; we reviewed the works by (Griffith 2001) for illustration purpose.

$$Y_{it} = A_{it}K_{it}^{\alpha}L_{it}^{\beta}X_{it}^{\gamma} \tag{2-5}$$

Where Y_{it} is the output of establishment (firm) I at time t, A is the Hicks-neutral productivity shift parameter, K is capital input, L is labor input, and X is intermediate inputs, α, β, γ are the elasticity of output with respect to capital, labor and intermediate inputs respectively, and $\alpha+\beta+\gamma = 1$ (constant returns to scale).

Log- linearize the above equation

$$y_{it} = \alpha k_{it} + \beta l_{it} + \gamma x_{it} + a_{it} \tag{2-6}$$

Where the lower letters are logs level, the residual term a_{it} can be interpreted as firm's TFP, and this term could be illustrated as following.

$$a_{it} = \eta_i + t_t + e_{it} \tag{2-7}$$

Where η_i captures firm specific differences in productivity (time invariant), t_t represents the common macro productivity shocks, e_{it} captures firm-specific time varying productivity shocks which is assumed to be idiosyncratic.

With the above TFP's illustration, the focus is on the η_i term. With the firm-specific advantage (which has been discussed early in this section), hence the hypothesis is developed as

$$\overline{\eta^f{}_{\iota}} > \overline{\eta^d{}_{\iota}} \tag{2-8}$$

In word the mean of η_i (firm productivity) for the firm in foreign-invested group is hypothesized to be greater than the mean of η_i for the firms in domestic group, If we assume that t_t and e_{it} are identical across the two types of firms (foreign-invested firms and local firm) then we can generalized from the above frequently hypothesized inequality as the foreign-invested firm has higher level of total factor productivity than domestic -owned firm.

To summarize, traditional MNCs theories or conjecture mainly refer to firm specific advantage as the main explaining factor for the existence of MNC; internalization theorists may differently view the motive for the direct foreign investment (DFI) by MNC differently; however; all agree that MNCs must possess some advantage in which local firms do not possess, and because of this possessed advantage they are enabled to overcome liability of foreign, for instance; the unfamiliar local preference, business practices in host nation. In the next sub-section, we discuss the recent theoretical framework which explains the productivity of foreign-invested firms in relative to other firm types.

2.2.2. Heterogeneity productivity model

In this model, the main factor which explains why some firms concentrate their production only in the domestic market, while a portion of firms exports, and a fraction no. of firms with direct investment activities, is the difference in productivity across the firms.

First we illustrate the existence of the firm by using the models by (Helpman 2004) and (Melitz 2003)

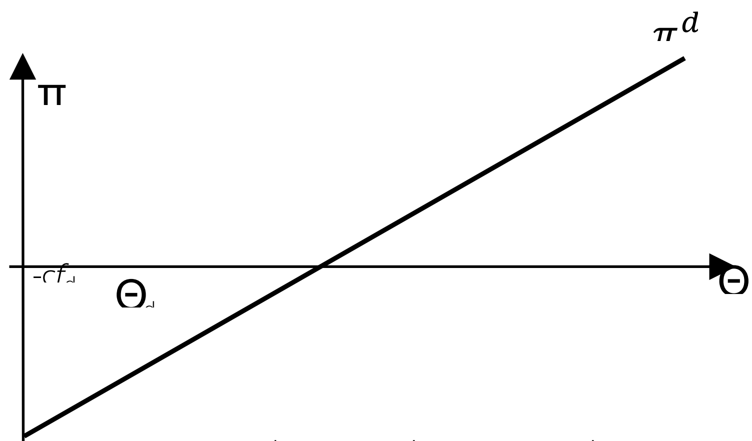

Figure2.2. Active production and Non active plant

Source: (Helpman 2004)

Where

cf_d: Firm operating fixed cost

π : Firm profit

π^d: Firm profit from domestic sale

Θ: Productivity

The above π^d line was developed on the profit function of engaging in domestic market

$$\pi_d(\Theta) = \Theta B - cf_d \qquad (2\text{-}9)$$

Where B is $(1-\alpha)A(\frac{c}{\alpha})^{1-\varepsilon}$ and A is a measure of the demand elasticity5, and $\frac{c}{\alpha}$ is the production variable cost per unit of output,

From the above figure, there are two existing conditions, existing firms and non-existing condition. For the firm with productivity above Θ_d, their profit would be positive hence they would likely to persist in the markets; however, the firm with productivity under the cutoff point would experience the loss due to their fixed cost of operation is greater than its markup revenue (sale – variable cost) hence firms with a productivity lower than Θ_d could not exist.

Introducing the profit function from the exportation to country j and horizontal direct investment in country j by (Melitz 2003) as following

$$\pi_x^j(\Theta) = \tau^{1-\epsilon}\Theta B^j - cf_x \qquad (2\text{-}10)$$

$$\pi_h^j(\Theta) = \Theta B^j - cf_h \qquad (2\text{-}11)$$

Where $\pi_x^j(\Theta)$, $\pi_h^j(\Theta)$ are the profit obtained from exportation to country j and profit obtained from conducting horizontal investment in country j respectively, B^j is defined as the B in the equation 1.11 except this B^j represents the market J, cf_x and cf_h are the operating fixed cost from the exportation and conducting the horizontal investment. Assume that operating fixed cost of direct investment abroad cf_h is greater than the operating fixed cost of exportation, and the engaging in domestic production alone would provide the lowest operating fixed cost. Mathematically; (Helpman 2004) assume

$$|cf_d| < |cf_x| < |cf_h|$$

[5] Which is assumed to be constant

With the above equation 2.10, 2.11 (Helpman 2004) illustrate the following figure

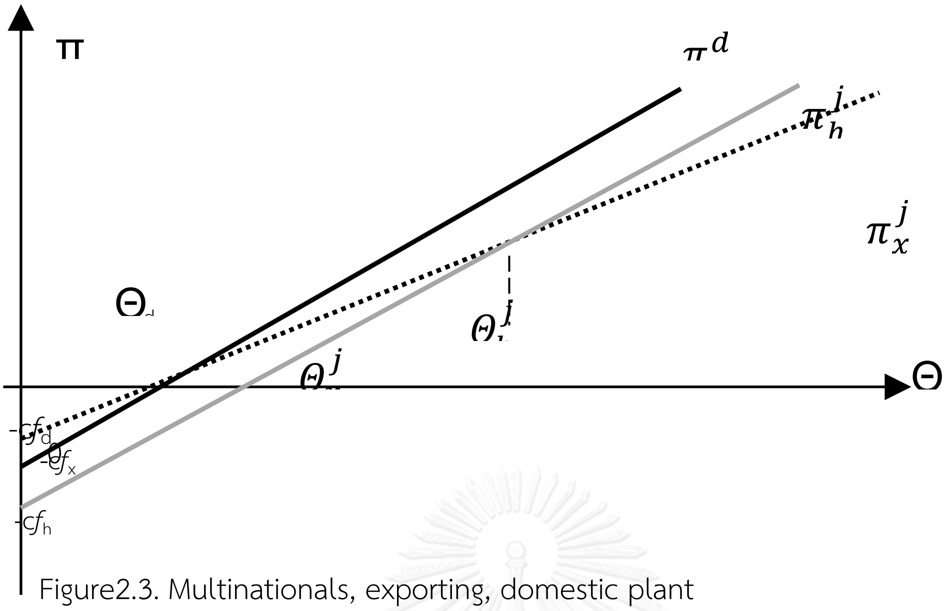

Figure2.3. Multinationals, exporting, domestic plant

The figure depicts the profit from domestic operation, exporting, and direct investment activities. With the assumption identical demand level between home and foreign market j (Aj=A) then the profit from domestic operation and horizontal direct investment is steeper than the exportation choice due to the existing of trading cost .

There are four intervals to be interpreted from the above figure. First, for the firm with productivity less than the Θ_d, this type of firm are not exist under profit maximization assumption since their profit is negative, while for firm which has their productivity within the range of [Θ_d , Θ_x^j] would serve their domestic market only, and for the firm with higher level of productivity which is between [Θ_x^j , Θ_h^j] could gain further profit from exportation. Lastly, for the firm which desired to directly invest in country j, their productivity must be greater than Θ_h^j. From the above conceptual framework, we can summarize that the MNE firms is the type of firm which possess the greatest productivity, following by the exporting firms, the local firm with non-exportation. Referring to the previous section abbreviation and Θ to represent productivity, we can write

Θ of type h firm > Θ of type d firm (with export) >Θ of typed firm (with non-export)

To conclude this section, foreign invested firm is believed to have better productivity than the local firm in the host country, and from the descriptive statistic provided in BOT data the we can observe that majority of the FDI flow are from developed countries; for example, 37% of those capital flow are the investment from Japan investors, 19% from Singapore, approximately 10% from USA.

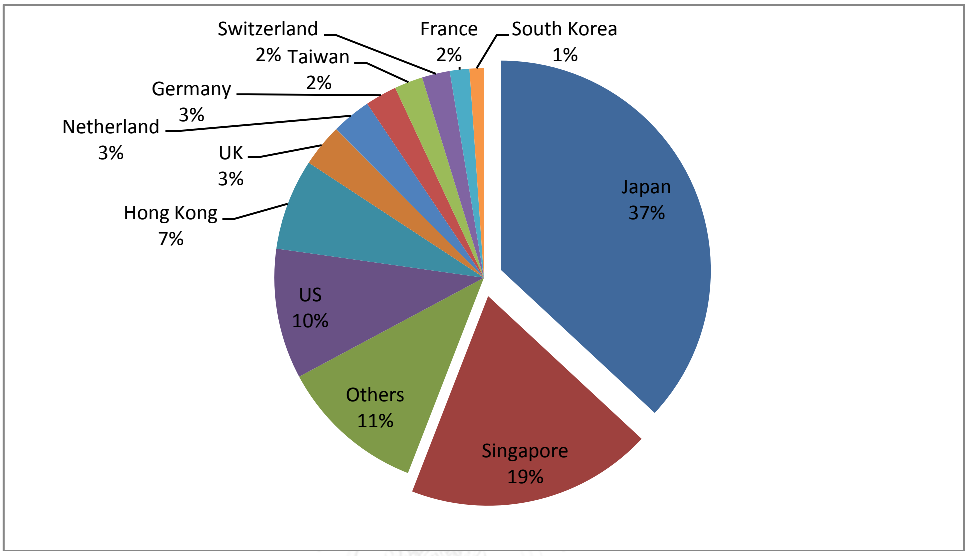

Figure2.4. BOT's accumulated FDI flow 1961-2010, Source: Bank of Thailand

For Thailand, Thai plant averagely has lower productivity than the average firm from those developed countries; for example, Japan, Singapore, and US hence we can transitive our suspicious to that Thai firm could have a lower productivity than foreign invested firm's affiliate in Thailand.

From the analysis of (Helpman 2004) optimal integration strategies, and firm specific advantage; we can hypothesize that multinational enterprise (regardless of horizontal or vertical type) possess some superiority in productivity over the domestically operated firms as implied and shown in the previous stated framework.

From the analysis of earlier works by (Hymer 1976), (Dunning 1977), and the researchers who have concurred with firm specific advantage of multinational firms, and the analysis of the latest theoretical model on the productivity of foreign invested firm. We relatively agree with the most recognized hypothesis in international business which stated MNC could perform better than local firm through its pre-requisite strength as they had turned to multinational status; however this hypothesized superiority has not been a consensus among empirical research works. In the next section, we explore another type of firms' performance, the ability of foreign-firm vs the ability of local firms to insulate them from the foreign exchange exposure.

2.3. Comparative performance between MNCs and local firms: Foreign exchange exposure

The initiative of reviewing the "foreign exchange exposure" literatures is inspired by the following expression

> "Having endeavored to forecast exchange rates for more than half a century, I have understandably developed significant humility about my ability in this area"
>
> Alan Greenspan

Remarked before the Euro 50 Roundtable, Washington D.C., November 30, 2001

Even Mr. Alan Greenspan publicly admitted that forecasting the exchange rate is a humbling experience. Throughout the passing decades, the econometric and statistical tools have been progressively developed; however, there is no single ultimate model which can accurately forecast the exchange rate. With the awareness of the difficulties in the exchange rate estimation and the surge of international trade and investment, I perceive that the researches, which are designed to investigate the impact of this volatility, are valuable input for the economic units to prepare for this unpredictable factor which make them become an inevitable type of exposure.

Beside the comparison of economic trade, and financial performance between local firms and MNCs depicted in the previous component. In this component, I compare the insulating ability of local firms and MNCs from this inevitable type of exposure. The insightful understanding on this type of firm's ability could further enhance the financial performance differential between local and MNC describe in the previous component.

In Principle, either firms operating in the global environment or the firms with inactive international activities exposes to foreign exchange risk (FX risk). On the other hand, it is surprising that the efforts to detect the effects of this exposure (for example; (Jorion 1991), (Amihud 1994) and (Bodnar 1993) is relative unsuccessful in documenting the significant of this exposure. This is an interesting puzzle that further initiates me to analyze the foreign exchange exposure literatures.

Since the abolishment of Baht pegged exchange rate regime, the exchange rate volatility has been being received the attention, especially in risk management framework. In order to fully develop the immunity for this type of risk, the understanding of how firms are affected by the exchange rate movement is a pre requisite; however, up to my knowledge, only a limited no. research that directly investigate the effect of the exchange rate to the value of Thai listed firm are available; hence this study generally aim to study the foreign exchange exposure of the listed firms in Thailand.

The economic exposure is provoked when firm's current and future cash flow are directly or indirectly affected by changes in exchange rate; hence even international inactive firms are still expose to exchange rate fluctuation by this definition. My analysis emphasizes on this economic exposure with the illustrating framework on how exchange rate can affect firm's value through the changes in the component of firm's earning. Changes in exchange rate could theoretically alter firm's future earnings, thus the present value of firm's cash flow, which is the value of the firm's under strong capital market efficiency, and from the review of literatures we found out that the MNC is expected to have less vulnerable to foreign exchange exposure than local firms due to its flexibility in sourcing and choosing the manufacturing location.

The theoretical concepts on foreign exchange exposure and the insulating capacity of the firms have been discussed in the chapter 2. The following paragraph provides the review of empirical literatures on the firm's foreign exchange rate exposure.

(Amihud 1994), Griffin and (Slutz 2000) and (Allayannis 1996), notably find low or negligible levels of exposure for most firms. (Amihud 1994) examines the largest US exporting firms, and he found that the hypothesis of exchange rate changes do not affect the value of exporting companies could not be rejected. (Pritamani D. Mahesh D. 2004) empirically explain the insignificant of exporting firm's exposure under the term of dual effect[6], and the importing firms' foreign exchange exposure is significant as expected under their purposed hypothesis of dual effect[7]. First we begin with the meaning of firm's foreign exchange exposure.

2.3.1. Firm's Foreign exchange exposure

In general, firm's foreign exchange exposure is frequently defined as the sensitivity of firm value to movement in exchange rate. The early study of firm's exchange rate exposure focus on the accounting perspective of how firm's consolidated financial statements can be affected by the exchange rate movement. Besides the exposure from accounting framework, (Shapiro 1997) firstly pointed out that the economic perspective of firm's foreign exchange exposure as follow.

$$V = R + \pi x - A_0 \tag{2-12}$$

Where $A_0 = \pi_0 x$ where x is net non-home currency assets and R is the present value of a given firm's future earnings, π is the exchange rate (home value of a unit foreign currency), and. π_0 is the initial exchange rate.

Firm's future earning (R) is affected by changes in π, that is:

$$R = R(\pi)$$

or

$$\mathrm{COV}(\mathrm{R}, \pi) \neq 0$$

Differentiate equation S3-1 with respect to π, then we obtain

$$\partial V/\partial\pi = \partial R/\partial \pi + x$$

---

6 For exporting firms, the adverse effects (Decline in firm's competitiveness) of a strengthening of home currency is expected to be partially offset by gains in the stronger domestic economy (Result in higher domestic sale) associated with the stronger of home currency.

7 For the importing firm, the dual effect would further enhance the expected sign since the appreciation of home currency would result in cheaper cost to import and higher domestic sale which is resulted from stronger domestic economy

As a result, the effect of exposure depends on the size of ∂R/∂ π and x. Different from the previous accounting definition of exposure; with this simple equation change in foreign exchange can also affect the firm's present value through its effect on firm's future earnings$(\partial R/\partial\pi)$. With this framework, not only the firms engaging in international activities, but also firms which are not involving in the international activities still expose to the exchange rate fluctuation. From economic perspective, it is essential to explore how firm's discounted future earning are affected by change in exchange rate. I have additionally reviewed three main theoretical models of firm's foreign exchange exposure with the emphasizes on how change in exchange rate could affect firm's structure of future cash flow (firm's profit and loss)

(Bodnar 2001) model: Similar to the above general framework by Shapiro, (Bodnar 2001) have purposed the following framework, where firm value is defined as.

$$V = \sum_{t=1}^{\infty} \frac{CF_t}{(1+\rho)^t} \tag{2-13}$$

Where ρ is the investor's required rate of return (discount rate) CF_t represents the expected cash flow of the firm. Hence the firm value (V) is the discounted sum of firm future cash flow and the authors define cash flow as after tax profit less net investment.

Assume that firm the net investment amount of the firm equals to 0 in every period, and more importantly constant after tax cash flow. Then the above equation could be written as

$$V = \frac{CF}{\rho}$$

Given with CF = (1- τ)EBT the the above eqution can rewritten as $V = \frac{(1-\tau)}{\rho} EBT$.

EBT is earning before tax, further assume τ and ρ are constant term, then differentiate the above equation with respect to exchange rate and then we obtain

$$\frac{dv}{d\pi} = [\frac{1-\tau}{\rho}] \frac{dEBT}{d\pi}$$

Where π represents exchange rate, the firm's value proportionally depend on the derivative of current earnings before tax with respect to exchange rate. From the above, firm's value could be affected by the change in exchange rate (dv/dπ) through the change in its EBT caused by change in exchange rate.

Change in firm earnings before taxes (EBT) can be initiated from change in firm's sale change in firm's cost of goods sold and change in firm's operating expenses, hence the scope on how change in exchange rate could potentially influence these component changes deserves an attention. Continue on(Bodnar 2001), and focusing on the earnings before taxes of firms which engage in both domestic and foreign distribution and production.

$$EBT = X[D(X)] + \pi X^*[D^*(X^*)] - C(X+X^*) - \pi C^*(X+X^*) + Z[F(Z)] + \pi Z^*[F^*(Z^*)] - K(Z+Z^*) - \pi K^*(Z+Z^*) \qquad (2\text{-}14)$$

Regroup equation S2-14

$$EBT = \underbrace{\{X[D(X)] + \pi X^*[D^*(X^*)] + Z[F(Z)] + \pi Z^*[F^*(Z^*)]\}}_{TR} - \underbrace{\{C(X+X^*) + \pi C^*(X+X^*) + K(Z+Z^*) + \pi K^*(Z+Z^*)\}}_{TC} \qquad (2\text{-}15)$$

Where π represents exchange rate and the other abbreviations are summarized in following table.

Variable/ Type	At home	Abroad
Sales of domestic goods	X	X^*
Sales of foreign-produced goods	Z	Z^*
	In home currency	In foreign currency
Cost function of domestic goods	C	C^*
Cost function of foreign produced goods	K	K^*
Firm's total revenue (TR)	$X[D(X)] + \pi X^*[D^*(X^*)] + Z[F(Z)] + \pi Z^*[F^*(Z^*)]$	
Firm's total cost (TC)	$C(X+X^*) + \pi C^*(X+X^*) + K(Z+Z^*) + \pi K^*(Z+Z^*)$	

Table2.3. Summary and explanation of abbreviation

D(X) and D(X*) are the quantity sold for goods X and goods X* respectively, while F(Z) and F*(Z) are the quantity sold for goods Z and Z* respectively.

The first term (TR) in the right hand side of equation 2-15 is to the total revenue in firm profit and loss statement, and TC term is the combination of cost of goods sold and operating expense in firm's profit and loss statement.

Differentiate the equation 2-30 with respect to exchange rate

$$\frac{dEBT}{d\pi} = \left(\frac{dEBT}{dx}\right)\left[\frac{dX}{d\pi}\right] + \left(\frac{dEBT}{dX^*}\right)\left[\frac{dX^*}{d\pi}\right] + \left(\frac{dEBT}{dZ}\right)\left[\frac{dZ}{d\pi}\right] + \left(\frac{dEBT}{dZ^*}\right)\left[\frac{dZ^*}{d\pi}\right] + \{[X^* D^*(X^*) - C^*(X+X^*)] + [Z^* F^*(Zs^*) - K^*(Z+Z^*)]\} \tag{2-16}$$

Earnings before taxes adjust to changes in the exchange rate through two channels, firstly all four types of outputs changes in response change in exchange rate (gray term). Secondly, earnings before taxes adjusts in response to the net revenue denominated in foreign currency, the term in {} of equation S2-16

Firms maximize the profit with respect to firm's output (X, X^*, Z, Z^*), then four first order conditions could be derived as follows

$$\frac{dEBT}{dX} = D(X) + X\,D_0(X) - C_0(X+X^*) - \pi C_0^*(X+X^*) = 0 \tag{2-17}$$
$$\frac{dEBT}{dX^*} = \pi D^*(X^*) + \pi X^*\,D_0^*(X^*) - C_0(X+X^*) - \pi C_0^*(X+X^*) = 0 \tag{2-18}$$
$$\frac{dEBT}{dZ} = F(Z) + Z\,F_0(Z) - K_0(Z+Z^*) - \pi K_0^*(Z+Z^*) = 0 \tag{2-19}$$
$$\frac{dEBT}{dZ^*} = \pi D^*(X^*) + \pi X^*\,D_0^*(X^*) - C_0(X+X^*) - \pi C_0^*(X+X^*) = 0 \tag{2-20}$$

Where the derivative of each function with respect to output is denoted by subscript 0, If output is selected optimally by firm as eq. (2-17 to 2-20), then the effect through the gray term in equation 2-16 disappear as its multiplicative term is zero as firm maximize their output, then equation S2-15 becomes

$$\frac{dEBT}{d\pi} = [X^* D^*(X^*) - C^*(X+X^*)] + [Z^* F^*(Z^*) - K^*(Z+Z^*)] \tag{2-21}$$

Now the exchange rate exposure of the firms is equal to the initial level of net profit denominated in foreign currency ,first term is the net profit from selling domestic goods abroad [X*] while the second term represent the net profit selling foreign goods abroad [Z*] .

The exposure elasticity (δ) of this model could be expressed as

$$\delta = \frac{dEBT}{d\pi}\frac{\pi}{EBT} \tag{2-22}$$

or

$$\delta = \pi\,\{[X^*D^*(X^*) - C^*(X+X^*)] + [Z^*F^*(Z^*) - K^*(Z+Z^*)]\} / EBT$$

Recall from table 1 in the previous page

$$\mathrm{TR} = X\,[D(X)] + \pi X^*[D^*(X^*)] + Z\,[F(Z)] + \pi Z^*\,[F^*(Z^*)]$$

$$\mathrm{TC} = C(X+X^*) + \pi C^*(X+X^*) + K(Z+Z^*) + \pi K^*(Z+Z^*)$$

Let define % of firm foreign currency denominated revenue as firm's total revenue, h_1 as

$$\{\pi[X^*[D^*(X^*)] + Z^* [F^*(Z^*)]\}/TR$$

Let define % of firm foreign currency denominated cost as a% of total cost, h_2 as

$$\{\pi[C^*(X+X^*)] + K^*(Z+Z^*)]\}/TC$$

Then the equation (2-22) could be simplified to.

$$\delta = h_1 \frac{TR}{EBT} - h_2 \frac{TC}{EBT}$$

Let the profit rate(r) = EBT/TR, then

$$\delta = \left(\frac{h_1}{r}\right) - h_2 \left(\frac{1}{r} - 1\right) \quad (2\text{-}23)$$

In term of factors determining the foreign exchange exposure, there are three determinants to foreign exchange exposure, the percentage of firm's revenue denominated in foreign currency (h_1), the percentage of firm's expense denominated in foreign currency (h_2), and the profit rate (r).

2.3.2. Volatility insulating capabilities of firms

Recall equation eq. (S2-12)

$$V = R + \pi x - A_0$$

Where $A_0 = \pi_0$ x where x is net non-home currency assets and R is the present value of a given firm's future earnings, π is the exchange rate (home value of a unit foreign currency), and. π_0 is the initial exchange rate

As shown in the previous sub section, differentiate the above equation with respect to exchange rate would yield the term $\partial R/\partial \pi$ and **x**. Not only how firm's earning is affected by exchange rate, which has been analyzed in the previous sub section, exists; and the second term [x].

Hedging and (Levi 1994) model:

Referred to the derived output from the model in the appendix section A, For Exporter

$$\frac{\pi_j}{V}\frac{\partial V}{\partial \pi_j} = \eta_j \frac{\pi_j q_j \left(p_j - \frac{c}{\pi_j}\right)(1-\tau)/\rho}{V} + \frac{\pi_j X_j}{V}$$

For Importer

$$\frac{\pi_j}{V}\frac{\partial V}{\partial \pi_j} = (1-\eta) q_j \left(p - \frac{c}{\pi_j}\right)\frac{(1-\tau)}{\rho} + \frac{\pi_j X_j}{V}$$

Where the left hand side of both equations represents the sensitivity of firm's value with respect to exchange rates, the variables in the first term in the right hand sides of both equations had been discussed in the previous section. I would elaborate the Xj (net monetary asset/liability position in currency j) and its role to the firm's exchange rate exposure in this section.

For the exporters who aim to eliminate the exposure in the earning section, and aim for non-foreign exchange rate exposure, he hereby set the left hand side of equation equals to 0, and then we obtain

$$X_j = -\eta_j q_j \left(p_j - \frac{c}{\pi_j}\right)\frac{(1-\tau)}{\rho} \tag{2-23}$$

Where X_j (net monetary asset/liability position in currency j), τ = Tax rate, ρ = Investor's risk adjusted required rate of return, π_j = exchange rate (home / unit of currency i), and c = marginal cost of production.

For the importers case, their X_j could be derived from setting the left hand side of equation to 0 and derived their decision in holding foreign asset and liabilities.

$$X_j = (1-\eta_j) q_j \left(\frac{p}{\pi_j} - c_j\right)\frac{(1-\tau)}{\rho} \tag{2-24}$$

To fully secure from the fluctuation of exchange rate, exporting firms must set the x_j with negative value which implies that exporting firm must have a net liabilities foreign currency (currency j) denominated equals to firm's discounted after tax earnings. For the importing firms, they must set positive value of X_j, (Long position in currency j denominated asset) equal to the negative value of the first term[8] in equation S3-18 which is the importing firm's discounted after tax earnings[9].

Without doubt, if we compare the abilities to hedge against the volatility of exchange rate between MNC and domestic firm, we could conclude that foreign-invested *firm possess greater ability to hedge since they have their more diversified foreign asset/liabilities (either holding positive or negative X_j) in other nation (in this case nation j) then the domestic firm who would likely confine their holding of asset/liabilities in their home nation only.* To conclude, MNE is conceptually more protected than the domestic firm throughout their network of asset/liabilities in other nation.

To conclude, exporters can diminish or fully eliminate their foreign exchange exposure by holding the foreign currency denominated asset (negative X_j) while the importer can reduce or completely eliminate their foreign exchange exposure through their holding of foreign liabilities.

Hedging and {C.R., 1985 #84} model

$$VE = VCF_u + (1-\tau)VD + VF \tag{2-25}$$

The equity ownership value is the sum of the individual elements of value. The main element is the base case value VCF_u, and this value is adjusted to reflect the incremental values of outstanding foreign financing (VD) and forward foreign currency commitments (VF). With adjustment to equation 2-25 then we can derive.

$$VE = VCF_u - AVD + VF \tag{2-26}$$

To completely determine the firm effect of exchange rate on the firm value, value of equity, the adjustment for the value of debt (AVD) is deducted from the base case value which I had analyzed in the previous section (first term on the right hand side of the above equation), to fully gain the overall sensitivity of firm value to change in

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[8] When the demand is elastic ,then the elasticity term in equation S2-18 is greater than one, hence the cash flow term (first term) is minus

[9] Since the elasticity term in equation S2-18 is greater than one, hence the cash flow term (first term) is minus

exchange rate, there are two more component to be defined. In determining the value of equity (VE), the adjustment for the value of debt (AVD) is deducted from the VCFu, and AVD term could be defined as following

$$AVD = \sum_{t=1}^{T} \frac{[(1-\tau)i_t + D_t]E(\pi_t)}{(1+\rho_d)^t}$$

Where AVD: adjustment for the value of debt, τ is tax rate i_t: the tax deductible interest payment at time t, D_t is the principle repayment at time t, ρ_d is the pre tax base currency return commensurate with the risk of the flow to the bond holder, and π_t is the exchange rate

From literature review, we replace E (π_t) with $E[exp(\hat{\pi}\,.\,t)]$ in the above term and we can obtain

$$AVD = \sum_{t=1}^{T} \frac{[(1-\tau)i_t + D_t]\pi_o E[exp(\hat{\pi}\,.\,t)]}{(1+\rho_d)^t} \qquad (2\text{-}27)$$

To Study the impact of exchange rate toward this AVD we differentiate equation S2-27 with respect to exchange rate (π_o). Then

$$\frac{dAVD}{d\pi_o} = \sum_{t=1}^{T} \frac{[(1-\tau)i_t + D_t]E[exp(\hat{\pi}\,.\,t)]}{(1+\rho_d)^t} \qquad (2\text{-}28)$$

Beside the assumed constant parameter τ (tax), ρ_d and change in exchange rate variable $\hat{\pi}$, the internal factor which could determine the firm's foreign exchange exposure through the AVD term, firm could internally influence their level of exposure through their manipulation of their principle repayment at time t (D_t).

The operational hedging is the use of firm's net position in firm's asset or liabilities to hedge against the effect of the exchange rate on firm's earnings (VCF_u) term. If firm wish to use operational hedging as the sole instrument for hedging firm can set their principle repayment (D_t) in equation 2-28 to match with the firm' cash flow exposure in equation S2-26 so that the AVD term in equation(2-27) cancel the effect of exchange rate on the VCF_u, first term of equation (2-26).

The last term of equation (S2-26) is VF, and I refer to expression in {C.R., 1985 #84} model

$$VF = \sum_{t=1}^{T} \frac{G_t[\bar{F}_t - F_t]}{(1+\rho_h)^t} \tag{2-29}$$

Further describe VF: the value of outstanding forward foreign exchange contracts, $\bar{F}_t$: the contractual forward rate on an existing commitment for settlement at time t, F_t is the current market rate for forward exchange for delivery at time t, and G_t the contractual forward rate on an existing commitment for settlement at time t.

Where F_t is defined as[10]

$$F_t = \pi_o exp(p_f.t)E[exp(\hat{\pi}.t)]$$

Then equation 2-29 become

$$VF = \sum_{t=1}^{T} \frac{G_t\left[\bar{F}_{k,t} - \pi_o exp(p_f.t)E[exp(\hat{\pi}.t)]\right]}{(1+\rho_h)^t} \tag{2-30}$$

Take the first derivative of the above equation with respect to exchange rate give

$$\frac{dVF}{ds_0} = -\sum_{t=1}^{T} \frac{G_t\bar{F}_t/s_0}{(1+\rho_h)^t} \tag{2-31}$$

From the above equation, firm can internally set the level of forward commitment (G_t). Firm can set their own G_t to match the unlevered cash flow from the first term of the right hand side of equation 2-26 (VCF_u). Securing firms unlevered firm's cash flow with the forward commitment is considered as firm's financial hedging strategies.

Completing the {C.R., 1985 #84}model

Recall equation 2-26

$$VE = VCF_u - AVD + VF \tag{2-32}$$

Replace VCF_u AVD, and the term VF by the above derived regression.

[10] To keep the appropriate length of my analysis and scope on the operating exposure of the firms , for more information on this term please refer to the original paper Heckman (1985)

$$VE = \sum_{t=1}^{T} \frac{\alpha_k.\beta.p_t^{\eta} E[\exp \hat{\pi} \,.(1-\eta).t]\pi_0^{(1-\eta)}}{(1+\rho_0)^t} - \sum_{t=1}^{T} \frac{[(1-\tau)i_t + D_t]\pi_o E[exp(\hat{\pi}\,.t)]}{(1+\rho_d)^t} + \sum_{t=1}^{T} \frac{G_t\left[\bar{F}_{k,t} - \pi_o exp\left(p_f.t\right)E[exp(\hat{\pi}\,.t)]\right]}{(1+\rho_h)^t}$$

To find the impact of exchange rate on the firm value, we differentiate the above equation with respect to exchange rate π_o and then we get the following result

$$\frac{dVE}{d\pi_o} = (1-\eta)\sum_{t=1}^{T} \frac{\alpha_k.\beta.p_t^{\eta} E[\exp \hat{\pi}\,.(1-\eta).t]\pi_0^{(1-\eta)-1}}{(1+\rho_0)^t} - \sum_{t=1}^{T} \frac{[(1-\tau)i_t + D_t]E[exp(\hat{\pi}\,.t)]}{(1+\rho_d)^t} + \sum_{t=1}^{T} \frac{G_t[F_t]/\pi_o}{(1+\rho_h)^t}$$

With some manipulation of the above equation we can write the above term in term of elasticity.

$$\frac{dVE}{d\pi_o}.\frac{\pi_o}{VE} = (1-\eta)\frac{VCF_u}{VE} - \frac{AVD}{VE} - \frac{\sum_{t=1}^{T} \frac{G_t[F_t]}{(1+\rho_h)^t}}{VE} \qquad (2\text{-}33)$$

Assuming perfect capital markets, a Cobb Douglas production function with constant production parameters and constant returns, there are three components of corporate value, which are the share of after tax cash flow to total equity value [11](VCF_u/VE), the adjustment share of outstanding debt value to total equity value (AVD/VE) and the share of firm's forward commitment to total equity value (last term).

Alternative 1: Operational hedge: The operational hedging is the use of firm's net position in firm's asset or liabilities to hedge against the effect of the exchange rate on firm's earnings (VCF_u) term. If firm wish to use operational hedging as the sole instrument for hedging firm can set their principle repayment (D_t) to match with the firm' cash flow exposure; so, that the AVD term in equation cancel the effect of exchange rate on the VCF_u, first term of equation.

Alternative 2: Financial hedging: From the equation 2-33, firm can internally set the level of forward commitment (G_t). Firm can set their own G_t to match the unlevered

[11] After tax non financial operating cash flows

cash flow from the term of (VCF_u). Securing firms unlevered firm's cash flow with the forward commitment is considered as firm's financial hedging strategies.

From the {C.R., 1985 #84} framework, *we can conclude that foreign-invested firms are better equipped than the domestic firm through their abilities to set the D_t (principle repayment) of equation S2-33 to fully or partially eliminate the exposure of VCF_u term through their multinational operation network (ex… they might intentionally require their subsidies in other nation to borrow in host nation). Through the second alternative, the financial hedging, both MNCs and domestic firm could engage in derivative transaction to immune themselves against their risk; however according to the empirical work by (Pantzalis 2001), who found that MNE commit to forward/option or other types of derivative than the domestic firms, then we can conclude that the immune system of MNE is better than the abilities to hedge against foreign exchange exposure of domestic firm.*

Hedging and (Bodnar 2001)

Recall equation

$$\delta = \left(\frac{h_1}{r}\right) - h_2\left(\frac{1}{r} - 1\right)$$

From the above equation (2-23), firm could manipulate the foreign exchange exposure through the adjustment of h_2 in complying with$\left(\frac{h_1}{r}\right)$; for example given with the value of h1 and r as 0.5, and 0.1 then to cancel the value of first term (5), then firm should set their foreign currency denominated cost (h2) as 55.56% of their total cost.

A: Pure exporting domestic firm: if we holding the profit rate constant, for the domestic firm without importation, their h_2 is inevitably zero then equation s3-8 for pure exporting domestic firm would be left with the first term (h_1/r).

B: Pure exporting MNE: even though their importation is set as zero as the pure exporting domestic firm case, but they still have the foreign operation hence h_2 is not zero as the previous case. MNE still have flexibilities in setting their foreign currency denominated cost portion although they are pure exporter in which pure exporting domestic firm could not implement.

C: Pure importing domestic firm: holding the profit rate constant, h_1 is inevitably set as zero then the equation s2-23 would be reduced to the second term, then importing domestic firm's exposure would be influenced by exchange rate through its foreign currency denominated cost portion.

D: Pure importing MNE: these type of firm might import intermediate from their subsidiaries for further production in home, or import the final goods for the distribution in home market without exporting to the third country. If we hold the profit rate constant, they still have the flexibilities to adjust their foreign currency denominated revenue portion (h_1) to be positive through their foreign subsidiaries sale. Then they could appropriately set this portion to match with their [h_2 [(1/r)-1]] term, this inherent absorption abilities could not be found in the case of pure importing domestic firms

Comparing between scenario A and scenario B, and further compare scenario C with D we can conclude that even in the extreme case of pure exporting or pure importing firm. Foreign invested firms could still have their flexibilities in adjusting their revenue and cost structure to match with their foreign exchange exposure.

Mathematically, MNC has greater flexibility in selecting the input source C, C*, K, and K* to raise the expected future cash flow and optimally manage foreign exposure. As commented in Carter, Pantzalis and Simkins (2003), MNC has "switching options" to select their sourcing/production decision either from home/foreign or among their choice of foreign locations.

From the analysis of (Bodnar 2001), (Carter 2001) also stated that firm with operations spread over many currency and business area are more insulated from foreign exchange exposure because they have greater alternatives to devise the operational hedging.

To conclude this section, all of the conceptual framework model has synergized and conclude that MNE could absorb the volatility of foreign exchange rate better than domestic firms through their used of cross boarder operation network (operation hedging) beside the use of financial derivative; hence the existence of MNE or their incoming would automatically reduce the average burden of firm's foreign exchange exposure in the FDI recipient nations. In the chapter number 6, the discussion of empirical studies on firm's foreign exchange exposure is intergrated in the introduction of the chapter.

2.4. Spillovers effects from the presence of MNCs

The previous section revealed that productivity of foreign-invested plants is likely to outperform the local operated plants' productivity. This section theoretically discusses the effects from the presence of foreign-invested plants toward the productivity of local plants. First, we discuss spillovers channel from MNCs to local firms in the same sector/industry, the intra industry spillover; then, the vertical spillover.

2.4.1. Intra industry spillover [Spillovers from MNCs within the same industry]

<u>Through Demonstration (Imitation) effect:</u> First, domestic firms can learn from foreign competitors' product and service, process, and technology through imitation; for example, reverse engineering process (Bloomstrom M 1992) of proprietary knowledge used in the product, and technology which are introduced to the local market by foreign-invested firms.

<u>*Through competition*</u>*:* the presence of foreign invested firms would pressurize the domestic firms to improve their existing offers, process, and technology. With other factors constant, this pressurized force would indirectly lead to the increase in their productivities (Glass 2002)

<u>*Through export spillover*</u>*:* domestic firms can learn the related export information (ex… foreign markets, exporting procedures, and choice of transportation) from multinationals firms, who already have the established information on these exporting related issues, this learning could potentially benefit the indigenous firms (Aitken 1997). Since the investigation of export performance between foreign-

invested and local operated plant is relatively unique, the analysis of export performance differential and spillover are illustrated in chapter 5.

Through the worker mobility: domestic firms could be benefited from the knowledge-invested employees who have moved from foreign-invested firms, with intra-firm learning process, not only firm can learn the new technology, process and proprietary knowledge from those set of workers, but also the existing workers could formally and informally learn these knowledge body from these group of workers who have previously hired by foreign invested firms and eventually the productivities of these domestic firms would improve.

To fully understand the spillover effect, all of the above 4 channels should be analyzed[12]. Spillover through the worker mobility which has been perceived as the most important transmittal channel (Haacker 1999). From our perspectives, the spillover through the imitation or other type of demonstration effect, would be less prominent with current intellectual property right, and to prevent their competitive advantage, those foreign-invested firms disclose their proprietary knowledge.

2.4.1.1. Spillover through Worker mobility channel

I analyze the model purposed by (Fosfuri A. 2001). In which the pre-requisite for utilizing the proprietary knowledge in foreign subsidies is the training of local workers. The model has the general outlines as following;

Foreign-invested firms firstly train the local worker and then both MNCs and local firms compete for the service of the trained worker. Positive externalities to the local firms generated when the trained worker is hired by the local firm. The model is based on game theory. To comply with the u_t term, *we denote that all the type proprietary knowledge which held by the foreign invested firms (FIF) as technology,* and with the competitive advantage of MNC suggested by multinational corporation theory we can denote that technology has been accumulated prior to the game by foreign invested firms, and it is exogenously given.   Only after the local firm (L) had

[12] Export spillover is discussed in the section 2.5.

completely learned the technology, then they can sell their products and service. Model is set as following.

At t_0: The MNE has two choices to penetrate the local market exporting and foreign direct investment. Through exporting choice, firms would train no local workers, while the direct investment choice would cause *the foreign-invested firms' fix investment cost (G),* for domestic firms, this cost is not incurred. Cost of training (F) in the multinational corporation is assumed to be 0. The trained workers are hired from a pool of identical untrained workers and he/she is paid with (w) which is normalized to zero and with the training, this worker has all necessary expertise technology and information to produce the goods.

At t_1: The only type of firm who can produce the goods is foreign invested firm, since the local firms has no access to this technology. Hence they enjoy the monopoly profit of π_M.

Through the exporting choice, foreign-invested firms enjoy the profit of

$$N_1 \pi_M^E(t)$$

If foreign-invested firm directly invest in the host country, they would enjoy the profit of $N_1 \pi_M$

Where N_1 is the size of market at period 1, and it is normalized to one, τ is an related exporting cost (tariff, transportation cost or wage differential) they further normalize N1 to one and the authors assume $\pi_M > \pi_M^E(\tau)$ which implies the monopoly profit from direct investment option is more than the monopoly profit from the exporting option.

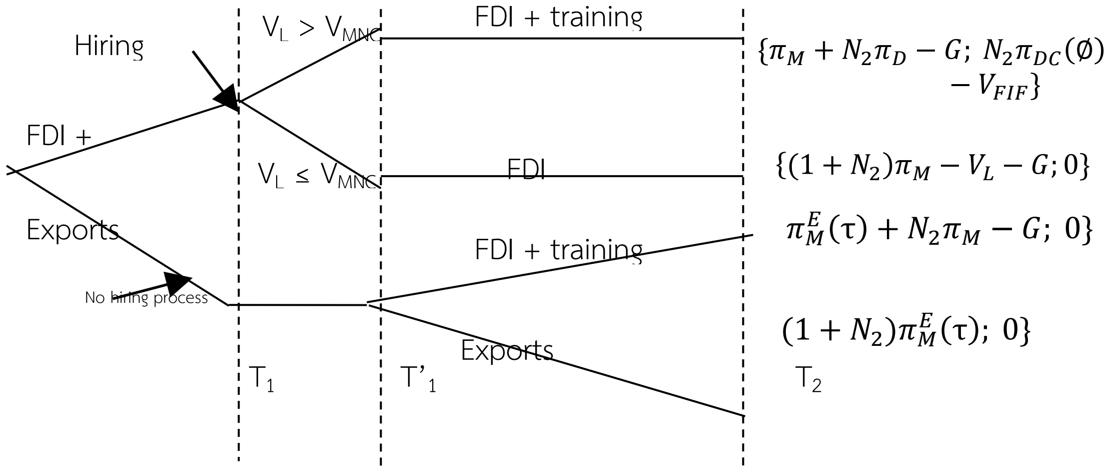

Figure2.5. Game tree /Source (Fosfuri A. 2001)

Where N_2 is the second period market size, the parameter $\emptyset$ ε [0,1] is an inverse measure of degree of competition in the industry and authors further assume that $\pi_D[\emptyset]$ is differentiable and strictly increasing in $\emptyset$ with $\pi_D[0]$=0 and $\pi_D[1]$= π_M. Authors assume when the market is monopoly, then $\emptyset = 0$ while with competitive market structure, then$\emptyset = 1$. For a local firm to adapt the new technology from the trained workers, fixed cost k, which is k ≥ 0, is incurred. The model take $\emptyset$ and k as exogenous factors.

Foreign-invested firms would enjoy the monopoly profit $[\pi_M]$ if they can retain their trained workers, while they earn dominant profit in the dominant competitive fringe structure if they lose their trained workers[13]. To compete for the trained worker both foreign-invested firms and local firm must evaluate the value of trained workers.

Local firm valuation of the trained worker: V_L= $N_2\pi_{Cf}(\emptyset) - k$,

Foreign-invested firms valuation of trained worker: V_{FIF} = $N_2[\pi_M - \pi_{Df}(\emptyset)]$

Case 1: if VFIF ≥ VL, foreign-invested firms keeps the trained worker by paying him/her with wage equals to the local firm value of trained worker

$$W = N_2\pi_{Cf}(\emptyset) - k \qquad (2\text{-}34)$$

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[13] Originally the model use the duopoly setting, I had changed the industry setting to dominant firms competitive fringe firms industry structure in order to comply with the setting in the model, this adjustment would not change the significant feature in the analysis and the result.

In this case, foreign-invested firms pay the local worker more than the average wage in the pool of labor market, then the labor market enjoy the pecuniary spillover, in which the average wage of the workers in the pool of labor increased. However this paper would not mainly focus on this type of spillover, my paper is aimed to study the impact of foreign invested firms to local firm not the wage structure.

Case 2: if $V_L > V_{FIF}$, local firm value can extract the trained workers to work with them through paying him/her with wage equals to

$$W = N_2[\pi_M - \pi_{Df}(\emptyset)] \tag{2-35}$$

In this case the technology spillover from foreign-invested firms to local firms exists, which could be further explained as following

Spillover never arise if

$$V_{FIF} \geq V_L$$

Substitute the above inequality with (2.12) and (2.13).

$$N_2[\pi_M - \pi_{Df}(\emptyset)] \geq N_2\pi_{Cf}(\emptyset) - k$$

Or

$$N_2\pi_M - N_2\pi_{Df}(\emptyset) - N_2\pi_{Cf}(\emptyset) + \mathrm{k} \geq 0$$

Rearrange

$$N_2[\pi_M - \pi_{Df}(\emptyset) - N_2\pi_{Cf}(\emptyset)] + \mathrm{k} \geq 0 \tag{2-36}$$

To ensure the above inequality

$$\pi_M \geq [\pi_{Df}(\emptyset) + N_2\pi_{Cf}(\emptyset)] \tag{2-37}$$

In which the foreign-invested firms retain all of their trained workers, then there is no technological spillover from foreign invested firms to domestic firm. Equation 2-36 implies that the gross profit of a monopolist is larger than the sum of the gross profit of dominant and competitive fringe firms, and the above condition would hold if the dominant firms and competitive fringe firms are fiercely competing, which would facilitate the MNCs corporation to retain their worker, then there is no technological spillover under this circumstance. Adding with the following condition, foreign-invested firms would undertake the direct foreign investment instead of exporting choice.

$$\pi_M - \pi_M^E(t) \geq \; N_2[\pi_M - \pi_{Df}(\emptyset)] \tag{2-16}$$

If the above condition and the equation S2-37 do not hold, both setting would guarantee that foreign invested firms would directly invest in the host country and the technology would spillover from MNCs to the domestic firms in the stage 2. However if the above condition is replaced with the following condition

$$\pi_M - \pi_M^E(t) \geq N_2\pi_{Cf}(\emptyset) - k$$

Then, foreign-invested firm choose the direct investment choice to penetrate the market; but, there is no technology spillover since the trained workers are retained in multinational corporations with the wage of $N_2\pi_{Cf}(\emptyset) - k$ paid to the trained worker by the MNCs. To have a spillover, MNC must undertake FDI penetration mode in the first stage and trained workers must be released from their company through higher offered wage by local firm, this condition is likely to occur when the MNC perceive that the competition in the host nation is not fierce and cost of adopting the technology is low to moderate, as explained by the following figure. The spillover would occur when market competition is low [$\emptyset$ is high] and the cost of adapting the technology is low (technology is easily transferable). Low K and Low $\emptyset$: which imply that competition is high but technology is easily transferable. Strong competition implies that the local firm gets low profit from hiring the trained worker even though the technology is easily transferable. Hence it is relatively low cost for the MNE to retain the trained workers. With fix K, as $\emptyset$ is increasing which implies that competition is weaken, the bid from the local firm to recruit the trained workers increase; hence there is a higher probability of technological spillover.

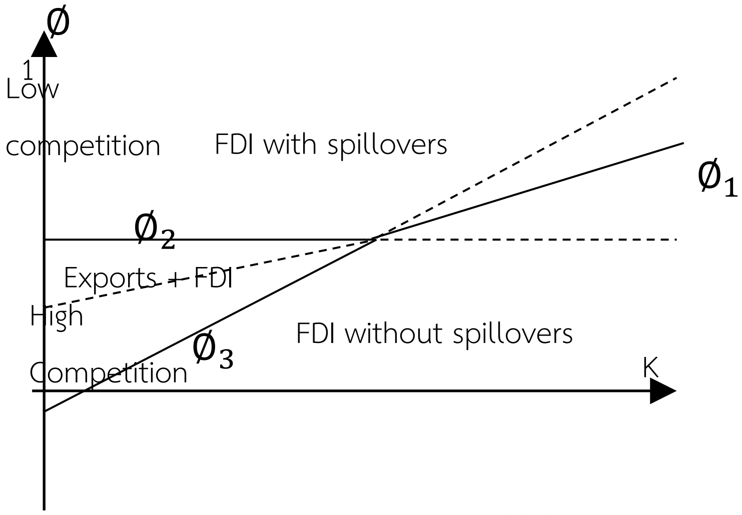

Figure2.6. Spillover, Export and FDI Source: (Fosfuri A. 2001)

If $\emptyset$ ε $[\emptyset_1 \emptyset_3] \cap [\emptyset_1 \emptyset_2]$ which implies competition is still sufficiently high, so that MNE would export in the first period than following by direct foreign investment to avoid the diffusion of their proprietary knowledge. Then there is no worker mobility under this region.

If $\emptyset$ further rise to laid above$\emptyset_2$, and then the following conclusion could be derived. Competition in the product market is relatively weak which lead to the insignificant drops of foreign invested firm's profit even though the local firms have acquired the trained workers because the MNCs as the dominants firms still strongly dominate the market. Thus multinational corporations would pursue their investment in the first stage although they had anticipated that they will lose those trained worker at the period 2. For parameter k, transferability of the technology, with a given level of competition if the technology is easily transferable (low k) then the value of the trained worker through the local firm's perspective would decline, and then their bid would declines which will facilitate the foreign-invested firms to retain their workers.

To close this sub section, the implied statements from the analysis of the above model, which focus on the labor mobility as the only technological spillover channel, are *the higher level of competition between the foreign-invested firms, the lower mobility of labor thus the lower technological spillover.* In addition, if the transferability of the technology is made easier, the higher level of worker mobility, and thus the more spillover from foreign-invested firms.

2.4.1.2. Demonstration Effects

The simplified key issue in this channel is “learning by watching”, local firm could directly learn the knowledge employed by MNE during their presence in the local market/production through imitation of technology, production techniques, managerial know-how and other firm-specific advantage which currently belong to foreign-invested firms.

We partially use the theoretical model by (Bloomstrom M 1992) to show that how direct technology transfer from foreign invested firm to local firm would be initiated. The model would show that foreign invested firm would be benefited from transferring the technology to local firm which implies the demonstration of the technology.

We scope our analysis on part of the model which discusses the technology transfer process; we can also assume that the technology is expected to be heavily in the form of “MNCs to their Local partner (Joint venture) or to local firms”, which coincide with the scope of my current study. The model is shown in the appendix section; the model could be summarized as following

For domestic firm their investment in learning is subjected to the amount of technology transferred by foreign firms, domestic firm’s discount rate, and domestic firm’s efficiency of an their investment in learning. In order to illustrate the amount of transferred technology, we refer to the figure purposed by (Bloomstrom M 1992), which show the interaction of investment in learning by domestic firms (or local partners of MNC) and the amount of technology transfer by foreign firm

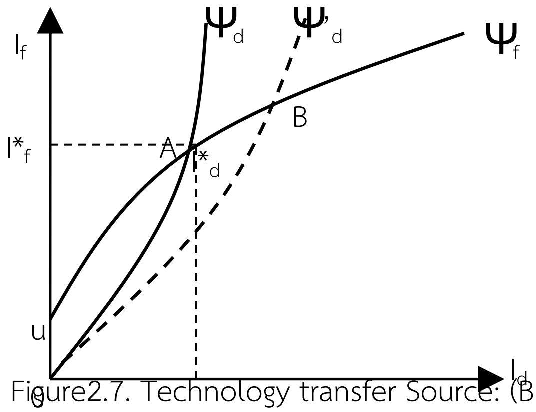

Figure2.7. Technology transfer Source: (Bloomstrom M 1992)

Point A depict the original Nash equilibrium in which foreign-invested firm transfer their technology at the magnitude of I^*_f and the investment of domestic firm in learning new technology I^*_d. This Nash equilibrium of the game is determined by the intersection of best reply mappings of the action by foreign firm and domestic firm[14]. We could see that the technology transfer is not exclusively depend on foreign firm, it also depend on domestic firm's investment effort in learning.

The following equation is employed as the baseline in (Bloomstrom M 1992),

$$\frac{|R'_d|\emptyset'(I_d)}{(\rho + I_f)}\left[\frac{I_f}{\emptyset(I_d)}\right]^2 = \theta C'_d(I_d) \qquad (2\text{-}40)$$

This equation simply state the marginal revenue of investment in learning by domestic firm should be equal to its marginal cost. Hence, the smaller cost of learning (lower θ), which mean that domestic firm achieve a better efficiency in their learning, which means that the marginal cost of learning is lower which in turn could shift the investment in learning function of domestic firm (Ψ_d) curve downward turning to Ψ'_d Then the new equilibrium would each point B, which has higher level of technology transferred (higher demonstration activities). Change in another factor which could perform this downward turning of Ψ_d is the domestic firm's discount rate, the lower discount rate of domestic firm could lead to larger amount of discounted future cash flow, and hence the more willingness that the domestic firm (or MNC's local partner) would devote their resources in learning activities. Therefore,

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[14]For detailed illustration, please refer to the Bloomstrom, M., and Wang, Y. (1992). "Foreign Direct Investment and technology transfer: A simple mode." European Economic Review **36**: 137-155.

the spillover effects through this channel are the interaction between the domestic' chosen investment in learning process and MNC's chosen level of investment in technology transfer.

2.4.1.3. Competition effects

The underlying logic of this positive perception on competition effect is the motivation for domestic firm to improve their competitiveness, especially their cost competitiveness, in order to cope with the new entrance of foreign invested firms or their presence. The original claim could be dated back to 1960 as appeared in Macdougall(1960) which comment that the presence of foreign-invested firm would force local firm to adopt more efficiency method to operate even they haven't adopt the new technology bought by MNC.

(Aitken 1999) found that domestic firms are significantly worst off in productivities by the presence of foreign-invested firms. Their empirical result also confirms their conceptual framework which they had initially purposed, and it is shown in the figure in the following page.

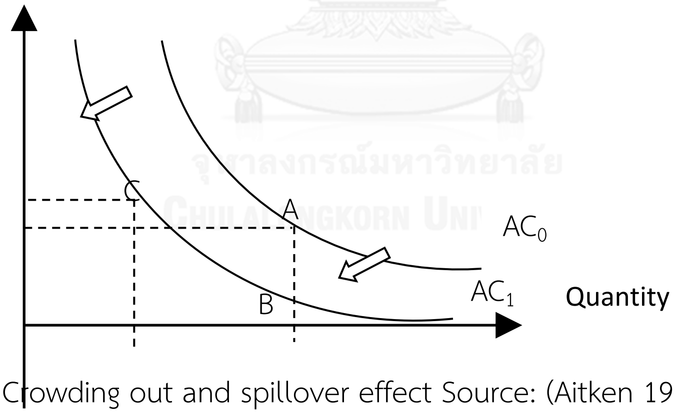

Figure2.8. Crowding out and spillover effect Source: (Aitken 1999)

The positive externalities due to the proprietary knowledge, technology spillover would shift the AC curve inward. Then the unit cost, with given quantity of output, would drop from point A to B. However, the presence of Foreign-invested firm does not only shift this AC curve inward but it also crowd out the demand for the product of this domestic firms. Although the externalities from the presence of FDI could shift the unit cost down from point A to B, but the presence of foreign-invested firm crowd out the demand for domestic firms to the point which is less efficiency to produce.

the presence of multinational firm could adversely reduce the demand of the domestic firm's product which is shown as "change D" in figure 2-8; however, their presence could also motivate the domestic firm to strive for a more efficiency of their existing production ability, which could partially (as one channel of spillover effect) lead to the shift of AC_0 to AC_1 line in figure 2-8.

Most of the theoretical models in spillover effect are designed to analyze the upward and downward spillover effect of FDI; however those theoretical frameworks also recognize the competition effect in the model. (Barrios 2004), (Markusen), show that there are two linkage effect of FDI to local firms; first they are linked through input-output network, and Darwinian rule, their presence would drive out inefficiency local firm(s). In the model purposed by (Barrios 2004) they postulate their numerical analysis on their derived system and they found the u curve relationship between the equilibrium no. of local firm and the no. foreign-invested firms.

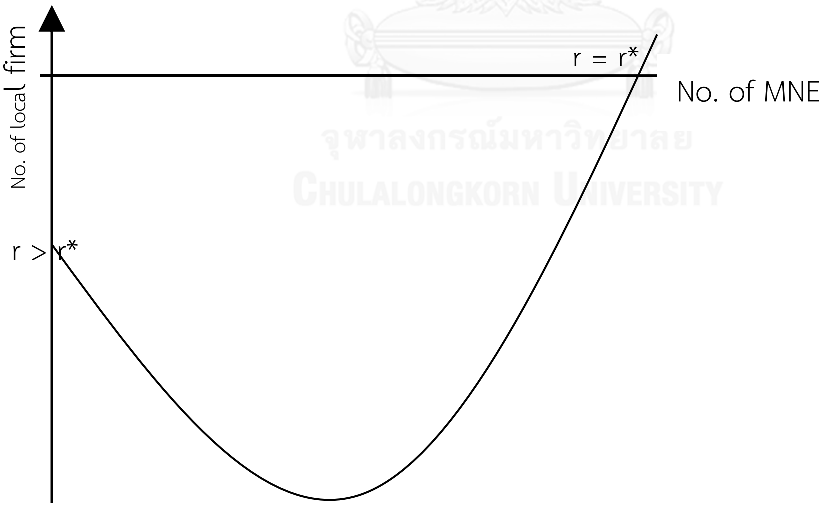

Figure2.9. Competition effect Source: (Barrios 2004)

In their model the entrance of foreign invested firm would end when the price of the product in host country (r) equals to the price of MNE home country (r*). At the initial state, the entrance of the foreign-invested firm would reduce the no. of local firm, this claim coincide with crowding out effect literature, which has been discussed as crowding out effect. however as the no. of MNE increase the no. of local firm also increase as the positive externalities to local firm is feasible, and their paper enlist both bright side of competition (motivation for local firm to compete and inter industry linkage) to mainly explain reincarnation of local firms in the above figure. Since this part focus on the competition effect, then the inter industry spillover would be discussed in the subsequent section. In their paper, they expect for a net positive externalities from foreign-invested firms to local firms since the equilibrium no. of local firm is higher than its initial figure.

The improvement of local firm's efficiency could be implemented in a variety ways. For the illustrating purpose, I reviewed and present some of those related works. As commented in (Greenaway 2004) (2, a stronger competition from the foreign new comer would pressurize the local firm to reduce X-inefficiency which would benefit the existing production and the adoption of new technology. As in (Bloomstrom M. 1999), the better cost conscious management, an effective motivation plan for worker are the example of reduction of local's X-inefficiency.

2.4.2. Inter industry spillover (Vertical spillovers)

Many of the theoretical and empirical work have been devoted to find whether the positive externalities from FDI to local firms in related industries are statistically notable. To FDI promoter, the critics on crowding out effect are not a vulnerable issue as in the case of intra industry spillover. We can further decompose the potential of spillover from foreign-invested firm to spillover to firm in upstream industry (spillover from MNC's presence in downstream industries), and spillover to local firm in downstream industry (spillover from MNC's presence in upstream industries).

2.4.2.A Spillover from downstream sector/industry

(Markusen) theoretically explain the impact of MNE toward the local supplier or firms in the upstream industry. There are four types of firm, and two industries, final goods industry and intermediate goods industry the main scope of the analysis would be targeted to later one.

In order to see the impact of FDI, we first assume that domestic market is free from multinational firms. The following figure could explain the interaction of domestic firms in final goods and its upstream sector.

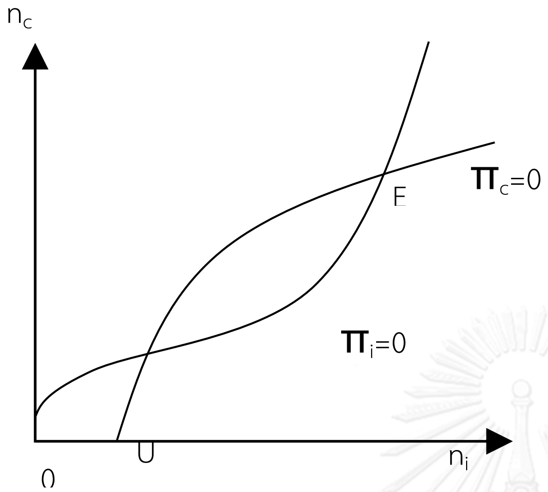

Figure2.10. Case 1 the absence of MNCs Source: (Markusen)

Vertical axe represents the no. of domestic firm in final goods industry, while horizontal axe is the no. of domestic firms in the intermediate goods industry. Both curves give the combination of both type of firms in zero profit condition in specific markets, the upper curve represents when there is not profit in final goods industry (π_c=0) while another curve show the zero profit condition in intermediate goods market.

To the right of the π_i=0 curve, firms in the industry would experience loss; hence some firm would exist the industry; however to the left of the line, there is a positive incentive for firm to penetrate this industry. There are three equilibriums in the above configuration.

At origin, there is no firm exists to produce intermediate goods, and all of the final goods are imported from foreign firms. At point U and E, there is a local production in both intermediate goods and final goods industry; however point U is not sustainable; an increase in the no. of firm in final goods or intermediate goods industry would deviate to point E. At point E, an increase in the no. of firms in final goods industry could induce a larger no. of firm to the right of π_i=0 which is a negative profit territory; some firm would exists and restore the no. of firm back to the point on π_i=0 curve, which is also the inefficient number of firms in final goods, the adjustment would continue until point E is restored.

The following figure mimics the interaction of the firm in final goods and intermediate industry as shown in previous figure with the adding of multinational firms to the model.

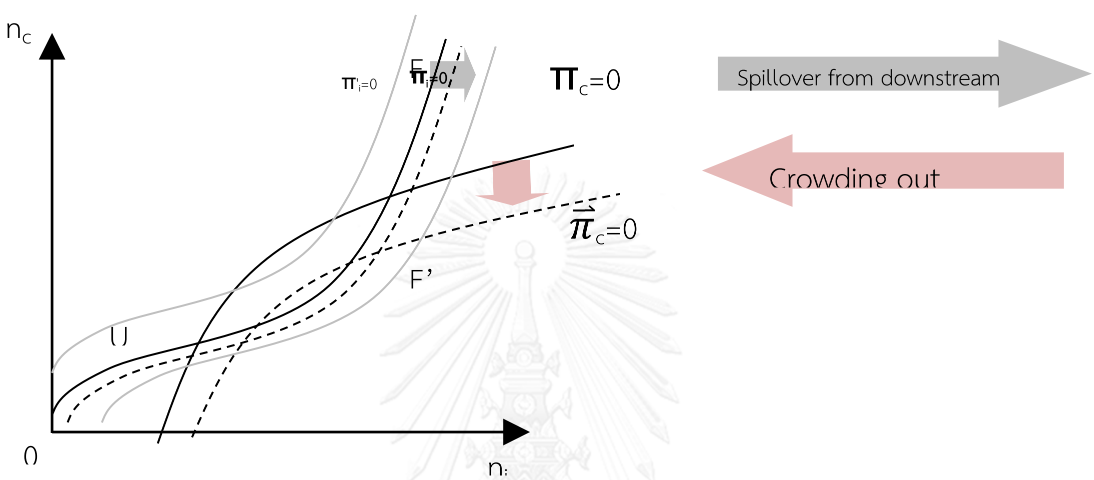

Figure2.11. Interaction of firm in final goods, industry with the presence of MNC

Source: (Markusen)

The presence of multinational firms, which is assumed to be exogenous, would firstly shift the π_c=0 curve to $\vec{\pi}_c$=0 as their presence crowd out the demand for domestic firm product which would drive the domestic firm out from final goods industry (crowding out effect). Then an exit of domestic firms would shift the π_i=0 inward to π'_i=0 as there is a less demand for intermediate goods due to decreasing no. of domestic firm in the final goods industry; however the presence of multinational firm also create demand for intermediate goods, this impact could be seen as π_i=0 shift outward to π''_i=0. The net effect of the multinational firms on local intermediate industry depends on the local material requirement of the MNE's production, and the above figure is drawn based on the assumption that the μ_m is greater than μ_c hence the presence of MNE in final goods industry could not lead to an increased in demand for intermediate goods due to an equal decreasing no. of demand for intermediate goods resulted from declining no. of final goods producing domestic firms.

Hence the new equilibrium would be shift to point E' with same no. of domestic intermediate goods producing firms (Backward linkage), and lower no. of domestic firm in final goods market due to competition (Crowding out effect).

However if the multinational firm use less intermediate from local supplier than the replaced local final goods producer, then the crowding out effect would outweighed any positive externalities generated from MNCs to firms in upstream industry. Then multinational firm would adversely affect domestic firm regardless of the local firm's industry. Point E'' in the following figure, next page, represents the condition that when multinational firms does not use local intermediate goods at all, when μ_m is zero, hence there is no backward linkage (spillover from MNC in downstream industries to local firms) externality in this scenario. This claim could reinforce the conclusion of crowding out effect.

However; if the existence of multinational firms displaces the imported product from foreign firms and μ_m is non-zero (MNE use local intermediate in their final goods production). In this case, pro FDI group can argue that although there is negative externality for the firm who directly compete with MNE; however their presence could also provide externality to the domestic firm(s) in the related upstream industry. Point E''' shows the situation when the entrance of multinational firms completely displaced foreign firms' imported product, and μ_m is non zero, and at this MNE's final product would completely replace the foreign firm's imported product as a result there is no crowding out effect; hence the presence of multinational firms would enhance the firm

in both industries through increasing demand for intermediate goods which further increase the no. of intermediate goods local suppliers, $\pi'_i=0$ then price of the intermediate goods decline which would increase the profit of the firm in the final goods industry which would further lead to an increase in the no. of firm in this final goods industry too.

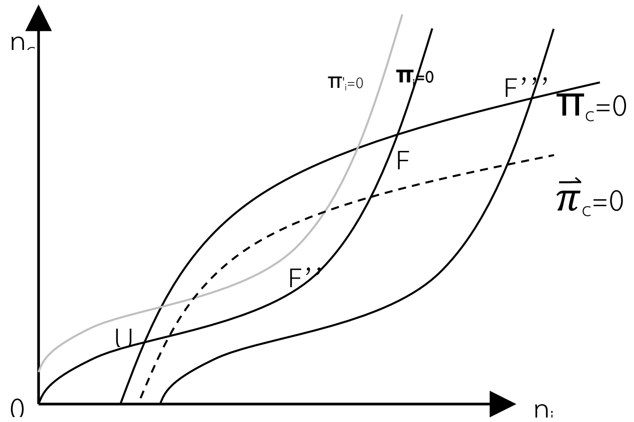

Figure2.12. 100% crowding out, and 100% backward linkage Source: (Markusen)

Even though the above analysis is done based on domestic market, the analyzed outcome is not significantly changed in the case of tradable final goods; for example, if final goods produced by domestic firm and MNE can be exported, and if the incoming MNE is export inducing company, then their presence would not significantly create crowding out effect (pink arrow) as shown in figure 2-11, and if MNE completely export their produced final goods then the entrance and presence of MNE could lead to an equilibrium point E''' as in the previous 100% replacement of foreign firm's imported product case since there is no crowding out effect in the final goods industry. In this circumstance, competition is arisen at integrated world market, but backward linkage arisen at national level, which leads to the development in intermediate industry, As commented in (Javorcik 2004); the increasing demand for the intermediate goods would lead the local supplier to reap the benefit of scale economies which further enhances firms (both local and multinational) in final goods industry through increasing profit as a result of cheaper intermediate goods.

Latter (Lin 2005)'s work enhanced the (Markusen) 's work through the recognition of exclusivity between MNE and its local suppliers. The model conclude that not only entrance of Multinational firms would crowd out the domestic firm in final goods industry, and eventually its demand for intermediate goods, it also could lower the no. of local intermediate suppliers who are willing to supply to local final goods producer due to the exclusiveness of the contract made to the local intermediate goods producers by the presence of MNEs.

Since MNE would be benefited from improved intermediate goods, (Javorcik 2004) stated that multinational have no incentive to prevent the knowledge spillover to upstream sector, hence (Javorcik 2004) perceive that this channel of spillover would likely to be empirical significant. Further supported by the latest empirical works, which employed panel data analysis, by (Blalock 2005), (Javorcik 2004) those empirical works support the positive externalities from MNE to local firm in the upstream industry. Later in his work Javocik found the determinant of backward spillover effect, the conclusion is similar to (Markusen)'s work in which local intermediate used in MNE production, and the status of MNE's product in relative to industry's export and import.

2.4.2.B Spillovers from Upstream industry

As stated earlier, majority of the empirical which scope their analysis on vertical industry spillover has reported the significant of upstream industry; however they found insignificant effect of the MNE to the local firm in the downstream industry.

(Ethier 1982) firstly pointed out that the presence of MNE would lead to a greater variety of inputs which could lead to an improvement of firms in downstream industries. The underlying benefit which MNE could offered for firm in downstream industry is the upgrade of intermediate input through their introduced technology, passive or even active assistant to domestic customers which could lead to a better usage of product.

Although (Blalock 2005), (Javorcik 2004) found a solid backward linkage; they could not found the validity of the forward linkage (downstream industry spillover) in the case of their Indonesian sampled firms. In Chili, (Ricardo 2007) had reported the significant of downstream spillover which they commented that the spillover flow as the value chain of product, from upstream to downstream and not the opposite direction.   Although survey paper by Javorcik in 2004 strongly agreed with the upstream industry spillover, he pointed out that spillover to downstream industries is likely to be feasible in the case of service sector due to its non-tradable characteristics of offered service which further require those foreign firm to improve and upgrade the existing distribution channels and facilities to distribute their service rather than exporting their manufactured to third markets.

In summary, the presence of MNE could theoretically benefit local firms at the horizontal basis through the 4 transmission; through worker mobility, through spillover in the export activities, through demonstration and competition effect. As the reader could observe in the next part of this section; considerable no. of empirical researches has concurred with the existing of intra-industry positive externalities from MNE, especially spillover through worker mobility channel. However, some of the economist (for example, Javorcik) does emphasized more on inter industry spillover effect since there is no discourage factors as crowding out effect, which is frequently attributed as the main cause of net negative impact of FDI to local firms. As previously shown, vertical spillover effect, especially spillover from MNCs reside in the downstream industries, tends to dominate.

To conclude this section, foreign invested plants are proofed to possess the advantage over the local plants in the original works initiated in the decade of 1970; in addition, the recent conceptual framework also revealed that foreign-invested firms are the group of firms which has highest productivity in relative to other types of firms. The theory of MNCs and the literatures on productivity differential further guide us to explore whether there is any mechanism in which the foreign plants' superiority can be transmitted to local operated plants. There are 3 channels of spillovers, the demonstration effects, the competition effects, and through the labor mobility. In addition to the productivity spillover, we also found numerous literatures dedicated to explain the linkage between the local plants' export performance and the foreign plants' presence. Evolved from this section, we discuss the main objectives and hypothesis of the dissertation.

2.5. Export spillover effects

The following section is presented with a simple theoretical framework by (Aitken 1997). The model has the setting as follow; firm can choose whether to serve only domestic market, foreign market through export, or both, they further assume that all multiple foreign markets could be united to one single entity, and there is difference in the production and distribution cost between foreign and domestic market.

Setting: For a representative firm, total cost is given by

$$h(q_l + q_f) + m_l(q_l) + m_f(q_f) \qquad (2\text{-}41)$$

Where subscript l represents domestic market, f represent foreign market, h(■) is the production cost function, m(■) is the distribution cost function. The authors separate these two types of cost in order to distinguish the associated cost like, advertisement, transportation cost and tariff, which are named as market specific cost. As audience can observe from the above expression there is market specific cost for exporting to foreign market m_f(qf), and they further assume that this exporting market specific cost are a decreasing function of the local concentration of export activity, or it can be expressed as following inequality[15].

$$\frac{\partial m_f(q_f)}{\partial TEX} \leq 0 \qquad (2\text{-}42)$$

$$\frac{\partial m_f(q_f)}{\partial FDIEX} \leq 0 \qquad (2\text{-}43)$$

Where TEX is the total exporting activity and FDIEX is the export activity by foreign controlled plants in the industry which local plant belongs to and the amount of export propensity of MNC is usually larger than local plant, (Ramstetter 2006).

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[15] In Uruguay; Kokko, A., Zejan, M., & Tansini, R., (2001). "Trade regimes and spillover effects of FDI: Evidence from Uruguay." Review of World economics **137**(1): 124-149. found that the entrance of the foreign plants to the industry could enhance the probability to export of domestic firms.

(Aitken 1997) further assume their production function form to follow simple production function.

$$h(q_l + q_f) = \frac{\alpha}{2}(q_l + q_f)^2 + g(q_l + q_f) \quad (2\text{-}44)$$

and distribution function as following

$$m_m(q_m) = \frac{b_i}{2}q_m^2 + c_m q_m \quad (2\text{-}45)$$

Where a, g, b_i, and c_m (m= d, f) are scalar parameters, g and c_i are further expressed as following

$$g = g(X)$$
$$c_l = c_l(X, Z_l)$$
$$c_f = c_f(X, Z_f, TEX, FDIEX)$$

Then representative firm maximize their profit as follow

$$\max_{q_d, q_f} P_l\, q_d + P_f q_f - h(q_l + q_f) - m_l(q_l) - m_f(q_f) \quad (2\text{-}46)$$

s.t. q_l, $q_f \geq 0$

q_f (exporting) quantity of the firm might be 0; however we assume that in order to for firm to exist they must either produce product in either market domestic or foreign market. To have a corner solution, latent variable q_f^* is introduced, and it is set as

$$q_f^* = q_f \quad \text{if } q_f > 0$$
$$q_f^* = 0 \quad 0/w \quad (2\text{-}47)$$

Then the first order condition of the firm's maximization problem is

$$q_l = \frac{1}{a + b_l}\{P_l - aq_f^* - g(X) - c_l(X, Z_l)\}$$
$$q_f^* = \frac{1}{a + b_f}\{P_l - aq_l - g(X) - c_f(X, Z_f, TEX, FDIEX)\}$$

For the estimation purpose the above equation could be re-written as

$$q_{lj} = \alpha_1 P_l + \alpha_2 q_{fj}^* + \alpha'_3 Z_{lj} + \alpha'_4 X_j + \epsilon_{di} \quad (2\text{-}48)$$
$$q_{fj}^* = \beta_1 P_f + \beta_2 q_{dj} + \beta'_3 Z_{fj} + \beta'_4 X_j + \beta_5 TEX_j + \beta_6 FDIEX_j + \epsilon_{fj} \quad (2\text{-}49)$$

Where Z_{lj} is vector of cost variables specific to local markets, while Z_{fj} is the vector of cost variables specific to foreign markets and Xj is the vector of cost variables which applied to both domestic and foreign markets. Since we focus on the externalities from foreign-invested firms to local plant's export quantity, we focus on the relationship between the term q_f^* and q_l in the above equations. The scope of the analysis is the investigation of relationship between export quantity of the local plant q_f^* and the export intensity of the foreign plant in the industry. If the first order condition of assumed in inequality eq. (0.3) is valid, and then the export volume of local plants should increase, if export intensity of foreign plants in the industry (FDIEXj) increase, as stated in equation2-49. Testing model is discussed in chapter 5.

Chapter 3
Comparing Productivity in Foreign-Invested and Local Plants in Thai Manufacturing

3.1. Background

As the vehicle of globalization, multinational corporations (MNCs) have played a vital role in this era; the authorities in many host nations have been participating in the fierce competitions to attract for Foreign Direct investment (FDI). With the perception that the presence of MNCs could eventually contribute to the host nations' economic development, a vast number of researches have been conducted to empirically test these aggregate impacts of FDI on host nations. However, a much less studied issue is the study of MNCs' externalities to local firms, which could potentially serve as the answer to the puzzle or at least a passage to solve the puzzle of whether those privileges provided to attract the FDI for the anticipation of spillover effects are empirically justified.

We perceive that the prerequisite for MNCs' externalities to local plants is a closer examination on whether the differential between foreign-controlled and local controlled units does statistically exist. As stated as first objectives in the section 1.2, the main research question for this chapter is *Do the foreign-controlled plants have higher productivity than local-operated plants?*

Previous studies in Thai manufacturing sector had focused their investigations on whether the differentials statistically exist but a relatively solid response to the question on in which industries the gap does statistically exist is still ambiguous. In addition, board of Investment (BOI) of Thailand has recently changed the eligibility for investment promotion from regional based criteria to industry based criteria. Hence the question of performance gap differential in each particular industry is increasingly important. The primary aim of this work is not only to investigate whether this gap is statistically valid in Thai manufacturing sector, but we also strive to verify in which industries (at ISIC 2 digit level), does the productivity differential significantly exists?.

With the 2007 NSO plant level data (NSO 2007), the Translog derived production functions are employed throughout the study in order to avoid the constant return to scale assumption posted on factor of production. In addition to the model with 2 factors of production, the models with three-type of labor[16] and the model with the control for industry effect are added throughout the analysis in order to control the potential influence from the non-physical skill intensity of the plant. The finding from this plant level analysis at each industry (ISIC 2 digits) could potentially shed the light on the competitiveness of Thai manufacturing plant in relative to their foreign counterpart.

Full reviews on theory of MNCs are illustrated in the section 2.2.; the following section briefly revisits those conceptual frameworks and discussion of the related previous empirical works.

The origin of the theory of MNC is derived from Hymer's original work (Hymer 1976), which fundamentally explain why MNCs invests abroad. At the center of his framework, there is a firm-specific advantages, which are specific asset possessed by a group of multinational corporations. This firm-specific asset could allow MNCs to overcome the incremental cost of doing business abroad, competitively compete with local plants in unfamiliar markets, unfamiliar supply chain networks and rules and regulations during their entrance or their presence in host nations. The possession of the firm-specific assets would give multinational plants with some market power or cost advantage in competing with local plant in the host countries.

To support this particular claim through the previous studies in Thai manufacturing industries; recent empirical works in Thailand revealed that most of the registered patents in Thailand were granted to foreign entity 90% during 2006-2008 while only 10% of registered patents were granted to local entities (Jongwanich 2010). A

[16] Skill blue collar worker, non-skill blue collar worker and white collar worker

hypothesis on the productivity differential between foreign-controlled and local-controlled units could be developed. As this kind of firm-specific assets, which mostly in form of intangible production, marketing knowhow and management practice as generally concluded by(Ramstetter 2006). This possession serves as a source which enables multinational plants to have a higher productivity than the domestic plants[17]. Among the first batch of empirical papers in this field, results from (Willmore 1986) had revealed that a group of foreign controlled firms generally has higher productivity than local operated firm. (Doms 1998) used various definition of productivity; their results generally reveal that the productivity of foreign plants is significantly greater than the productivity of locally owned plants in USA.

(Lui 2000) which had conducted the study in China, their results revealed that multinational status could significantly enhance labor's productivity of the firm; while, (Manikandan 2006) also used the simple T test to test for the difference between foreign and local firms in various industries. However, he found that the productivity differential is not statistically valid in most cases but the difference in firm's capital intensity does statistically prevail in many industries. An empirical Work by (Ito 2002) focuses on the plant productivity in Thai Automobile Industry and he found that foreign plant generally has higher labor productivity than local firm. This superiority is concluded as the result of a higher capital intensity of foreign firm in the automotive industry.

Through the use of Translog production function, (Ramstetter 2002) found greater number of industries with the reports of production technology differential than his estimation from Cobb-Douglas based production function.

However, most of the industries were still reported with insignificant differentials in industry average total factor productivity. Even more surprisingly, the author found

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[17] Latest theoretical framework which explains Multinational Corporation's behavior is the Heterogeneity model, the model generally concludes that to become multinational corporation, this group of firm must possess sufficiently high productivity, higher than productivity of domestically operated firm and exporting firm. The full review of the heterogeneity productivity model is illustrated in the previous section.

that in those industries with significant productivity gap, foreign plants were not necessarily illustrated with superiority in productivity. Similar results are also found in the case of Vietnamese manufacturing firms (Ramstetter 2008).

Unlike theoretical literatures in this field, the consensus among empirical works is still a distant destination; results differ across the region, time, and employed methodologies. This paper aims to investigate this puzzle with the latest firm level data, (NSO 2007), of Thai manufacturing firms. In connection with the main research question, firm specific advantage (FSA) framework, and the results from previous empirical side, **the hypothesis** is

1. Plants with foreign-controlled status have higher productivity than local-operated plants

As the reader can further observe in the next section, the slight adjustment of our methodologies can also allow us to test for another null **supplement hypothesis** of

2. There is no production technology differential between foreign-controlled and local-operated plants.

The second hypothesis is further set to test for the robustness of the result; the detailed discussion is explained in the appendix sectionB.1.1. The following section discusses the main testing models.

3.2. Methodology, Data and Measurements

Most of the empirical studies in this field have employed log linear Cobb-Douglas derived estimating regression as following

$$\ln \mathrm{Y}_i = \beta_0 + \beta_1 . ln[K_i] + \beta_2 . \ln[L_i] + \beta_3 . \ln[M_i] + \epsilon_i \qquad 3\text{-}1$$

As (Doms 1998) and (Bellak 2004) The regression eq. (3-1) is further added with the control variables to control for other plant's characteristic (X_{ki}). The key variable is plant's multinational status which is designed to test for the influence from foreign-control status of the plant.

$$\ln(\mathrm{Y})_i = \beta_0 + \beta_1 . ln[K_i] + \beta_2 . \ln[L_i] + +\beta_3 . \ln[M_i] + \beta_4 . MNCstatus_i + \sum_{k=1}^{n} \beta_k X_{ki} + \epsilon_i \qquad 3\text{-}2$$

Where Y is the output of the plant, K is capital, L is labor hour, and X_{ki} is the vector of control variables. Subscript i represent firm i. However; the Cobb Douglas production function assumed constant return to scale and perfect substitute of inputs. Inspired by the work (Ramstetter 2002)[18], The Translog production function, which has more flexibility to describe the relationship between firm's production and firm's factor of production, is employed instead. Hence, the Translog production is mainly employed. In addition, value added of the plant is employed as dependent variables instead of plant's output, then regression 3-1 and 3-2 become

$$\ln(\mathrm{V})_i = \beta_0 + \beta_1 . ln[K_i] + \beta_2 . ln[L_i] + \beta_3 . [ln[K_i]]^2 + \beta_4 . [ln[L_i]]^2 + \beta_5 . [ln[K_i] . ln[L_i]] + \sum_{k=1}^{n} \beta_k X_{ki} + \epsilon_i \tag{3-3}$$

With other plant's characteristics, the above Translog model could be rewritten as following

$$\ln(\mathrm{V})_i = \beta_0 + \beta_1 . ln[K_i] + \beta_2 . \ln[L_i] + \beta_3 . [\ln[K_i]]^2 + \beta_4 . [\ln[L_i]]^2 + \beta_5 . [ln[K_i] . \ln[L_i]] + \beta_6 . dMNC_i + \beta_7 . dSize_i + \beta_8 . dAge_i + \beta_9 . dBOI_i + \epsilon_i \tag{3-4}$$

K is the plants capital (please see table 3.3 for further detail) and L represents workers' total working hour. dMNC is the dummy on multinational status of the plant (0 if plant is locally controlled plants, 1 otherwise). To avoid potential multicollinearity problem, dSize, dAge and dBOI are the dummy variable on firm's size. In addition, the dBOI variable (whether the plant had received investment promotion privilege) is added as control variable. , ϵ_i is the residual of the regression.

We further classify the plant's labor to three types, the skilled blue collar worker, unskilled blue collar worker and the white collar worker in order to control the potential effect of non-physical skilled intensity toward the plant's productivity. Hence, the following model is adjusted from eq.3-4

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18 In fact, Ramstetter (2002) had found that the technology differential between foreign and local operated plants are more common when the constant return to scaleand perfect substitution of inputs assumption are less restricted.

In addition, this decomposition mainly relaxes the assumption of homogeneity across different types of labor, which could potentially result in the insignificant of the key variable.

$$\ln(\mathrm{V})_i = \beta_0 + \beta_1.ln[K_i] + \beta_2.\ln[SkillBlue_i] + \beta_3.\ln[NonSkillBlue_i] + \beta_4.\ln[White_i] + \beta_5.[\ln[K_i]]^2 + \beta_6.[\ln[SkillBlue_i]]^2 + \beta_7.[\ln[NonSkillBlue_i]]^2 + \beta_8.[\ln[White_i]]^2 + \beta_9.[ln[K_i].\ln[Skillblue_i]] + \beta_{10}.[ln[K_i].\ln[NonSkillblue_i]] + \beta_{11}.[ln[K_i].\ln[White_i]] + \beta_{12}.[ln[Skillblue_i].\ln[NonSkillblue_i]] + \beta_{13}.[ln[Skillblue_i].\ln[White_i]] + \beta_{14}.[ln[Nonskillblue_i].\ln[White_i]] + \beta_{15}.dMNC_i + \beta_{16}.dSize_i + \beta_{17}.dAge_i + \beta_{18}.dBOI_i + \epsilon_i \qquad \text{3-5}$$

Where $SkillBlue_i$ is the skilled operative labor hour, $NonSkillBlue_i$ is the non-skilled operative labor hour, while $White_i$ is the non-operative labor hour of the plant. The measurement of each variable is depicted in the table 3-3, data and measurement section.

To control for the industry selective bias, as foreign investment is naturally attached to the industry with high productivity which could lead to the endogeneity problem[19]. The vector of the industry dummy variables is added to equation 3-4 and 3-5; hence, we have the following new models.

For two factors of production model:

$$\ln(\mathrm{V})_i = \beta_0 + \beta_1.ln[K_i] + \beta_2.\ln[L_i] + \beta_3.[\ln[K_i]]^2 + \beta_4.[\ln[L_i]]^2 + \beta_5.[ln[K_i].\ln[L_i]] + \beta_6.dMNC_i + \beta_7.dSize_i + \beta_8.dAge_i + \beta_9.dBOI_i + \textstyle\sum_k^n \beta_k(ISIC_{iK}) + \epsilon_i \qquad \text{3-6}$$

And, four factors of production model:

$$\ln(\mathrm{V})_i = \beta_0 + \beta_1.ln[K_i] + \beta_2.\ln[SkillBlue_i] + \beta_3.\ln[NonSkillBlue_i] + \beta_4.\ln[White_i] + \beta_5.[\ln[K_i]]^2 + \beta_6.[\ln[SkillBlue_i]]^2 + \beta_7.[\ln[NonSkillBlue_i]]^2 + \beta_8.[\ln[White_i]]^2 + \beta_9.[ln[K_i].\ln[Skillblue_i]] + \beta_{10}.[ln[K_i].\ln[NonSkillblue_i]] + \beta_{11}.[ln[K_i].\ln[White_i]] + \beta_{12}.[ln[Skillblue_i].\ln[NonSkillblue_i]] + \beta_{13}.[ln[Skillblue_i].\ln[White_i]] + \beta_{14}.[ln[Nonskillblue_i].\ln[White_i]] + \beta_{15}.dMNC_i + \beta_{16}.dSize_i + \beta_{17}.dAge_i + \beta_{18}.dBOI_i + \textstyle\sum_k^n \beta_k(ISIC_{iK}) + \epsilon_i \qquad \text{3-7}$$

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[19] As Aitken and Harrison (1999), this problem of endogenity is less severe in the case of plant level data than sectoral level data. In addition, Ramstter (2006) had stated in his finding that this problem is relatively not severe in the case of Thai cross sectional data. For more discussion of the limitation posted by cross sectional data, please see the concluding section.

Where k is the number of industries in the categories, $ISIC_{iK}$ is the industry (ISIC 2 digit or ISIC 4 digit) in which plant i belong. The results from the regression 6 would be shown in parallel to the results of regression 3-4. For the model with four factor of production, the output of regression 3-5 would be illustrated in parallel to the regression 3-7's result.

With other variable being constant, the significance and positive value of multinational status's coefficients would implies that plants with multinational status ($DMNC_i$ recorded as 1) have additional adding term to the constants, which had been viewed as the average total factor productivity of manufacturing sector or studied industries (Ramstetter 2002), (Ramstetter 2005)[20].

The data from NSO 2007 industrial census (NSO 2007), which plant level data is available in the year 2009, are employed throughout this study. Industrial in the census is classified by ISIC code. There are 23 industries comprised of 457,968 plants of which 73,931 plant's information are in database. However there are large discrepancies between the report from NSO and statistical report from other organizations; for example, department of labor, as well as the problem of duplication of data due to the misperception by respondents; hence the removal of duplication is needed. If any two or more observations simultaneously have identical registered categories of industry, value of fixed asset, and gross sale, they would be treated as duplicated series, and they would be disregarded from the list. It should be stated again; in order to avoid disproportional in number of foreign and local plants. We scope my analysis to plants with the size (classified by number of labor) in categories 6 and above, which have total number of workers greater than 15, and the firm which has sales per labor above Baht 10,000, and fixed asset per labor above Baht 5,000 per year. We exclude Tobacco [ISIC 16], publishing and printing [ISIC 22], manufacture of oil and coal product [ISIC 23], other transport equipment [ISIC 35] and other manufacturing (ISIC 3699) and recycling [ISIC 37] industries from

[20] We are interested to investigate the effects of foreign controlled status on the average productivity of plants in the sector/ industries.

our analysis since there is limited number of foreign controlled plants which could lead to insufficient number of observation in the test.

The following table reveals the descriptive statistic of our scoped observations.

	Foreign plant	**Local plant**	**All plant**
No. of plant	1,516 13.68%	9,569 86.32%	11,085 100.00%
Output (million Baht)	1,274,262 43.22%	1,673,959 56.78%	2,948,222 100.00%
Value added (million Baht)	387,886 43.17%	510,719 56.83%	898,605 100.00%
Capital (million Baht)	515,412 42.99%	683,587 57.01%	1,198,999 100.00%
Total number of Labor (person)	601,357 33.56%	1,190,418 66.44%	1,791,775 100.00%
Operative Labor hour (in '000 hours)	1,634,642 34.43%	3,112,768 65.57%	4,747,410 100.00%
Non-Operative Labor hour (in '000 hours)	198,216 32.36%	414,281 67.64%	612,497 100.00%
Total labor hour (in '000 hours)	1,832,858 34.20%	3,527,049 65.80%	5,359,907 100.00%
Capital intensity per plant (in Baht/Labor)	857,081	574,241	669,168
% Diff between foreign plant and….	+(49.25%) from local, +(28.08%) from industry mean		
Output per labor per plant (in Baht/Labor)	2,118,978	1,406,195	1,645,420
% Diff between foreign plant and….	+(50.69%) from local, +(28.78%) from industry mean		
Plant's value added per labor (in Baht/Labor)	645,018	429,025	501,517
% Diff between foreign plant and….	+(50.35%) from local, +(28.61%) from industry mean		
Plant's value added to Capital(in Baht)	752,576	574,241	669,168
% Diff between foreign plant and….	+(31.06%) from local, +(12.46%) from industry mean		

Table3.1. Descriptive analysis of the studied observations,

Note: The figures in the first half of the table are presented in Total amount, while the figures in second half of the table are illustrated as weighted average amount.

Although the number of foreign controlled plant is account for only 13.68% of the total plants, their output, value added are accounted for about half of the manufacturing sector' s output and value added. Moreover, foreign plants also play significant role in the employment of both blue and white collar workers. The second half of the table illustrated the performance comparison between foreign and local plant. Through simple indicator of plants' productivity, the value added per labor of foreign-controlled plant is higher than their local counterpart by 50.68%. This brief descriptive comparison further encourages us to investigate whether these gaps still exists if we account for other variables which could influence the productivity of the plant in our regression analysis.

The following table further describes the number of observations in the studied industries. It is worth to restate again that manufacture of tobacco products (ISIC 16), Publishing, printing and reproduction of recorded media (ISIC 22), manufacture of coke, refined petroleum and nuclear fuel (ISIC 23) and manufacture of other transport equipment (ISIC 35) and Recycling industry (ISIC 37) are excluded from this study as we have insufficient number of foreign observations.

Manufacture of …..	ISIC	Number of Plant			Output		Employment	
		Foreign	Local	Total	Industry Total (Billion Baht)	Foreign share	Industr y Total (no. of worker)	Foreig n share
Food products & beverages	15	114	1,605	1,71 9	546.20	15.54%	319,812	18.53%
Textiles	17	84	770	854	158.78	25.39%	134,685	14.16%
Wearing apparel and Footwear	18-19	75	942	1017	142.88	20.42%	196,693	15.31%
Wood, wood products and Paper	20-21	59	846	905	157.44	29.24%	92,584	14.32%
Chemical & chemical products	24	119	648	767	205.28	43.62%	81,865	23.47%
Rubber & plastic products	25	194	968	1162	212.16	39.58%	153,179	36.05%
Non-Metallic products	26	52	686	738	98.66	18.46%	77,265	16.47%
Basic and Fabricated metal	27-28	196	1,305	1,50 1	263.55	36.18%	139,006	32.70%
General Machinery & equipments	29	125	482	607	181.86	66.73%	86,923	54.58%
Electronic and precious instruments	30-33	254	425	679	586.20	76.51%	291,486	71.43%
Motor vehicles & parts	34	105	238	343	278.45	60.33%	79,010	51.29%
Jewelry	3691	83	161	244	52.15	54.29%	53,789	54.04%
Furniture, Toys, Sport & musical instruments	3610 3692 -94	56	493	549	64.62	31.90%	85,478	25.46%

Table3.2. Descriptive statistic of the studied observations in each industry

Two-factor based estimation models require the homogeneous assumption on type of labor; while, the four-factor based models, which further decompose labor to three types. This three-factors model are more effective regression to control for the other factors which could influence the productivity differential of the plants besides the multinational status of the plants

Abbreviation	Measurement
$\ln(K_i)$	Log of plant's book value of physical capital[21]* % annual hour used
$\ln(L_i)$	Log of plant's total labor hour
$\ln(Skillblue_i)$	Log of plant's skilled Blue collar's labor hour
$\ln(NonSkillblue_i)$	Log of plant's non skilled Blue collar's labor hour working hour
$\ln(White_i)$	Log of plant's White collar labor hour
$dMNC_i$	1: if plant is foreign controlled plants (≥10%), 0: otherwise
$dSize_i$	1: if plant's sale is larger than industry average (4 digit), 0: otherwise
$dAge_i$	1: if plant's age is larger than industry average (4 digit), 0: otherwise
$dBOI_i$	1: if plant has received BOI promotion, 0: if not
$ISIC_i$	Industry dummy variable (ISIC 2 digits for the analysis at the sector level, ISIC 4 digits for the analysis at the industry level)

Table3.3. Variables and their measurements[22]

We discuss the results of the study in the following section, the results from all plant is firstly depicted and the results on each major industries are subsequently illustrated.

3.3. Results

3.3.1 All manufacturing plants

Through simple measurement of plants' labor and capital productivity illustrated in table 3.1 in page 65, foreign plants are generally exhibited with larger value in every indicator of plant productivities. For example, the foreign plants' value added per labor is larger than the local plant by 50% and 28.61% larger than sector average value added per labor.

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21 Book value of fixed asset (land value is excluded) at the beginning of the year multiplied with percentage ofl hour (annual) of working.

22 As in the final part of this chapter, we intend to verify whether the productivity gap between foreign and local sample have been expanded or reduced in comparison with the results from Ramstetter (2006) , the variables Ki, Li, $Skillblue_i$, $NonSkillblue_i$ and $white_i$ are measured as relative to ISIC 4 digit industry's mean value.

With proper controls of the difference in plant's factors of production, and other plant specific characteristics of the plant in the regression analysis, the table 3.4 reveals the results for plant in manufacturing sector. The results from the model with two-factor production model indicate that average plant with foreign controlled status significantly has higher average total factor productivity than locally controlled plant. In addition, this claim is still statistically valid even in the model in which we had controlled for the industry effect through the introduction of industry dummy variables (ISIC 2 digits). While, the model with four-factor of production does also reveal that the multinational status of plant could significantly influence the sector's average factor productivity and the magnitude is relatively the same as the previous model. In addition, the results from four-factor production function, we found that the scale of influence toward the value added of the plant from the skilled operative labor is greater than the influence from non-skilled operative labor or the impact from non-operative labor. For other plants' characteristic control dummy variables, relative size and age of the plant could also positively influence the average productivity of the plants, as well as, the plant's BOI status.

Interestingly, the powers of influences from plant's multinational status are averagely less offensive in the model with the control for industry effects. This disparity in results from the model with industry effect and the model without industry effect further encourage us to further conduct the investigation at each major 13 industries.

	Two factors models		Four factors models	
	Without industry dummy	With industry dummy	Without industry Dummy	With industry dummy
C	16.249		15.567	
	(0.00)		(0.00)	
ln(K)	0.210	0.222	0.241	0.241
	(0.00)	(0.00)	(0.00)	(0.00)
$(\ln(K))^2$	-0.017	-0.013	0.007	0.002
	(0.00)	(0.00)	(0.00)	(0.29)
ln(L)	0.576	0.603	-	-
	(0.00)	(0.00)	-	-
$(\ln(L))^2$	-0.003	-0.009	-	-
	(0.76)	(0.37)	-	-
(ln(K))*(ln(L))	0.002	-0.012	-	-
	(0.87)	(0.20)	-	-
ln(SkillBlue)	-	-	0.154	0.197
	-	-	(0.00)	(0.00)
ln(NonSkillBlue)	-	-	0.033	0.035
	-	-	(0.00)	(0.00)
ln(White)	-	-	0.075	0.087
	-	-	(0.00)	(0.00)
$(\ln(SkillBlue))^2$	-	-	0.013	0.017
	-	-	(0.00)	(0.00)
$(\ln(Nonskillblue))^2$	-	-	0.013	0.010
	-	-	(0.00)	(0.00)
$(\ln(White))^2$	-	-	0.007	0.010
	-	-	(0.00)	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.011	-0.009
	-	-	(0.00)	(0.00)
(ln(K))*(ln(NonSkillBlue))	-	-	-0.011	-0.008
	-	-	(0.00)	(0.00)
(ln(K))*(ln(White))	-	-	-0.019	-0.018
	-	-	(0.00)	(0.00)
(ln(SkillBlue))*	-	-	0.004	0.001
(ln(NonSkillBlue))	-	-	(0.00)	(0.59)
(ln(SkillBlue))*	-	-	-0.003	-0.003
(ln(White))	-	-	(0.00)	(0.00)
(ln(NonSkillBlue))*	-	-	-0.001	-0.001
(ln(White))	-	-	(0.01)	(0.02)
DMNC	**0.390**	**0.160**	**0.389**	**0.167**
	(0.00)	**(0.00)**	**(0.00)**	**(0.00)**
Size Dummy	0.933	0.953	1.187	1.158
	(0.00)	(0.00)	(0.00)	(0.00)
Age Dummy	0.122	0.100	0.133	0.104
	(0.00)	(0.00)	(0.00)	(0.00)
BOI Dummy	0.318	0.228	0.358	0.270
	(0.00)	(0.00)	(0.00)	(0.00)
Observation	11,085	11,085	11,085	11,085
R-Square	0.701	0.750	0.693	0.741

Table3.4. The result from regression (3-4) to (3-7), the number in parenthesis is the p value of the coefficient.

For detail on industry dummy variable's coefficients please see appendix section B.2.

To conclude, the results from operating regression eq. (3-4) to eq. (3-7) strongly suggest that whether the plant is foreign controlled status does statistically matter. Foreign controlled plants are illustrated with additional productivity add in which does not exist in the case of local plant.

Although the results from regression eq. (3-6) and eq. (3-7) have accounted for the industry differential two digit ISIC code, plants in different manufacturing type are still broadly classified in the same industry under ISIC 2 digits code; for instance, manufacture of cement (ISIC 2694) and manufacture of glass (ISIC 2610) are in ISIC 26 (non-metallic product). In addition, the study at each industry would further provide the guidance for the policy implication part; hence, the following section reveals the plant level study at each industry.

3.3.2. Plants in each Industry [ISIC 2 digits]

The results from the analysis at each industry are shown in ISIC descending order.

3.3.2.1. Manufacture of food products and beverage [ISIC 15]

From Table 3.4, we found that the multinational status of the plants the manufacture of food products and beverage are not significant in every model (both two and four factor models with and without industry control dummy variables). If we directly compare the production technology between foreign and local controlled sample as illustrated in appendix section B.2, we also found that the null hypothesis of identical production technology across these two types of plants could not be rejected in the two-factor production model as well.

Back to table 4, we also found that plant's relative size and plant BOI's status are also statistically significant at 0.05 level of significant. We also found that in the four-factor model, the magnitude power of "Skillblue" coefficient (skill operative worker) is stronger than the magnitude of variables which represent either non-skill operative worker or non-operative worker's hour.

3.3.2.2. Manufacture of textiles [ISIC 17]

Results from all regressions strongly suggested that plants with foreign controlled status in this industry are not statistically exhibited with higher productivity than local-operated plants; as, the coefficients of multinational variables are not statistically significant in all regressions.

From the supplement null hypothesis of identical technology, we also could not find the evidence which shows difference between foreign plant's production technology and local plant's production technology. It should be noted that the other plants' characteristics, relative age and BOI status of the plant are also statistically significant in this industry.

	ISIC 15				ISIC 17			
	Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)		Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)	
Two-Factor model	Coefficient	p value	Coefficient	p value	Coefficient	p value	coefficient	p value
C	16.302	(0.00)			15.904	(0.00)		
ln(K)	0.249	(0.00)	0.264	(0.00)	0.314	(0.00)	0.350	(0.00)
ln(L)	0.606	(0.00)	0.660	(0.00)	0.648	(0.00)	0.626	(0.00)
$(\ln(K))^2$	-0.034	(0.00)	-0.028	(0.00)	-0.026	(0.00)	-0.001	(0.93)
$(\ln(L))^2$	-0.023	(0.33)	-0.013	(0.52)	0.020	(0.60)	-0.050	(0.55)
(ln(K))*(ln(L))	0.023	(0.34)	0.011	(0.61)	-0.042	(0.17)	-0.059	(0.03)
MNC Dummy	-0.068	(0.50)	-0.036	(0.68)	0.191	(0.09)	0.104	(0.31)
Size Dummy	1.216	(0.00)	0.957	(0.00)	0.767	(0.00)	0.449	(0.00)
Age Dummy	0.125	(0.13)	0.102	(0.02)	0.291	(0.00)	0.236	(0.00)
BOI Dummy	0.278	(0.00)	0.164	(0.01)	0.314	(0.00)	0.066	(0.46)
Industry Dummy*	-		Appendix B.2		-		Appendix B.2	
R square	0.735		0.805		0.801		0.843	
Observations	1,719		1,719		854		854	
Four-Factor Model	*Eq.(3.5)*		*Eq.(3.7)*		*Eq.(3.5)*		*Eq.(3.7)*	
C	15.585	(0.00)			14.897	(0.00)		
ln(K)	0.312	(0.00)	0.287	(0.00)	0.247	(0.00)	0.250	(0.00)
ln(SkillBlue)	0.010	(0.00)	0.238	(0.00)	0.032	(0.00)	0.256	(0.00)
ln(NonSkillBlue)	0.044	(0.00)	0.061	(0.00)	0.112	(0.00)	0.052	(0.00)
ln(White)	0.059	(0.00)	0.081	(0.00)	0.168	(0.00)	0.129	(0.00)
$(\ln(K))^2$	0.002	(0.77)	-0.002	(0.67)	0.007	(0.30)	0.244	(0.00)
$(\ln(SkillBlue))^2$	0.008	(0.00)	0.022	(0.00)	0.008	(0.02)	0.015	(0.00)
$(\ln(Nonskillblue))^2$	0.013	(0.00)	0.012	(0.00)	0.019	(0.00)	0.018	(0.16)
$(\ln(White))^2$	0.005	(0.04)	0.011	(0.00)	0.011	(0.00)	0.019	(0.00)
(ln(K))*(ln(Sk))	-0.003	(0.48)	-0.007	(0.12)	-0.007	(0.40)	-0.002	(0.82)
(ln(K))*(ln(NonSk))	-0.009	(0.00)	-0.005	(0.05)	-0.015	(0.00)	-0.007	(0.06)
(ln(K))*(ln(White))	-0.018	(0.00)	-0.017	(0.00)	-0.031	(0.00)	-0.025	(0.00)
(ln(Sk))*(ln(NonSk))	0.002	(0.58)	-0.005	(0.03)	-0.007	(0.15)	-0.009	(0.03)
(ln(Sk))*(ln(White))	-0.003	(0.07)	-0.004	(0.02)	-0.004	(0.25)	-0.005	(0.14)
(ln(NonSk))*(ln(White))	-0.003	(0.02)	-0.003	(0.00)	-0.001	(0.38)	-0.001	(0.36)
MNC Dummy	-0.079	(0.45)	-0.033	(0.71)	0.075	(0.50)	0.043	(0.66)
Size Dummy	1.570	(0.00)	1.131	(0.00)	1.225	(0.00)	0.678	(0.00)
Age Dummy	0.119	(0.02)	0.085	(0.05)	0.281	(0.00)	0.153	(0.01)
BOI Dummy	0.357	(0.00)	0.214	(0.00)	0.321	(0.05)	0.118	(0.15)
Industry Dummy*	-		Appendix B.2		-		Appendix B.2	
R square	0.716		0.800		0.815		0.818	
Observations	1,719		1,719		854		854	

Table3.5. Result from regression (3-4) to (3-7) for Manufacture of Foods and Foods products ISIC (15), Manufacture of textile ISIC (17)

For The full reports with the coefficients of industry dummy variable are illustrated in the appendix section B.2.

3.3.2.3 Manufacture of wearing apparel [ISIC 18], and luggage& footwear [ISIC 19]

To provide sufficient number of foreign plant observations for the analysis, we combine ISIC 18 and ISIC 19 together. The results from every model, as presented in table 6, consistently indicate that the plants' multinational status could not further influence the factor productivity of the plants. This evidence reveals that foreign plants in this industry do not exhibited with superior in productivity over the local-operated plant. The result from appendix B. also found that the average total factor productivity of the foreign plant is lowers their local counterpart's average TFP in both two and four factor based models. However, the F statistic indicates that the production functions of local plant's production function are statistically differ from foreign plant 'production function.

3.3.2.4. Manufacture of wood & product of wood [ISIC 20], and papers [ISIC 21]

Plants in ISIC 20 and ISIC 21 are categorized in the same group in our study, and we found strong evidence that foreign plant has higher productivity over the domestic plant. The difference could be as high as 3.5% added to industry average total factor productivity (four-factor based without industry control variable model). As we can observe from right panel in table 5, the scale of influence from multinational variable is less when we account the for the industry effects. It should be noted that influence from foreign-controlled status of the plant increase, when the four factor production model are employed.

This result further signify the firm specific advantage of MNC; as, even we account for the non-physical skilled intensity in the model, the foreign status of the plant could still can significantly influence the productivity of the plant in this industry. BOI status of the plant in this industry could not statistically influence the plants' productivity. While, the coefficients of plant's relative size are still recorded as highly significance. To further verify this conclusion, the results from F test for the difference, from appendix section, also indicate the difference between the local plant and foreign plants production function

Two-Factor model	ISIC 18 and 19				ISIC 20 and 21			
	Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)		Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)	
	Coefficient	p value	Coefficient	p value	Coefficient	p value	coefficient	p value
C	16.301	(0.00)			16.137	(0.00)		
ln(K)	0.159	(0.00)	0.157	(0.00)	0.229	(0.00)	0.232	(0.00)
ln(L)	0.751	(0.00)	0.753	(0.00)	0.592	(0.00)	0.600	(0.00)
$(\ln(K))^2$	-0.026	(0.02)	-0.025	(0.02)	-0.010	(0.36)	0.001	(0.87)
$(\ln(L))^2$	-0.036	(0.10)	-0.038	(0.08)	-0.096	(0.05)	-0.048	(0.21)
(ln(K))*(ln(L))	0.004	(0.87)	0.001	(0.96)	0.037	(0.38)	-0.031	(0.35)
MNC Dummy	**-0.136**	**(0.12)**	**-0.128**	**(0.14)**	**0.526**	**(0.00)**	**0.208**	**(0.04)**
Size Dummy	0.745	(0.00)	0.779	(0.00)	0.945	(0.00)	1.002	(0.00)
Age Dummy	0.046	(0.31)	0.065	(0.15)	0.154	(0.01)	0.120	(0.01)
BOI Dummy	0.171	(0.00)	0.135	(0.01)	0.066	(0.42)	0.116	(0.08)
Industry Dummy*	-		Appendix B.2		-		Appendix B.2	
R square	0.796		0.803		0.648		0.783	
Observations	1,017		1,017		905		905	
Four-Factor Model	*Eq.(3-5)*		*Eq.(3-7)*		*Eq.(3-5)*		*Eq.(3-7)*	
C	15.394	(0.00)			15.436	(0.00)		
ln(K)	0.188	(0.00)	0.176	(0.00)	0.255	(0.00)	0.234	(0.00)
ln(SkillBlue)	0.306	(0.00)	0.329	(0.00)	0.168	(0.00)	0.244	(0.00)
ln(NonSkillBlue)	0.032	(0.00)	0.034	(0.00)	0.043	(0.00)	0.048	(0.00)
ln(White)	0.145	(0.00)	0.145	(0.00)	0.061	(0.00)	0.090	(0.00)
$(\ln(K))^2$	-0.008	(0.22)	-0.010	(0.15)	0.018	(0.01)	-0.001	(0.76)
$(\ln(SkillBlue))^2$	0.027	(0.00)	0.029	(0.00)	0.015	(0.00)	0.019	(0.00)
$(\ln(Nonskillblue))^2$	0.009	(0.00)	0.011	(0.00)	0.014	(0.00)	0.010	(0.00)
$(\ln(White))^2$	0.016	(0.00)	0.016	(0.00)	0.005	(0.02)	0.011	(0.00)
(ln(K))*(ln(Sk))	-0.006	(0.26)	-0.006	(0.22)	-0.021	(0.00)	-0.008	(0.17)
(ln(K))*(ln(NonSk)	-0.007	(0.04)	-0.007	(0.04)	-0.007	(0.08)	-0.002	(0.40)
(ln(K))*(ln(White))	-0.019	(0.00)	-0.020	(0.00)	-0.018	(0.00)	-0.009	(0.01)
(ln(Sk))*(ln(NonSk))	-0.000	(0.78)	-0.001	(0.50)	0.004	(0.39)	-0.004	(0.21)
(ln(Sk))*(ln(White))	-0.006	(0.00)	-0.006	(0.00)	0.000	(0.88)	0.000	(0.92)
(ln(NonSkill))*(ln(White))	-0.001	(0.09)	-0.001	(0.01)	0.000	(0.96)	0.000	(0.65)
MNC Dummy	**-0.137**	**(0.12)**	**-0.119**	**(0.17)**	**0.538**	**(0.00)**	**0.244**	**(0.02)**
Size Dummy	0.817	(0.00)	0.793	(0.00)	1.041	(0.00)	1.005	(0.00)
Age Dummy	0.011	(0.80)	0.029	(0.52)	0.122	(0.06)	0.072	(0.16)
BOI Dummy	0.218	(0.00)	0.178	(0.00)	0.088	(0.30)	0.073	(0.29)
Industry Dummy*	-		Appendix B.2		-		Appendix B.2	
R square	0.793		0.804		0.637		0.781	
Observations	1,017		1,017		905		905	

Table3.6. The result from regression (3-4) to (3-7) for Manufacture of wearing apparel and footwear ISIC (18 and 19), and Manufacture of wood & wood products and paper ISIC (20 and 21)

For The full reports with the coefficients of industry dummy variable are illustrated in the appendix section B.2.

3.3.2.5. Manufacture of chemical & chemical products [ISIC (24)]

Regardless of the regressions, the results from either two or four-factor based model, either with or without industry control variable, statistically reveal the significance of multinational status variable. For instance, being multinational plants in manufacture of chemical & chemical product can further increase 1.3% of plants' average productivity.

The F tests in the appendix section B from two and four factor production also consistently report the significant F value, which implies that the null hypothesis of identical production technology could be generally rejected. This further implies the statistical difference between foreign and local plant. It should be noted that the plant's BOI investment promotion status (1 if the plant is granted with BOI privileges, 0 otherwise) does statistically matter for the plant in this industry. We found that the coefficients of this variable are statistically significant in every model. Interestingly, the magnitude of skill operative labor in this industry is reported with stronger effect than the effect from plant's capital in the four-factor with industry effect model (eq. 3-6). This further emphasizes the importance of human capital in the production of chemical products.

3.3.2.6. Manufacture of rubber and rubber products [ISIC (25)]

Result consistently revealed that foreign plants have a higher productivity over the local operated plants for every two and four factor based models. However, the reported magnitudes are smaller in the models with the control of industry effect. It should be noted that there are only 3 ISIC 4 digits industry in the rubber and rubber product industry and the constant term presented in the table 3.7 is the average total factor productivity of the industry ISIC 2511, while the average TFP of other sub industries are presented in the Appendix B.2. Interestingly, the relative age's coefficient is found to be insignificant in this sample, while plant's BOI status and plant's relative size are significantly reported and their magnitude are relatively strong in comparison to the effects of plant's size and BOI status in other industries.

Two-Factor model	ISIC 24 Without industry dummy Eq.(3-4) Coefficient	p value	ISIC 24 With industry dummy Eq.(3-6) coefficient	p value	ISIC 25 Without industry dummy Eq.(3-4) coefficient	p value	ISIC 25 With industry dummy Eq.(3-6) Coefficient	p value
C	16.623	(0.00)			16.370	(0.00)		
ln(K)	0.213	(0.00)	0.247	(0.00)	0.140	(0.00)	0.143	(0.00)
ln(L)	0.554	(0.00)	0.577	(0.00)	0.573	(0.00)	0.589	(0.00)
$(\ln(K))^2$	-0.040	(0.00)	-0.022	(0.00)	0.020	(0.01)	0.021	(0.00)
$(\ln(L))^2$	-0.043	(0.35)	-0.046	(0.26)	-0.016	(0.55)	-0.034	(0.20)
(ln(K))*(ln(L))	0.043	(0.24)	0.000	(0.99)	-0.058	(0.02)	-0.061	(0.01)
MNC Dummy	**0.281**	**(0.00)**	**0.230**	**(0.00)**	**0.210**	**(0.00)**	**0.201**	**(0.00)**
Size Dummy	1.120	(0.00)	1.058	(0.00)	1.021	(0.00)	1.041	(0.00)
Age Dummy	0.232	(0.00)	0.211	(0.00)	-0.001	(0.97)	0.008	(0.83)
BOI Dummy	0.250	(0.00)	0.011	(0.87)	0.197	(0.00)	0.146	(0.00)
Industry Dummy*	-		Appendix B.2		-		Appendix B.2	
R square	0.702		0.776		0.774		0.784	
Observations	767		767		1,162		1,162	
Four-Factor Model	*Eq.(3-5)*		*Eq.(3-7)*		*Eq.(3-5)*		*Eq.(3-7)*	
C	15.995	(0.00)			15.456	(0.00)		
ln(K)	0.211	(0.00)	0.211	(0.00)	0.163	(0.00)	0.169	(0.00)
ln(SkillBlue)	0.179	(0.00)	0.274	(0.00)	0.247	(0.00)	0.244	(0.00)
ln(NonSkillBlue)	0.036	(0.00)	0.041	(0.00)	0.049	(0.00)	0.048	(0.00)
ln(White)	0.046	(0.01)	0.119	(0.00)	0.121	(0.00)	0.117	(0.00)
$(\ln(K))^2$	-0.015	(0.04)	-0.012	(0.05)	0.004	(0.34)	0.004	(0.42)
$(\ln(SkillBlue))^2$	0.016	(0.00)	0.021	(0.00)	0.019	(0.00)	0.019	(0.00)
$(\ln(Nonskillblue))^2$	0.013	(0.00)	0.008	(0.00)	0.013	(0.00)	0.012	(0.00)
$(\ln(White))^2$	0.000	(0.92)	0.011	(0.00)	0.019	(0.00)	0.018	(0.00)
(ln(K))*(ln(SkillBlue))	-0.000	(0.92)	0.007	(0.40)	-0.015	(0.00)	-0.016	(0.00)
(ln(K))*(ln(NonSk)	-0.009	(0.02)	-0.000	(0.92)	-0.006	(0.02)	-0.006	(0.02)
(ln(K))*(ln(White))	-0.012	(0.01)	-0.012	(0.00)	-0.018	(0.00)	-0.018	(0.00)
(ln(Sk))*(ln(NonSk))	-0.000	(0.90)	-0.011	(0.03)	-0.005	(0.04)	-0.006	(0.03)
(ln(Sk))*(ln(White))	-0.006	(0.14)	-0.011	(0.00)	-0.000	(0.77)	-0.000	(0.92)
(ln(NonSk)) *(ln(White))	-0.001	(0.36)	-0.004	(0.01)	0.000	(0.33)	0.001	(0.20)
MNC Dummy	**0.219**	**(0.03)**	**0.212**	**(0.01)**	**0.242**	**(0.00)**	**0.237**	**(0.00)**
Size Dummy	1.361	(0.00)	1.147	(0.00)	0.995	(0.00)	1.016	(0.00)
Age Dummy	0.275	(0.00)	0.213	(0.00)	0.021	(0.60)	0.031	(0.45)
BOI Dummy	0.268	(0.00)	0.024	(0.74)	0.166	(0.00)	0.136	(0.01)
Industry Dummy*	-		Appendix B.2		-		Appendix B.2	
R square	0.689		0.775		0.771		0.774	
Observations	767		767		1,162		1,162	

Table3.7. The result from regression (3-4) to (3-7) for Manufacture of chemical & chemical products ISIC (24), and Manufacture of Rubber and rubber products ISIC (25) For The full reports with the coefficients of industry dummy variable are illustrated in the appendix section B2.

3.3.2.7. Manufacture of other non-metallic other products [ISIC (26)]

Results from the model with industry effect control variable firmly indicate the significant of the multinational dummy variable in both two and four-factor production models. However, the results from equation 6 and 7 reject this positive effect of plant's multinational status. Another interesting aspect is derived from the test for the null hypothesis of identical production technology, as listed in appendix section 2, we found that the production technology of foreign plants is statistically differentiated from local plant's production technology in two factor production model. However the null hypothesis of identical production technology between these two groups of plants could also be rejected in the four-factor based model.

3.3.2.8. Manufacture of basic metal [ISIC (27)] and fabricated metal products [ISIC (28)]

Strong evidences of productivity differential are found for the plants in these steel - related industries. The plants with foreign controlled status possess additional plus factor (MNC variable is statistically significant) to the average productivity over the local operated plants in both two and four factor based models. The testing for the differences in production technology also strongly indicates differential in production functions across these two groups of plants. It should be noted that the relative age of the plant and plant's BOI status of the plant in these two industries are not statistically recorded, while the magnitude of plant relative size coefficients are relatively large and they are statistically significant in every employed models.

	ISIC 26				ISIC 27 and ISIC 28			
	Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)		Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)	
Two-Factor model	coefficient	p value	Coefficient	p value	Coefficient	p value	Coefficient	p value
C	16.050	(0.00)			16.092	(0.00)		
ln(K)	0.206	(0.00)	0.218	(0.00)	0.171	(0.00)	0.182	(0.00)
ln(L)	0.718	(0.00)	0.731	(0.00)	0.586	(0.00)	0.657	(0.00)
(ln(K))2	0.036	(0.00)	0.030	(0.03)	0.020	(0.03)	0.014	(0.08)
(ln(L))2	-0.043	(0.30)	-0.024	(0.51)	0.023	(0.45)	-0.002	(0.93)
(ln(K))*(ln(L))	-0.074	(0.05)	-0.077	(0.02)	-0.056	(0.06)	-0.055	(0.03)
MNC Dummy	0.343	(0.01)	0.134	(0.28)	0.144	(0.03)	0.142	(0.02)
Size Dummy	0.993	(0.00)	0.967	(0.00)	1.033	(0.00)	0.982	(0.00)
Age Dummy	-0.119	(0.08)	-0.143	(0.18)	0.036	(0.39)	0.029	(0.43)
BOI Dummy	0.095	(0.34)	-0.039	(0.68)	0.306	(0.00)	0.113	(0.05)
Industry Dummy*	-		Appendix B.2		-		Appendix B.2	
R square	0.687		0.753		0.706		0.779	
Observations	738		738		1,501		1,501	
Four-Factor Model	Eq.(3-5)		Eq.(3-7)		Eq.(3-5)		Eq.(3-7)	
C	15.307	(0.00)			15.42	(0.00)		
ln(K)	0.242	(0.00)	0.231	(0.00)	0.183	(0.00)	0.198	(0.00)
ln(SkillBlue)	0.198	(0.00)	0.261	(0.00)	0.267	(0.00)	0.277	(0.00)
ln(NonSkillBlue)	0.027	(0.00)	0.038	(0.00)	0.034	(0.00)	0.034	(0.00)
ln(White)	0.056	(0.00)	0.091	(0.00)	0.100	(0.00)	0.127	(0.00)
(ln(K))2	0.019	(0.02)	0.004	(0.60)	0.009	(0.15)	0.001	(0.80)
(ln(SkillBlue))2	0.016	(0.00)	0.021	(0.00)	0.025	(0.00)	0.025	(0.00)
(ln(Nonskillblue))2	0.015	(0.00)	0.012	(0.00)	0.011	(0.00)	0.008	(0.00)
(ln(White))2	0.035	(0.25)	0.011	(0.00)	0.013	(0.00)	0.019	(0.00)
(ln(K))*(ln(Sk))	-0.003	(0.72)	-0.005	(0.45)	-0.010	(0.15)	-0.012	(0.05)
(ln(K))*(ln(NonSk)	-0.009	(0.04)	-0.005	(0.22)	-0.010	(0.00)	-0.008	(0.00)
(ln(K))*(ln(White))	-0.016	(0.00)	-0.006	(0.14)	-0.009	(0.00)	-0.009	(0.00)
(ln(Sk))*(ln(NonSk))	-0.002	(0.61)	-0.006	(0.10)	0.002	(0.56)	-0.001	(0.62)
(ln(Sk))*(ln(White))	-0.005	(0.08)	-0.006	(0.01)	-0.003	(0.20)	-0.005	(0.03)
(ln(NonSk)) *(ln(White))	-0.001	(0.47)	-0.002	(0.16)	0.000	(0.39)	0.000	(0.73)
MNC Dummy	0.255	(0.08)	0.072	(0.58)	0.139	(0.04)	0.144	(0.02)
Size Dummy	1.245	(0.00)	1.129	(0.00)	1.111	(0.00)	1.069	(0.00)
Age Dummy	-0.060	(0.40)	-0.110	(0.08)	-0.003	(0.24)	0.049	(0.18)
BOI Dummy	0.135	(0.20)	0.000	(0.99)	0.000	(0.00)	0.113	(0.06)
Industry Dummy*	-		Appendix B.2		-		Appendix B.2	
R square	0.657		0.732		0.704		0.772	
Observations	738		738		1,501		1,501	

Table3.8. The result from regression (3-4) to (3-7) for Manufacture of non-metallic products ISIC (26), and Manufacture of basic metal and fabricated metal ISIC (27 to 28)

For The full reports with the coefficients of industry dummy variable are illustrated in the appendix section B.2.

3.3.2.9. Manufacture of general machinery [ISIC (29)]

First, we consider the model with two-factor production function, evidences from both with industry and without industry control regressions strongly indicate the foreign plants have higher average productivity over local-operated plants. For four-factor production function without industry effect control variable, average TFP of the foreign plant in this industry could be perceived as 2.08% top up than average TFP of the plant without multinational status. Interestingly, the magnitude of multinational dummy variable is weaker in the model which we had control for the industry effect; as in 15 sub industries. As their products are relatively vary, in this aggregately classified manufacture of machinery and equipment. The plausible explanation is that foreign plants might have chosen the sub-industries in which the average productivity is already high. The results from both two and four-factor based models. Appendix section B.2. also revealed that the production technologies of foreign plants statistically differ from the production technologies of their local counterparts.

3.3.2.10. Manufacture of Electric machinery [ISIC (30) to ISIC (33)]

With the scope on the plants that operate in ISIC 30 to ISIC 33, we found that the results are relatively different across the different types of model. The two-factor based models insist the superiority of foreign plant over the local plant, while the four-factor production model rejects the differential in productivity between foreign and local plants. With the proper control for the non-physical intensity the foreign plants (four-factor model), plants with multinational status are not exhibited with greater productivity as claimed. Results from appendix 2 also vary across different types of production function. The two factors based model found the differences in production functions between foreign and local sample. However, the four factor based model does not found this claimed difference at 0.05 significant level. The full results of industry effect model, as illustrated in appendix reveals.

	ISIC 29				ISIC 30 to 33			
	Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)		Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)	
Two-Factor model	Coefficient	p value	Coefficient	p value	coefficient	p value	Coefficient	p value
C	16.316	(0.00)			17.099	(0.00)		
ln(K)	0.124	(0.00)	0.124	(0.00)	0.176	(0.00)	0.188	(0.00)
ln(L)	0.663	(0.00)	0.721	(0.00)	0.553	(0.00)	0.598	(0.00)
(ln(K))^2	0.020	(0.21)	0.010	(0.47)	0.020	(0.15)	0.009	(0.44)
(ln(L))^2	0.031	(0.47)	-0.043	(0.27)	0.040	(0.26)	0.001	(0.75)
(ln(K))*(ln(L))	-0.021	(0.66)	-0.014	(0.74)	-0.052	(0.18)	-0.043	(0.21)
MNC Dummy	**0.273**	**(0.01)**	**0.166**	**(0.05)**	**0.314**	**(0.00)**	**0.063**	**(0.41)**
Size Dummy	0.416	(0.00)	0.726	(0.00)	0.781	(0.00)	0.909	(0.00)
Age Dummy	0.146	(0.04)	0.100	(0.11)	0.070	(0.32)	0.042	(0.51)
BOI Dummy	0.421	(0.00)	0.291	(0.00)	0.115	(0.19)	0.141	(0.07)
Industry Dummy*	-		Appendix B.2		-		Appendix B.2	
R square	0.693		0.764		0.757		0.812	
Observations	607		607		679		679	
Four-Factor Model	*Eq.(3-5)*		*Eq.(3-7)*		*Eq.(3-5)*		*Eq.(3-7)*	
C	15.700	(0.00)			16.372	(0.00)		
ln(K)	0.162	(0.00)	0.165	(0.00)	0.192	(0.00)	0.231	(0.00)
ln(SkillBlue)	0.340	(0.00)	0.315	(0.00)	0.300	(0.00)	0.289	(0.00)
ln(NonSkillBlue)	0.046	(0.00)	0.040	(0.00)	0.034	(0.00)	0.035	(0.00)
ln(White)	0.097	(0.00)	0.149	(0.00)	0.114	(0.00)	0.120	(0.00)
(ln(K))^2	0.028	(0.01)	0.012	(0.15)	0.006	(0.41)	-0.003	(0.69)
(ln(SkillBlue))^2	0.025	(0.00)	0.023	(0.00)	0.020	(0.00)	0.020	(0.00)
(ln(Nonskillblue))^2	0.010	(0.00)	0.005	(0.05)	0.014	(0.00)	0.008	(0.00)
(ln(White))^2	0.009	(0.01)	0.019	(0.00)	0.016	(0.00)	0.017	(0.00)
(ln(K))*(ln(Sk))	-0.013	(0.20)	-0.011	(0.23)	-0.001	(0.92)	-0.002	(0.78)
(ln(K))*(ln(NonSk)	0.001	(0.74)	0.005	(0.26)	-0.007	(0.06)	-0.003	(0.33)
(ln(K))*(ln(White))	-0.015	(0.01)	-0.016	(0.00)	-0.014	(0.00)	-0.013	(0.00)
(ln(Sk))*(ln(NonSk))	-0.013	(0.00)	-0.014	(0.00)	-0.002	(0.55)	0.000	(0.90)
(ln(Sk))*(ln(White))	-0.003	(0.35)	-0.005	(0.11)	-0.013	(0.00)	-0.014	(0.00)
(ln(NonSk)) *(ln(White))	0.000	(0.81)	0.001	(0.49)	-0.002	(0.21)	-0.001	(0.17)
MNC Dummy	**0.328**	**(0.00)**	**0.192**	**(0.03)**	**0.273**	**(0.00)**	**0.107**	**(0.18)**
Size Dummy	0.508	(0.00)	0.727	(0.00)	0.825	(0.00)	0.887	(0.00)
Age Dummy	0.164	(0.02)	0.091	(0.15)	0.010	(0.89)	0.000	(0.99)
BOI Dummy	0.395	(0.00)	0.282	(0.00)	0.232	(0.01)	0.139	(0.08)
Industry Dummy*	-		Appendix B.2		-		Appendix B.2	
R square	0.694		0.749		0.770		0.807	
Observations	607		607		679		679	

Table3.9. The result from regression (4) to (7) for Manufacture of general machinery ISIC (29), and Electronic related industries ISIC (30 to 33)

For The full reports with the coefficients of industry dummy variable are illustrated in the appendix section B.2.

3.3.2.11. Manufacture of motor vehicles, trailers and semi-trailers [ISIC (34)]

Surprisingly, we found no evidence that plants with multinational status possesses superior productivity than their local counterparts and the results from four factor based models also confirm this outcome. The models with full control of industry effects had revealed that the average total factor productivity of plant in manufacture of motor vehicles is the highest among manufacturer under ISIC 34 prefix. The null hypothesis of identical production technology across foreign and local plants had been tested as well, and the results indicate that the production technologies of foreign and local plants are identical for two-factor production model. However, the results from four-factor based model indicate the differences statistically exist. From appendix B.2, lower right panel, we found that the industry average TFP of foreign plant is only 5% higher than the average TFP of local group. We also found that the plants' relative size coefficient is significant; but their magnitude is small in comparison to the effect of plant size in other industries. By the nature of the plant in this industry, which require substantial of investment, the variation in plant size between local and foreign plants might not be as large as other industries. The insignificant of multination status variable and the failure to find the production technology differential further encourage us to take explore whether there is spillover effect.

3.3.2.12. Manufacture of Jewelry [ISIC (3691)]

Since there is no sub industry for manufacture of Jewelry, the regression eq. (3-6) and eq. (3-7) could not be implemented. The results from both two and four-factor production function suggest no evidence that foreign plants have higher average total factor productivity than local operated plant. While, the analysis from production function comparisons (supplement hypothesis) also reveal no evidence of differentials between foreign and local plants' production technologies.

	ISIC 34				ISIC 3691			
	Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)		Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)	
Two-Factor model	coefficient	p value	Coefficient	p value	Coefficient	p value	Coefficient	p value
C	16.973	(0.00)			16.539	(0.00)	N/A	
ln(K)	0.125	(0.00)	0.151	(0.00)	0.194	(0.00)		
ln(L)	0.802	(0.00)	0.802	(0.00)	0.713	(0.00)		
$(\ln(K))^2$	0.025	(0.11)	0.015	(0.30)	0.065	(0.02)		
$(\ln(L))^2$	-0.042	(0.47)	-0.051	(0.35)	0.062	(0.21)		
(ln(K))*(ln(L))	-0.002	(0.97)	-0.008	(0.88)	-0.164	(0.01)		
MNC Dummy	**0.176**	**(0.13)**	**-0.024**	**(0.83)**	**-0.028**	**(0.78)**		
Size Dummy	0.686	(0.00)	0.797	(0.00)	0.625	(0.00)		
Age Dummy	0.067	(0.46)	0.061	(0.48)	0.074	(0.43)		
BOI Dummy	0.257	(0.03)	0.214	(0.05)	0.302	(0.00)		
Industry Dummy*	-		Appendix B.2		-			
R square	0.801		0.830		0.798			
Observations	343		343		244			
Four-Factor Model	*Eq.(3-5)*		*Eq.(3-7)*		*Eq.(3-5)*			
C	15.907	(0.00)			16.200	(0.00)	N/A	
ln(K)	0.172	(0.00)	0.184	(0.00)	0.216	(0.00)		
ln(SkillBlue)	0.408	(0.00)	0.405	(0.00)	0.380	(0.00)		
ln(NonSkillBlue)	0.051	(0.00)	0.059	(0.00)	0.026	(0.21)		
ln(White)	0.156	(0.00)	0.197	(0.00)	0.186	(0.00)		
$(\ln(K))^2$	0.034	(0.00)	0.003	(0.01)	0.013	(0.55)		
$(\ln(SkillBlue))^2$	0.020	(0.00)	0.023	(0.00)	0.021	(0.02)		
$(\ln(Nonskillblue))^2$	0.018	(0.00)	0.016	(0.00)	0.005	(0.32)		
$(\ln(White))^2$	0.017	(0.00)	0.024	(0.00)	0.016	(0.01)		
(ln(K))*(ln(Sk))	-0.013	(0.56)	-0.032	(0.12)	-0.007	(0.53)		
(ln(K))*(ln(NonSk)	0.007	(0.23)	0.004	(0.47)	0.000	(0.99)		
(ln(K))*(ln(White))	-0.006	(0.39)	-0.009	(0.19)	-0.025	(0.04)		
(ln(Sk))*(ln(NonSk))	-0.030	(0.00)	-0.030	(0.00)	-0.012	(0.17)		
(ln(Sk))*(ln(White))	-0.010	(0.19)	-0.012	(0.08)	-0.013	(0.07)		
(ln(NonSk))*(ln(White))	-0.005	(0.03)	-0.005	(0.03)	-0.006	(0.02)		
MNC Dummy	**0.203**	**(0.09)**	**-0.019**	**(0.86)**	**-0.062**	**(0.54)**		
Size Dummy	0.500	(0.00)	0.630	(0.00)	0.557	(0.00)		
Age Dummy	0.134	(0.16)	0.116	(0.19)	0.047	(0.61)		
BOI Dummy	0.188	(0.12)	0.196	(0.08)	0.212	(0.04)		
Industry Dummy*	-		Appendix B.2		-			
R square	0.787		0.823		0.809			
Observations	343		343		244			

Table3.10. The result from regression (3-4) to (3-7) for Manufacture of automobile and parts ISIC (34), and Manufacturer of Jewelry ISIC (3691)

For The full reports with the coefficients of industry dummy variable are illustrated in the appendix section B.2.

3.3.2.13. Manufacture of furniture, other manufacturing, except manufacture of Jewelry [ISIC (3610), (3692), (3693) and (3694)].

Foreign plants are shown with greater productivity in all models; the coefficients in front of foreign controlled dummy variable are statistically significant in every model. The testing of supplement hypothesis of identical production technology also found indicates the differences between foreign plant's production function and local plant's production functions. The strong evidence of productivity differentials from various models firmly confirms the productivity gap between foreign and local group in this other manufacturing industries. Interestingly, the average total factor productivity of manufacture of sport goods is the highest among ISIC 36 sub-industries. The result table is shown in the following page.

	ISIC 3610, 3692, 3693 and ISIC 3694			
	Without industry dummy Eq.(3-4)		With industry dummy Eq.(3-6)	
Two-Factor model	Coefficient	p value	Coefficient	p value
C	16.031	(0.00)		
ln(K)	0.198	(0.00)	0.200	(0.00)
ln(L)	0.477	(0.00)	0.534	(0.00)
$(\ln(K))^2$	-0.023	(0.21)	-0.038	(0.03)
$(\ln(L))^2$	0.059	(0.17)	-0.003	(0.95)
(ln(K))*(ln(L))	-0.036	(0.45)	-0.004	(0.92)
MNC Dummy	**0.611**	**(0.00)**	**0.383**	**(0.00)**
Size Dummy	0.958	(0.00)	1.064	(0.00)
Age Dummy	0.079	(0.28)	0.060	(0.38)
BOI Dummy	0.072	(0.41)	-0.180	(0.04)
Industry Dummy*	-		Appendix B.2	
R square	0.714		0.751	
Observations	549		549	
Four-Factor Model	*Eq.(3-5)*		*Eq.(3-7)*	
C	15.269	(0.00)	15.477	(0.00)
ln(K)	0.204	(0.00)	0.206	(0.00)
ln(SkillBlue)	0.314	(0.00)	0.240	(0.00)
ln(NonSkillBlue)	0.061	(0.00)	0.038	(0.00)
ln(White)	0.111	(0.00)	0.127	(0.00)
$(\ln(K))^2$	0.006	(0.14)	0.012	(0.30)
$(\ln(SkillBlue))^2$	0.026	(0.00)	0.022	(0.00)
$(\ln(Nonskillblue))^2$	0.018	(0.00)	0.013	(0.00)
$(\ln(White))^2$	0.015	(0.00)	0.019	(0.00)
(ln(K))*(ln(Ski))	-0.024	(0.00)	-0.034	(0.00)
(ln(K))*(ln(NonSk)	-0.010	(0.01)	-0.011	(0.02)
(ln(K))*(ln(White))	-0.026	(0.00)	0.034	(0.00)
(ln(Sk))*(ln(NonSk))	-0.005	(0.52)	0.001	(0.78)
(ln(Sk))*(ln(White))	-0.002	(0.07)	0.004	(0.21)
(ln(NonSk))* (ln(White))	-0.003	(0.51)	-0.001	(0.50)
MNC Dummy	**0.101**	**(0.00)**	**0.345**	**(0.00)**
Size Dummy	1.104	(0.00)	1.058	(0.00)
Age Dummy	0.111	(0.88)	-0.014	(0.83)
BOI Dummy	0.214	(0.54)	-0.174	(0.03)
Industry Dummy*	-		Appendix B.2	
R square	0.748		0.782	
Observations	549		549	

Table3.11. The result from regression (4) to (7) for miscellaneous industry except jewelry ISIC (3610, 3692 to 3694)

For The full reports with the coefficients of industry dummy variable are illustrated in the appendix section B2.

To conclude this section, results of each industry are relatively robust across the models, and those results indicate that six industries out of 13 studied industries, the productivity gap between foreign and local statistically exist. The summary of the results from each model and further testing in the appendix section is shown.

ISIC code	Industry	Two-Factor Model		Four-Factor Model		Production tech. comparison [F test for diff.]	
		Without industry effect Eq.3.4	With industry effect Eq.3.6	Without industry effect Eq.3.5	With industry effect Eq.3.7	Two Factor model	Four Factor model
15xx	Food products and beverages	-0.068	-0.036	-0.079	-0.033	Accept Ho	Accept Ho
17xx	Textiles	0.191	0.104	0.075	0.043	Accept Ho	Accept Ho
18-19xx	Wearing apparel & Footwear	-0.136	-0.128	-0.137	-0.119	Do not accept Ho	Do not accept Ho
20-21xx	Wood & wood product and Paper	0.526**	0.208**	0.538**	0.244**	Do not accept Ho	Do not accept Ho
24xx	Chemicals and chemical pro.	0.281**	0.230**	0.219**	0.212**	Do not accept Ho	Do not accept Ho
25xx	Rubber and plastics products	0.210**	0.201**	0.242**	0.237**	Do not accept Ho	Do not accept Ho
26xx	Other non-metallic mineral products	0.343**	0.134	0.255*	0.072	Do not accept Ho	Accept Ho
27-28xx	Basic metals and metal product	0.144**	0.142*	0.139**	0.144**	Do not accept Ho	Do not accept Ho
29xx	Machinery and Equipment	0.273**	0.166**	0.328**	0.192**	Do not accept Ho	Do not accept Ho
30-33xx	Electrical Machinery	0.314**	0.063**	0.273**	0.107	Do not accept Ho	Accept Ho
34xx	Automotive and Parts	0.176	-0.024	0.203*	-0.019	Accept Ho	Accept Ho
3691	Jewelry and related articles	-0.028	N/A	-0.062	N/A	Accept Ho	Accept Ho
3610 3692-94	Furniture, Musical, Sport equipment & Toys	0.611**	0.383**	0.101**	0.345**	Do not accept Ho	Do not accept Ho

Table3.12. Summary table of coefficients of the key variable (DMNC) from Eq.3-4 to Eq.3-7

Note: the F test statistic for the difference across the production function (illustrated in the appendix Section A.2.2.Part A)[23].

[23] Figures which are marked with ** implies the coefficient is significant at 0.05 level of significant; while, * implies the coefficient is significant at 0.10 significant level.

As summarized in the right rows in the above table, the null hypothesis of identical production technologies between foreign and local plant should not be rejected in the list of the same 6 industries. These results imply the production technology differential between these two groups of plant is statistically insignificant. Hence; the claimed of multinational plants' superiority in average productivity is more convincing at aggregate levels than the disaggregate level. At disaggregate level, only 6 out of 13 major industries are consistently reported with performance gap between foreign and local operated plant. There are manufacture of wood & wood product [except furniture] and paper industries (ISIC 20to ISIC 21), manufacture of textiles (ISIC 17), manufacture of chemical and chemical products (ISIC 24), Manufacture of rubber and plastic product (ISIC 25), Manufacture of basic and fabricated metal (ISIC 27 to ISIC 28), manufacture of general Machinery and equipment (ISIC 29), and manufacture of furniture, toys, musical and sport equipment (ISIC 3610, ISIC 3692 to 3694). Generally speaking, multinational plants have higher productivity than local plants mostly in high technology industries.

3.4. Summary, Policy implication and Further study

Beside the two-factor translog production model, the estimation model for four factor based model in this study also revealed similar results to the typical 2 factors model. In addition, the study had been conducted at each major industry level (ISIC 2 digit classification) with the control of sub-industry (ISIC 4 digits) effect. We generally found that the claimed for multinational plants' superiority in average productivity is more convincing at aggregate manufacturing levels than the industry disaggregate level.

In general, the results from this study conform to the previous empirical studies (Ramstetter 2002), in which most of the industries were not significantly reported with productivity gap.

With various seemingly related approaches, the evidences from every model could identify six industries which foreign plants statistically differs from local plants.

There are manufacture of wood & wood product [except furniture] and paper industries (ISIC 20to ISIC 21), manufacture of textiles (ISIC 17), manufacture of chemical and chemical products (ISIC 24), Manufacture of rubber and plastic product (ISIC 25), Manufacture of basic and fabricated metal (ISIC 27 to ISIC 28), manufacture of general Machinery and equipment (ISIC 29), and manufacture of furniture, toys, musical and sport equipment (ISIC 3610, ISIC 3692 to 3694). Hence, privileges scheme, either given to local or foreign plants, should be redesigned in consideration the performance gaps between foreign and local plants. Another implication is that the further studies on the issue of spillover issue should acknowledge these 6 reported industries as the general prerequisite for the spillover effects to persist is already satisfied in the list of these six industries.

Since the analysis of this study is based on industrial census, the results from this study could be projected to the manufacturing plants only; this study could not answer whether there is significant performance gap between foreign and local entities in the service sectors. With the increasing presence of MNCs in hotels and commercial banks in Thailand, this extension could be the vital inputs for the policy makers to decide whether the privileges provided to those foreign-control units in service sector are empirically justified. The recently conducted “business and industrial census” by NSO (conducted in 2012) further allow researchers to analyze not only plant level data in the manufacturing sector, but also the firm level data in service sector.

Chapter 4
Testing for FDI externalities in Thailand: A plant level analysis of horizontal and vertical spillover effects

4.1. Background

Many empirical researches have been dedicated to study the direct impacts of MNC on host nations' economies however; the consensus among them is still a far reaching destination. Another effect is being discussed in this dissertation, the externalities toward the local plant generated by the presence of multinational plant. As previously discussed in the section 1.2, the main research question of this chapter is *whether the presences of foreign-controlled plants can statistically affect the productivity of local-operated plants?*

Theoretically, the presence of foreign firms not only could benefit local firms in the industry which they operate (Horizontal spillovers), but their presence could also enhance the performance of local firms who interact with them in the supply chain (Vertical spillovers).

If local plants can maintain their market share, empirical work by (Aitken 1999) pointed out that the presence of the foreign-controlled plants in the same industry could lower the unit cost of output produced by local plants through spillover effect[24]. This is the positive externalities from their presences. However their existence could potentially harm the current market share of local operators and this market share deterioration could eventually lead to less or to the point of insufficient production scale of local plants. This force is considered as negative externality of their presence. Since those two forces have opposite direction, the empirical consensus on this issue is not supportive as FDI promoting agents in many host nations have frequently claimed. For more detail, readers are invited to review section 2.4.

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[24] Please see section 2.3.1. for further explanation of this framework

From the review of the theoretical literatures, we found that externalities from MNC could be transmitted to local plants through the following channels which are worth to be revisited.

Through Imitation/Demonstration effects; (Bloomstrom M 1992) illustrated that Domestic firms can learn from foreign competitors' product and service, process, and technology through imitation; for example, reverse engineering process of proprietary knowledge used in the product, and technology which are introduced to the local counterparts by foreign-invested plant could be passed to the local firms through following channels. (Please see section 2.4.1.2., for the review of the models)

Through competition effect; beside the market share stealing threat of foreign firms, (Glass 2002) had shown that the presence of foreign invested firms would pressurize the domestic firms to improve their existing offers, process, and technology. With other factors constant, this pressurizing force would motivate local operators to increase their performance. (Please see section 2.4.1.3., for the review of the models)

Through export spillover[25]; Domestic firms can learn the related export information (for instance; foreign markets, exporting procedures, and choice of transportation) from multinationals firms, who already have the established exporting network; this learning could potentially benefit the indigenous firms (Aitken, Hanson, and Harrison, 1997) as the penetrators to the foreign markets. (Please see section 2.5, for the review of the models)

Through the worker mobility; Domestic firms could be benefited from the knowledge-invested employees who have moved from foreign-invested firms. Not only local plants can learn the new technology (Fosfuri A. 2001), process and proprietary knowledge from those set of workers, but also the existing workers could formally and informally learn these knowledge body from the group of transferred workers. (Please see section 2.4.1.A., for the review of the Fosfuri's model)

[25] Since this paper focus on the productivity spillovers, the effects of foreign presence on local plants' export performances are presented in the subsequent papers.

Empirically, the FDI spillovers are less visible than their suggested frameworks. As readers can observe in the Table 4.1, various proxies are employed to provisionally to check the robustness of the result, rather than to check whether particular channel exists. For the spillovers from the presence of foreign plants in downstream industries, (Javorcik 2004) stated that foreign controlled plants would be benefited from improved intermediate goods manufactured by local suppliers. Therefore, multinational plants are more willing to transfer the knowledge to their suppliers rather than transferring to their local counterparts in the same industry. However if multinational plants had engaged into the exclusive contract with particular suppliers, who are usually a foreign invested plants, (Markusen 1999) conclude that not only entrance of multinational plants would crowd out the domestic plant in final goods industry, but also local plants' demand for intermediate goods. The theory of MNC part, chapter 2, provides summary of theoretical frameworks of spillover from downstream industries. For more detail, please review the section 2.4.2.1.

Furthermore; the Spillover generated from the presence of foreign plants in upstream industries, (Ethier 1982) firstly pointed out that the presence of MNE would lead to a greater variety of inputs which could lead to an improvement of local plants' production.

The table presented in the following page summary the empirical works on spillover effect issue. Initially, the empirical works in this field had dedicated to investigate the impact of FDI toward the local firms in the same industry. Lately, researchers have integrated the vertical spillover into their analysis. Summary of recent empirical works are shown in the table 1. Most of the recent works had augmented the inter industry spillover to the analysis. For example, (Blalock 2005) and (Du 2012), they generally found that vertical spillover effects, especially spillover from the foreign plants in downstream industries, is more empirically supported than the horizontal of spillovers.

Authors	Studied Country	Dependent variable	Measurement of foreign presence	Testing for Vertical spillover	Results
Aitken and Harrion (1999)	Venezuela	Output	Foreign equity	No	(-) Crowding out effect
Blomstrom and Sjoholm (1999)	Indonesia	VA/worker	Output ratio	No	(+)
Takii (2001)	Indonesia	VA	Employment ratio	No	(+) overall, (-) industries with large technology gap
Todo and Miyamoto (2002)	Indonesia	VA/worker	Output ratio	No	(+)
Blalock and Gertler (2005)	Indonesia	Output	Output ratio	No	(+) more effect for local firm with low competency
Javorcik (2004)	Lithuania	Output	Output ratio	Yes	(+) **only** spillovers from MNCs in downstream ind.
Ramstetter (2006)	Thailand	VA/worker(hour)	Foreign equity	No	(+) small effect in the case of wholly-foreign MNC
Du, Harrison & Jefferson (2012)	Hong Kong, Macau, Taiwan	Output	Foreign equity, Output ratio	Yes	Non or weak in horizontal spillover (+) in vertical spillover
Xu and Sheng (2012)	China	Output, TFP	Output ratio	Yes	(+) Horizontal (-) Vertical spillover

Table4.1. Summary of recent empirical literatures

This paper is designed to investigate not only whether the presence of foreign-controlled plant in identical industry (horizontal FDI spillovers), but also their presence in the related industries (Vertical FDI spillovers) could enhance the performance of local plant. The following hypotheses are set in relative to the chapter objective based on different type of foreign presence.

1. The presence of foreign-invested plants could positively affect the average productivity of local-operated plants who reside in the same industry.

2. The presence of foreign-invested plants in the supplying industries could significantly increase the average productivity of local plants. (Spillovers from upstream industries)

3. The presence of foreign-invested plants in the downstream industries could statistically stimulate the average productivity of local plants. (Spillovers from downstream industries)

In addition, another indicator, local plant's labor productivity, is also directly tested against foreign presences in the industry; the results will be illustrated in parallel to the sector or industry's average productivity. The above hypotheses would be verified against the sample of local plants in manufacturing sector and in eight major industries, which accounted for 71% of our studied sample of local-operated plants.

4.2. Methodology, Data and Measurements

With the Cobb-Douglas production function, the setting could be written as

$$Y_i = A_i f(K_i L_i M_i) \tag{4-1}$$

Where Y_i is the output of the plant i

A_i is the Total factor productivity of the plant i

K_i is the amount of capital as factor of production of plant i

L_i is the number of labor as factor of production of plant i

M_i is the amount of material as factor of productivity of plant i

The log linearized form is

$$y_i = a_i + k_i + l_i + m_i$$

Where the small character of the previously stated variables are the log-linearized form of previously stated variable, and the conventional testing for the plant's TFP are based on the rearrangement of log-linearized form

$$y_i - k_i - l_i - m_i = a_i$$

Where a_i is log of plant's TFP. For the testing regression, (Aitken 1999) use the log linearized Cobb-Douglas regression with the control variables of basic factors of production to verify the effects from foreign presence in the industry on TFP of the firm in Venezuela.

(Javorcik 2004) initiatively augment the measurement of both vertical and horizontal spillover effects to the Aitken and Harrison's equation.

$$\ln(V)_{ij}^{Local} = \beta_0 + \beta_1 \ln(K)_{ij} + \beta_2 \ln(L)_{ij} + \beta_3 Horizontalspill_j + \beta_4 Spillfromdown_j$$

$$+ \beta_5 Spillfromup_j + \sum_{k=1}^{n} \beta_k X_{ki} + \varepsilon_i \tag{4-2}$$

Where V_{ij}^{Local} is the value added of local plant i in industry j, K is capital (measured as plant's beginning fixed asset), L is labor (measured as total labor hours)[26].Where X_k is the vector of control variables, while the foreign presences are measured as described in the table 4.2. In the study by (Ramstetter 2005) had focused his study to the foreign presence in the same industry toward the value added of the local plants. In addition, the testing against local plant's labor productivity is illustrated in appendix section C.1.

As the testing in previous chapter; in order to, have less restrictive assumption on constant return to scale and perfect substitution of inputs. (Ramstetter 2005) had introduced a Translog production function to the spillover effect study; we would also employ the Translog production function throughout this chapter

Type of Spillover	Measurements
Horizontalspill$_j$	Share of output by foreign plants in industry j
Spillfromdown$_j$	$\sum_{k\ if\ k\neq j} \alpha_{jk}\left[\frac{Output^{MNC}}{Ouput^{All}}\right]_k$ Where α_{jk} is portion of industry j output to industry k
Spillfromup$_j$	$\sum_{m\ if\ m\neq j} \varphi_{mj}\left[\frac{Output^{MNC}}{Ouput^{All}}\right]_m$ Where φ_{mj} is portion of industry m output to industry j

Table4.2. Measurements of foreign presences, horizontal, foreign presence in the upstream industries and foreign presence in the downstream industries.

The significance these variables would implies that either the presence of foreign plants in the same or related industries could additionally affect the average productivity or labor productivity of local manufacturing plants in the sector/industries. The regression (4-2) could be adjusted to the following regression.

[26] The full explanation of each measurement of the independent variable is explained in the section 3.2. Table3.3.

$DAge_{ij}$ $DSize_{ij}$ are dummy variables on plant i's age and size (1 if plant i older/larger than industry average, 0 otherwise), and $DBOI_{ij}$ is whether the plant i had received BOI investment privileges. It should be noted that the above estimation is subjected to constant return assumption as its function is based on Cobb-Douglas production function.

$$\ln(V)_{ij}^{Local} = \gamma_0 + \gamma_1 \ln(K)_{ij} + \gamma_2 \ln(L)_{ij} + \gamma_3 \ln((K)_{ij})^2 + \gamma_4 \ln((L)_{ij})^2 + \gamma_5[\ln(K)_{ij} * \ln(L)_{ij}]$$
$$\gamma_6 Horizontalspill_j + \gamma_7 Spillfromdown_j + \gamma_8 Spillfromup_j + \gamma_9 DAge_{ij} + \gamma_{10} DSize_{ij} +$$
$$\gamma_{11} DBOI_{ij} + \varepsilon_i$$

To control for the other plant specific variables, plants' age, size and BOI status are added to the regression. Labor is further decomposed to three types, Skill operative labor ($Skillblue_i$), Non-skill operative labor ($NonSkillBlue_i$) and White collar ($White_i$) labor. Then we can derive regression 4-3, as follow.

$$ln(V)_{ij}^{Local} = \beta_0 + \beta_1. ln[K_i] + \beta_2. ln[SkillBlue_i] + \beta_3. ln[NonSkillBlue_i] +$$
$$\beta_4. ln[White_i] + \beta_5. [ln[K_i]]^2 + \beta_6. [ln[SkillBlue_i]]^2 + \beta_7. [ln[NonSkillBlue_i]]^2 +$$
$$\beta_8. [ln[White_i]]^2 + \beta_9. [ln[K_i]. ln[Skillblue_i]] + \beta_{10}. [ln[K_i]. ln[NonSkillblue_i]] +$$
$$\beta_{11}. [ln[K_i]. ln[White_i]] + \beta_{12}. [ln[Skillblue_i]. ln[NonSkillblue_i]] +$$
$$\beta_{13}. [ln[Skillblue_i]. ln[White_i]] + \beta_{14}. [ln[Nonskillblue_i]. ln[White_i]] +$$
$$\beta_{15}. Horizontal_j + \beta_{16}. Spillfromdown_j + \beta_{17}. Spillfromup_j + \beta_{18}. dSize_i +$$
$$\beta_{19}. dAge_i + \beta_{20}. dBOI_i + \epsilon_i \qquad 4\text{-}4$$

To further control for the industry effect on the local plant's productivity, the industry dummy variables are further added to regression (4-3) and (4-4)[25]; then, we have the following regression in which superscript n is the number of industry (ISIC 5 digits) and subscript k is the number of industry dummy variables.

$$\ln(V)_{ij}^{Local} = \gamma_0 + \gamma_1 \ln(K)_{ij} + \gamma_2 \ln(L)_{ij} + \gamma_3 \ln((K)_{ij})^2 + \gamma_4 \ln((L)_{ij})^2 + \gamma_5[\ln(K)_{ij} * \ln(L)_{ij}]$$
$$\gamma_6 Horizontalspill_j + \gamma_7 Spillfromdown_j + \gamma_8 Spillfromup_j + \gamma_9 DAge_{ij} + \gamma_{10} DSize_{ij} +$$
$$\gamma_{11} DBOI_{ij} + \sum_k^n \beta_k (ISIC_{ik}) + \varepsilon_i \qquad 4\text{-}5$$

And

$$\ln(\mathrm{V})_{ij}^{Local} = \beta_0 + \beta_1.\ln[K_i] + \beta_2.\ln[SkillBlue_i] + \beta_3.\ln[NonSkillBlue_i] + \beta_4.\ln[White_i] + \beta_5.[\ln[K_i]]^2 + \beta_6.[\ln[SkillBlue_i]]^2 + \beta_7.[\ln[NonSkillBlue_i]]^2 + \beta_8.[\ln[White_i]]^2 + \beta_9.[\ln[K_i].\ln[Skillblue_i]] + \beta_{10}.[\ln[K_i].\ln[NonSkillblue_i]] + \beta_{11}.[\ln[K_i].\ln[White_i]] + \beta_{12}.[\ln[Skillblue_i].\ln[NonSkillblue_i]] + \beta_{13}.[\ln[Skillblue_i].\ln[White_i]] + \beta_{14}.[\ln[Nonskillblue_i].\ln[White_i]] + \beta_{15}.Horizontal_j + \beta_{16}.Spillfromdown_j + \beta_{17}.Spillfromup_j + \beta_{18}.dSize_i + \beta_{19}.dAge_i + \beta_{20}.dBOI_i + \sum_k^n \beta_k (ISIC_{ik}) + \epsilon_i \qquad \text{4-6}$$

The anlysis of this plant level data would be performed at both manufacturing sector and at the ISIC two digit level. It should be note that the industry dummy variable employed in this chapter for the analysis at industry level are from the Industry classification at 5 digit level.

The data from (NSO 2007), are employed throughout this study. Industrial census is classified by ISIC code. While the input-output coefficients ($\alpha_{jk}, \pi_{jk}, \varphi_{mj}, and\ \varphi_{mj}$) were compiled from (NESDB 2005) (Thailand‘s Office of National Economic and Social Development Board)[27]. One of the challenges for investigation of vertical spillover is the integration of Input Output table to industrial census. To match with ISIC industry classification, we had complied NESDB's input output coefficients with the NSO industrial classification. The matching of IO 180*180 classification and ISIC 4 digits are shown in all tables in appendix section C.2. In general, there are 78 pairs of the matched ISIC and IO code. The matching in the previous studies was made at the aggregate level; hence, there were less than 20 pairs which could not enable the study of vertical spillover at major industry level. With this matching, it can further allow us to investigate the analyze spillover effects at the industry level. The underlying advantage of using NSO industrial census is relatively large no. of observations which alleviate the outliner problem caused by either misfiling the answer or misunderstanding the question by respondents which are relatively common in paper based questionnaire survey.

[27] Since we scope our analysis on the impact of foreign plants in manufacturing sector, the input/output coefficients are based on the manufacturing sector only

4.3. Results

The descriptive table and analysis was discussed in the previous chapter. We firstly discussed the results from regression 2 (without the measurements of vertical spillover variables) but with various measurements of horizontal spillover.

4.3.1. Horizontal spillover effects

	Two-factors model			Four-factor model		
	Output	Labor	R&D	Output	Labor	R&D
Model w/o industry effect						
Hor. Spill Coefficient	0.98%	1.44%	0.20%	1.06%	1.47%	0.19%
p-value	(0.00)	(0.00)	(0.00)	(000)	(0.00)	(0.00)
Model w industry effect						
Hor. Spill. Coefficient	-0.05%	0.63%	-0.13%	-0.15%	0.48%	-0.18%
p-value	(0.51)	(0.00)	(0.00)	(0.08)	(0.00)	(0.00)

Table4.3. Coefficients' values of various measurements of foreign presences for horizontal spillover[28]

If we drop both of vertical spillover variables from both two and four factor based regression, and with further replacement of foreign presence through industry' MNC employment and R&D expenditure share (please see review of literatures part 2.4).

We found the strongest magnitude of positive spillover effects when the foreign presence is measured as MNCs' labor share in the industry. This result reinforces the previous finding by (Haacker 1999) which marked the vital role of labor mobility channel. Interestingly, the results from regressions which we had controlled for the industry effects still marked the significance of positive spillover toward the local plant's production from labor mobility channels. While other channels of spillovers in the model with could not either statistically influence or even negatively affect the local plant's production.

The following table summarizes the spillover effects on local plants' labor productivity based on each spillover channels.

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[28] The number in parenthesis is the p-value of each coefficient. Full details of the model are available in the appendix section C.

Labor Productivity of Local plants	Regression Appendix C-1 and C-2 (without vertical spillover variables) Output	Labor	R&D
Model w/o industry effect			
Hor. Spill. Coefficient	0.60%	0.77%	0.20%
p-value	(0.00)	(0.00)	(0.00)
Model w industry effect			
Hor. Spill. Coefficient	-0.30%	0.14%	-0.08%
p-value	(0.00)	(0.11)	(0.03)

Table4.4. Coefficients' values of various measurements of foreign presences for horizontal spillover[29]: Effects toward the local plant's labor productivity.

The pattern of the results on horizontal spillover effects toward the local plant's labor productivity is relatively similar to the previous table, in which, a positive spillover effects are found through different measurement in the model without the control for industry effects. However, these evidences of favorable effects disappear when the industry effects have been accounted for. In fact, the evidences of weak adverse effects through competition and demonstration effects are found instead. These results from both tables suggest that with the proper control of industry effect, spillovers are less statistically visible than our preliminary perception. As stated in the previous empirical findings, spillover effects are simply could be the industry-specific effects.

4.3.2. Horizontal spillovers and Spillover effects from up/down stream industries

First the results from manufacturing are discussed; then, the results of 8 major industries are discussed in ISIC two digit descending order.

4.3.2.1. For manufacturing sector

We found the evidences of positive horizontal spillover in both two and four-factor in the regressions with full consideration of all spillover layers. Positive spillover effects from foreign presence in the supplying industries are also reported. Results are relatively robust across two and four factors model, with or without industry effect control variable. As suggested by the conceptual frameworks, the expansion

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[29] The number in parenthesis is the p-value of each coefficient. Full details of the model are available in the appendix Section C.

of the output share by foreign plant in the industry or in the supplying industries could enhance both production and labor productivity of local plants. However, their expansion in client industries could adversely affect the labor productivity and production of local plants.

(n)=9569	Manufacturing sector			
	Equation Appendix C-1		Equation Appendix C-2	
	Coefficient	p-value	Coefficient	p-value
V/L as dependent variable				
C	4.2330	(0.00)	-	-
ln(K/L)	0.2317	(0.00)	0.2328	(0.00)
ln(SkillBlue/L)	0.0103	(0.00)	0.0100	(0.00)
ln(NonSkillBlue/L)	0.0002	(0.89)	0.0003	(0.84)
ln(White/L)	0.0307	(0.00)	0.0301	(0.00)
Spillfromupstream	0.0053	(0.00)	-0.0010	(0.44)
Horizontalspill	0.0066	(0.00)	0.0019	(0.06)
Spilfromdownstream	-0.0058	(0.00)	-0.0095	(0.00)
SIZEDUMMY	0.5822	(0.00)	0.5630	(0.00)
AGEDUMMY	0.0390	(0.03)	0.0355	(0.04)
BOIDUMMY	0.0036	(0.87)	0.0219	(0.34)
Industry Dummy	-	-	See Appendix C	
Adjusted R square	0.252		0.317	

Table4.5. Results from Equation Appendix C-1 and Appendix C-2 (Effects toward the labor productivity of local plants)

	Manufacturing Sector			
	Eq. (4-3)		Eq. (4-5)	
Two-Factor model	Coefficient	p-value	Coefficient	p-value
C	15.7916	(0.00)	-	-
ln(K)	0.2177	(0.00)	0.2232	(0.00)
ln(L)	0.5971	(0.00)	0.6210	(0.00)
$(\ln(K))^2$	-0.0175	(0.00)	-0.0138	(0.00)
$(\ln(L))^2$	0.0014	(0.90)	-0.0142	(0.18)
(ln(K))*(ln(L))	-0.0060	(0.58)	-0.0099	(0.33)
Spillfromupstream	0.0078	(0.00)	-0.0085	(0.00)
Horizontalspill	0.0058	(0.00)	0.0043	(0.00)
Spillfromdownstream	0.0000	(0.99)	-0.0059	(0.00)
SIZEDUMMY	0.9671	(0.00)	0.9441	(0.00)
AGEDUMMY	0.1024	(0.00)	0.0938	(0.00)
BOIDUMMY	0.3055	(0.00)	0.2593	(0.00)
Industry Dummy	N/A	N/A	Appendix C3	
adjusted R square	0.682		0.717	
Observation	9,569		9,569	
	Eq. (4-4)		Eq. (4-6)	
Four-Factor model	Coefficient	p-value	Coefficient	p-value
C	15.0645	(0.00)	-	-
ln(K)	0.2421	(0.00)	0.2442	(0.00)
ln(SkillBlue)	0.1750	(0.00)	0.1968	(0.00)
ln(NonSkillBlue)	0.0338	(0.00)	0.0356	(0.00)
ln(White)	0.0850	(0.00)	0.0885	(0.00)
$(\ln(K))^2$	0.0058	(0.02)	0.0047	(0.04)
$(\ln(SkillBlue))^2$	0.0161	(0.00)	0.0175	(0.00)
$(\ln(Nonskillblue))^2$	0.0116	(0.00)	0.0104	(0.00)
$(\ln(White))^2$	0.0094	(0.00)	0.0102	(0.00)
(ln(K))*(ln(SkillBlue))	-0.0120	(0.00)	-0.0096	(0.00)
(ln(K))*(ln(NonSk)	-0.0103	(0.00)	-0.0083	(0.00)
(ln(K))*(ln(White))	-0.0208	(0.00)	-0.0200	(0.00)
(ln(Sk))*(ln(NonSk))	0.0031	(0.01)	0.0011	(0.33)
(ln(Sk))*(ln(White))	-0.0030	(0.00)	-0.0031	(0.00)
(ln(NonSkill))*(ln(White))	-0.0011	(0.02)	-0.0012	(0.01)
Spillfromupstream	0.7817	(0.00)	-0.7380	(0.00)
Horizontalspill	0.7091	(0.00)	0.3505	(0.00)
Spillfromdownstream	-0.0767	(0.42)	-0.6643	(0.00)
SIZEDUMMY	1.2176	(0.00)	1.1646	(0.00)
AGEDUMMY	0.1028	(0.00)	0.0938	(0.00)
BOIDUMMY	0.3411	(0.00)	0.3063	(0.00)
Industry Dummy	N/A	N/A	Appendix C3	
adjusted R square	0.674		0.708	
Observation	9,569		9,569	

Table4.6. Results from regression (4-3) to (4-6), Spillover effects toward the local plants in manufacturing.[30]

[30] The full reports of the coefficients are illustrated in the appendix section C.

In order to further investigate whether these founded externalities are industry specific effect, foreign plants select to operate in the industry with high productivity, we decided to implement the above testing procedure at the industry level[31].

4.3.2.2. Manufacture of food products and beverage [ISIC 15]

In term of local plant's production, we found that the presence of foreign operated plants in the upstream industries could actually harm the local food product and beverage manufacturers and this result is relatively robust across different types of the model. It should be noted that the negative magnitude is more severe in the models which we had controlled for the industry specific effect. We found no evidence of spillover effects from the presence of foreign plants in the downstream industries. While another adverse effect from the horizontal spillover effect is found in two-factor production model. However, these effects are not statistically significant in the model which we further relax the assumption of heterogeneous productivity within the industry eq. (4-6).

In term of labor productivity, we found no statistical evidence of horizontal spillovers; which implies that the expansion of foreign plants in the industry could neither increase the labor productivity nor the production of local plant as previously claimed in the sample of manufacturing sector. While the negative spillover effects from foreign presence in the downstream industries are again found toward the local plant's labor productivity. To conclude, evidences does not statistically concur that the performance of domestically-operated food and beverage producers would be enhanced by the existence of foreign plants, either in the same or related industries. Instead, we found robust evidence on the negative influences from their presence in upstream industries.

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[31] Through ISIC 2 digit based classification, the analysis is possible in 8 major industries, which account for 71% of total plant observatrions in the manufacturing sector.

4.3.2.3. Manufacturing of Textiles [ISIC 17]

From the left panel of the table 4.5, we found evidence of positive spillover effects toward the local plant's production and labor productivity in the models without industry effect control dummy variables (4-3) and (4-4).

The positive horizontal influence could potentially explain positive spillovers from foreign presence in up/down stream industries. However, these report of positive spillover effect is invalid in the regressions which we had control for industry specific effect. Negative effects from the foreign presence in the supplying industries are statistically reported in the results from all production regressions. In addition, this adverse effect is more severe in the industry effects model. For example, a percent increase in the foreign presence in upstream industries could significantly lead to a decline in local plants' production by 15% as reported in eq. (4-6), lower left panel of table 4.5. The plausible explanation is the possible destruction of existing local suppliers as foreign plant expanded in those supplying industries. A diminishing performance of existing local suppliers; for instant, domestic plants in spinning and weaving industries, could negatively influence the production of local textile producers. Interestingly, no evidence of negative spillover from foreign presence in the downstream industries was found regardless of whether the local plants' performance is either measured through labor productivity or value added terms. Both of the two-factor and four-factor production based models consistently reveals the insignificant of spillovers from downstream industries. For other plant's characteristics, plant's relative size and age are statistically reported in every model.

(n)=1605	Food Product and Beverage ISIC (15)			
	Coefficient	p-value	Coefficient	p-value
V/L as dependent variable				
C	4.8673	(0.00)	-	-
ln(K/L)	0.2912	(0.00)	0.2732	(0.00)
ln(SkillBlue/L)	0.0109	(0.14)	0.0093	(0.19)
ln(NonSkillBlue/L)	0.0013	(0.79)	0.0009	(0.85)
ln(White/L)	0.0281	(0.00)	0.0238	(0.00)
Spillfromupstream	0.0028	(0.22)	-0.0199	(0.01)
Horizontalspill	-0.0061	(0.10)	0.0063	(0.45)
Spilfromdownstream	-0.0198	(0.00)	-0.0290	(0.01)
SIZEDUMMY	0.7401	(0.00)	0.6253	(0.00)
AGEDUMMY	0.0932	(0.05)	0.1027	(0.02)
BOIDUMMY	-0.0945	(0.11)	0.0744	(0.21)
Industry Dummy	N/A	N/A	Appendix C.3.	
Adjusted R-square	0.3602		0.3159	
V as dependent variable: Two-Factors		Eq.(4-3)	Eq.(4-5)	
C	17.1172	(0.00)	-	-
ln(K)	0.2558	(0.00)	0.2516	(0.00)
ln(L)	0.6256	(0.00)	0.6722	(0.00)
(ln(K))2	-0.0251	(0.00)	-0.0261	(0.00)
(ln(L))2	-0.0278	(0.24)	-0.0110	(0.62)
(ln(K))*(ln(L))	0.0094	(0.70)	-0.0021	(0.93)
Spillfromupstream	-0.0170	(0.00)	-0.0248	(0.00)
Horizontalspill	-0.0191	(0.00)	-0.0067	(0.43)
Spillfromdownstream	-0.0030	(0.50)	-0.0026	(0.82)
SIZEDUMMY	1.1692	(0.00)	0.9336	(0.00)
AGEDUMMY	0.1228	(0.01)	0.1313	(0.00)
BOIDUMMY	0.2682	(0.00)	0.2000	(0.00)
Industry Dummy	N/A	N/A	Appendix C.3.	
Adjusted R square	0.752893		0.8005	
V as dependent variable: Four-Factors		Eq.(4-4)	Eq.(4-6)	
C	16.4410	(0.00)	-	-
ln(K)	0.3083	(0.00)	0.2804	(0.00)
ln(SkillBlue)	0.1274	(0.00)	0.2185	(0.00)
ln(NonSkillBlue)	0.0513	(0.00)	0.0617	(0.00)
ln(White)	0.0606	(0.00)	0.0749	(0.00)
$(ln(K))^2$	0.0064	(0.29)	-0.0035	(0.54)
$(ln(SkillBlue))^2$	0.0098	(0.00)	0.0189	(0.00)
$(ln(Nonskillblue))^2$	0.0124	(0.00)	0.0123	(0.00)
$(ln(White))^2$	0.0055	(0.02)	0.0102	(0.00)
(ln(K))*(ln(SkillBlue))	-0.0043	(0.42)	-0.0042	(0.39)
(ln(K))*(ln(NonSk)	-0.0066	(0.05)	-0.0055	(0.07)
(ln(K))*(ln(White))	-0.0194	(0.00)	-0.0164	(0.00)
(ln(Sk))*(ln(NonSk))	-0.0006	(0.83)	-0.0045	(0.07)
(ln(Sk))*(ln(White))	-0.0040	(0.03)	-0.0043	(0.01)
(ln(NonSkill))*(ln(White))	-0.0041	(0.00)	-0.0042	(0.00)
Spillfromupstream	-0.0177	(0.00)	-0.0336	(0.00)
Horizontalspill	-0.0166	(0.00)	-0.0050	(0.57)
Spilfromdownstream	-0.0088	(0.06)	-0.0167	(0.14)
SIZEDUMMY	1.4976	(0.00)	1.1479	(0.00)
AGEDUMMY	0.1097	(0.03)	0.1136	(0.02)
BOIDUMMY	0.3249	(0.00)	0.2558	(0.00)
Industry Dummy	N/A	N/A	Appendix C.3.	
Adjusted R square	0.7377		0.7899	

Table4.7. Results from regression (4-3) to (4-6), spillover effects toward local plants in manufacturer of foods and beverages (ISIC 15)[32]

[32] The full reports of the industry dummy coefficient coefficients are illustrated in the appendix C.

(n)=770	Textiles (ISIC 17)			
	Coefficient	p-value	Coefficient	p-value
V/L as dependent variable				
C	4.9226	(0.00)	-	-
ln(K/L)	0.3064	(0.00)	0.2931	(0.00)
ln(SkillBlue/L)	0.0226	(0.04)	0.0175	(0.10)
ln(NonSkillBlue/L)	-0.0020	(0.77)	-0.0083	(0.22)
ln(White/L)	0.0677	(0.00)	0.0611	(0.00)
Spillfromupstream	-0.0428	(0.00)	-0.0438	(0.26)
Horizontalspill	0.0099	(0.03)	-0.0067	(0.86)
Spilfromdownstream	0.0076	(0.21)	0.0032	(0.87)
SIZEDUMMY	0.2632	(0.01)	0.2106	(0.02)
AGEDUMMY	0.1886	(0.00)	0.1734	(0.01)
BOIDUMMY	-0.0470	(0.62)	-0.0098	(0.92)
Industry Dummy	N/A	N/A	Appendix C.3.	
Adjusted R-square	0.5278		0.5681	
V as dependent variable: Two-Factors		Eq.(4-3)	Eq.(4-5)	
C	17.7564	(0.00)	-	-
ln(K)	0.3434	(0.00)	0.3204	(0.00)
ln(L)	0.6703	(0.00)	0.6634	(0.00)
(ln(K))2	-0.0097	(0.28)	0.0032	(0.70)
(ln(L))2	0.0150	(0.70)	0.0344	(0.35)
(ln(K))*(ln(L))	-0.0572	(0.07)	-0.0700	(0.02)
Spillfromupstream	-0.0561	(0.00)	-0.1055	(0.01)
Horizontalspill	0.0126	(0.01)	0.0376	(0.34)
Spillfromdownstream	-0.0075	(0.25)	-0.0181	(0.37)
SIZEDUMMY	0.6071	(0.00)	0.4810	(0.00)
AGEDUMMY	0.2885	(0.00)	0.2607	(0.00)
BOIDUMMY	0.0523	(0.62)	0.0395	(0.69)
Industry Dummy	N/A	N/A	Appendix C.3.	
Adjusted R square	0.8078		0.8408	
V as dependent variable: Four-Factors		Eq.(4-4)	Eq.(4-6)	
C	16.4760	(0.00)	-	-
ln(K)	0.2624	(0.00)	0.2532	(0.00)
ln(SkillBlue)	0.1444	(0.00)	0.2263	(0.00)
ln(NonSkillBlue)	0.0396	(0.00)	0.0446	(0.00)
ln(White)	0.1209	(0.00)	0.1254	(0.00)
$(ln(K))^2$	0.0156	(0.04)	0.0131	(0.06)
$(ln(SkillBlue))^2$	0.0103	(0.01)	0.0138	(0.00)
$(ln(Nonskillblue))^2$	0.0195	(0.00)	0.0179	(0.00)
$(ln(White))^2$	0.0126	(0.00)	0.0168	(0.00)
(ln(K))*(ln(SkillBlue))	-0.0044	(0.57)	0.0018	(0.80)
(ln(K))*(ln(NonSk)	-0.0142	(0.00)	-0.0074	(0.06)
(ln(K))*(ln(White))	-0.0286	(0.00)	-0.0268	(0.00)
(ln(Sk))*(ln(NonSk))	0.0016	(0.76)	-0.0091	(0.06)
(ln(Sk))*(ln(White))	-0.0059	(0.09)	-0.0038	(0.23)
(ln(NonSkill))*(ln(White))	-0.0010	(0.53)	0.0001	(0.93)
Spillfromupstream	-0.0552	(0.00)	-0.1467	(0.00)
Horizontalspill	0.0091	(0.06)	0.0580	(0.13)
Spilfromdownstream	0.0012	(0.85)	-0.0190	(0.32)
SIZEDUMMY	0.9426	(0.00)	0.6436	(0.00)
AGEDUMMY	0.2454	(0.00)	0.1841	(0.00)
BOIDUMMY	0.1438	(0.16)	0.1129	(0.23)
Industry Dummy	N/A	N/A	Appendix C.3.	
Adjusted R square	0.8248		0.8567	

Table4.8. Results from regression (4-3) to (4-6), spillover effects toward local plants in manufacture of textiles (ISIC 17)

4.3.2.4. Manufacture of wood products (except furniture) and paper products (ISIC 20-21)

Results are illustrated in table 4.8. With the control for industry effects, we found evidences that show the positive linkage between foreign market share's expansion and the value added of local plants and the magnitude of spillovers are as high as 3.19% and 2.80% in the two-factor and four-factors model respectively.

Positive spillover effects from foreign presence in the upstream industries were found in the model without industry control variables; however, a strong adverse effect was revealed in the models with industry effect control variables. These contradictory results suggest that the spillover effects for these two industries are industries specific effect as suggested by (Ramstetter 2005).

Another possible explanation is that due to limitation of number of foreign-plant observations in manufacture of wood products and the number of multinational plant observations in paper industries, we have to combine these two industries together. Hence, these grouping could lead to a discrepancy in the results across the models with and without industry effect.

The presence of foreign plants in the buying industries could harm both labor productivity and production of local-operated plants. As suggested by (Markusen) illustrated in the theory of MNC chapter, the expansion of foreign plants in the client industries could potentially crowd out the existing buyers of local suppliers. This phenomenon particularly happens in the case that foreign plants have an exclusive contract with foreign suppliers in the host nation.   Again, relative size of the local plants does statistically matter, while other plants' characteristics, relative age and BOI status of the plants are mostly not significant.

4.3.2.5. Manufacture of chemical and chemical products (ISIC 24)

Results are illustrated in table 4.9. Positive spillover effects from the presence of foreign chemical products manufacturers are consistently found throughout all models, and the magnitude of the effect could be as high as 6.2% toward the local plant's labor productivity and 8.13% toward the local plants production.

In the previous chapter, we found strong evidence of productivity differential in between local and foreign plants in the manufacture of chemical product industry. In addition, it should be noted that foreign plants plays significant role in the production of this industry. The negative spillover effects from foreign presence in upstream industries are consistently reported in all models instead. For instance, the magnitude of -24% is reported in the case the four-factor functions with industry control variables.

Interestingly, the magnitude of the plants' relative size is large in comparison to other industries. This remarks the importance of economy of scale production as frequently revealed in this high-technology industries. Plant in these industries, mainly purchase their input from Manufacturer of basic chemical (ISIC 2411/IO code 84). Foreign plants account for 31% of output share this basic chemical industry. Moreover; a closer look at the industrial structure of this basic chemical industry revealed that approximately 1/3 of the industry output are supplied by top 5 plants, and 3 of them are foreign plants. This implies high domination of foreign plants in the industry which could adversely affect small local basic chemical plants and eventually transmitted to other local manufacturer who source their input from those basic chemical local manufacturers.

(n)=846	Woods product and Paper (ISIC 20-21)			
	Coefficient	p-value	Coefficient	p-value
V/L as dependent variable				
C	4.0094	(0.00)	-	-
ln(K/L)	0.2329	(0.00)	0.2046	(0.00)
ln(SkillBlue/L)	0.0155	(0.15)	0.0006	(0.95)
ln(NonSkillBlue/L)	0.0026	(0.63)	0.0009	(0.87)
ln(White/L)	0.0293	(0.00)	0.0247	(0.00)
Spillfromupstream	0.0248	(0.00)	-0.0611	(0.12)
Horizontalspill	0.0011	(0.76)	0.0176	(0.11)
Spilfromdownstream	-0.0139	(0.00)	-0.0262	(0.02)
SIZEDUMMY	0.6492	(0.00)	0.6179	(0.00)
AGEDUMMY	0.0157	(0.77)	0.0089	(0.86)
BOIDUMMY	-0.0868	(0.22)	-0.0536	(0.44)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R-square	0.3834		0.4544	
V as dependent variable: Two-Factors		Eq.(4-3)	Eq.(4-5)	
C	15.6688	(0.00)	-	-
ln(K)	0.2327	(0.00)	0.2132	(0.00)
ln(L)	0.5709	(0.00)	0.6128	(0.00)
(ln(K))2	0.0035	(0.75)	0.0188	(0.06)
(ln(L))2	-0.0532	(0.23)	-0.0189	(0.64)
(ln(K))*(ln(L))	-0.0293	(0.46)	-0.0681	(0.05)
Spillfromupstream	0.0279	(0.00)	-0.1801	(0.00)
Horizontalspill	0.0066	(0.08)	0.0319	(0.00)
Spillfromdownstream	-0.0187	(0.00)	-0.0509	(0.00)
SIZEDUMMY	1.0780	(0.00)	0.9594	(0.00)
AGEDUMMY	0.1003	(0.09)	0.0671	(0.20)
BOIDUMMY	0.1771	(0.02)	0.0851	(0.24)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R square	0.7147		0.7793	
V as dependent variable: Four-Factors		Eq. (4-4)	Eq.(4-6)	
C	14.9597	(0.00)	-	-
ln(K)	0.2347	(0.00)	0.2343	(0.00)
ln(SkillBlue)	0.2486	(0.00)	0.2563	(0.00)
ln(NonSkillBlue)	0.0471	(0.00)	0.0489	(0.00)
ln(White)	0.0760	(0.00)	0.0791	(0.00)
(ln(K))2	0.0108	(0.15)	0.0038	(0.58)
(ln(SkillBlue))2	0.0230	(0.00)	0.0214	(0.00)
(ln(Nonskillblue))2	0.0128	(0.00)	0.0109	(0.00)
(ln(White))2	0.0094	(0.00)	0.0100	(0.00)
(ln(K))*(ln(SkillBlue))	-0.0191	(0.00)	-0.0075	(0.22)
(ln(K))*(ln(NonSk)	-0.0059	(0.14)	-0.0014	(0.71)
(ln(K))*(ln(White))	-0.0154	(0.00)	-0.0108	(0.01)
(ln(Sk))*(ln(NonSk))	0.0008	(0.85)	-0.0049	(0.20)
(ln(Sk))*(ln(White))	0.0034	(0.28)	0.0009	(0.76)
(ln(NonSkill))*(ln(White))	0.0009	(0.52)	0.0009	(0.50)
Spillfromupstream	0.0316	(0.00)	-0.1963	(0.00)
Horizontalspill	0.0043	(0.25)	0.0280	(0.01)
Spilfromdownstream	-0.0219	(0.00)	-0.0626	(0.00)
SIZEDUMMY	1.0399	(0.00)	0.9561	(0.00)
AGEDUMMY	0.0475	(0.42)	0.0311	(0.56)
BOIDUMMY	0.1167	(0.14)	0.0605	(0.42)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R square	0.7170		0.7725	

Table4.9. Results from regression (4-3) to (4-6), spillover effects toward local plants in manufacture of wood products and paper (ISIC 20-21)

(n)=648	Chemical Product (ISIC 24)			
	Coefficient	p-value	Coefficient	p-value
V/L as dependent variable				
C	5.2522	(0.00)	-	-
ln(K/L)	0.2597	(0.00)	0.2547	(0.00)
ln(SkillBlue/L)	-0.0134	(0.35)	-0.0206	(0.14)
ln(NonSkillBlue/L)	-0.0064	(0.37)	-0.0068	(0.32)
ln(White/L)	0.0364	(0.00)	0.0319	(0.00)
Spillfromupstream	-0.0253	(0.06)	-0.1404	(0.02)
Horizontalspill	0.0162	(0.01)	0.0620	(0.00)
Spilfromdownstream	-0.0012	(0.83)	0.0136	(0.59)
SIZEDUMMY	0.7357	(0.00)	0.6860	(0.00)
AGEDUMMY	0.2584	(0.00)	0.2013	(0.00)
BOIDUMMY	-0.0163	(0.85)	-0.0509	(0.54)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R-square	0.3503		0.4622	
V as dependent variable: Two-Factors	Eq.(4-3)		Eq.(4-5)	
C	19.4093	(0.00)	-	-
ln(K)	0.1921	(0.00)	0.2167	(0.00)
ln(L)	0.5732	(0.00)	0.5938	(0.00)
(ln(K))2	-0.0451	(0.00)	-0.0287	(0.00)
(ln(L))2	-0.0461	(0.36)	-0.0314	(0.49)
(ln(K))*(ln(L))	0.0209	(0.59)	0.0000	(1.00)
Spillfromupstream	-0.0851	(0.00)	-0.1696	(0.00)
Horizontalspill	0.0332	(0.00)	0.0620	(0.00)
Spillfromdownstream	-0.0072	(0.22)	0.0239	(0.33)
SIZEDUMMY	1.1515	(0.00)	1.0337	(0.00)
AGEDUMMY	0.2838	(0.00)	0.2044	(0.00)
BOIDUMMY	0.2015	(0.02)	0.0608	(0.47)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R square	0.6968		0.7632	
V as dependent variable: Four-Factors	Eq. (4-4)		Eq.(4-6)	
C	19.7178	(0.00)	-	(0.00)
ln(K)	0.1846	(0.00)	0.2007	(0.00)
ln(SkillBlue)	0.2180	(0.00)	0.2749	(0.00)
ln(NonSkillBlue)	0.0395	(0.00)	0.0416	(0.00)
ln(White)	0.0604	(0.00)	0.1098	(0.00)
$(\ln(K))^2$	-0.0195	(0.04)	-0.0146	(0.10)
$(\ln(SkillBlue))^2$	0.0202	(0.00)	0.0236	(0.00)
$(\ln(Nonskillblue))^2$	0.0103	(0.00)	0.0077	(0.02)
$(\ln(White))^2$	0.0035	(0.22)	0.0107	(0.00)
(ln(K))*(ln(SkillBlue))	-0.0026	(0.82)	0.0067	(0.53)
(ln(K))*(ln(NonSk)	-0.0070	(0.17)	-0.0009	(0.85)
(ln(K))*(ln(White))	-0.0165	(0.01)	-0.0129	(0.02)
(ln(Sk))*(ln(NonSk))	-0.0037	(0.59)	-0.0090	(0.15)
(ln(Sk))*(ln(White))	-0.0087	(0.07)	-0.0106	(0.01)
(ln(NonSkill))*(ln(White))	-0.0029	(0.18)	-0.0031	(0.12)
Spillfromupstream	-0.1079	(0.00)	-0.2473	(0.00)
Horizontalspill	0.0390	(0.00)	0.0813	(0.00)
Spilfromdownstream	-0.0112	(0.07)	0.0242	(0.34)
SIZEDUMMY	1.3572	(0.00)	1.1336	(0.00)
AGEDUMMY	0.3024	(0.00)	0.2204	(0.00)
BOIDUMMY	0.2218	(0.02)	0.0958	(0.26)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R square	0.6849		0.7567	

Table4.10. Results from regression (4-3) to (4-6), spillover effects toward local plants in manufacture of chemical and chemical product (ISIC 24)

4.3.2.6. Manufacture of non-metallic product (ISIC 26)

There evidence of positive horizontal spillover is shown in the table 4.8, and the results are consistent across two and four factor model. The interpretation of this positive influence is based on the improvement existing local buyers' productivity through fair level of competition effect from modest level of foreign presence in non-metallic industry. However, this effect does not statistically valid in the model in which we control for industry specific effect. While a week evidence of negative spillover from the presence of foreign plants in the downstream industries is detected in the equation (4-3) and (4-4); however, these effects are also invalid in the industry controlled model. Regardless of type and layer of spillover effects, no spillover effects are found in the models which industry dummy variables have been accounted for.

4.3.2.7. Manufacture of Basic and Fabricated metal (ISIC 27 and ISIC 28)

A consistent evidence of positive spillover effects from foreign presence in the downstream industries are reported throughout most employed regressions. We found positive horizontal spillover effects in both two-factor and four factor based regression; but, this positive effect disappear if our regression has been controlled for industry effect.

It should be stated that no evidences of horizontal spillover effect are found in the models which the industry effects have been accounted for, while crowding effects can be found in the baseline models. The plausible explanation is that plants in these two industries remarkably diversified as there are 62 sub industries in these two industries. As the same as previously reported industries, the coefficient of local plant's relative size are statistically reported at 0.05 level of significant. In addition, the magnitude of skill labor's coefficient is relatively high in comparison with this coefficient value in the previous industries. This implies that the local plant's productions in these industries are significantly linked with the skill-labor operative hours.

(n)=686	Non-Metallic (ISIC 26)			
	Coefficient	p-value	coefficient	p-value
V/L as dependent variable				
C	4.9849	(0.00)	-	-
ln(K/L)	0.1986	(0.00)	0.1877	(0.00)
ln(SkillBlue/L)	0.0059	(0.63)	0.0085	(0.47)
ln(NonSkillBlue/L)	0.0029	(0.67)	0.0063	(0.34)
ln(White/L)	0.0213	(0.01)	0.0147	(0.05)
Spillfromupstream	-0.0157	(0.00)	-0.0032	(0.81)
Horizontalspill	0.0028	(0.78)	-0.0031	(0.87)
Spilfromdownstream	-0.0057	(0.34)	-0.0139	(0.24)
SIZEDUMMY	0.8027	(0.00)	0.7675	(0.00)
AGEDUMMY	-0.1455	(0.03)	-0.1455	(0.02)
BOIDUMMY	-0.0664	(0.53)	-0.1036	(0.33)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R-square	0.2725		0.3769	
V as dependent variable: Two-Factors		Eq. (4-3)	Eq.(4-5)	
C	15.9702	(0.00)	-	-
ln(K)	0.2066	(0.00)	0.1904	(0.00)
ln(L)	0.7619	(0.00)	0.7271	(0.00)
(ln(K))2	0.0362	(0.00)	0.0266	(0.01)
(ln(L))2	-0.0744	(0.09)	-0.0455	(0.26)
(ln(K))*(ln(L))	-0.0640	(0.09)	-0.0602	(0.09)
Spillfromupstream	0.0022	(0.70)	0.0072	(0.58)
Horizontalspill	0.0300	(0.00)	0.0109	(0.56)
Spillfromdownstream	-0.0137	(0.03)	-0.0167	(0.15)
SIZEDUMMY	1.0194	(0.00)	1.0249	(0.00)
AGEDUMMY	-0.0990	(0.16)	-0.0951	(0.13)
BOIDUMMY	0.0563	(0.62)	0.0341	(0.75)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R square	0.6757		0.7480	
V as dependent variable: Four-Factors		Eq. (4-4)	Eq.(4-6)	
C	15.2736	(0.00)	-	C
ln(K)	0.2323	(0.00)	0.2115	(0.00)
ln(SkillBlue)	0.2454	(0.00)	0.2479	(0.00)
ln(NonSkillBlue)	0.0325	(0.00)	0.0390	(0.00)
ln(White)	0.0574	(0.00)	0.0786	(0.00)
$(\ln(K))^2$	0.0247	(0.01)	0.0112	(0.18)
$(\ln(SkillBlue))^2$	0.0211	(0.00)	0.0208	(0.00)
$(\ln(Nonskillblue))^2$	0.0139	(0.00)	0.0112	(0.00)
$(\ln(White))^2$	0.0042	(0.19)	0.0102	(0.00)
(ln(K))*(ln(SkillBlue))	-0.0024	(0.77)	-0.0036	(0.64)
(ln(K))*(ln(NonSk)	-0.0072	(0.12)	-0.0062	(0.13)
(ln(K))*(ln(White))	-0.0203	(0.00)	-0.0129	(0.01)
(ln(Sk))*(ln(NonSk))	-0.0041	(0.34)	-0.0052	(0.19)
(ln(Sk))*(ln(White))	-0.0070	(0.02)	-0.0063	(0.02)
(ln(NonSkill))*(ln(White))	-0.0019	(0.29)	-0.0012	(0.46)
Spillfromupstream	-0.0053	(0.38)	0.0037	(0.79)
Horizontalspill	0.0378	(0.00)	0.0102	(0.61)
Spilfromdownstream	-0.0157	(0.02)	-0.0193	(0.12)
SIZEDUMMY	1.2493	(0.00)	1.1956	(0.00)
AGEDUMMY	-0.0480	(0.51)	-0.0529	(0.43)
BOIDUMMY	0.0889	(0.46)	0.0563	(0.62)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R square	0.6473		0.7232	

Table4.11. Results from regression (4-3) to (4-6), spillover effects toward local plants in manufacture of non-metallic (ISIC 26)

(n)=1305	Basic and Fabricated metal (ISIC 27-28)			
	Coefficient	p-value	Coefficient	p-value
V/L as dependent variable				
C	6.3844	(0.00)	-	-
ln(K/L)	0.1725	(0.00)	0.1677	(0.27)
ln(SkillBlue/L)	-0.0124	(0.22)	-0.0116	(0.82)
ln(NonSkillBlue/L)	-0.0002	(0.96)	-0.0009	(0.01)
ln(White/L)	0.0145	(0.00)	0.0130	(0.02)
Spillfromupstream	-0.0479	(0.00)	-0.0505	(0.14)
Horizontalspill	-0.0019	(0.42)	0.0113	(0.49)
Spilfromdownstream	-0.0011	(0.55)	0.0044	(0.00)
SIZEDUMMY	0.6619	(0.00)	0.6609	(0.67)
AGEDUMMY	-0.0147	(0.70)	-0.0168	(0.32)
BOIDUMMY	0.0888	(0.18)	0.0682	(0.00)
Industry Dummy	-	-	Appendix C	
Adjusted R-square	0.2763		0.2871	
V as dependent variable: Two-Factors		Eq. (4-3)	Eq.(4-5)	
C	19.0517	(0.00)	-	-
ln(K)	0.1746	(0.00)	0.1716	(0.00)
ln(L)	0.6772	(0.00)	0.7033	(0.00)
(ln(K))2	0.0092	(0.33)	0.0120	(0.20)
(ln(L))2	-0.0472	(0.14)	-0.0464	(0.15)
(ln(K))*(ln(L))	-0.0366	(0.22)	-0.0471	(0.12)
Spillfromupstream	-0.0841	(0.00)	-0.0826	(0.00)
Horizontalspill	-0.0055	(0.02)	0.0065	(0.39)
Spillfromdownstream	0.0102	(0.00)	0.0190	(0.00)
SIZEDUMMY	1.0472	(0.00)	1.0075	(0.00)
AGEDUMMY	0.0200	(0.61)	0.0130	(0.74)
BOIDUMMY	0.2070	(0.00)	0.1628	(0.02)
Industry Dummy	-	-	Appendix C	
Adjusted R square	0.7370		0.7528	
V as dependent variable: Four-Factors		Eq. (4-4)	Eq.(4-6)	
C	18.2250	(0.00)	-	-
ln(K)	0.1955	(0.00)	0.1927	(0.00)
ln(SkillBlue)	0.3034	(0.00)	0.3002	(0.00)
ln(NonSkillBlue)	0.0355	(0.00)	0.0343	(0.00)
ln(White)	0.1186	(0.00)	0.1318	(0.00)
$(\ln(K))^2$	0.0004	(0.95)	0.0009	(0.89)
$(\ln(SkillBlue))^2$	0.0275	(0.00)	0.0266	(0.00)
$(\ln(Nonskillblue))^2$	0.0069	(0.00)	0.0067	(0.00)
$(\ln(White))^2$	0.0173	(0.00)	0.0204	(0.00)
(ln(K))*(ln(SkillBlue))	-0.0120	(0.10)	-0.0090	(0.23)
(ln(K))*(ln(NonSk)	-0.0080	(0.01)	-0.0071	(0.02)
(ln(K))*(ln(White))	-0.0075	(0.02)	-0.0091	(0.01)
(ln(Sk))*(ln(NonSk))	0.0002	(0.95)	-0.0002	(0.94)
(ln(Sk))*(ln(White))	-0.0073	(0.00)	-0.0083	(0.00)
(ln(NonSkill))*(ln(White))	-0.0001	(0.89)	0.0003	(0.74)
Spillfromupstream	-0.0719	(0.00)	-0.0780	(0.00)
Horizontalspill	-0.0095	(0.00)	0.0076	(0.33)
Spilfromdownstream	0.0063	(0.00)	0.0086	(0.19)
SIZEDUMMY	1.1062	(0.00)	1.0602	(0.00)
AGEDUMMY	0.0466	(0.25)	0.0364	(0.37)
BOIDUMMY	0.2025	(0.00)	0.1538	(0.04)
Industry Dummy	-	-	Appendix C	
Adjusted R square	0.7294		0.7419	

Table4.12. Results from regression (4-3) to (4-6) , spillover effects toward local plants in manufacture of basic and fabricated metal (ISIC 27-28)

4.3.2.8. Manufacture of general machinery (ISIC 29)

In term of labor productivity, we found no evidence that neither the presence of foreign plant in the industry nor their presence in upstream industries could statistically impact the performances of local machinery manufacturers. In fact, negative spillover effects are found in the two-factor models and regression 4-5.

For the effects on local plants' production, the strong and robust evidences of spillover effects from foreign presence in the downstream can be found in this industry. For instance, a one percentage increase in the foreign presence in the downstream industries could increase the value added of local plant in this industry as high as 18% in the four-factor production model, lower left panel of the following table. We also found that about half of the output share of general machinery's downstream industries is occupied by the foreign plants. These ratios indicate high level of foreign participation in the supply chain of general machinery industry. In addition; as suggested by conceptual framework, their presence in the buying industries require qualified raw material. As the nature of this industry, which require complex and qualified input, technology transfer to local suppliers would likely to be feasible.

However, the evidences of negative spillovers from foreign presence in upstream industries are reported with less severity in their magnitude. This implies that their presence in supplying industries could potentially crowd out the existing local suppliers who currently serve local manufacturer. An high degree of foreign participation in upstream industries (about half of the aggregate input of plants in this industry are contributed by foreign plants) would implies a foreign dominance in the supplying industries which could affect the price of raw material served to local general machinery. However, this adverse effect is not found in the extended model with the control of industry effects.

4.3.2.9. Manufacture of electrical machinery and precious instruments (ISIC 30-33)

As the general machinery industry, we found no linkage between foreign presence, either horizontally or vertically, and the labor productivity of the local plants. These absences of linkages would imply that an inclusion of foreign-invested plant in the industry could not lead to an increase in labor productivity of local plants as frequently claimed.

The positive spillover effects from the foreign presence in downstream industries were reported instead; and, the magnitude of this variable is relatively large too. This implies that spillover from downstream is an industry-specific effect, and we found relatively high foreign plant's intensity in the downstream industries of this group of industries.

Positive horizontal spillover effects are found only in the model which we have not control for diversity within the major industries. Interestingly, relative size of the plant is not strong as its effect in other industries; while, plant's relative age is not statistically reported.

(n)=482	General Machinery (ISIC 29)			
	Coefficient	p-value	coefficient	p-value
V/L as dependent variable				
C	3.6430	(0.00)	-	-
ln(K/L)	0.1357	(0.00)	0.1458	(0.00)
ln(SkillBlue/L)	0.0344	(0.03)	0.0380	(0.02)
ln(NonSkillBlue/L)	-0.0007	(0.91)	-0.0055	(0.41)
ln(White/L)	0.0288	(0.00)	0.0270	(0.00)
Spillfromupstream	0.0026	(0.83)	-0.0348	(0.60)
Horizontalspill	0.0002	(0.97)	-0.0850	(0.07)
Spilfromdownstream	0.0171	(0.42)	0.1944	(0.09)
SIZEDUMMY	0.3825	(0.00)	0.5867	(0.00)
AGEDUMMY	0.0291	(0.64)	0.0085	(0.90)
BOIDUMMY	0.2867	(0.00)	0.1899	(0.03)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R-square	0.1741		0.2863	
V as dependent variable: Two-Factors		Eq.(4-3)	Eq.(4-5)	
C	13.4714	(0.00)	-	-
ln(K)	0.1521	(0.00)	0.1517	(0.00)
ln(L)	0.7538	(0.00)	0.7669	(0.00)
(ln(K))2	0.0046	(0.80)	0.0079	(0.64)
(ln(L))2	-0.0661	(0.21)	-0.0719	(0.17)
(ln(K))*(ln(L))	0.0614	(0.26)	0.0135	(0.79)
Spillfromupstream	-0.0508	(0.00)	-0.1442	(0.03)
Horizontalspill	-0.0395	(0.00)	-0.1350	(0.00)
Spillfromdownstream	0.1626	(0.00)	0.3782	(0.00)
SIZEDUMMY	0.3285	(0.01)	0.7318	(0.00)
AGEDUMMY	0.0980	(0.16)	0.0470	(0.50)
BOIDUMMY	0.3987	(0.00)	0.2800	(0.00)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R square	0.6512		0.7315	
V as dependent variable: Four-Factors		Eq. (4-4)	Eq.(4-6)	
C	12.6720	(0.00)	-	(0.00)
ln(K)	0.1937	(0.00)	0.1928	(0.00)
ln(SkillBlue)	0.4187	(0.00)	0.3905	(0.00)
ln(NonSkillBlue)	0.0416	(0.00)	0.0396	(0.00)
ln(White)	0.1230	(0.00)	0.1362	(0.00)
$(ln(K))^2$	0.0337	(0.00)	0.0217	(0.05)
$(ln(SkillBlue))^2$	0.0356	(0.00)	0.0318	(0.00)
$(ln(Nonskillblue))^2$	0.0064	(0.04)	0.0085	(0.01)
$(ln(White))^2$	0.0134	(0.00)	0.0158	(0.00)
(ln(K))*(ln(SkillBlue))	-0.0172	(0.15)	-0.0128	(0.29)
(ln(K))*(ln(NonSk)	0.0015	(0.76)	0.0031	(0.53)
(ln(K))*(ln(White))	-0.0107	(0.08)	-0.0113	(0.06)
(ln(Sk))*(ln(NonSk))	-0.0127	(0.01)	-0.0123	(0.01)
(ln(Sk))*(ln(White))	-0.0063	(0.11)	-0.0065	(0.10)
(ln(NonSkill))*(ln(White))	-0.0004	(0.84)	0.0001	(0.96)
Spillfromupstream	-0.0632	(0.00)	-0.0164	(0.82)
Horizontalspill	-0.0415	(0.00)	-0.0881	(0.08)
Spilfromdownstream	0.1802	(0.00)	0.2433	(0.05)
SIZEDUMMY	0.4232	(0.00)	0.7177	(0.00)
AGEDUMMY	0.1022	(0.14)	0.0578	(0.41)
BOIDUMMY	0.3844	(0.00)	0.2283	(0.01)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R square	0.6599		0.7227	

Table4.13. Results from regression (4-3) to (4-6) , spillover effects toward local plants in manufacture of general machinery (ISIC 29)

(n)=425	Electronic Machinery (ISIC 30-33)			
	coefficient	p-value	coefficient	p-value
V/L as dependent variable				
C	4.8379	(0.00)	-	-
ln(K/L)	0.1946	(0.00)	0.2098	(0.00)
ln(SkillBlue/L)	0.0213	(0.38)	0.0275	(0.30)
ln(NonSkillBlue/L)	0.0102	(0.19)	0.0101	(0.21)
ln(White/L)	0.0072	(0.47)	0.0091	(0.37)
Spillfromupstream	-0.0105	(0.11)	0.0295	(0.41)
Horizontalspill	0.0022	(0.73)	-0.0047	(0.93)
Spilfromdownstream	0.0076	(0.26)	0.0420	(0.57)
SIZEDUMMY	0.3447	(0.01)	0.2514	(0.07)
AGEDUMMY	0.0110	(0.89)	0.0258	(0.76)
BOIDUMMY	0.0687	(0.48)	0.0339	(0.75)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R-square	0.1235		0.2021	
V as dependent variable: Two-Factors		Eq.(4-3)	Eq.(4-5)	
C	15.8568	(0.00)	-	-
ln(K)	0.1924	(0.00)	0.2077	(0.00)
ln(L)	0.5951	(0.00)	0.6162	(0.59)
(ln(K))2	0.0113	(0.51)	-0.0091	(0.44)
(ln(L))2	0.0164	(0.78)	-0.0421	(0.79)
(ln(K))*(ln(L))	-0.0153	(0.78)	0.0138	(0.51)
Spillfromupstream	-0.0031	(0.67)	-0.0239	(0.09)
Horizontalspill	0.0189	(0.01)	-0.0961	(0.00)
Spillfromdownstream	0.0026	(0.73)	0.3345	(0.00)
SIZEDUMMY	0.7050	(0.00)	0.6701	(0.68)
AGEDUMMY	0.0577	(0.52)	0.0345	(0.30)
BOIDUMMY	0.3029	(0.01)	0.1133	(0.00)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R square	0.6663		0.7458	
V as dependent variable: Four-Factors		Eq. (4-4)	Eq.(4-6)	
C	15.6278	(0.00)	-	-
ln(K)	0.2004	(0.00)	0.2216	(0.00)
ln(SkillBlue)	0.3350	(0.00)	0.3457	(0.00)
ln(NonSkillBlue)	0.0388	(0.00)	0.0373	(0.00)
ln(White)	0.0857	(0.00)	0.0887	(0.00)
$(ln(K))^2$	0.0022	(0.82)	-0.0129	(0.25)
$(ln(SkillBlue))^2$	0.0260	(0.00)	0.0265	(0.00)
$(ln(Nonskillblue))^2$	0.0150	(0.00)	0.0131	(0.00)
$(ln(White))^2$	0.0112	(0.01)	0.0110	(0.02)
(ln(K))*(ln(SkillBlue))	0.0059	(0.59)	0.0052	(0.76)
(ln(K))*(ln(NonSk)	-0.0057	(0.24)	-0.0026	(0.66)
(ln(K))*(ln(White))	-0.0102	(0.10)	-0.0117	(0.06)
(ln(Sk))*(ln(NonSk))	-0.0005	(0.91)	0.0016	(0.80)
(ln(Sk))*(ln(White))	-0.0155	(0.00)	-0.0121	(0.02)
(ln(NonSkill))*(ln(White))	-0.0018	(0.37)	-0.0025	(0.21)
Spillfromupstream	-0.0055	(0.45)	-0.0371	(0.34)
Horizontalspill	0.0141	(0.05)	-0.0805	(0.18)
Spilfromdownstream	0.0022	(0.77)	0.3181	(0.00)
SIZEDUMMY	0.6739	(0.00)	0.5851	(0.00)
AGEDUMMY	0.0107	(0.90)	-0.0014	(0.99)
BOIDUMMY	0.3163	(0.00)	0.1385	(0.21)
Industry Dummy	N/A	N/A	Appendix C	
Adjusted R square	0.6760		0.7430	

Table4.14. Results from regression (4-3) to (4-6) , spillover effects toward local plants in manufacture of electronic machinery and precious instruments (ISIC 30-33)

The following table summarizes the results of all layer of spillovers from the model with industry control dummy variables

Sector/Industries	V/L as dependent	V as dependent variable	
		Two-Factor model	Four-Factor model
Manufacturing sector	(+)**Horizontal (+)**Down	(-)**UP (+)** Horizontal (-)**Down	(-)UP** (+)** Horizontal (-)**Down
Foods and Beverage	(-)** UP (-)** Down	(-)UP	(-)UP
Textiles	Insignificant effects from all layers	(-)UP	(-)UP
Woods and Paper	(-)**Down	(-)**UP (+)**Horizontal (-)**Down	(-)**UP (+)** Horizontal (-)**Down
Chemical and Chemical product	(-)**UP (+)** Horizontal	(-)**UP (+)** Horizontal	(-)UP (+) **Horizontal
Non-Metallic	Insignificant effects from all layers	Insignificant effects from all layers	Insignificant effects from all layers
Metal and Fabricated metal	(+**)Down	(-)**UP (+)**Down	(-)**UP
General Machinery	(+)*Down	(-)** Horizontal (+)**Down	(-)**Horizontal (+)**Down
Electronics	Insignificant effects from all layers	(-)** Horizontal (+)**Down	(+)**Down

Note: The analysis can be conducted in the above 8 major industries, which account for 71% of total observations in manufacturing sector (+) implies that the effect is positive, (-) implies that the effect is negative ** coefficients is significant at 0.05 level of significant, * coefficient is significant at 0.10 level of significant

Table4.15. Summary of the results from models with industry/sub industries control variables

To facilitate the reader’s understanding, the above table reveals the results from the previous section. Generally speaking; we found spillover from downstream is relatively common in technology based industries. While the consistent report of horizontal spillover are found in the sample of local plants in chemical and chemical industries. The discussions of these results are illustrated in the next section.

4.4. Summary, Policy implication and Further study.

Given with one of the most frequently used rational to induce FDI to every host nations, "an anticipation for technology transfer to local firms", this paper investigate whether this claimed externalities toward local plants is statistically exist. The empirical investigation is based on the plant level data from the latest industrial census, and the latest input-output table had been integrated in order to conduct vertical spillover impacts analysis. With the matching of two industry classifications (ISIC code and IO table code) at the disaggregate level, this study can further customize the analysis to each of the 8 major industries.

For the testing of hypothesis on horizontal spillover effects, we found that the presence of the foreign plants in the industry could statistically benefit the production and labor productivity of local plants in the manufacturing sectors. This result is relatively robust even with further scope on local plants' labor productivity. However; the disaggregate analysis to each major industry level had consistently revealed that only the performance of local plants in manufacturer of chemical and chemical product (ISIC 24) industry could be positively influenced by the presence of their foreign counterparts in the industry.

For the hypothesis of spillovers from upstream industries, no evidences of linkage between foreign suppliers and local manufacturers are found in the model with the control for industry effect. In fact, the weak adverse effects from their presence in upstream industries are instead revealed in many industries. They are manufacturer of foods and beverage (ISIC 15), Chemical and chemical products (ISIC 24) and manufacture of basic and fabricated metal (ISIC 27-28). These negative results somehow remind us with the myopia relationship between FDI and host nation's growth from previous sector based studies (Alfaro 2003).

While, the significant and positive spillovers effects from downstream industries are substantially suggested by the evidences in the technology-intensive industries; manufacture of basic and fabricated metal [ISIC 27-28], Manufacturer of General Machinery, [ISIC 29], and Manufacturer of electronic and precious instrument [ISIC 30-

33]. This finding of backward linkage is coincide with the famous work by (Javorcik 2004), who is among the first to remark the importance role of local-supplier relationship. The plausible explanation is lay on the fact that the production in these industries highly require high complicated raw materials, in which inherently require the transfers of technology and know-how from foreign manufacturers to local suppliers. At a glance, the rational of promoting FDI as the mechanism to increase the performances of local plants is relatively justified for the whole manufacturing sectors. However, a customized analysis at the industry level does statistically revealed the adverse effects of foreign presence in many industries. Hence, a uniform investment promoting is not likely to be applicable to every industry. Investment authority should also concern the possibility of negative production and productivity externalities to local plants in some industries. More discussion of policy implication is illustrated in the concluding chapter.

Since there is a discrepancy between industry classification by NSO industrial census and industry classification used in the input-output table, the variables which require integration from these two sources of data could not be conducted at very disaggregate industry level. As (Libsey 2002); the relationship between plants in different industries could conceptually be separately verified by observation of variables that represent the different layer of spillover effects. Practically, plants in the same classified industry, even in the four digit ISIC classification, could interact as supplier-manufacture. Hence, the horizontal spillover effect could be overstated. We suggest that any further researches to check not only ISIC classification code; but also, other type of establishment information; for instance, product codes, in the data processing step.

In addition, Most of the studies have rely on the industrial census to analyze the impacts of the presence of foreign plants toward the local manufacturing firms. Because establishments included in the industrial census are manufacturing plant only, the result could be only projected to the industrial sectors. This study could not answer whether there is significant spillover from MNCs in the service sectors to the local units in the same industries or related industries. Furthermore, the recent

FDI study (macro-level data) in India, (Chakraborty 2008) has suggested that FDI in service sector can spur the growth in manufacturing sector. Hence, the inter-sector (manufacturing and service sectors) relationship should be acknowledged in further study.

Chapter 5
Testing for export performance differential and FDI externalities on local export performance

5.1. Background

As same as other developing nations in Asia, Thailand has experienced a net inflow of foreign direct investment since the 1980 and the amount is consistently grow, and its accumulated position reached the amount of U$ 185 Billion in the year 2012.

The following figure reveals the export of goods and service of the nation.

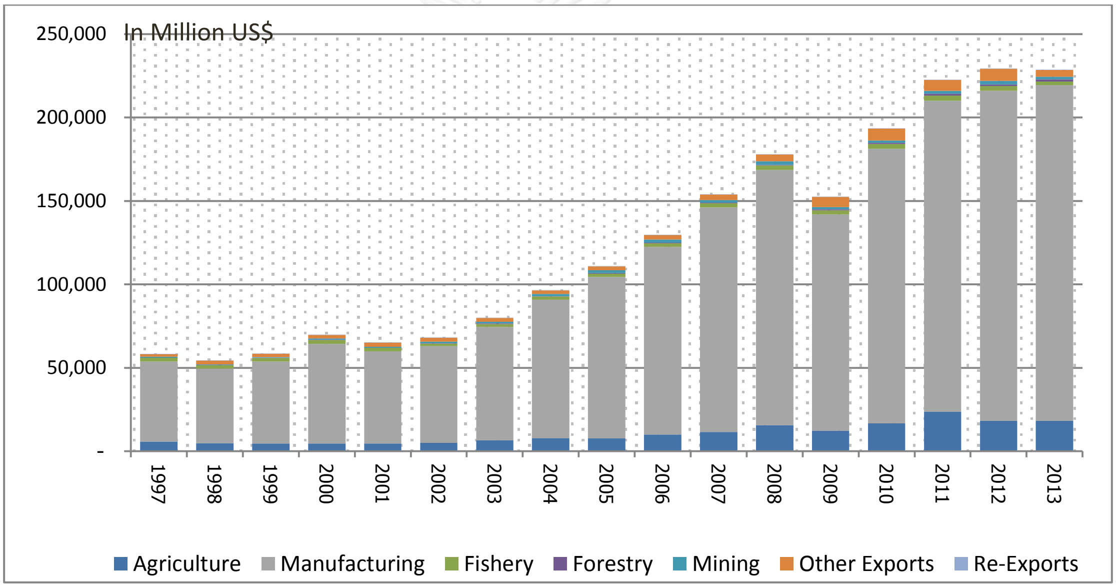

Figure5.1. Thailand's export by sectors

Exportation has been the main driving engine for Thai Economy, Percentage in Export of goods and service to GDP in the year 2013 is recorded as 74% (WorldBank). Eighty to eighty-five percent of those export value are contributed by plants in manufacturing sector.

Although, the number of foreign-invested plants in manufacturing sector is approximately 14 % - 17% in the (NSO 2007), but their contribution is large in term of sector's employment, sector's output and; especially, sector's export. 45.8 % of the sector's export is shipped by foreign-controlled plants.

Due to their established global network, Multinational corporations is perceived as an export catalyst for host nation's exporting activities; many of the host nation authorities, including Thailand, have been striving to attract the foreign direct investment with the underlying wisdom of promoting their nation exporting activities.

Previous empirical researches reveals that the existing of Multinational Corporation in the industries would not always leads to a higher exportation of domestic plants, and the results vary across type of industries. The previous empirical findings had suggested that the export performance differential is more empirically convincing than the productivity differentials (Ramstetter 2006). However; there are some sector/industries in which local plant's performance is found to be better than Multinational corporations.

This part of dissertation aims to investigate *whether the foreign plants' has higher export performance than locally-operated plants. Secondly; we investigate whether their presences could significantly increase the export performances of locally-operated plants.*

In term of export performance differentials; due to MNCs' superiority in their establishment of global marketing network, their international trade, which result in low transaction cost in relative to local firm's cost (Ramstetter 2006). As (Aitken 1997) market specific cost, (Ramstetter 2006) further reviewed thtat whether the tendency of firm's export is related to the level of foreign participation. His work had employed Probit to verify whether foreign plants has greater export possibility and ordered Probit to test whether export propensity of plant is influence by multinational status of the plant and He found that foreign plants are more likely to have higher export possibility and export probability than local plants.

Subsidies of foreign plants have easier access to foreign markets' information or established distribution network, as they are part of the established multinational networks. Their increased cost to export to foreign markets would be less than the incremental cost to export of local operated plants; for example, plants with multinational status could use the established transport infrastructure, distribution network or existing marketing know-how. However, local operated plants do not possessed those established infrastructure and know-how, this implies that the incremental cost to export, (Krungman 1989) is higher in the local plant sample.

As foreign exchange risk is one of an incremental sunk cost to export to new exporter, we also would like to compare the foreign exchange exposure of foreign-controlled units and FX exposure of local-operated units in this study too.

The descriptive statistic in Table 3.2 reveals the simple comparison between export performance of foreign-invested plants and local plant's export performance. If we further compare the output per worker of the non-exporting and exporting plants in local establishment sample, we found that the output to labor of exporting plants, regardless of their export ratio, are greater than the output per labor of non-exporting plants. In addition, if we further compare the labor productivity across foreign and local sample, we found that output per labor in foreign-controlled plant sample is higher than output per labor in local plants in every categories of plants' export to output share. With this simple indicator of labor productivity, the export behavior and foreign participation of plants in Thailand relatively comply with this recent theoretical framework. Related empirical works by (Hallward 2002) found that firm with foreign ownership and exporting firm are more productive than non-exporting firm, and the disparity is larger in less developed markets.

Differentiated from other export spillover papers, this paper take a necessary prerequisite step to firstly verify whether the export performance gap between foreign and local plants as claimed.

This section discusses the export spillover empirical literatures. The conceptual frameworks had been discussed in section 2.5. The presence of their foreign plants could potentially generate externalities to local plants; this externality to local plants is called spillover effects[33]. The spillover toward local plants' export performance is called export spillovers. (Greenaway 2004) pointed out that there are

[33] For the quantitative illustration of export spillovers, please further refer to Aitken and Harrison (1997)'s paper

3 channels of spillover through information externalities, demonstration and competition effects. Competition effect is expressed as the MNCs' employment share, while MNCs' R&D share in the industry represents demonstration effects. MNCs' export intensity represents spillovers through information externalities channel in which local plants learn from the foreign plants' export subsidies; this transmission of knowledge could potentially increase the probability to export of local plants which are existing exporters or non-exporters. (Sun 2009) also found the positive spillover effect in China. In the early findings; however, (Barrios 2001) found insignificant influence from the presence of multinational firms in Spain manufacturing industries during 1990-1997. Among the findings in ASEAN countries, (Blalock 2009) study the export spillover in Indonesia, and they found an evidence of spillover from the presence of foreign plants in the downstream industries. While (Anwar 2011) study the impact of MNC's presence on both possibility to export and export share of local plants in Vietnam, and horizontal spillovers and spillover from the existence of foreign plants in the upstream industries were reported. (Jongwanich 2010) study the export spillovers in Thailand, and they found that these positive trade externalities to local plants were reported; however, these spillover effects are not always incurred.

From the review of above literatures, which have advised us that MNCs are a group of firms which has proprietary asset which enable them to prevail over the local plants, and we also found that foreign plant can be a catalyst for the export activity of the local plants.

Export performance is further defined as export probability of the plant and plant' export intensity in this study and both of them should be examined. Hence the following hypothesis can be developed.

1. Foreign-controlled plants have higher export probability than local-operated plants.
2. Foreign-invested plants have higher export intensity than local-controlled plants.

3. The presence of foreign plants in the industry can statistically increase the probability to export of the local-operated plants.

4. There is a positive relationship between the local plants' export intensity and the presence of foreign plants in the industry.

5. The presences of foreign-invested plants in related industries (upstream and downstream) can significantly stimulate the possibility to export of local-operated plants.

6. There is a positive relationship between local plants' export intensity and the presences of foreign-invested plant either in upstream or downstream industries.

By using Heckman selection model (discussed in the next section), our tests could analyze both probabilities to export and export intensity of the plant. In addition, the analysis is also conducted at the major industries to enhance policy implication.

5.2. Methodology, Data and Measurements

Only small fraction of studies on export performances have been designed to test for the export performance differential between foreign-invested and local plants. We perceive that both testing are interrelated and they cannot be discretely performed; to be specific, the testing involved in export performance differential is a prerequisite for the export spillover topic. As one of the main supposition of export spillover topic is the superiority of foreign plants over local operated plants, and these claimed are not always valid in every industries.

The following section discusses the estimation models which are designed to test for the export performance differentials. *Export decision* and *Export propensity* of plant i are used as the main indicators for the analysis of both export differentials and spillovers.

After controlling other factors which could influence plant i's export performance; hence, we can observe a direct effect of multinational status of plant i toward plant i's decision to export or export propensity. As the previous models, the control variables of capital intensity, age, size of plant i and whether plant i receive investment privileges are added to regressions. Hence the regression for probability to export (Export decision) of plant i could be written as follow.

$$Dex_i = \beta_0 + \beta_1(K/L)_i + \beta_2(SK/L)_i + \beta_3 productivity_i + \beta_4 DAGE_i + \beta_5 DSIZE_i + \beta_6 DBOI_i + \beta_7 DproductDEV_i + \beta_8 DMNC_i + \varepsilon_i \qquad 5\text{-}1$$

For export intensity's of the plant

$$Exratio_i = \pi_0 + \pi_1(K/L)_i + \pi_2(SK/L)_i + \pi_3 productivity_i + \pi_4 AGE_i + \pi_5 DSIZE_i + \pi_6 DBOI_i + \pi_7 DproductDEV_i + \pi_8 DMNC_i + \upsilon_i \qquad 5\text{-}2$$

Where Dex_i is 1 when plant i engage in export, while 0 otherwise, $(Exratio)_i$ is the export ratio of plant i. While $(K/L)_i$ is capital intensity of plant i, which is quantified by the total fixed asset (beginning of the year value) divided by no. of employee in plant i, $(SK/L)_i$ is the skill intensity of the plant, it measured by number of skilled labor divided by plant's no of labor. $DAGE_i$ take value of 1 if plant i is older than industry average age, 0 otherwise. $DSIZE_i$ is 1 if sale of plant i is higher than industry average sale. $DBOI_i$ takes the value of 1 if plant i receive investment privileges from Thailand's Board of investment. $DproductDEV_i$ is dummy variable on the product development activity of the plant, if plant engage in the development of product, this variable would be marked as 1, and 0 otherwise. $DMNC_i$ is the dummy variable, 1 if the plant is foreign controlled plant[34], 0 otherwise. Since the increase in capital intensity of the plant can influence the labor productivity as more machine is available for each labor and an increase in labor productivity could influence the plants' export probability or the export propensity of the existing exporters[35]. Conversely, (Ramstetter 2006) and (Jongwanich 2010) had stated that the relationship between (K/L) and export performance should be negative in order to reflect the comparative advantage of Thailand's export structure. While K/L represents physical

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[34] As many previous studies, we considered plant as foreign controlled plant if there is 10% and above foreign participation in the plant; however, in order to enhance the interpretation; we also replace this multinational status with other types of foreign plant classification, minority foreign, majority foreign and wholly owned foreign.

[35] Please see heterogeneity productivity model Helpman, E., Melitz, M., and Yeaple, S. (2004). "Export versus FDI with Heterogeneous firms " American Economic review **4**(1): 300-316.

skill intensity, (SK/L) represents non-physical skill intensity of the plants; hence, the expected sign for this variable is also expected to be inconclusive as capital to labor ratio.

Secondly, we aim to test whether the presence of foreign-invested plants could statistically influence the export performance of local plants. The following model is adjusted from equation 5-1 and 5-2; respectively.

$$Dex_{ij}^{\ L} = \alpha_0 + \alpha_1 (K/L)_i^L + \alpha_2 (SK/L)_i^L + \alpha_3 productivity_i^L + \alpha_4 DAGE_i^L + \alpha_5 DSIZE_i^L + \alpha_6 DBOI_i^L$$
$$+ \alpha_7 DproductDEV_i^{\ L} + \alpha_8 Horizontalspill_j + \varepsilon_i \qquad 5\text{-}3$$

For export propensity of local exporting plant, the response equation

$$Exratio_{ij}^{\ L} = \alpha'_0 + \alpha'_1 (K/L)_i^L + \alpha'_2 (SK/L)_i^L + \alpha'_3 productivity_i^L + \alpha'_4 DAGE_i^L + \alpha'_5 DSIZE_i^L + \alpha'_6 DBOI_i^L$$
$$+ \alpha'_7 DproductDEV_i^L + \alpha'_8 Horizontalspill_j + \upsilon_i \qquad 5\text{-}4$$

Dex^{L}_{ij} is still the export decisions of the local plant i, reside in industry J. $Exratio^{L}_{ij}$ is the export propensity of local exporting plants i in industry j. Superscript L represents local operated plant.

To reflect all channels of spillovers, the key variable Horizontalspillj would be further replaced with other measurements of each channel of spillovers, the following table summarizes the information on the measurement of each channel.

	Information Externalities	Competition Effects	Demonstration Effects
Measurement	$\left[\dfrac{Export^{MNC}}{Export^{All}}\right]_j$	$\left[\dfrac{Output^{MNC}}{Output^{All}}\right]_j$	$\left[\dfrac{R\&D^{MNC}}{R\&D^{All}}\right]_j$

Table5.1. Measurements of foreign presence and export spillover channels

As has stated, the Heckman sample selection model (Heckman 1979) should be applied in order to avoid the potential selection biased problem, when we are operating the export intensity equation.

As we could not identify whether 0 export ratio indicate that either the plant is not willing to export or their export ratio is inherently 0 (although they are willing to export). Sample selection model would firstly decide in the selection model ((5-3) in this case) whether the particular observation is in the group of observation that will enter to the response equation ((5-4)). If the unobservable in equation 5-3 is not statistically correlated to the unobservable in the response equation 5-4, then the reported RHO coefficient from Heckman selection model would not be significance. This can further imply that selection process to the second equation is already random, and then OLS is appropriate (please see the appendix section). By pursuing the Heckman selection method as the first step, we are allowed to verify whether a decision to export of the local plant (5-3) is related to the decision on how much should they export (5-4).

To enlist the foreign presence in both supplying and buying industries, we further add two testing variables to the baseline regression (5-3) and (5-4), the model could be shown as follow.

Selection equation

$$Dex_{ij}^{L} = \alpha_0 + \alpha_1 (K/L)_i^L + \alpha_2 (SK/L)_i^L + \alpha_3 productivity_i^L + \alpha_4 DAGE_i^L + \alpha_5 DSIZE_i^L + \alpha_6 DBOI_i^L$$
$$+ \alpha_7 DproductDEV_i^L + \alpha_8 Spillfromup_j + \alpha_9 Horizontalspill_j + \alpha_{10} Spillfromdown_j + \varepsilon_i \quad \text{5-3'}$$

Response equation

$$Exratio_{ij}^{L} = \alpha'_0 + \alpha'_1 (K/L)_i^L + \alpha'_2 (SK/L)_i^L + \alpha'_3 productivity_i^L + \alpha'_4 DAGE_i^L + \alpha'_5 DSIZE_i^L + \alpha'_6 DBOI_i^L$$
$$+ \alpha'_7 DproductDEV_i^L + \alpha'_8 Spillfromup_j + \alpha'_9 Horizontalspill_j + \alpha'_{10} Spillfromdown_j + v_i \quad \text{5-4'}$$

And the measurement of the keys variable are illustrated in the following tables

	Spillover from upstream	Horizontal spillover	Spillover from downstream
Measurement	$\sum_{m \text{ if } m \neq j} \varphi_{mj} \left[\frac{Output^{MNC}}{Ouput^{All}}\right]_m$ Where φ_{mj} is portion of industry m output to industry j	$\left[\frac{Output^{MNC}}{Output^{All}}\right]_j$	$\sum_{k \text{ if } k \neq j} \sigma_{jk} \left[\frac{Output^{MNC}}{Ouput^{All}}\right]_k$ Where σ_{jk} is portion of industry j output to industry k

Table5.2. Measurements of foreign presence in up/down stream.

As the previous chapter, the input-output coefficients (σ_{jk} *and* φ_{mj}) were obtained from NESDB (NESDB 2005). One of the challenges for investigation of vertical spillover is the integration of Input-Output table to industrial census. To match with ISIC industry classification, we had complied NESDB's input output coefficients with the NSO industrial classification. We had decided to match them at the most disaggregate level (ISIC 4 digits code) in order to effectively reflect the foreign presence in the industry. In addition, the matching at the most ISIC 4 digit code could also further enable us to outline the study to each main industry.

As previous two chapter, the scope of this analysis is limited to plants with the size (classified by no. of labor) in categories 6 and above, which have number. of workers greater than 15, and establishment which has sale per labor above Baht 10,000, and fixed asset per labor above Baht 5,000 per year. Other standards of defining the sample remain the same as the previous chapters. For this chapter, the analysis at industry level can be done in 10 major industries.

5.3. Results

The table illustrated in the next page briefly shows the descriptive statistic of the foreign and local-operated plants. We found that about two out of three foreign plants export their products to abroad, while only one of five local plants engage in export activities. From table 5.3, eighty-eight percent of total number of foreign plants has export share greater or at least equal to half of their manufactured outputs. Furthermore, the export value of foreign plants is at least twice larger than the export value of local plant. Foreign plants also outweigh local operated plants in both export value per labor and export value per capital. These indicators imply the superiority of foreign plants in export performance over the local operated plants.

	Local plants		Foreign plants	
Total number of plants	9,569		1,516	
Number of plants with exportation	2,240	100%	1,061	100%
Number of plants with 1% to 49% export share	1,169	52%	434	41%
Number of plants with 50% to 99% export share	796	36%	463	44%
Number of plants with 100% export share	796	36%	463	44%
Total Output (Q^{all}) by all plants (in million Baht)	1,673,959		1,274,262	
Total Capital (K^{ex}) by exporting plants (in million Baht)	429,529		436,632	
Total Labor (L^{ex}) by exporting plants (in no. of labor)	632,332		509,515	
Value added (VA^{ex}) by exporting plants (in million Baht)	294,180		330,276	
Total Output (Q^{ex}) by exporting plants (in million Baht)	960,832		1,080,093	
Total Export value (Ex) (in million Baht)	487,840	51%	671,444	62%
Total Domestic sale (Q^{ex}) - (Ex) (in million Baht)	472,991	49%	408,649	38%
Weighted Average export value per plant (in million Baht)	217.79		632.84	
Weighted Average export value per labor (in million Baht)	0.7715		1.3178	
Weighted Average export value per capital (in million Baht)	1.1358		1.5378	
Labor productivity of exporting plants (Q^{ex}/L^{ex}) (in million Baht)	1.5195		2.1198	

Table5.3. Descriptive statistics of local and foreign plants

5.3.1. Export performance differential at the manufacturing sector

First, we further verify whether the multinational status of the plant could enhance the relative export performance of the plant. We found that multinational status of the plants can positively influence the export probability of the plant. To response to the export propensity question, the response equation indicates that the multinational status of the plant could also influence the export propensity of the plant too. Wald test which reflects the goodness of fit of the model is statistically significant; however, RHO (ρ) is statistically different from 0 which implies that both export decision and export intensity equations of the plant are statistically related. The results from both Probit and OLS estimation are further added to the Heckman Selection model.

	PROBIT	OLS	Heckman Selection		
			Selection	Response	
C	-2.1356 (0.00)	-9.1314 (0.00)	-2.1191 (0.00)	0.2301 (0.28)	C
LOG(K/L)	0.0799 (0.00)	0.0387 (0.00)	0.0785 (0.00)	-0.0424 (0.03)	LOG(K/L)
LOG(Sk/L)	0.0241 (0.01)	0.0166 (0.00)	0.0230 (0.01)	0.0168 (0.10)	LOG(Sk/L)
PRODUCTIVTY	0.0991 (0.00)	0.0790 (0.00)	0.1005 (0.00)	0.0422 (0.09)	PRODUCTIVTY
DMNC	0.2669 (0.00)	0.3110 (0.00)	0.2503 (0.00)	0.2518 (0.00)	DMNC
ADEDUMMY	0.2689 (0.00)	0.1603 (0.00)	0.2506 (0.00)	-0.0709 (0.13)	ADEDUMMY
SIZEDUMMY	0.2431 (0.00)	0.2012 (0.00)	0.2338 (0.00)	0.0632 (0.20)	SIZEDUMMY
BOIDUMMY	3.8230 (0.00)	7.3252 (0.00)	3.7247 (0.00)	-1.5181 (0.00)	BOIDUMMY
PRODUCTDEV	0.2843 (0.00)	0.0730 (0.16)	0.2448 (0.00)	-0.2544 (0.00)	PRODUCTDEV
			(0.00)		RHO
R-Square	0.7522	0.7997	9,636 (0.00)		Wald test
Observation		11,085			Observation

Table5.4. Export differential results from Probit, OLS and Sample selection models from plant in manufacturing sector[36]

Results from Probit model for export probability of the plant; and, OLS for export intensity of the plant also confirm the superiority of foreign plant over local plant in export. It should be note that the results from OLS is subjected to sample selection bias; as the RHO coefficient from Heckman selection model is statistically significant at 0.05 level of significant which implies that the plant's decision to export and how much to export (export intensity) are related.

We also found that plants with BOI privileges are more export oriented than Non-BOI plant, and we also found that the plant's productivity are positively related to the export propensity of the plant. The skill intensity of the plant can increase the export intensity of the plant. As suggested by (Krungman 1989), one of the incremental cost to export is the foreign exchange rate risk management in which foreign-controlled units are likely to have better insulating capacity than local-operated units. The

[36] The number in parenthesis is the p value of coefficient, coefficients. RHO (ρ) is estimated correlation between the error terms of selection and response equations, its p value is reported in parenthesis

following sub-section discussed the brief comparison of foreign exchange exposure of foreign vs local operated plants.

5.3.1.A. An incremental sunk cost to export: Foreign exchange exposure

The following section specially reveals the comparison result in FX exposure. The derivation of the following FX testing regression is shown in the appendix section D.2.

$$\mathrm{R_{it}} = \alpha_{\mathrm{i}} + \varphi_{1\mathrm{i}}\mathrm{R_{mt}} + \varphi_{2\mathrm{i}}\hat{\pi}_{\mathrm{t}} + \sum_{k=1}^{n} \beta_k X_{kit} + \varepsilon_{\mathrm{it}}$$

Where R_{it} is the total return (change in stock price) of firm i in period t, and $\hat{\pi}_t$ is the change in exchange rate at time t, hence the coefficient φ_i represents foreign exchange rate exposure of firm i. Under efficient capital market, the exchange rate exposure φ_i express the overall effect of exchange rate risk on the value of the firms, which is now represented through firm's return. Additionally, R_{mt} is the overall stock market return period t, and then φ_{1i} shows firm i' s return sensitivity to market risk (market beta). If CAPM were the true model for asset pricing, the coefficient on the change in exchange rate (φ_{2i}) should be statistically indifferent from zero which states the firm's total risk exposure should be explained by firm's systematic risk only. The significant of φ_{2i} imply that CAPM does not hold or the change in exchange rate can statistically affect the firm's return. X_{kit} is a vector of control variable, please see the appendix equation A4.10, for the full detail.

The above FX testing regression had been applied to each 112 listed firms in Agriculture and industrial industries and for the listed firms which have been listed in the market prior to January 2005; the total number of observation for each listed firm is 70 firms. As the CAPM model is employed, the listed firms' data are required. The following table summarizes the FX exposure and the mean of absolute value of φ_{2i} of exporting firms with/without multinational status.

With 0.10 level of significant	Exporting foreign-controlled listed firms			Exporting local controlled listed Firms		
	With FX exposure	Without FX exposure	Total	With FX exposure	Without FX exposure	To tal
Number of listed firms	4	19	23	4	27	31
Mean of absolute value FX parameter	1.0936			1.2861		

Table5.5. Summary of FX exposure [at 0.10 level of significance] of exporting foreign-controlled vs. exporting local-controlled listed firms in agribusiness and industrial sectors.

The absolute mean value of FX parameter strongly indicates that the foreign exchange exposure is less in the group of foreign firms in relative to the local-operated firms. Hence, multinational firms are likely to have less incremental cost to export than local operated as suggested theoretical framework. In word, this listed multinational firms could use their existence network to manage the anticipated foreign revenue (for example, repayment of their foreign loan upon the receivable of foreign revenue or they can use their financial hedging platform)[37]. This better shield against the risk is one of the plausible explanations for the export probability and export propensity differential between foreign and local controlled plants. Additional summary of foreign exchange exposure is provided in Appendix section D.2.

To conclude this special section, we found that not only foreign plants have greater probability to export; but, they also have higher export intensity than local-invested plant. Our results conform with the previous studies; for example, (Ramstetter 2006). The following section compare the export performance at eight major industries, the reports are shown in the ISIC2 digits ascending orders.

[37]Please see section 2.3.2.

5.3.2. Export performance differential at each industry

	ISIC 15				ISIC 17			
	Selection Equation		Response Equation		Selection Equation		Response Equation	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	-1.2036	(0.14)	-2.0664	(0.00)	-2.1512	(0.00)	-2.6359	(0.00)
LOG(K/L)	-0.0867	(0.10)	0.0527	(0.34)	0.0367	(0.54)	0.0604	(0.39)
LOG(Sk/L)	0.0160	(0.44)	0.0504	(0.04)	-0.1131	(0.01)	0.0266	(0.49)
PRODUCTIVTY	-0.0674	(0.33)	0.0129	(0.86)	0.1858	(0.02)	0.1654	(0.06)
DMNC	0.3791	(0.01)	0.3574	(0.21)	0.4688	(0.01)	0.8385	(0.00)
ADEDUMMY	-0.0217	(0.85)	0.0265	(0.85)	-0.0025	(0.99)	0.5665	(0.00)
SIZEDUMMY	-0.0246	(0.84)	0.3103	(0.07)	0.1642	(0.33)	0.7687	(0.00)
BOIDUMMY	0.3820	(0.62)	4.1060	(0.00)	0.5388	(0.28)	4.1434	(0.00)
PRODUCTDEV	-0.1351	(0.28)	0.4759	(0.01)	-0.3386	(0.10)	-0.3263	(0.34)
Rho	(0.814)				(0.332)			
Observation	1,719				854			
	Separate Probit and OLS' results are provided in Appendix section D				Separate Probit and OLS'results are provided In Appendix section D			

	ISIC 18- ISIC 19				ISIC 20-ISIC 21			
	Selection Equation		Response Equation		Selection Equation		Response Equation	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	-0.9983	(0.05)	-1.5346	(0.00)	2.6811	(0.00)	-2.4714	(0.00)
LOG(K/L)	-0.0827	(0.12)	0.1128	(0.07)	-0.0253	(0.70)	-0.0599	(0.33)
LOG(Sk/L)	-0.0268	(0.18)	0.0054	(0.82)	0.0327	(0.39)	0.0594	(0.15)
PRODUCTIVTY	0.0525	(0.31)	0.0417	(0.53)	-0.0795	(0.35)	0.0972	(0.27)
DMNC	0.2455	(0.10)	0.6736	(0.02)	-0.0529	(0.83)	-0.5461	(0.19)
ADEDUMMY	0.0309	(0.77)	0.2763	(0.03)	-0.5011	(0.00)	0.3180	(0.03)
SIZEDUMMY	0.3121	(0.01)	0.5245	(0.00)	-0.3855	(0.02)	0.5924	(0.00)
BOIDUMMY	-0.0055	(0.99)	3.5535	(0.00)	-3.1169	(0.00)	3.5850	(0.00)
PRODUCTDEV	-0.2751	(0.10)	0.3429	(0.31)	-1.0838	(0.00)	0.7679	(0.00)
Rho	(0.643)				(0.000)			
Observation	1,017				905			
	Separate Probit and OLS' results are provided in Appendix section D				Standard OLS would yield sample selection Bias			

Table5.6. Export differential results from sample selection models for ISIC 15 to ISIC 21 industries

5.3.2.1. Manufacture of food products and beverages [ISIC 15]

From the above table, we found that foreign-controlled plants are exhibited with higher probability to export than local-controlled plants; however, they are not significantly exhibited with higher export intensity. This implies that being multinational plants could enhance the change to export; however, this plant' foreign controlled status could not enhance the plants' decision on how much to export.

RHO is not statistically significant which implies that the plant's decision on how much to export is not statistically related to the plants' decision on whether they should engage in export. In this case, the results from OLS method (shown in the appendix) would be statistically valid and the probit model indicates that multinational status of the plants could not increase the plant's decision to export. However, this plant's status could increase only the plant's export intensity.

5.3.2.2. Manufacture of Textiles [ISIC 17]

We found that multinational status of the plant could statistically influence not only the export probability of the plant but also the export intensity of the plant. The difference in export intensity could be as high as 83% differences between foreign and local controlled units. As the same as the results from previous industries, the p value of RHO indicate the insignificant of this variable, which implies the disconnection between the plant decision to export and how much to export. Hence, the results of OLS and Probit model in the appendix section 4 also exhibit the similar results.

5.3.2.3. Manufacture of wearing apparel [ISIC 18], and luggage& footwear [ISIC 19]

Since, we found no linkage between multinational status of the plant and the plant's probability to export. Probit and OLS models' results are shown in the appendix section. Plant with multinational status can increase both plant's export probability and plant's export intensity. These results imply that not only foreign-controlled status of plant could result in plant' decision to export; but it also can influence their decision on how much to export.

5.3.2.4. Manufacture of wood & product of wood [ISIC 20] and paper [ISIC 21]

We found that neither the chance to export of the plant nor the plant's export intensity could statistically influenced by the plant's multinational status. Interestingly, results from the RHO coefficients also indicate that the unobservable in the decision to export (selection regression) are statistically related to the unobservable in the export intensity (response) regression.

	ISIC 24				ISIC 25			
	Selection Equation		Response Equation		Selection Equation		Response Equation	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	-1.1261	(0.40)	-1.8808	(0.00)	0.4399	(0.46)	-2.2884	(0.00)
LOG(K/L)	0.0691	(0.39)	0.0143	(0.85)	-0.0022	(0.97)	0.1182	(0.08)
LOG(Sk/L)	0.0635	(0.13)	0.0472	(0.30)	0.0438	(0.08)	0.0552	(0.09)
PRODUCTIVTY	-0.0203	(0.87)	-0.0228	(0.81)	0.0133	(0.89)	0.1100	(0.21)
DMNC	0.5556	(0.00)	0.1439	(0.63)	0.4290	(0.01)	-0.3060	(0.25)
ADEDUMMY	-0.1487	(0.39)	0.3568	(0.04)	-0.0659	(0.66)	0.3169	(0.04)
SIZEDUMMY	0.0481	(0.81)	0.1555	(0.49)	-0.1315	(0.39)	0.2436	(0.20)
BOIDUMMY	-1.0769	(0.42)	4.2319	(0.00)	-1.8175	(0.00)	3.9727	(0.00)
PRODUCTDEV	-0.0443	(0.80)	0.4052	(0.02)	-0.0793	(0.68)	0.3590	(0.14)
Rho	(0.56)				(0.00)			
Observation	767				1162			
	Separate Probit and OLS's result are provided In appendix section D				Standard OLS would yield sample selection Bias			
	ISIC 26				ISIC 27-28			
	Selection Equation		Response Equation		Selection Equation		Response Equation	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	1.6167	(0.02)	-2.6957	(0.00)	-3.7384	(0.00)	-2.5807	(0.00)
LOG(K/L)	-0.0868	(0.36)	0.2208	(0.01)	0.0441	(0.57)	0.1031	(0.22)
LOG(Sk/L)	0.1059	(0.18)	0.0086	(0.83)	0.0001	(1.00)	0.0095	(0.82)
PRODUCTIVTY	0.1203	(0.23)	0.2462	(0.00)	0.2399	(0.02)	0.1142	(0.16)
DMNC	0.6092	(0.03)	-0.1195	(0.80)	0.5725	(0.00)	-0.4608	(0.22)
ADEDUMMY	-0.2489	(0.26)	0.3636	(0.05)	0.0555	(0.76)	0.4205	(0.01)
SIZEDUMMY	-0.0343	(0.90)	-0.5791	(0.05)	-0.3392	(0.08)	0.4197	(0.04)
BOIDUMMY	-3.1568	(0.00)	3.4899	(0.00)	1.3157	(0.10)	10.4568	(1.00)
PRODUCTDEV	-0.0353	(0.90)	0.4168	(0.09)	-0.3747	(0.11)	0.4286	(0.12)
Rho	(0.00)				(0.03)			
Observation	738				1,501			
	Standard OLS would yield sample selection Bias				Standard OLS would yield sample selection Bias			

Table5.7. Export differential results from sample selection models for ISIC 24 to ISIC 28 industries

5.3.2.5 Manufacture of chemical & chemical products [ISIC (24)]

As Rho is not statistically significant, the results from Probit and OLS are provided in the appendix section. Interestingly, the results from probit model indicate no linkage between plants' multinational status and plant's decision to export. However, the linkage between plant's export intensity and its foreign-controlled status are found in OLS models.

5.3.2.6 Manufacture of rubber and rubber products [ISIC (25)]

Again, foreign plants are only exhibited with better export performance than local-operated plants in term of export probability; but, not in term of plant' export intensity. However, the p-value of RHO coefficients indicate that both of the export decision and export propensity regression are statistically related, and the ordinary least square method to test for the effect of multinational status of the plant on the plant' export propensity would be insufficient.

5.3.2.7. Manufacture of non-metallic other product [ISIC (26)]

We found the insignificant effect from the multinational status on plant's export propensity while their effects on probability to export of the plant are reported. The significance of the RHO coefficient indicates the selection bias problem of response regression; hence the Heckman selection model results are mainly utilized in the interpretation.

5.3.2.8. Manufacture of basic metal [ISIC (27)] and fabricated metal products [ISIC (28)]

Foreign control status of the plant could significantly increase only the plant's chance to export. While the p-value of the coefficient RHO indicate that the plants' decision on how much to export and their decision on whether to engage in export is statistically related. Hence both regressions could not be separately implemented due to potential selection bias. Heckman selection method is optimal estimation choice.

5.3.2.9. Manufacture of general machinery [ISIC (29)]

If we are holding other factor constants, plants with foreign-controlled status in this industry has higher export probability than local-operated plants; while, we found no linkage between the plant's export propensity and multinational status of the plant.

5.3.2.10 Manufacture of Electric machinery [ISIC (30) to ISIC (33)]

Table, illustrated in the next page, also shows the interrelation between plant's decision to export and plant' export propensity; however, we found no evidence that foreign controlled plants either have higher chance to export or higher export intensity than their local counterpart in this industry.

	ISIC 29				ISIC 30to33			
	Selection Equation		Response Equation		Selection Equation		Response Equation	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	-0.4911	(0.46)	-2.0307	(0.00)	0.2825	(0.74)	-2.0166	(0.00)
LOG(K/L)	0.0485	(0.55)	0.1338	(0.24)	0.0672	(0.26)	0.2965	(0.01)
LOG(Sk/L)	0.0735	(0.10)	0.0271	(0.69)	-0.0297	(0.41)	0.0489	(0.50)
PRODUCTIVTY	-0.0472	(0.67)	0.0031	(0.98)	0.0209	(0.78)	-0.0399	(0.76)
DMNC	0.3654	(0.05)	-0.3797	(0.38)	0.1324	(0.35)	0.4950	(0.07)
ADEDUMMY	0.1892	(0.30)	0.3899	(0.10)	0.0575	(0.67)	0.2415	(0.35)
SIZEDUMMY	0.8482	(0.00)	0.0642	(0.86)	0.5186	(0.00)	-0.1710	(0.62)
BOIDUMMY	-1.6532	(0.01)	4.5848	(0.00)	-1.7066	(0.03)	4.2221	(0.00)
PRODUCTDEV	-0.0661	(0.80)	-0.4922	(0.41)	0.0732	(0.66)	0.2198	(0.58)
Rho	(0.00)				(0.02)			
Observation	607				679			
	Standard OLS would yield sample selection Bias				Standard OLS would yield sample selection Bias			

Table5.8. Export differential results from sample selection models for ISIC 29-33 industries

To conclude the section 5.3.1 and section 5.3.2, we generally found that not only foreign plants have higher chance to export; but, their export propensity is also higher than their local counterparts. The results are relatively robust across the models with or without the Heckman selection model as remedies to the problem of selection bias.

However, the testing at each industry level does indicate that the results relatively vary across industries. Some of the industries, the superiority in export only exists in the case of plant's export probability only. While; in some industries, the superiority in export performance of foreign plant is not statistically valid at all. As stated in the review of literature section 2.3, plants with multinational network are likely to have more tools and resources to cope with foreign exchange exposure than indigenous plants, the following section reveals the comparison results between foreign and local operated units in foreign exchange exposure.

Next; we discuss whether this superiority of foreign plant in export performances could statistically transmitted to local control plants, the export spillover part.

5.3.3. Export spillovers at the manufacturing sector

	Information Externalities		Competition Effect		Demonstration Effect	
	Selection	Response	Selection	Response	Selection	Response
C	-2.1125 (0.00)	0.3270 (0.26)	-2.2312 (0.00)	0.2911 (0.29)	-2.1552 (0.00)	0.1751 (0.51)
LOG(K/L)	0.0835 (0.00)	-0.0341 (0.16)	0.0854 (0.00)	-0.0339 (0.16)	0.0835 (0.00)	-0.0369 (0.13)
LOG(Sk/L)	0.0209 (0.03)	0.0180 (0.12)	0.0211 (0.03)	0.0193 (0.10)	0.0210 (0.03)	0.0206 (0.09)
PRODUCTIVTY	0.1134 (0.00)	0.0729 (0.01)	0.1130 (0.00)	0.0800 (0.00)	0.1139 (0.00)	0.0718 (0.01)
Foreign presence	-0.0016 (0.09)	-0.0082 (0.00)	0.00158 (0.21)	-0.0067 (0.00)	-0.0009 (0.29)	-0.0011 (0.26)
ADEDUMMY	-0.1690 (0.08)	-0.8315 (0.00)	0.1525 (0.22)	-0.6802 (0.00)	-0.0904 (0.28)	-0.1117 (0.25)
SIZEDUMMY	0.2739 (0.00)	-0.0894 (0.11)	0.2675 (0.00)	-0.0931 (0.10)	0.2710 (0.00)	-0.1076 (0.06)
BOIDUMMY	0.3094 (0.00)	-0.0011 (0.98)	0.3215 (0.00)	0.0127 (0.83)	0.3125 (0.00)	0.0437 (0.48)
PRODUCTDEV	3.7864 (0.00)	-1.2951 (0.00)	3.7693 (0.00)	-1.4002 (0.00)	3.7539 (0.00)	-1.4504 (0.00)
Rho(sig. level)	(0.00)		(0.00)		(0.00)	
Observation	9,564		9,569		9,482	

Table5.9. Export spillover results from sample selection models from various measurement of horizontal spillover effect[38], manufacturing sector

Results indicates that neither export share of MNC, the output share of MNC, and the R&D share of MNC in the industry could not positively influence export probability of the local plant. Regardless of channel of spillovers and employed techniques, the presence of foreign plant in the industry could not enhance the chance to export of their local-counterparts.

In term of local plants' export intensity, not only the favorable spillover effects could not be found; but the results in the above table also revealed the negative spillover effects from the competition effects and information externalities channel.

If we further extend our analysis to include the presence of foreign plants in supplying industries and the presence of foreign plants in downstream industries to

[38] The number in parenthesis is the p value of coefficient, coefficients. RHO (ρ) is estimated correlation between the error terms of selection and response equations, its p value is reported in parenthesis

the base line equations (5-3) and (5-4) with the measurement of foreign output share; the extended models as described in section 5.2. The following table depicts the results from this extended models (5-3)' and (5-4)'. We still found no evidences that the foreign presence either in the same industries or their presence in supplying industries could statistically increase the local plant's chance to export; or, their export intensity.

	PROBIT	OLS	Heckman Selection		
			Selection	Response	
C	-2.3426 (0.00)	-9.1855 (0.00)	-2.3258 (0.00)	0.3834 (0.16)	C
LOG(K/L)	0.0899 (0.00)	0.0464 (0.00)	0.0867 (0.00)	-0.0345 (0.16)	LOG(K/L)
LOG(Sk/L)	0.02228 (0.03)	0.0145 (0.01)	0.0205 (0.03)	0.0198 (0.09)	LOG(Sk/L)
PRODUCTIVTY	0.1168 (0.00)	0.0910 (0.00)	0.1099 (0.00)	0.0707 (0.01)	PRODUCTIVTY
Upoutput	-0.3124 (0.26)	-0.5114 (0.00)	-0.3003 (0.27)	-0.0199 (0.00)	Upoutput
Horizontalspill	-0.2384 (0.25)	-0.3380 (0.01)	-0.2480 (0.22)	-0.0071 (0.00)	Horizontalspill
Downoutput	0.9800 (0.00)	0.9042 (0.00)	0.9883 (0.00)	0.0108 (0.00)	Downoutput
ADEDUMMY	0.2857 (0.00)	0.1772 (0.00)	0.2657 (0.00)	-0.0902 (0.11)	ADEDUMMY
SIZEDUMMY	0.3243 (0.00)	0.2673 (0.00)	0.3163 (0.00)	0.0101 (0.86)	SIZEDUMMY
BOIDUMMY	3.8410 (0.00)	7.3019 (0.00)	3.7649 (0.00)	-1.3950 (0.00)	BOIDUMMY
PRODUCTDEV	0.2862 (0.00)	0.0651 (0.25)	0.2609 (0.00)	-0.3837 (0.00)	PRODUCTDEV
			(0.00)		Rho (significant)
R-square	0.7191	0.7693			
Observation		9,569			Observation

Table5.10. Export spillover results from Probit, OLS and Sample selection models from plant in manufacturing sector[39] manufacturing sector

Instead, we found that it is an increase in the productivity of plants i that can statistically increase their export probability and export intensity. Export intensity and

[39] The number in parenthesis is the p value of coefficient, coefficients. RHO (ρ) is estimated correlation between the error terms of selection and response equations, its p value is reported in parenthesis

probability of local plant can also be influenced by the age, size and whether that particular local plant had received BOI privileges, or whether the plant had engaged in the product development.

In the next section, we further investigate whether the export spillover effects are heterogeneous across industry; and, if they are. It would be beneficial to the policy maker to be verified the list of industries in which local plants' export performance could be enhanced by the presence of foreign-controlled plant. In the next subsection, the analysis of Heckman selection techniques is applied throughout the section.

5.3.4 Export spillover effects at each industry

5.3.4.1. Manufacture of food product and beverages [ISIC (15)]

Neither intra-spillover effect nor inter-spillover effects were statistically found, we can interpret that the as local plant's chance to export could not be positively influenced by the presence of foreign plant in the industry or their presence in downstream industries. Instead, we found that an increase in foreign presence in the upstream industries could actually harm the export propensity of the local plants. The plausible explanation for this adverse effect is an input crowding out effect. As foreign plants expand in the supplying industries; they could potentially harm the existing local suppliers. As Rho is not statistically reported, the OLS and Probit model results are further provided in the appendix section. Results are relatively the same as Heckman selection model; except, OLS result had revealed a positive spillover from foreign presence in downstream industries.

5.3.4.2 Manufacture of Textiles [ISIC 17]

We found no evidence of horizontal spillovers, neither the effects toward the chance to export of local plant or their exportability (export propensity). As the previous industries, negative spillover effects from upstream industries were found not only through the measurements of local plants' export propensity; but also, their export propensity. As the reported p-value Rho of Heckman selection model is lower than

0.05 significant level; the results from Probit and OLS model are reported in appendix section 4. Results are relatively similar to the previously reported results.

5.3.4.3. Manufacture of wearing apparel [ISIC 18], and luggage& footwear [ISIC 19]

We found a strong positive spillover effect from the foreign presence in upstream industries and positive horizontal spillover effect. , and the magnitude is relatively large. The presence of foreign plant in basic wearing apparel industries; like, Button, cloth’s zipper could upgrade the quality of the manufactured apparels which could further increase the export performance of the local manufacturer.

However, we found some evidence that the presence of foreign plant in the downstream industries (intra-industry) could diminished the export intensity of their local counterpart. Results are relatively similar even if Probit and OLS techniques were used; the results are shown in appendix section 4.

5.3.4.4. Manufacture of wood & product of wood [ISIC 20] and paper [ISIC 21]

Tables in the next page, In term of export probability, we found negative horizontal spillover effect; however, the presence of foreign invested plants in up/downs stream industries can statistically enhance the exporting chance of local-operated plants. In addition, the effect from their presence in the downstream industries also could influence the export propensity of the local counterparts.

	ISIC 15				ISIC 17			
	Selection Equation		Response Equation		Selection Equation		Response Equation	
	Coefficie nt	P- value	Coefficie nt	P- value	Coefficie nt	P- value	Coefficie nt	P- value
C	-2.5839	(0.00)	-1.8802	(0.01)	-0.5958	(0.38)	-0.6689	(0.41)
LOG(K/L)	0.0741	(0.20)	-0.1037	(0.06)	0.1052	(0.20)	0.1118	(0.12)
LOG(Sk/L)	0.0495	(0.05)	0.0155	(0.46)	0.0372	(0.48)	-0.0296	(0.65)
PRODUCTIVTY	0.0333	(0.64)	-0.0759	(0.31)	0.1265	(0.19)	0.1873	(0.04)
Spilloverfromup	0.0072	(0.31)	-0.0030	(0.00)	-0.0074	(0.00)	-0.0088	(0.00)
Horizontalspill	0.0060	(0.59)	-0.0010	(0.25)	0.0011	(0.43)	-0.0018	(0.83)
Spilloverfromdown	-0.0076	(0.55)	-0.0030	(0.78)	0.0092	(0.57)	0.0037	(0.01)
ADEDUMMY	0.0565	(0.69)	0.0459	(0.72)	0.6392	(0.00)	0.0739	(0.69)
SIZEDUMMY	0.3189	(0.07)	-0.1217	(0.38)	0.4680	(0.08)	0.0961	(0.60)
BOIDUMMY	4.1181	(0.00)	0.5699	(0.42)	3.9826	(0.00)	0.6788	(0.29)
PRODUCTDEV	0.5033	(0.00)	-0.0933	(0.50)	0.0750	(0.83)	-0.1055	(0.65)
Rho	(0.9820)				(0.4135)			
Observation	1,605				770			

	ISIC 18-19				ISIC 20-21			
	Selection Equation		Response Equation		Selection Equation		Response Equation	
	Coefficie nt	P- value	Coefficie nt	P- value	Coefficie nt	P- value	Coefficie nt	P- value
C	-50.8798	(0.06)	-54.7584	(0.00)	-4.0205	(0.00)	1.9948	(0.03)
LOG(K/L)	0.1256	(0.04)	-0.1058	(0.06)	-0.1630	(0.05)	-0.1272	(0.06)
LOG(Sk/L)	0.0058	(0.80)	-0.0243	(0.25)	0.0658	(0.19)	-0.0052	(0.88)
PRODUCTIVTY	0.0644	(0.34)	0.0326	(0.53)	0.0502	(0.67)	-0.1053	(0.29)
Spilloverfromup	1.111	(0.08)	0.0119	(0.01)	0.0043	(0.02)	-0.0038	(0.03)
Horizontalspill	1.775	(0.08)	0.0192	(0.01)	-0.0034	(0.00)	0.0010	(0.30)
Spilloverfromdo wn	-0.868	(0.08)	-0.0092	(0.01)	0.0025	(0.01)	0.0019	(0.03)
ADEDUMMY	0.2713	(0.03)	0.0621	(0.58)	0.3959	(0.04)	-0.6767	(0.00)
SIZEDUMMY	0.5467	(0.00)	0.4175	(0.00)	0.7692	(0.00)	-0.3519	(0.05)
BOIDUMMY	3.5857	(0.00)	0.2170	(0.64)	4.2718	(0.00)	-1.9487	(0.00)
PRODUCTDEV	0.3129	(0.44)	-0.2668	(0.15)	0.7039	(0.03)	-0.8613	(0.00)
Rho	(0.8466)				(0.0000)			
Observation	942				846			

Table5.11. Spillover effect results from sample selection model for ISIC (15) to ISIC (21) industries

5.3.4.5. Manufacture of chemical & chemical products [ISIC (24)]

Results are illustrated in the table shown in the next page. The effects of foreign presence are more statistically valid toward the export probability of local plants than their effects on export propensity of local plants. Positive horizontal spillover effects are found, while negative spillover effect from the presence of foreign plants in upstream industries is found. It implies that their expansion in supplying industries could distract the chance to export of local manufacturer. The plausible explanation is as previous section, the crowding out effect on existing suppliers of local manufacturer. Results from OLS and Probit model are provided in the appendix section, similar effects could be found in these two conventional methods as well.

5.3.4.6. Manufacture of other non-metallic other products [ISIC (26)]

We found that an expansion of foreign' output share in the industry could not significantly increase the chance to export of local-operated plants; however, their presence can increase the local plat's export propensity. We found positive spillover from foreign presence in supplying industries on the local manufacturer' export probability. Rho coefficient is statistically different from 0, which implies that both plant's decision to export and plant decision on how much to export is interrelated. As a result, regressing the selection and response regression separately would yield biased coefficients.

5.3.2.7. Manufacture of basic metal [ISIC (27)] and fabricated metal products [ISIC (28)]:

Horizontal spillover effects are found to be insignificant in both measurements of local plants' export performance. Interestingly, we found that positive vertical spillover effects. Foreign presences in both upstream and downstream industries can enhance the chance to export of local steel and metal manufacturers. The Rho value also indicates the interrelation between export decision and decision on how much to export.

	ISIC 24				ISIC 26			
	Selection Equation		Response Equation		Selection Equation		Response Equation	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	5.8348	(0.00)	-1.7744	(0.35)	-4.9297	(0.00)	-4.1161	(0.00)
LOG(K/L)	-0.0018	(0.98)	0.0182	(0.85)	0.1959	(0.07)	-0.0416	(0.69)
LOG(Sk/L)	0.0516	(0.31)	0.0659	(0.18)	-0.0024	(0.95)	0.0892	(0.19)
PRODUCTIVTY	-0.1827	(0.11)	-0.0843	(0.57)	0.2262	(0.01)	0.0915	(0.40)
Spilloverfromup	-0.2150	(0.00)	0.0015	(0.77)	0.0054	(0.00)	0.0025	(0.90)
Horizontalspill	0.0059	(0.00)	0.0039	(0.05)	0.0044	(0.85)	0.1071	(0.00)
Spilloverfromdown	-0.0085	(0.62)	-0.0044	(0.01)	0.0117	(0.41)	-0.0349	(0.08)
ADEDUMMY	0.5469	(0.00)	-0.1069	(0.61)	0.4139	(0.07)	0.2296	(0.36)
SIZEDUMMY	0.3266	(0.19)	-0.0127	(0.95)	-0.1387	(0.66)	-0.2145	(0.46)
BOIDUMMY	4.3569	(0.00)	-0.9606	(0.41)	3.7327	(0.00)	1.2719	(0.01)
PRODUCTDEV	0.3733	(0.07)	0.1817	(0.41)	0.3547	(0.23)	0.1379	(0.65)
Rho	(0.6370)				(0.0000)			
Observation	648				686			

	ISIC 27-28				ISIC 30-33			
	Selection Equation		Response Equation		Selection Equation		Response Equation	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	-5.6920	(0.00)	-0.3139	(0.79)	-2.4093	(0.03)	-2.5804	(0.06)
LOG(K/L)	0.1527	(0.07)	0.1188	(0.18)	0.2175	(0.14)	0.1771	(0.05)
LOG(Sk/L)	0.0392	(0.45)	-0.0192	(0.72)	-0.0122	(0.89)	-0.0504	(0.47)
PRODUCTIVTY	0.1584	(0.05)	0.2976	(0.01)	0.0326	(0.84)	0.0453	(0.70)
Spilloverfromup	0.0607	(0.03)	-0.0179	(0.55)	0.0117	(0.68)	-0.0336	(0.02)
Horizontalspill	-0.0012	(0.88)	-0.0016	(0.85)	-0.0197	(0.47)	0.0277	(0.13)
Spilloverfromdown	0.0222	(0.00)	0.0150	(0.12)	0.0088	(0.77)	0.0130	(0.47)
ADEDUMMY	0.5306	(0.00)	-0.0095	(0.96)	0.6052	(0.08)	0.0427	(0.83)
SIZEDUMMY	0.4551	(0.03)	-0.5073	(0.02)	-0.2673	(0.62)	0.3954	(0.09)
BOIDUMMY	9.3784	(1.00)	-2.0009	(0.00)	4.6316	(0.00)	0.4957	(0.67)
PRODUCTDEV	0.3074	(0.30)	-0.9062	(0.00)	0.2455	(0.60)	-0.4605	(0.06)
Rho	(0.0001)				(0.7532)			
Observation	1305				425			

Table5.12. Spillover effect results from sample selection model for ISIC (25) to ISIC (33) industries

5.3.4.7. Manufacture of Electric machinery [ISIC (30) to ISIC (33)]

We found no evidence that the presence of foreign plants could increase the chance to export of local plants, neither the evidence which show that their presence could increase the export probability of local-operated plants. Instead, we still found that their presence in supplying industries could diminish their local counterpart's export intensity.

To conclude this section, results illustrated in first section strongly advocate for the influence of plants' multinational status on export performance of the plants, and as previous studies, we found strong evidence of the superiority plants with foreign control status over the domestic plants. However, we found weak evidences to proof that these superiorities in export could be transmitted to local operated plant as claimed by the investment promotion authority. Next section, we discuss the limitation and suggestion for further study.

5.4. Summary, Policy implication and Further study

Being as a part of the global network, foreign-controlled plants are conceptually perceived as having superiority in export performance over the local operated plants. We employed various employed methodologies, sample selection model, Probit and OLS techniques. Despite the testing techniques, the results are relatively robust across the methodologies. We found that multinational status of the plant could statistically increase both export probability and export intensity of the plants in manufacturing sector sample.

For the testing of export spillover hypothesis (3^{rd} to 6^{th} chapter hypothesis), regardless of how the foreign presences are measured, the evidence of externalities from foreign presence toward the local-operated plant is relative weak. This study also acknowledge that the potential spillovers from foreign presence in upstream and downstream industries; however, we found weak evidence that only the presence of foreign plants in downstream industries could stimulate the export performances of the local-operated plants.

As the results from this study and previous study ((Ramstetter 2006)) for export performance differential is more validate than the productivity differential between foreign-invested and local-operated plants. We can conclude that the existing of foreign plants could increase industry's export performance; and, eventually the manufacturing sector's export performance. However, there is limited evidence of externalities from their presence on local plants' export performances as frequently claimed by investment promotion authorities. Authorities should instead consider the development of local plants' productivity; further encourage the investment in product development. Since, we found that these variables can generally increase the probability to export of local plant.

As (Libsey 2002); the relationship between plants in different industries could conceptually be separately verified by observation of variables that represent the different layer of spillover effects. Practically, plants in the same classified industry could interact as supplier-manufacture or manufacturer-buyer. This disarrangement could potentially lead to overstatement of the reported value, since the measurement of foreign plants in the industry includes not only foreign counterpart but also foreign suppliers or buyers. We suggest any further researches to not only check industry code; but, they should also check other type of establishment's information; for example, product code. In addition, Spillover from upstream and downstream industries are restrictedly measured as only foreign presence in upstream manufacturing industries or downstream manufacturing industries, the measurement could not be extended to include the foreign presence in the upstream/downstream in other sectors. The new business census conducted in 2012 (micro level data are expected to be available in 2015) enlisted establishments in service and retail sectors, any further study should consider the extension of the analysis to the foreign sale in these retail and service sectors.

Chapter 6
Limitation

The main analysis of this dissertation is based on the NSO 2007' industrial census which is cross sectional data. The author perceives that the most optimal method is to employ panel data to investigate whether the change in foreign presence could statistically lead to a change in local plants' performances. Although the models in the previous sections have augmented solution for the endogeneity effects potentially arisen from the selection of foreign plants to the industries with high productivity / export intensity, there are some issues which worth indicating in this limitation section.

First; although the spillover effects on local plant's productivity could not be statistically observed in many industries by using this set of data. With panel data, it is likely that if we allow for longer period of time; the effects of foreign's presence on local plants could be potentially revealed; as, the change in plant's productivity could be observed in longer term than the change in plant's export performance. Thus, our findings which have tendency toward the export performance differentials than the productivity differentials could actually caused by the lack of panel data.

Second; the measurements of foreign presence in upstream and downstream industries are strictly limited to the foreign presence in related manufacturing sector only. Those variables do not include the foreign presences in service and retail sectors. Hence, the insignificances of those variables do not imply their presences in every upstream or downstream industry could not influence the performance of local plants. They strictly mean relationship between local plants and foreign manufacturer suppliers and foreign buyers in manufacturing industries.

Third; the recent works in these fields; for example, (Javorcik 2004), (Du 2012) further employed the Olley and Pakes model (Olley 1996) method to account for potential endogenity between the amount of plant's capital and plant's output. As the census has been mainly employed throughout the analysis, the employment of model are not likely to be applicable in this dissertation. In addition, the previous works by (Ramstetter 2006) had also mentioned that this problem is relatively not severe in the case of Thai's industrial census.

The new census was conducted in the year 2012 and this latest census includes the service and retail establishments in the study; hence, the spillover effects from the foreign presence in other sectors could be now verified by the new set of micro-level data (establishment level data are estimated to be completely available in the year 2015). If the establishment of new census ID coding system were the same as two preceding censuses, it would be possible to construct the set of panel data from the available censuses. Therefore, we recommend that all future censuses use the same coding system for each observation so that panel data would readily available for an improved study.

Chapter 7
Conclusion and Policy implication

The initial motivation of this dissertation is to investigate whether the presence of foreign plants generate externalities, the spillover effects, toward the performances of Thai indigenous plants. From the theoretical frameworks, not only the presence of foreign-invested plants could influence the domestic plant's performance (horizontal spillovers); but also, the performance of domestic plants in upstream/downstream industries. However, the previous empirical evidences on these FDI's externalities are relatively ambiguous and vary across the regions. Two types of plant's performances are discussed in this dissertation, productivity and export performance.

Instead of having a prerequisite assumption of foreign plant's preeminence in both types of performances, the study on productivity differentials and export performance differential are conducted prior to the spillover testing.

The results from various methods strongly indicate that foreign plants have greater productivity and they are more export oriented than local-operated plants in the whole sample of manufacturing sector. However; the disaggregate studies at major industry level indicate that the productivity gap between foreign and local operated plants are consistently supported only in 6 industries. There are manufacturer of wood and paper products, manufacture of chemical industries, manufacturer of rubber and plastic product, manufacturer of basic and fabricated metal and miscellaneous industries (manufacturer of furniture, musical, sport equipment and toys).

Conversely, the analysis of export performance differentials at the industry level concurs to the existences of the superiority of foreign plant performance over local-operated plant than the productivity differential study. One of the plausible explanations for this differential in export performance is being explored in this dissertation as well, the foreign exchange exposure between foreign-invested and local-operated firms. In which, we found the magnitude of foreign exchange exposure of exporting firms is lower in the group of foreign-invested firms than the group of local-operated firms.

With the matching of two different industries classification systems, ISIC classification and IO code, at the most disaggregate level, the studies of both horizontal and vertical spillover effects could be conducted at the major industries. First, we found strong evidences of positive horizontal spillover effect in aggregate manufacturing sample. However, only few industries (a sub set of the previous list with the report of significant productivity differentials) are reported with the evidences of horizontal spillover effects. In fact, the studies at the industry level shows that the presence of foreign plants in the supplying industries could actually diminish the average productivity of local plants in manufacture of Chemical and chemical products (ISIC 24) and manufacture of basic and fabricated metal (ISIC 27-28). While, we found that their presence in downstream industries can positively affect the average productivity of Thai indigenous plants in manufacture of general machinery (ISIC 29), and manufacture of electronics and precious instrument (ISIC 30-33). As the nature of these technology intensive industries, the requirements of the sophisticated raw material or work in process are needed. Hence the transfers of technology to the local suppliers are likely to be valid in this group of industries.

Although; both of plant's decision to export and plant's export intensity can be statistically influenced by the multinational status of the plant; and most of the industries are reported with export performance differential. However, we found only a small fraction of evidences to support these claims for export spillover effects. Only the foreign presences in downstream industries are found to have positive relationship with local plants' export performance.

As the previous literatures (Ramstetter 2005), and (Ramstetter 2006), the results on export performance differentials is more convincing than the productivity differentials. First, A policy targeted on export led type of FDI is at least serve its purpose to increase average export performance of many industries; only few industries through the productivity differential topics.

Even though the evidences from this dissertation had suggested that an increase in net inflows of FDI to the manufacturing sector could generally increase the average productivity; however, the analysis at each major industry level suggest another policy implication nexus.

Secondly, as we have failed to find the existences of FDI externalities toward the local operated plants' productivity in most of the studied industries, and the productivity differentials are found to be statistically significant only in aforementioned six industries. As the contribution from a uniform FDI promoting policy which ignore the industries which plants belongs is increasingly questionable from our perspectives, the Zoning based FDI promoting policies would likely to be less effective than the newly adopted industries/activity based policies (implemented in mid. of 2014).

Third As horizontal spillover effects are found in the industries which the difference between foreign and local plants is not large, the absorptive capacity of the local plants should be in the policy makers' spotlight. As (Bloomstrom 2003) had concluded that spillover effect is not an automatic consequence of FDI. Hence, the authority should further explore the local plant's motivation to invest in learning process. As the result of horizontal spillover effects are consistently reported in ISIC 24 industry, where the indices for absorptive capacity of local plants are relatively high.

In addition, the evidence of positive spillover from foreign presence in downstream industries leads us to suggest that the effects on local entities from the presence of foreign plants are not restricted to intra-industry basis. A policy maker should consider how the net inflows of FDI in particular industry could affect the performance of local units in the related industries as well.

Generally speaking, the effects of FDI on local plant's performance and the productivity differentials between foreign-invested and local-operated plants differ greatly across the industry; hence, a uniform FDI promoting policy is highly trivial.

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APPENDIX

Appendix A
Appendix to Conceptual frameworks

A.1. Further detailed on foreign exchange exposure's conceptual framework

A.1.1.Levi Model (Levi 1994) model

Levi had developed an extensive framework for the foreign exchange exposure of exporting and importing firm.

(Levi 1994) Exporting firm's framework

Under perfect capital market, the market value of the firms reflects its true value; Levi defines the market value of the exporting firms as follow

$$V = \left(\left(\frac{TR-TC}{\rho}\right)(1-\tau)\right) + \sum_{i=0}^{k} \pi_i X_i \qquad \text{(A-1)}$$

Where $TR = \sum_{i=0}^{k} \pi_i p_i q_i$ eq. (A1-1A) and $TC = c\sum_{i=0}^{k} q_i$ eq. (A1-1B)

V=Market value of the firms TR=Total revenue TC=Total cost τ = Tax rate

ρ = Investor's risk adjusted required rate of return

π_i = exchange rate (home / unit of currency i)

p_i = product price in country I q_i = quantity sold in country I c = marginal cost of production at home

X_i = net monetary asset/liability position in currency I (negative for net liabilities)

Total revenue derives from sales in k countries, converted to home currency, and firm's total cost is calculated with the assumption of constant marginal cost (c), and all of the cost incurred at home.

The effect of change in exchange rate of currency j could affect the exporting firm's value[40] , through using the term in equation A1-1A and A1-1B in equation A1-1, and

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[40] Under efficient capital market assumption, the market value of the firms and its intrinsic value could be used interchangeable.

then taking the first derivative of equation S1-1 with respect to particular currency, π_j, then

$$\frac{\partial V}{\partial \pi_j} = \left[p_j q_j + \pi_j p_j \frac{dq_j}{dp_j}\frac{dp_j}{d\pi_j} + \pi_j q_j \frac{dp_j}{d\pi_j} - c\frac{dq_j}{dp_j}\frac{dp_j}{d\pi_j}\right]\frac{(1-\tau)}{\rho} + X_j \tag{A-2}$$

Further assume that tax rate is independent from the exchange rate, and ρ (share holder's required rate of return) is invariant to the exchange rate, and the assumption which presumes that firm's decision of output produced does not relate to exchange rate.

Firm with profit maximizing objective will set *dTR/dq_j* equals to *dTC/dq_j* and from the expression in the A-1 and A-2; we have.

$$\pi_j p_j + \pi_j q_j \frac{dp_j}{dq_j} = c$$

Or expressed in term of price in country j as

$$p_j = \frac{c}{\pi_j\left(1 - \frac{1}{\eta_j}\right)} \tag{A-3}$$

Where $$\eta_j = -\frac{dq_j}{dp_j}\frac{p_j}{q_j} \tag{A-4}$$

η_j is the elasticity of demand in country j, with the manipulation of equation A-4

$$\pi_j p_j = \frac{c}{\left(1 - \frac{1}{\eta_j}\right)}$$

As no firm sells where demand is inelastic then η_j is greater than one, thus p_j is positive

From eq. (A-3) we have

$\frac{dp_j}{d\pi_j} = -\frac{p_j}{\pi_j}$ and equation A-4 we can rewrite equation A-2 as follow

$$\frac{\partial V}{\partial \pi_j} = [p_j q_j - p_j q_j(1-\eta_j) + c\left(\frac{dq_j}{dp_j}\frac{p_j}{\pi_j}\right)]\frac{(1-\tau)}{\rho} + X_j$$

Or

$$\frac{\partial V}{\partial \pi_j} = \eta_j q_j\left(p_j - \frac{c}{\pi_j}\right)\frac{(1-\tau)}{\rho} + X_j \tag{A-5}$$

Then the elasticity of exporting firm value to exchange rate could be stated as following

$$\frac{\pi_j}{V}\frac{\partial V}{\partial \pi_j} = \eta_j \frac{\pi_j q_j\left(p_j - \frac{c}{\pi_j}\right)(1-\tau)/\rho}{V} + \frac{\pi_j X_j}{V} \quad \text{(A-6)}$$

Then sensitivity of the exporting firm value derived from foreign exchange variability, directly depend on the elasticity of demand for the firm's product in country j (η_j) , per unit mark-up (p_j - c/π_j) and quantity sold (q_j). In addition to above determinants the sensitivity of firm value to the exchange rate also conversely varies to tax rate and the investor's required rate of return. X_j a net financial position of the firm in country j also impact the value of the exporting firm. Since I am focusing on the factors which affecting firm's cash flow, I would emphasize my analysis on η_j, (p_j – c/π_j), and q_j.

Quantity product sold in country j (q_j) would directly affect the firm's foreign revenue which is part of exporting firm's total revenue [term (1) in figure 1] and eventually firms' earnings, while the elasticity of demand for the firm's product in country j would indirectly influence the firm's revenue as well. As same as the profit rate (r) from the (Bodnar 2001)'s model, the firm's per unit mark up (p_j - c/π_j) would determine the firm's foreign exchange exposure through the relative of firm's price per unit to the sum of cost of goods sold per unit (2) and operating expense per unit.

Levi (1994) importing firm's framework

With a slight change from exporter's setting, the setting of importer is illustrated as following.

$$V = \left(\left(\frac{TR-TC}{\rho}\right)(1-\tau)\right) + \sum_{i=0}^{k}\pi_i X_i \quad \text{(A-7)}$$

Where $TR = \sum_{i=0}^{k} q_i$ ____(A1-7A) and $TC = \sum_{i=0}^{k}\pi_i c_i q_i$ _____(A1-7B)

V=Market value of the firms TR=Total revenue TC=Total cost τ = Tax rate

ρ = Investor's risk adjusted required rate of return

π_i = exchange rate (home / unit of currency i)

q_i = quantity of imported goods c = marginal cost of production at home

X_i = net monetary asset/liability position in currency I (negative for net liabilities)

p represents the price of product in home country, and with the same assumption as in the exporting section, and further assume that import is homogenous. In addition the author also assume that $dc_j/d\pi_i$ = 0, the first derivative of eq. (A-7) with respect to currency j' ex. rate is

$$\frac{\partial V}{\partial \pi_j} = \left[p\frac{dq_j}{dp}\frac{dp}{d\pi_j} + q_j\frac{dp}{d\pi_j} - c_jq_j - \pi_jc_j\frac{dq_j}{dp}\frac{dp_j}{d\pi_j}\right]\frac{(1-\tau)}{\rho} + X_j \quad \text{(A-8)}$$

Setting the output to the maximization problem and follow the same process, firm set $dTR/dq_j = dTC/dq_j$ then

$$p + q_j\frac{dp}{dq_j} = \pi_jc_j$$

Recall the definition of elasticity term in A-8 then the above equation could be expressed in p as

$$p = \frac{\pi_jc_j}{\left(1-\frac{1}{\eta}\right)} \quad \text{(A-8')}$$

From $\frac{dp}{d\pi_j} = \frac{p}{\pi_j}$ we can rewrite equation A-8, as

$$\frac{\partial V}{\partial \pi_j} = \left(-\frac{pq_j}{\pi_j}\eta + \frac{pq_j}{\pi_j} - cq_j + cq_j\eta\right)\frac{(1-\tau)}{\rho} + X_j$$

or

$$\frac{\partial V}{\partial \pi_j} = (1-\eta)q_j\left(\frac{p}{\pi_j} - c_j\right)\frac{(1-\tau)}{\rho} + X_j \quad \text{(A-9)}$$

Then the elasticity could be expressed as

$$\frac{\pi_j}{V}\frac{\partial V}{\partial \pi_j} = (1-\eta)q_j\left(p - \frac{c}{\pi_j}\right)\frac{(1-\tau)}{V} + \frac{\pi_jX_j}{V} \quad \text{(A-10)}$$

As same as the exporting firm, the quantity of product import would directly determine firm's foreign exchange exposure through its revenue, while the elasticity of demand for the imported goods would indirectly influence firm's foreign exchange exposure through the firm's revenue as well. The term ($p-c/\pi_j$) can be denoted as the importing firm's mark up which simultaneously affect firm value through price, cost of goods sold , and operating expense in firm' earnings structure.

A.1.2.Hekman (Hekman 1985) model:

(Hekman 1985) model use the corporate valuation theory, he examines the impact of the expected exchange rate fluctuations on the components of firm's value. I review this conceptual framework in order to gain insightful understanding how the exchange rate changes could influence the component of firm's cash flow, and consequently firm's present value which is the firm's market value under perfect capital market.

$$VE = VCF_u + (1-\mathbf{T})VD + VF \qquad (A-11)$$

Where, VE: present value of the flows to equity holders which is value of firm "V"

VCF_u: the base case value, the present value of firm's future after-tax operating cash flow (exclude the payments to suppliers of capital or to forward contract commitment)

VD: the present value of the flows to existing bondholders

VF: the value of outstanding forward foreign exchange contracts

T: the net effect of corporate and personal tax structure on the gain to leverage

Defines VCFu: as

$$VCF_u = \sum_{t=1}^{T} \frac{E(\pi_t . EAT_t)}{(1+\rho_0)^t} \qquad (A-12)$$

Whereπ_t : is the spot exchange rate, EATt: is earning after taxes, ρ0 is the unlevered and unhedgd required rate of return. With the scope on how exchange rate could influence the element in firm's current and future profit and loss statement and eventually firm's cash flow which determine the firm' present value; I would scope my analysis on the term VCF_u in this sub section, for the VD and VF term, the analysis would be conducted in the following sub section.

With the Cobb-Douglas production and market perfection assumption (dividend is irrelevant) which implies that return to capital are constant proportion of total revenue, α_k Which is similar to the firms' net profit margin of firms.

$$EAT_t = \alpha_k TR \qquad (A-13)$$

Where TR: total revenue which is defined in Hekman (1985) as follow

$$TR = \beta\tilde{p}_t^{\eta} \tag{A-14}$$

Where β is a constant parameter, η is an aggregate elasticity of revenue with respect to change in foreign currency traded goods price index, and $\tilde{p}_t$ is the index of traded good price at time t in foreign currency.

Further substitutes TR in equation A-14 to equation A-13

$$EAT_t = \alpha_k\, \beta\tilde{p}_t^{\eta} \tag{A-15}$$

With purchasing power parity for traded goods

$$\pi_t = \frac{p_t}{\tilde{p}_t}$$

p_t: is the index of traded goods prices in home currency.

Replace p_t in the purchasing power parity identity to the equation A-15

$$EAT_t = \alpha_k\, \beta p_t^{\eta}\pi_t^{-\eta} \tag{A-16}$$

Replace term in EAT_t in equation A-12

$$VCF_u = \sum_{t=1}^{T}\frac{E(\pi_t.\alpha_k\, \beta p_t^{\eta}\pi_t^{-\eta})}{(1+\rho_0)^t}$$

Rearrange

$$VCF_u = \sum_{t=1}^{T}\frac{E(\alpha_k\, \beta p_t^{\eta}\pi_t^{1-\eta})}{(1+\rho_0)^t} \tag{A-17}$$

Since αk, β, and p_t^{η} are constant, equation A-13 could be rewritten as.

$$VCF_u = \sum_{t=1}^{T}\alpha_k.\beta.p_t^{\eta}\frac{E[\pi_t^{1-\eta}]}{(1+\rho_0)^t} \tag{A-18}$$

Since exchange rate is the remaining variable in the expectation operator, we would continue to further clarify this variable. Assume that the exchange rate evolves as a random walk with drift (μ) and its error term (ε) is normally distributed as.

$$\ln\pi_{t+1} - \ln\pi_t = \mu + \varepsilon_t$$

Where $\varepsilon_t \sim N(0, \sigma^2)$

Then $\hat{\pi}_t \equiv \ln\frac{\pi_{t+1}}{\pi_t}$

Then $\ln\frac{\pi_{t+1}}{\pi_t} \sim N(\mu, \sigma^2)$

$$\pi_t = \pi_o.\exp(\hat{\pi}.t) \tag{A-19}$$

Recall that π_o is initial exchange rate, and further elaborate the term in $E[\pi_t^{1-\eta}]$ in A-18

$$E\left[\pi_t^{1-\eta}\right] = E[exp\,\hat{\pi}\,.(1-\eta).t]\pi_0^{(1-\eta)}$$

Further place this elaborated term in equation

$$VCF_u = \sum_{t=1}^{T} \frac{\alpha_k.\beta.p_t^{\eta}E[exp\,\hat{\pi}\,.(1-\eta).t]\pi_0^{(1-\eta)}}{(1+\rho_0)^t} \quad \text{(A-20)}$$

To find the foreign exchange exposure, we differentiate the equation A-20 with respect to initial exchange rate.

$$\frac{dVCF_u}{d\pi_o} = (1-\eta)\sum_{t=1}^{T} \frac{\alpha_k.\beta.p_t^{\eta}E[exp\,\hat{\pi}\,.(1-\eta).t]\pi_0^{(1-\eta)-1}}{(1+\rho_0)^t} \quad \text{(A-21)}$$

Multiplied equation A-21 with π_o, and refer to the definition of VCFu in equation A-17, then

$$\frac{dVCF_u}{\frac{d\pi_o}{\pi_o}} = (1-\eta)VCF_u \quad \text{(A-22)}$$

or

$$\frac{\frac{dVCF_u}{VCF_u}}{\frac{d\pi_o}{\pi_o}} = (1-\eta) \quad \text{(A1-22)'}$$

Then the sensitivity of firm's after tax operating cash flow to change in exchange rate depends on the difference between unity and aggregate η elasticity of firm's revenue in foreign currency with respect to price of foreign traded goods. The elasticity term in front of the term adjust the nominal cash flow (VCF_u) to capture real exposure.

Recall equation A-22

$$\frac{dVCF_u}{d\pi_o} = (1-\eta)\sum_{t=1}^{T} \frac{\alpha_k.\beta.p_t^{\eta}E[exp\,\hat{\pi}\,.(1-\eta).t]\pi_0^{(1-\eta)-1}}{(1+\rho_0)^t}$$

Besides η the corporate revenue's elasticity and p_t which affect firm's total revenue in firm profit and loss statement. α_k which is the share of remaining profit to firm's total revenue, which is analogue to profit rate (r) in the (Bodnar 2001), and (p-c/π_j in the (Levi 1994) model would simultaneously affects cost of goods sold and operating expense component.

Appendix B
Appendix to Comparing Productivity in Foreign-Invested and Local Plants in Thai Manufacturing

B.1. Appendix to Chapter Methodologies

B.1.1. Testing for production technology differential between foreign and local plant.

To further test whether the production function of foreign and local plants are statistically identical, the following tests are separately employed for foreign and local sample.

For unrestricted regression: A two factor production model

$$\ln(\mathrm{V})_i = \beta_0 + \beta_1.ln[K_i] + \beta_2.\ln[L_i] + \beta_3.[\ln[K_i]]^2 + \beta_4.[\ln[L_i]]^2 + \beta_5.[ln[K_i].\ln[L_i]] + \beta_6.dSize_i + \beta_7.dAge_i + \beta_8.dBOI_i + \epsilon_i \quad \text{B-1}$$

For Foreign controlled plant: A two-factor production model

$$\ln(\mathrm{V}_i^F) = \beta_0 + \beta_1.ln[K_i^F] + \beta_2.ln[L_i^F] + \beta_3.[ln[K_i^F]]^2 + \beta_4.[ln[L_i^F]]^2 + \beta_5.[ln[K_i^F].ln[L_i^F]] + \beta_6.dSize_i^F + \beta_7.dAge_i^F + \beta_8.dBOI_i^F + \epsilon_i \quad \text{B-2}$$

For Local controlled plant: A two factor production model

$$\ln(\mathrm{V}_i^L) = \beta_0 + \beta_1.ln[K_i^L] + \beta_2.ln[L_i^L] + \beta_3.[ln[K_i^L]]^2 + \beta_4.[ln[L_i^L]]^2 + \beta_5.[ln[K_i^L].ln[L_i^L]] + \beta_6.dSize_i^L + \beta_7.dAge_i^L + \beta_8.dBOI_i^L + \epsilon_i \quad \text{B-3}$$

Where superscript F and L represent whether the plant is foreign and local operated plant, both equations are separately operated, and then we use the F test to determine whether the production functions of both foreign and local plants are statistically different from the following restricted regression restricted regression.

For a model with four-factor production model

Unrestricted regression

$$\ln(\mathrm{V})_i = \beta_0 + \beta_1.ln[K_i] + \beta_2.\ln[Skillblue_i] + \beta_3.\ln[NonSkillblue_i] + \beta_4.\ln[White_i] + \beta_5.[\ln[K_i]]^2 + \beta_6.[\ln[Skillblue_i]]^2 + \beta_7.[\ln[NonSkillblue_i]]^2 + \beta_8.[\ln[White]]^2 + \beta_9.[ln[K_i].\ln[Skillblue_i]] + \beta_{10}.[ln[K_i].\ln[NonSkillblue_i]] + \beta_{11}.[ln[K_i].\ln[White_i]] + \beta_{12}.[ln[Skillblue_i].\ln[NonSkillblue_i]] + \beta_{13}.[ln[Skillblue_i].\ln[White_i]] + \beta_{14}.[ln[Nonskillblue_i].\ln[White_i]] + \beta_{15}.dSize_i + \beta_{16}.dAge_i + \beta_{17}.dBOI_i + \epsilon_i \quad \text{B-4}$$

For foreign-controlled plant

$$ln(V_i^F) = \beta_0 + \beta_1.ln[K_i^F] + \beta_2.ln[Skillblue_i^F] + \beta_3.ln[NonSkillblue_i^F] + \beta_4.ln[White_i^F] + \beta_5.[ln[K_i^F]]^2 + \beta_6.[ln[Skillblue_i^F]]^2 + \beta_7.[ln[NonSkillblue_i^F]]^2 + \beta_8.[ln[White_i^F]]^2 + \beta_9.[ln[K_i^F].ln[Skillblue_i^F]] + \beta_{10}.[ln[K_i^F].ln[NonSkillblue_i^F]] + \beta_{11}.[ln[K_i^F].ln[White_i^F]] + \beta_{12}.[ln[Skillblue_i^F].ln[NonSkillblue_i^F]] + \beta_{13}.[ln[Skillblue_i^F].ln[White_i^F]] + \beta_{14}.[ln[NonSkillblue_i^F].ln[White_i^F]] + \beta_{15}.dSize_i^F + \beta_{16}.dAge_i^F + \beta_{17}.dBOI_i^F + \epsilon_i \quad \text{B-5}$$

For local-controlled plant

$$ln(V_i^L) = \beta_0 + \beta_1.ln[K_i^L] + \beta_2.ln[Skillblue_i^L] + \beta_3.ln[NonSkillblue_i^L] + \beta_4.ln[White_i^L] + \beta_5.[ln[K_i^L]]^2 + \beta_6.[ln[Skillblue_i^L]]^2 + \beta_7.[ln[NonSkillblue_i^L]]^2 + \beta_8.[ln[White_i^L]]^2 + \beta_9.[ln[K_i^L].ln[Skillblue_i^L]] + \beta_{10}.[ln[K_i^L].ln[NonSkillblue_i^L]] + \beta_{11}.[ln[K_i^L].ln[White_i^L]] + \beta_{12}.[ln[Skillblue_i^L].ln[NonSkillblue_i^L]] + \beta_{13}.[ln[Skillblue_i^L].ln[White_i^L]] + \beta_{14}.[ln[NonSkillblue_i^L].ln[White_i^L]] + \beta_{15}.dSize_i^L + \beta_{16}.dAge_i^L + \beta_{17}.dBOI_i^L + \epsilon_i \quad \text{B-6}$$

Then the test statistic

$$F_{k,N+M-2K} = \frac{(ESS_R - ESS_{UR})/k}{ESS_{UR}/(N+M-2k)} \quad \text{B-7}$$

is employed to verify whether the two functions are statistically unique. Where ESS_r and ESS_{ur} are error sum of square residual of restricted (ESS from all types of firm sample) and unrestricted regression (combination of ESS from local and foreign sample); respectively. The above regression would be separately operated with [superscript: L] local plant sample, [superscript: F] foreign plant sample and [none of superscript] all plants sample. ESSr is error sum of square residual obtained from operating above regression with all plants sample, while ESSur is the combination of error sum of square residual obtained from above regression with [L] sample and error sum of square residual operated from above regression with [F] sample. K is no. of parameter (in this case 12 variables), N and M are the no. of observation in [L] and [F] respectively. The measurements of variables remain the same as listed in table presented in the main context. It should be note the testing is based on two factor and four factor- production model without an industry control variable in order to enable the sufficient level of degree of freedom for the analysis at the industry level. Results are illustrated in the following sections.

B.2. Chapter appendix tables

Detailed of the coefficients shown in chapter 3, supplement hypotheis, are further illustrated in this section

B.2.1. Further testing on Production technology differentials

The tables in the following section reveals the full results from regression illustrated in the methodologies section.

	ISIC 15					
	All (UR)		Foreign (R_1)		Local (R_2)	
	Coefficient	p value	Coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	16.300	(0.00)	16.550	(0.00)	16.288	(0.00)
ln(K)	0.248	(0.00)	0.159	(0.21)	0.250	(0.00)
ln(L)	0.605	(0.00)	0.496	(0.00)	0.612	(0.00)
(ln(K))2	-0.034	(0.00)	-0.034	(0.45)	-0.032	(0.00)
(ln(L))2	-0.023	(0.33)	-0.045	(0.55)	-0.016	(0.51)
(ln(K))*(ln(L))	0.023	(0.35)	0.084	(0.42)	0.016	(0.51)
Size Dummy	1.216	(0.00)	1.094	(0.00)	1.227	(0.00)
Age Dummy	0.127	(0.01)	0.011	(0.96)	0.137	(0.01)
BOI Dummy	0.270	(0.00)	0.113	(0.61)	0.291	(0.00)
Sum of Residual square	1,666.56		104.910		1550.440	
R square	0.735		0.672		0.728	
Observations	1,719		114		1,605	
F-statistics [Test for the Diff. between UR and R]			1.28			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	15.584	(0.00)	15.653	(0.00)	15.594	(0.00)
ln(K)	0.311	(0.00)	0.292	(0.02)	0.314	(0.00)
ln(SkillBlue)	0.100	(0.00)	0.071	(0.42)	0.098	(0.00)
ln(NonSkillBlue)	0.044	(0.00)	0.007	(0.84)	0.045	(0.00)
ln(White)	0.058	(0.00)	0.025	(0.54)	0.058	(0.00)
$(ln(K))^2$	0.002	(0.79)	0.008	(0.81)	0.002	(0.77)
$(ln(SkillBlue))^2$	0.008	(0.00)	0.018	(0.13)	0.007	(0.01)
$(ln(Nonskillblue))^2$	0.013	(0.00)	0.020	(0.01)	0.012	(0.00)
$(ln(White))^2$	0.005	(0.04)	0.001	(0.87)	0.005	(0.04)
(ln(K))*(ln(SkillBlue))	-0.004	(0.46)	-0.015	(0.69)	-0.003	(0.65)
(ln(K))*(ln(NonSk)	-0.009	(0.01)	-0.026	(0.09)	-0.006	(0.06)
(ln(K))*(ln(White))	-0.018	(0.00)	-0.012	(0.44)	-0.018	(0.00)
(ln(Sk))*(ln(NonSk))	0.002	(0.57)	0.010	(0.46)	0.001	(0.63)
(ln(Sk))*(ln(White))	-0.003	(0.08)	0.004	(0.70)	-0.004	(0.06)
(ln(NonSkill))*(ln(White))	-0.003	(0.02)	0.006	(0.11)	-0.003	(0.00)
Size Dummy	1.569	(0.00)	1.389	(0.00)	1.595	(0.00)
Age Dummy	0.120	(0.02)	-0.180	(0.42)	0.133	(0.01)
BOI Dummy	0.347	(0.00)	0.290	(0.23)	0.363	(0.00)
Sum of Residual square	1,778.17		106.490		1650.190	
R square	0.716		0.636		0.709	
Observations	1,719		114		1,605	
F-statistics [Test for the Diff. between UR and R]			1.144			

TableB.1. The result from regression Eq. B-1 to Eq. B-6 for Manufacture of food product and beverage (ISIC 15)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance.

	ISIC 17					
	All		Foreign		Local	
	Coefficient	p value	Coefficient	P value	Coefficient	P value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	15.918	(0.00)	16.214	(0.00)	15.901	(0.00)
ln(K)	0.318	(0.00)	0.040	(0.68)	0.324	(0.00)
ln(L)	0.643	(0.00)	0.656	(0.00)	0.649	(0.00)
(ln(K))2	-0.025	(0.00)	0.006	(0.84)	-0.022	(0.02)
(ln(L))2	0.016	(0.68)	-0.038	(0.74)	0.030	(0.47)
(ln(K))*(ln(L))	-0.042	(0.17)	-0.006	(0.95)	-0.054	(0.10)
Size Dummy	0.793	(0.00)	1.098	(0.00)	0.731	(0.00)
Age Dummy	0.287	(0.00)	0.150	(0.46)	0.295	(0.00)
BOI Dummy	0.345	(0.00)	0.406	(0.05)	0.302	(0.00)
Sum of Residual square	703.29		47.515		643.919	
R square	0.801		0.745		0.793	
Observations	854		84		770	
F-statistics [Test for the Diff. between UR and R]			1.593			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	14.904	(0.00)	15.430	(0.00)	14.887	(0.00)
ln(K)	0.249	(0.00)	0.173	(0.15)	0.260	(0.00)
ln(SkillBlue)	0.100	(0.00)	0.068	(0.58)	0.090	(0.00)
ln(NonSkillBlue)	0.032	(0.00)	0.047	(0.10)	0.027	(0.00)
ln(White)	0.112	(0.00)	-0.035	(0.51)	0.117	(0.00)
$(\ln(K))^2$	0.008	(0.27)	-0.005	(0.84)	0.016	(0.04)
$(\ln(SkillBlue))^2$	0.008	(0.03)	0.017	(0.25)	0.008	(0.03)
$(\ln(Nonskillblue))^2$	0.019	(0.00)	0.020	(0.02)	0.020	(0.00)
$(\ln(White))^2$	0.011	(0.00)	0.003	(0.72)	0.011	(0.00)
(ln(K))*(ln(SkillBlue))	-0.007	(0.37)	-0.013	(0.76)	-0.010	(0.22)
(ln(K))*(ln(NonSk)	-0.016	(0.00)	-0.020	(0.11)	-0.018	(0.00)
(ln(K))*(ln(White))	-0.031	(0.00)	-0.011	(0.58)	-0.033	(0.00)
(ln(Sk))*(ln(NonSk))	0.007	(0.15)	-0.001	(0.97)	0.008	(0.13)
(ln(Sk))*(ln(White))	-0.004	(0.24)	0.035	(0.28)	-0.004	(0.31)
(ln(NonSkill))*(ln(White))	-0.001	(0.37)	0.006	(0.37)	-0.001	(0.73)
Size Dummy	1.233	(0.00)	1.639	(0.00)	1.145	(0.00)
Age Dummy	0.279	(0.00)	0.156	(0.49)	0.274	(0.00)
BOI Dummy	0.334	(0.00)	0.053	(0.84)	0.343	(0.00)
Sum of Residual square	645.20		50.479		578.350	
R square	0.815		0.692		0.812	
Observations	854		84		770	
F-statistics [Test for the Diff. between UR and R]			1.183			

TableB.2. The result from regression Eq. B-1 to Eq. B-6 for Manufacture of textiles (ISIC 17)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance.

	ISIC 18 and 19					
	All		Foreign		Local	
Two-Factor model	Coefficient	p value	coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	16.293	(0.00)	16.051	(0.00)	16.317	(0.00)
ln(K)	0.157	(0.00)	0.157	(0.14)	0.153	(0.00)
ln(L)	0.749	(0.00)	0.637	(0.00)	0.754	(0.00)
$(\ln(K))^2$	-0.027	(0.02)	-0.010	(0.86)	-0.028	(0.02)
$(\ln(L))^2$	-0.035	(0.12)	0.077	(0.32)	-0.040	(0.09)
(ln(K))*(ln(L))	0.003	(0.91)	-0.004	(0.97)	-0.002	(0.94)
Size Dummy	0.748	(0.00)	0.539	(0.01)	0.774	(0.00)
Age Dummy	0.049	(0.30)	0.383	(0.01)	0.029	(0.55)
BOI Dummy	0.161	(0.00)	-0.147	(0.36)	0.198	(0.00)
Sum of Residual square	514.087		23.055		482.480	
R square	0.796		0.854		0.786	
Observations	1,017		75		942	
F-statistics [Test for the Diff. between UR and R]			1.878**			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	15.391	(0.00)	14.794	(0.00)	15.454	(0.00)
ln(K)	0.186	(0.00)	0.095	(0.34)	0.178	(0.00)
ln(SkillBlue)	0.306	(0.00)	0.344	(0.00)	0.318	(0.00)
ln(NonSkillBlue)	0.033	(0.00)	0.041	(0.05)	0.033	(0.00)
ln(White)	0.144	(0.00)	0.165	(0.00)	0.140	(0.00)
$(\ln(SkillBlue))^2$	-0.009	(0.20)	0.025	(0.35)	-0.015	(0.06)
$(\ln(Nonskillblue))^2$	0.027	(0.00)	0.018	(0.01)	0.029	(0.00)
$(\ln(White))^2$	0.010	(0.00)	0.019	(0.00)	0.008	(0.00)
$(\ln(K))^2$	0.017	(0.00)	0.022	(0.00)	0.016	(0.00)
(ln(K))*(ln(SkillBlue))	-0.006	(0.26)	-0.007	(0.70)	-0.005	(0.39)
(ln(K))*(ln(NonSk)	-0.007	(0.05)	-0.008	(0.50)	-0.005	(0.17)
(ln(K))*(ln(White))	-0.019	(0.00)	0.007	(0.67)	-0.022	(0.00)
(ln(Sk))*(ln(NonSk))	-0.001	(0.79)	-0.011	(0.34)	0.000	(0.97)
(ln(Sk))*(ln(White))	-0.007	(0.00)	-0.012	(0.49)	-0.007	(0.00)
(ln(NonSkill))*(ln(White))	-0.002	(0.09)	0.004	(0.22)	-0.002	(0.08)
Size Dummy	0.820	(0.00)	0.576	(0.01)	0.884	(0.00)
Age Dummy	0.013	(0.78)	0.363	(0.01)	-0.003	(0.95)
BOI Dummy	0.207	(0.00)	-0.054	(0.72)	0.231	(0.00)
Sum of Residual square	518.850		16.105		487.360	
R square	0.792		0.881		0.782	
Observation	1017		75		942	
F-statistics [Test for the Diff. between UR and R]			1.665**			

TableB.3. The result from regression Eq. B-1 to Eq. B-6 for Manufacture of wearing apparel and footwear (ISIC 18-19)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance.

	ISIC 20 and 21					
	All		Foreign		Local	
	Coefficient	p value	Coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	16.156	(0.00)	16.623	(0.00)	16.143	(0.00)
ln(K)	0.238	(0.00)	0.007	(0.96)	0.238	(0.00)
ln(L)	0.591	(0.00)	0.677	(0.00)	0.589	(0.00)
(ln(K))2	-0.010	(0.39)	-0.017	(0.76)	-0.008	(0.51)
(ln(L))2	-0.102	(0.04)	-0.293	(0.14)	-0.088	(0.09)
(ln(K))*(ln(L))	0.044	(0.31)	0.197	(0.31)	0.028	(0.53)
Size Dummy	0.957	(0.00)	0.980	(0.00)	0.953	(0.00)
Age Dummy	0.154	(0.02)	0.386	(0.11)	0.136	(0.04)
BOI Dummy	0.104	(0.22)	0.258	(0.30)	0.047	(0.60)
Sum of Residual square	798.170		34.620		744.550	
R square	0.642		0.706		0.621	
Observations	905		59		846	
F-statistics [Test for the Diff. between UR and R]			2.403**			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	15.461	(0.00)	15.646	(0.00)	15.453	(0.00)
ln(K)	0.264	(0.00)	0.188	(0.16)	0.263	(0.00)
ln(SkillBlue)	0.166	(0.00)	-0.026	(0.87)	0.176	(0.00)
ln(NonSkillBlue)	0.043	(0.00)	0.059	(0.17)	0.042	(0.00)
ln(White)	0.059	(0.00)	0.053	(0.53)	0.062	(0.00)
$(\ln(SkillBlue))^2$	0.021	(0.01)	-0.048	(0.27)	0.022	(0.01)
$(\ln(Nonskillblue))^2$	0.015	(0.00)	0.008	(0.60)	0.016	(0.00)
$(\ln(White))^2$	0.014	(0.00)	0.026	(0.03)	0.014	(0.00)
$(\ln(K))^2$	0.005	(0.04)	-0.002	(0.86)	0.006	(0.03)
(ln(K))*(ln(SkillBlue))	-0.021	(0.01)	0.100	(0.17)	-0.021	(0.01)
(ln(K))*(ln(NonSk)	-0.008	(0.05)	-0.020	(0.21)	-0.006	(0.17)
(ln(K))*(ln(White))	-0.019	(0.00)	0.002	(0.94)	-0.021	(0.00)
(ln(Sk))*(ln(NonSk))	0.004	(0.37)	0.014	(0.63)	0.004	(0.40)
(ln(Sk))*(ln(White))	0.000	(0.90)	-0.047	(0.34)	0.001	(0.72)
(ln(NonSkill))*(ln(White))	0.000	(0.96)	-0.007	(0.28)	0.000	(0.77)
Size Dummy	1.057	(0.00)	1.091	(0.01)	1.042	(0.00)
Age Dummy	0.122	(0.07)	0.478	(0.08)	0.097	(0.16)
BOI Dummy	0.127	(0.14)	0.612	(0.06)	0.043	(0.64)
Sum of Residual square	815.560		32.746		756.547	
R square	0.630		0.661		0.661	
Observations	905		59		846	
F-statistics [Test for the Diff. between UR and R]			1.610**			

TableB.4. The result from regression Eq. B-1 to Eq. B-6 for Manufacture of wood & wood product and paper (ISIC 20-21)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance.

	ISIC 24					
	All		Foreign		Local	
	Coefficient	p value	Coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	16.639	(0.00)	16.911	(0.00)	16.622	(0.00)
ln(K)	0.226	(0.00)	0.188	(0.05)	0.176	(0.00)
ln(L)	0.544	(0.00)	0.385	(0.05)	0.584	(0.00)
(ln(K))2	-0.039	(0.00)	-0.012	(0.69)	-0.053	(0.00)
(ln(L))2	-0.045	(0.35)	-0.001	(0.99)	-0.030	(0.56)
(ln(K))*(ln(L))	0.043	(0.25)	0.023	(0.83)	0.040	(0.32)
Size Dummy	1.144	(0.00)	1.447	(0.00)	1.110	(0.00)
Age Dummy	0.233	(0.00)	-0.064	(0.72)	0.282	(0.00)
BOI Dummy	0.299	(0.00)	0.029	(0.89)	0.307	(0.00)
Sum of Residual square	623.076		92.330		510.099	
R square	0.699		0.662		0.676	
Observations	767		119		648	
F-statistics			2.852**			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	16.014	(0.00)	16.512	(0.00)	15.963	(0.00)
ln(K)	0.220	(0.00)	0.229	(0.01)	0.185	(0.00)
ln(SkillBlue)	0.173	(0.00)	0.220	(0.06)	0.162	(0.00)
ln(NonSkillBlue)	0.035	(0.00)	0.019	(0.50)	0.035	(0.00)
ln(White)	0.046	(0.01)	-0.011	(0.86)	0.050	(0.01)
$(\ln(K))^2$	-0.013	(0.08)	-0.007	(0.73)	-0.023	(0.02)
$(\ln(SkillBlue))^2$	0.016	(0.00)	0.011	(0.28)	0.017	(0.00)
$(\ln(Nonskillblue))^2$	0.013	(0.00)	0.008	(0.39)	0.014	(0.00)
$(\ln(White))^2$	0.000	(0.92)	-0.008	(0.32)	0.002	(0.58)
(ln(K))*(ln(SkillBlue))	-0.002	(0.86)	0.011	(0.81)	-0.003	(0.78)
(ln(K))*(ln(NonSk)	-0.011	(0.01)	0.011	(0.28)	-0.012	(0.03)
(ln(K))*(ln(White))	-0.013	(0.01)	-0.019	(0.36)	-0.015	(0.02)
(ln(Sk))*(ln(NonSk))	0.000	(0.99)	-0.032	(0.05)	0.004	(0.59)
(ln(Sk))*(ln(White))	-0.007	(0.16)	0.024	(0.39)	-0.007	(0.17)
(ln(NonSkill))*(ln(White))	-0.002	(0.44)	-0.003	(0.65)	-0.001	(0.73)
Size Dummy	1.378	(0.00)	1.664	(0.00)	1.385	(0.00)
Age Dummy	0.275	(0.00)	0.070	(0.71)	0.309	(0.00)
BOI Dummy	0.305	(0.00)	-0.070	(0.74)	0.347	(0.00)
Sum of Residual square	638.504		85.740		531.960	
R square	0.689		0.659		0.657	
Observations	767		119		648	
F-Statistics			1.6258**			

TableB.5. The result from regression Eq. B-1 to Eq. B-6 for Manufacture of chemical and chemical product (ISIC 24)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance.

	ISIC 25					
	All		Foreign		Local	
	Coefficient	p value	coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	16.394	(0.00)	16.570	(0.00)	16.402	(0.00)
ln(K)	0.150	(0.00)	0.123	(0.03)	0.139	(0.00)
ln(L)	0.570	(0.00)	0.412	(0.00)	0.583	(0.00)
(ln(K))2	0.023	(0.01)	0.040	(0.09)	0.019	(0.05)
(ln(L))2	-0.015	(0.59)	0.086	(0.17)	-0.046	(0.14)
(ln(K))*(ln(L))	-0.063	(0.02)	-0.097	(0.13)	-0.051	(0.08)
Size Dummy	1.034	(0.00)	1.134	(0.00)	1.013	(0.00)
Age Dummy	-0.019	(0.65)	0.104	(0.30)	-0.032	(0.48)
BOI Dummy	0.249	(0.00)	-0.024	(0.83)	0.276	(0.00)
Sum of Residual square	536.399		83.874		439.480	
R square	0.772		0.757		0.735	
Observations	1,162		194		968	
F-statistics			3.169**			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	15.493	(0.00)	15.742	(0.00)	15.472	(0.00)
ln(K)	0.175	(0.00)	0.176	(0.00)	0.163	(0.00)
ln(SkillBlue)	0.241	(0.00)	0.128	(0.01)	0.275	(0.00)
ln(NonSkillBlue)	0.048	(0.00)	0.053	(0.00)	0.049	(0.00)
ln(White)	0.125	(0.00)	0.113	(0.01)	0.120	(0.00)
$(\ln(SkillBlue))^2$	0.006	(0.23)	0.000	(0.99)	0.007	(0.27)
$(\ln(Nonskillblue))^2$	0.019	(0.00)	0.010	(0.08)	0.022	(0.00)
$(\ln(White))^2$	0.013	(0.00)	0.015	(0.00)	0.013	(0.00)
$(\ln(K))^2$	0.020	(0.00)	0.023	(0.00)	0.018	(0.00)
(ln(K))*(ln(SkillBlue))	-0.015	(0.00)	0.003	(0.83)	-0.018	(0.00)
(ln(K))*(ln(NonSk)	-0.006	(0.02)	-0.009	(0.22)	-0.007	(0.04)
(ln(K))*(ln(White))	-0.019	(0.00)	-0.006	(0.53)	-0.018	(0.00)
(ln(Sk))*(ln(NonSk))	-0.006	(0.03)	-0.003	(0.75)	-0.006	(0.06)
(ln(Sk))*(ln(White))	-0.001	(0.60)	-0.009	(0.11)	0.001	(0.70)
(ln(NonSkill))*(ln(White))	0.001	(0.37)	-0.002	(0.58)	0.001	(0.29)
Size Dummy	1.008	(0.00)	1.085	(0.00)	0.948	(0.00)
Age Dummy	0.003	(0.95)	0.095	(0.34)	0.000	(1.00)
BOI Dummy	0.226	(0.00)	-0.018	(0.87)	0.213	(0.00)
Sum of Residual square	540.981		76.020		447.630	
R square	0.768		0.768		0.727	
Observations	1,162		194		968	
F-Statistics			2.070**			

TableB.6. The result from regression Eq. B-1 to Eq. B-6 for Manufacture of rubber and plastic product (ISIC 25)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies F value is significant at 0.05 level of significance

	ISIC 26					
	All Coefficient	p value	Foreign coefficient	p value	Local coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	16.060	(0.00)	16.659	(0.00)	16.036	(0.00)
ln(K)	0.210	(0.00)	0.335	(0.02)	0.204	(0.00)
ln(L)	0.710	(0.00)	0.333	(0.20)	0.743	(0.00)
(ln(K))2	0.036	(0.00)	-0.029	(0.72)	0.037	(0.00)
(ln(L))2	-0.042	(0.31)	-0.001	(0.99)	-0.060	(0.17)
(ln(K))*(ln(L))	-0.073	(0.05)	0.074	(0.74)	-0.070	(0.06)
Size Dummy	1.018	(0.00)	0.734	(0.05)	1.036	(0.00)
Age Dummy	-0.131	(0.05)	-0.436	(0.15)	-0.097	(0.17)
BOI Dummy	0.168	(0.08)	-0.083	(0.76)	0.128	(0.23)
Sum of Residual square	568.657		30.221		524.078	
R square	0.685		0.697		0.672	
Observations	738		52		686	
F-statistics			2.072**			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	15.334	(0.00)	16.592	(0.00)	15.209	(0.00)
ln(K)	0.244	(0.00)	0.480	(0.00)	0.235	(0.00)
ln(SkillBlue)	0.195	(0.00)	-0.134	(0.55)	0.210	(0.00)
ln(NonSkillBlue)	0.027	(0.00)	-0.024	(0.59)	0.029	(0.00)
ln(White)	0.057	(0.00)	-0.061	(0.42)	0.059	(0.00)
$(\ln(SkillBlue))^2$	0.019	(0.02)	-0.097	(0.27)	0.027	(0.00)
$(\ln(Nonskillblue))^2$	0.016	(0.00)	-0.037	(0.41)	0.017	(0.00)
$(\ln(White))^2$	0.013	(0.00)	0.009	(0.53)	0.015	(0.00)
$(\ln(K))^2$	0.004	(0.23)	-0.013	(0.27)	0.005	(0.12)
(ln(K))*(ln(SkillBlue))	-0.002	(0.80)	0.200	(0.22)	-0.004	(0.64)
(ln(K))*(ln(NonSk)	-0.009	(0.05)	0.008	(0.77)	-0.008	(0.08)
(ln(K))*(ln(White))	-0.017	(0.00)	-0.026	(0.44)	-0.023	(0.00)
(ln(Sk))*(ln(NonSk))	-0.002	(0.63)	0.003	(0.91)	-0.003	(0.47)
(ln(Sk))*(ln(White))	-0.005	(0.07)	0.046	(0.21)	-0.006	(0.05)
(ln(NonSkill))*(ln(White))	-0.001	(0.45)	0.001	(0.87)	-0.002	(0.33)
Size Dummy	1.266	(0.00)	0.923	(0.09)	1.298	(0.00)
Age Dummy	-0.068	(0.34)	-0.304	(0.45)	-0.042	(0.56)
BOI Dummy	0.190	(0.06)	0.022	(0.94)	0.137	(0.23)
Sum of Residual square	612.912		28.834		564.436	
R square	0.656		0.635		0.6424	
Observations	738		52		686	
F-Statistics			1.291			

TableB.7. The result from regression Eq. B-1 to Eq. B-6 for Manufacture of non-metallic product (ISIC 26)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance.

	ISIC 27 and ISIC 28					
	All		Foreign		Local	
	coefficient	p value	coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	16.103	(0.00)	16.449	(0.00)	16.093	(0.00)
ln(K)	0.176	(0.00)	0.157	(0.00)	0.171	(0.00)
ln(L)	0.588	(0.00)	0.272	(0.01)	0.606	(0.00)
(ln(K))2	0.022	(0.02)	-0.007	(0.74)	0.023	(0.03)
(ln(L))2	0.025	(0.41)	0.024	(0.69)	0.018	(0.62)
(ln(K))*(ln(L))	-0.059	(0.04)	0.042	(0.49)	-0.059	(0.08)
Size Dummy	1.046	(0.00)	0.950	(0.00)	1.064	(0.00)
Age Dummy	0.028	(0.50)	0.270	(0.03)	0.007	(0.87)
BOI Dummy	0.342	(0.00)	0.158	(0.18)	0.383	(0.00)
Sum of Residual square	909.320		108.486		782.315	
R square	0.705		0.692		0.662	
Observations	1,501		196		1,305	
F-statistics			3.426**			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	15.421	(0.00)	15.885	(0.00)	15.389	(0.00)
ln(K)	0.187	(0.00)	0.169	(0.00)	0.187	(0.00)
ln(SkillBlue)	0.266	(0.00)	0.123	(0.06)	0.281	(0.00)
ln(NonSkillBlue)	0.033	(0.00)	0.024	(0.13)	0.035	(0.00)
ln(White)	0.102	(0.00)	0.053	(0.14)	0.102	(0.00)
$(\ln(\text{SkillBlue}))^2$	0.010	(0.11)	0.001	(0.97)	0.015	(0.03)
$(\ln(\text{Nonskillblue}))^2$	0.025	(0.00)	0.017	(0.04)	0.026	(0.00)
$(\ln(\text{White}))^2$	0.011	(0.00)	0.011	(0.02)	0.011	(0.00)
$(\ln(K))^2$	0.013	(0.00)	0.011	(0.09)	0.014	(0.00)
(ln(K))*(ln(SkillBlue))	-0.010	(0.15)	0.012	(0.47)	-0.012	(0.16)
(ln(K))*(ln(NonSk)	-0.010	(0.00)	-0.011	(0.18)	-0.010	(0.00)
(ln(K))*(ln(White))	-0.009	(0.00)	0.000	(0.99)	-0.010	(0.01)
(ln(Sk))*(ln(NonSk))	0.002	(0.57)	0.009	(0.38)	0.001	(0.84)
(ln(Sk))*(ln(White))	-0.003	(0.18)	0.006	(0.33)	-0.004	(0.11)
(ln(NonSkill))*(ln(White))	0.001	(0.41)	0.000	(0.98)	0.001	(0.58)
Size Dummy	1.124	(0.00)	0.949	(0.00)	1.131	(0.00)
Age Dummy	0.043	(0.31)	0.279	(0.03)	0.027	(0.54)
BOI Dummy	0.321	(0.00)	0.174	(0.16)	0.353	(0.00)
Sum of Residual square	906.102		106.914		778.797	
R square	0.704		0.681		1305	
Observations	1501		196		1,305	
F-Statistics			1.874**			

TableB.8. The result from regression Eq. B-1 to Eq. B-6 for Manufacture of basic metal and metal product (ISIC 27-28)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance.

	ISIC 29					
	All		Foreign		Local	
	Coefficient	p value	coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	16.342	(0.00)	16.525	(0.00)	16.354	(0.00)
ln(K)	0.136	(0.00)	-0.062	(0.49)	0.158	(0.00)
ln(L)	0.665	(0.00)	0.380	(0.02)	0.717	(0.00)
(ln(K))2	0.023	(0.15)	0.083	(0.01)	0.007	(0.70)
(ln(L))2	0.044	(0.31)	0.147	(0.07)	-0.007	(0.89)
(ln(K))*(ln(L))	-0.028	(0.55)	-0.132	(0.12)	0.062	(0.27)
Size Dummy	0.425	(0.00)	0.986	(0.00)	0.240	(0.08)
Age Dummy	0.125	(0.07)	0.383	(0.03)	0.106	(0.15)
BOI Dummy	0.497	(0.00)	0.285	(0.12)	0.447	(0.00)
Sum of Residual square	403.577		88.933		289.350	
R square	0.690		0.697		0.608	
Observations	607		125		482	
F-statistics			4.376**			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	15.716	(0.00)	16.189	(0.00)	15.669	(0.00)
ln(K)	0.176	(0.00)	-0.056	(0.52)	0.213	(0.00)
ln(SkillBlue)	0.341	(0.00)	0.196	(0.02)	0.388	(0.00)
ln(NonSkillBlue)	0.046	(0.00)	0.030	(0.18)	0.044	(0.00)
ln(White)	0.099	(0.00)	0.096	(0.04)	0.098	(0.00)
$(\ln(K))^2$	0.032	(0.00)	0.061	(0.01)	0.044	(0.00)
$(\ln(SkillBlue))^2$	0.026	(0.00)	0.012	(0.11)	0.031	(0.00)
$(\ln(Nonskillblue))^2$	0.010	(0.00)	0.008	(0.21)	0.011	(0.00)
$(\ln(White))^2$	0.009	(0.00)	0.007	(0.27)	0.008	(0.01)
(ln(K))*(ln(SkillBlue))	-0.014	(0.15)	-0.005	(0.88)	-0.012	(0.35)
(ln(K))*(ln(NonSk)	0.000	(0.96)	-0.001	(0.90)	0.000	(0.95)
(ln(K))*(ln(White))	-0.015	(0.01)	-0.033	(0.01)	-0.012	(0.07)
(ln(Sk))*(ln(NonSk))	-0.013	(0.00)	-0.011	(0.05)	-0.013	(0.01)
(ln(Sk))*(ln(White))	-0.004	(0.27)	0.003	(0.73)	-0.004	(0.30)
(ln(NonSkill))*(ln(White))	0.001	(0.68)	0.009	(0.03)	-0.002	(0.39)
Size Dummy	0.523	(0.00)	1.033	(0.00)	0.348	(0.01)
Age Dummy	0.144	(0.04)	0.468	(0.01)	0.122	(0.10)
BOI Dummy	0.490	(0.00)	0.273	(0.15)	0.424	(0.00)
Sum of Residual square	398.514		81.528		282.406	
R square	0.689		0.699		0.610	
Observations	607		125		482	
F-Statistics			3.014**			

TableB.9. The result from regression Eq. B-1 to Eq. B-6 for Manufacture of general machinery (ISIC 29)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance.

	ISIC 30 to 33					
	All		Foreign		Local	
	coefficient	p value	coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	17.166	(0.00)	17.559	(0.00)	17.079	(0.00)
ln(K)	0.181	(0.00)	0.147	(0.00)	0.195	(0.00)
ln(L)	0.567	(0.00)	0.574	(0.00)	0.578	(0.00)
(ln(K))2	0.021	(0.13)	0.028	(0.24)	0.013	(0.45)
(ln(L))2	0.045	(0.20)	0.038	(0.41)	0.040	(0.50)
(ln(K))*(ln(L))	-0.057	(0.14)	-0.072	(0.20)	-0.019	(0.74)
Size Dummy	0.853	(0.00)	0.931	(0.00)	0.601	(0.00)
Age Dummy	0.052	(0.46)	0.088	(0.44)	0.063	(0.49)
BOI Dummy	0.399	(0.00)	0.091	(0.49)	0.398	(0.00)
Sum of Residual square	540.992		169.298		354.266	
R square	0.753		0.753		0.649	
Observations	679		254		425	
F-statistics			2.445**			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	16.396	(0.00)	16.849	(0.00)	16.311	(0.00)
ln(K)	0.196	(0.00)	0.176	(0.00)	0.193	(0.00)
ln(SkillBlue)	0.304	(0.00)	0.310	(0.00)	0.328	(0.00)
ln(NonSkillBlue)	0.035	(0.00)	0.041	(0.00)	0.038	(0.00)
ln(White)	0.117	(0.00)	0.118	(0.00)	0.097	(0.00)
$(\ln(SkillBlue))^2$	0.006	(0.44)	0.016	(0.23)	0.004	(0.66)
$(\ln(Nonskillblue))^2$	0.021	(0.00)	0.014	(0.01)	0.025	(0.00)
$(\ln(White))^2$	0.015	(0.00)	0.010	(0.02)	0.016	(0.00)
$(\ln(K))^2$	0.017	(0.00)	0.019	(0.00)	0.013	(0.00)
(ln(K))*(ln(SkillBlue))	0.000	(0.97)	-0.021	(0.22)	0.008	(0.48)
(ln(K))*(ln(NonSk)	-0.007	(0.05)	-0.003	(0.62)	-0.006	(0.26)
(ln(K))*(ln(White))	-0.014	(0.00)	-0.019	(0.04)	-0.011	(0.07)
(ln(Sk))*(ln(NonSk))	-0.003	(0.37)	-0.012	(0.12)	-0.002	(0.64)
(ln(Sk))*(ln(White))	-0.013	(0.00)	-0.001	(0.93)	-0.016	(0.00)
(ln(NonSkill))*(ln(White))	-0.002	(0.26)	-0.001	(0.60)	-0.002	(0.29)
Size Dummy	0.853	(0.00)	0.980	(0.00)	0.612	(0.00)
Age Dummy	-0.013	(0.86)	0.006	(0.95)	0.009	(0.92)
BOI Dummy	0.323	(0.00)	0.033	(0.80)	0.369	(0.00)
Sum of Residual square	503.750		156.933		326.063	
R square	0.767		0.762		0.67	
Observations	679		254		425	
F-Statistics			1.535*			

TableB.10. The result from regression Eq. B-1 to Eq. B-6 for Electric machinery (ISIC 30 to ISIC 33)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value significant at 0.05 level of significant. * implies the F value is significant at 0.10 level of significance.

	ISIC 34					
	All		Foreign		Local	
	coefficient	p value	coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	17.008	(0.00)	17.163	(0.00)	17.022	(0.00)
ln(K)	0.135	(0.00)	0.096	(0.31)	0.121	(0.01)
ln(L)	0.793	(0.00)	0.574	(0.00)	0.847	(0.00)
(ln(K))2	0.026	(0.10)	0.030	(0.40)	0.021	(0.32)
(ln(L))2	-0.041	(0.48)	-0.043	(0.70)	-0.076	(0.28)
(ln(K))*(ln(L))	-0.006	(0.91)	0.056	(0.63)	0.007	(0.92)
Size Dummy	0.727	(0.00)	0.810	(0.00)	0.753	(0.00)
Age Dummy	0.048	(0.60)	0.114	(0.56)	0.029	(0.78)
BOI Dummy	0.314	(0.00)	0.118	(0.57)	0.341	(0.02)
Sum of Residual square	213.221		69.841		135.149	
R square	0.800		0.752		0.765	
Observations	343		105		238	
F-statistics			1.45			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	15.964	(0.00)	16.571	(0.00)	15.782	(0.00)
ln(K)	0.183	(0.00)	0.081	(0.40)	0.175	(0.00)
ln(SkillBlue)	0.402	(0.00)	0.205	(0.10)	0.504	(0.00)
ln(NonSkillBlue)	0.051	(0.00)	0.000	(1.00)	0.056	(0.00)
ln(White)	0.152	(0.00)	0.262	(0.01)	0.106	(0.04)
$(\ln(SkillBlue))^2$	0.034	(0.00)	0.070	(0.02)	0.033	(0.02)
$(\ln(Nonskillblue))^2$	0.020	(0.00)	0.025	(0.70)	0.020	(0.01)
$(\ln(White))^2$	0.018	(0.00)	0.002	(0.86)	0.024	(0.00)
$(\ln(K))^2$	0.017	(0.00)	0.027	(0.02)	0.012	(0.09)
(ln(K))*(ln(SkillBlue))	-0.015	(0.52)	-0.022	(0.77)	-0.008	(0.76)
(ln(K))*(ln(NonSk)	0.007	(0.25)	0.012	(0.38)	0.004	(0.62)
(ln(K))*(ln(White))	-0.006	(0.38)	-0.016	(0.41)	-0.007	(0.51)
(ln(Sk))*(ln(NonSk))	-0.030	(0.00)	-0.004	(0.83)	-0.045	(0.00)
(ln(Sk))*(ln(White))	-0.009	(0.22)	-0.010	(0.71)	-0.008	(0.29)
(ln(NonSkill))*(ln(White))	-0.005	(0.03)	-0.007	(0.15)	-0.004	(0.12)
Size Dummy	0.548	(0.00)	0.802	(0.01)	0.419	(0.09)
Age Dummy	0.109	(0.25)	0.237	(0.26)	0.091	(0.40)
BOI Dummy	0.254	(0.03)	0.043	(0.85)	0.324	(0.03)
Sum of Residual square	222.182		70.366		132.287	
R square	0.786		0.724		0.761	
Observations	343		105		238	
F-Statistics			1.650*			

TableB.11. The result from regression Eq. B-1 to Eq. B-6 for manufacture of motor vehicle and parts (ISIC34)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance. * implies that the F value is significant at 0.10 level of significance.

	ISIC 3691					
	All		Foreign		Local	
	coefficient	p value	coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	16.531	(0.00)	16.660	(0.00)	16.525	(0.00)
ln(K)	0.193	(0.00)	0.107	(0.06)	0.237	(0.00)
ln(L)	0.710	(0.00)	0.719	(0.00)	0.704	(0.00)
(ln(K))2	0.065	(0.02)	0.018	(0.71)	0.087	(0.02)
(ln(L))2	0.062	(0.20)	-0.022	(0.78)	0.067	(0.29)
(ln(K))*(ln(L))	-0.166	(0.01)	-0.021	(0.85)	-0.201	(0.01)
Size Dummy	0.629	(0.00)	0.785	(0.00)	0.509	(0.03)
Age Dummy	0.074	(0.43)	0.094	(0.41)	0.068	(0.60)
BOI Dummy	0.296	(0.00)	0.106	(0.42)	0.377	(0.01)
Sum of Residual square	110.736		16.771		90.898	
R square	0.800		0.888		0.739	
Observations	244		83		161	
F-statistics			0.715			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	16.185	(0.00)	16.186	(0.00)	16.111	(0.00)
ln(K)	0.215	(0.00)	0.180	(0.01)	0.267	(0.00)
ln(SkillBlue)	0.373	(0.00)	0.458	(0.00)	0.335	(0.00)
ln(NonSkillBlue)	0.026	(0.21)	0.038	(0.15)	0.023	(0.48)
ln(White)	0.190	(0.00)	0.220	(0.01)	0.209	(0.00)
$(\ln(K))^2$	0.012	(0.58)	0.013	(0.72)	0.051	(0.15)
$(\ln(SkillBlue))^2$	0.021	(0.02)	0.039	(0.00)	0.037	(0.05)
$(\ln(Nonskillblue))^2$	0.005	(0.33)	0.007	(0.19)	0.005	(0.53)
$(\ln(White))^2$	0.016	(0.00)	0.000	(1.00)	0.019	(0.02)
(ln(K))*(ln(SkillBlue))	0.015	(0.51)	-0.009	(0.88)	-0.055	(0.32)
(ln(K))*(ln(NonSk)	0.000	(0.98)	-0.006	(0.56)	-0.001	(0.95)
(ln(K))*(ln(White))	-0.025	(0.04)	-0.026	(0.63)	-0.018	(0.24)
(ln(Sk))*(ln(NonSk))	-0.012	(0.17)	0.013	(0.33)	-0.012	(0.36)
(ln(Sk))*(ln(White))	-0.013	(0.07)	-0.047	(0.12)	-0.023	(0.03)
(ln(NonSkill))*(ln(White))	-0.007	(0.02)	-0.024	(0.07)	-0.007	(0.06)
Size Dummy	0.563	(0.00)	0.724	(0.00)	0.523	(0.03)
Age Dummy	0.047	(0.61)	0.084	(0.48)	0.046	(0.72)
BOI Dummy	0.199	(0.05)	0.100	(0.47)	0.264	(0.07)
Sum of Residual square	101.437		15.134		81.533	
R square	0.809		0.884		0.751	
Observations	244		83		161	
F-Statistics			0.570			

TableB.12. The result from regression Eq. B-1 to Eq. B-6 for manufacture of jewelry and related articles (ISIC3691)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance.

	ISIC 3610, 3692, 3693, and 3694					
	All		Foreign		Local	
	coefficient	p value	coefficient	p value	coefficient	p value
	Eq.B-1		Eq.B-2		Eq.B-3	
C	16.037	(0.00)	16.704	(0.00)	16.035	(0.00)
ln(K)	0.187	(0.00)	0.138	(0.23)	0.203	(0.00)
ln(L)	0.480	(0.00)	0.592	(0.00)	0.465	(0.00)
(ln(K))2	-0.026	(0.17)	-0.025	(0.71)	-0.025	(0.20)
(ln(L))2	0.058	(0.20)	-0.048	(0.76)	0.059	(0.20)
(ln(K))*(ln(L))	-0.030	(0.53)	0.084	(0.66)	-0.041	(0.41)
Size Dummy	1.009	(0.00)	0.699	(0.06)	1.005	(0.00)
Age Dummy	0.096	(0.20)	0.215	(0.38)	0.063	(0.41)
BOI Dummy	0.197	(0.02)	-0.045	(0.89)	0.086	(0.35)
Sum of Residual square	356.147		32.762		305.854	
R square	0.701		0.714		0.681	
Observations	549		56		493	
F-statistics			3.055**			
Four-Factor Model	Eq.B-4		Eq.B-5		Eq.B-6	
C	15.205	(0.00)	15.391	(0.00)	15.207	(0.00)
ln(K)	0.181	(0.00)	0.207	(0.14)	0.188	(0.00)
ln(SkillBlue)	0.261	(0.00)	0.266	(0.03)	0.248	(0.00)
ln(NonSkillBlue)	0.038	(0.00)	0.051	(0.25)	0.039	(0.00)
ln(White)	0.096	(0.00)	0.202	(0.02)	0.090	(0.00)
$(\ln(\text{SkillBlue}))^2$	0.018	(0.14)	0.011	(0.86)	0.022	(0.09)
$(\ln(\text{Nonskillblue}))^2$	0.025	(0.00)	0.023	(0.15)	0.024	(0.00)
$(\ln(\text{White}))^2$	0.016	(0.00)	0.023	(0.03)	0.016	(0.00)
$(\ln(K))^2$	0.012	(0.00)	0.023	(0.07)	0.011	(0.00)
(ln(K))*(ln(SkillBlue))	-0.041	(0.00)	0.001	(0.99)	-0.045	(0.00)
(ln(K))*(ln(NonSk)	-0.011	(0.03)	-0.024	(0.37)	-0.011	(0.03)
(ln(K))*(ln(White))	-0.032	(0.00)	-0.044	(0.11)	-0.031	(0.00)
(ln(Sk))*(ln(NonSk))	0.003	(0.53)	-0.002	(0.95)	0.003	(0.51)
(ln(Sk))*(ln(White))	0.006	(0.06)	-0.016	(0.62)	0.006	(0.06)
(ln(NonSkill))*(ln(White))	-0.001	(0.73)	0.002	(0.75)	-0.001	(0.37)
Size Dummy	1.034	(0.00)	0.562	(0.16)	1.022	(0.00)
Age Dummy	0.023	(0.74)	0.243	(0.36)	-0.016	(0.83)
BOI Dummy	0.174	(0.03)	-0.096	(0.77)	0.067	(0.44)
Sum of Residual square	308.853		27.019		262.345	
R square	0.736		0.708		0.720	
Observations	549		56		494.000	
F-Statistics			1.923**			

TableB.13. The result from regression Eq. B-1 to Eq. B-6 for manufacture of furniture, toys, sport and musical equipment (ISIC 3610, 3692-3694)

The F statistic indicate the test for the difference between unrestricted regression and the restricted regression, ** implies the F value is significant at 0.05 level of significance.

B.2.2.Part B. Detailed results

As referred from the main content the following section show the full detail of the results from regression (3-6) and (3-7).

	Manufacturing Sectors			
	Two-Factor model		Four-Factor model	
ln(K)	0.222	(0.00)	0.241	(0.00)
(ln(K))2	-0.013	(0.00)	0.002	(0.29)
ln(L)	0.603	(0.00)	-	-
(ln(L))2	-0.009	(0.37)	-	-
(ln(K))*(ln(L))	-0.012	(0.20)	-	-
ln(SkillBlue)	-	-	0.197	(0.00)
ln(NonSkillBlue)	-	-	0.035	(0.00)
ln(White)	-	-	0.087	(0.00)
$(\ln(\mathrm{SkillBlue}))^2$	-	-	0.017	(0.00)
$(\ln(\mathrm{Nonskillblue}))^2$	-	-	0.010	(0.00)
$(\ln(\mathrm{White}))^2$	-	-	0.010	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.009	(0.00)
(ln(K))*(ln(NonSk)	-	-	-0.008	(0.00)
(ln(K))*(ln(White))	-	-	-0.018	(0.00)
(ln(Sk))*(ln(NonSk))	-	-	0.001	(0.59)
(ln(Sk))*(ln(White))	-	-	-0.003	(0.00)
(ln(NonSkill))*(ln(White))	-	-	-0.001	(0.02)
DMNC	0.160	(0.00)	0.167	(0.00)
SIZEDUMMY	0.953	(0.00)	1.158	(0.00)
AGEDUMMY	0.100	(0.00)	0.104	(0.00)
BOIDUMMY	0.228	(0.00)	0.270	(0.00)
ISIC 15 Dummy	16.317	(0.00)	15.511	(0.00)
ISIC 17 Dummy	15.840	(0.00)	15.072	(0.00)
ISIC 18 Dummy	16.158	(0.00)	15.475	(0.00)
ISIC 19 Dummy	16.073	(0.00)	15.331	(0.00)
ISIC 20 Dummy	15.742	(0.00)	15.037	(0.00)
ISIC 21 Dummy	16.576	(0.00)	15.929	(0.00)
ISIC 24 Dummy	16.667	(0.00)	16.020	(0.00)
ISIC 25 Dummy	16.381	(0.00)	15.680	(0.00)
ISIC 26 Dummy	16.014	(0.00)	15.305	(0.00)
ISIC 27 Dummy	16.744	(0.00)	16.079	(0.00)
ISIC 28 Dummy	16.019	(0.00)	15.420	(0.00)
ISIC 29 Dummy	16.453	(0.00)	15.832	(0.00)
ISIC 30 Dummy	17.792	(0.00)	16.977	(0.00)
ISIC 31 Dummy	17.024	(0.00)	16.386	(0.00)
ISIC 32 Dummy	17.679	(0.00)	16.853	(0.00)
ISIC 33 Dummy	17.069	(0.00)	16.416	(0.00)
ISIC 34 Dummy+	17.082	(0.00)	16.421	(0.00)
ISIC 36 Dummy	16.194	(0.00)	15.538	(0.00)
Observation	11,085		11,085	
R-Square	0.75		0.741	

TableB.14. The result from regression Eq. 3-6 to Eq. 3-7 for Manufacturing sector (ISIC 15 to ISIC 36).

	15			
	Two-Factor model		Four-Factor model	
ln(K)	0.264	(0.00)	0.287	(0.00)
(ln(K))2	-0.028	(0.00)	-0.002	(0.67)
ln(L)	0.660	(0.00)	-	-
(ln(L))2	-0.013	(0.52)	-	-
(ln(K))*(ln(L))	0.011	(0.61)	-	-
ln(SkillBlue)	-	-	0.24	(0.00)
ln(NonSkillBlue)	-	-	0.06	(0.00)
ln(White)	-	-	0.08	(0.00)
$(\ln(\text{SkillBlue}))^2$	-	-	0.02	(0.00)
$(\ln(\text{Nonskillblue}))^2$	-	-	0.01	(0.00)
$(\ln(\text{White}))^2$	-	-	0.01	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.01	(0.12)
(ln(K))*(ln(NonSk)	-	-	-0.01	(0.05)
(ln(K))*(ln(White))	-	-	-0.02	(0.00)
(ln(Sk))*(ln(NonSk))	-	-	-0.01	(0.03)
(ln(Sk))*(ln(White))	-	-	0.00	(0.02)
(ln(NonSkill))*(ln(White))	-	-	0.00	(0.00)
DMNC	-0.036	(0.68)	-0.03	(0.71)
SIZEDUMMY	0.957	(0.00)	1.13	(0.00)
AGEDUMMY	0.102	(0.02)	0.08	(0.05)
BOIDUMMY	0.164	(0.00)	0.21	(0.00)
ISIC 1511 Dummy	16.452	(0.00)	15.368	(0.00)
ISIC 1512 Dummy	16.561	(0.00)	15.404	(0.00)
ISIC 1513 Dummy	15.939	(0.00)	14.807	(0.00)
ISIC 1514 Dummy	17.108	(0.00)	16.397	(0.00)
ISIC 1520 Dummy	16.731	(0.00)	15.866	(0.00)
ISIC 1531 Dummy	16.187	(0.00)	15.222	(0.00)
ISIC 1532 Dummy	17.342	(0.00)	16.631	(0.00)
ISIC 1533 Dummy	17.139	(0.00)	16.278	(0.00)
ISIC 1541 Dummy	16.403	(0.00)	15.454	(0.00)
ISIC 1542 Dummy	17.818	(0.00)	16.877	(0.00)
ISIC 1543 Dummy	15.612	(0.00)	14.423	(0.00)
ISIC 1544 Dummy	15.975	(0.00)	14.776	(0.00)
ISIC 1549 Dummy	15.852	(0.00)	14.805	(0.00)
ISIC 1551 Dummy	17.997	(0.00)	17.441	(0.00)
ISIC 1552 Dummy	15.517	(0.00)	14.688	(0.00)
ISIC 1554 Dummy+	19.090	(0.00)	18.295	(0.00)
ISIC 1554 Dummy	16.525	(0.00)	15.484	(0.00)
Observation	1,719		1,719	
R-Square	0.805		0.800	

TableB.15. The full result from regression Eq. 3-6 to Eq. 3-7 for manufacture of food product and beverage industry (ISIC 15)

	17			
	Two-Factor model		Four-Factor model	
ln(K)	0.350	(0.00)	0.248	(0.00)
(ln(K))2	-0.001	(0.94)	0.008	(0.16)
ln(L)	0.674	(0.00)	-	-
(ln(L))2	0.020	(0.55)	-	-
(ln(K))*(ln(L))	-0.059	(0.03)	-	-
ln(SkillBlue)	-	-	0.241	(0.00)
ln(NonSkillBlue)	-	-	0.052	(0.00)
ln(White)	-	-	0.129	(0.00)
$(\ln(SkillBlue))^2$	-	-	0.015	(0.00)
$(\ln(Nonskillblue))^2$	-	-	0.018	(0.00)
$(\ln(White))^2$	-	-	0.019	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	0.002	(0.82)
(ln(K))*(ln(NonSk)	-	-	-0.007	(0.06)
(ln(K))*(ln(White))	-	-	-0.025	(0.00)
(ln(Sk))*(ln(NonSk))	-	-	-0.009	(0.03)
(ln(Sk))*(ln(White))	-	-	-0.005	(0.14)
(ln(NonSkill))*(ln(White))	-	-	-0.001	(0.36)
DMNC	0.104	(0.30)	0.043	(0.66)
SIZEDUMMY	0.449	(0.00)	0.678	(0.00)
AGEDUMMY	0.236	(0.00)	0.152	(0.01)
BOIDUMMY	0.065	(0.46)	0.117	(0.16)
ISIC 1711 Dummy	15.538	(0.00)	14.207	(0.00)
ISIC 1712 Dummy	16.460	(0.00)	15.199	(0.00)
ISIC 1721 Dummy	15.717	(0.00)	14.469	(0.00)
ISIC 1722 Dummy+	16.238	(0.00)	14.806	(0.00)
ISIC 1723 Dummy	16.468	(0.00)	15.240	(0.00)
ISIC 1729 Dummy	16.577	(0.00)	15.670	(0.00)
ISIC 1730 Dummy	16.803	(0.00)	15.802	(0.00)
Observation	854		854	
R-Square	0.843		0.863	

TableB.16. The full result from regression Eq. 3-6 to Eq. 3-7 for manufacture of textile (ISIC 17)

	18-19			
	Two-Factor model		Four-Factor model	
ln(K)	0.158	(0.00)	0.176	(0.00)
(ln(K))2	-0.025	(0.02)	-0.010	(0.16)
ln(L)	0.753	(0.00)	-	-
(ln(L))2	-0.039	(0.08)	-	-
(ln(K))*(ln(L))	0.001	(0.97)	-	-
ln(SkillBlue)	-	-	0.330	(0.00)
ln(NonSkillBlue)	-	-	0.034	(0.00)
ln(White)	-	-	0.146	(0.00)
$(\ln(\text{SkillBlue}))^2$	-	-	0.029	(0.00)
$(\ln(\text{Nonskillblue}))^2$	-	-	0.011	(0.00)
$(\ln(\text{White}))^2$	-	-	0.017	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.007	(0.23)
(ln(K))*(ln(NonSk)	-	-	-0.007	(0.04)
(ln(K))*(ln(White))	-	-	-0.020	(0.00)
(ln(Sk))*(ln(NonSk))	-	-	-0.002	(0.51)
(ln(Sk))*(ln(White))	-	-	-0.006	(0.00)
(ln(NonSkill))*(ln(White))	-	-	-0.002	(0.14)
DMNC	-0.128	(0.14)	-0.120	(0.17)
SIZEDUMMY	0.779	(0.00)	0.793	(0.00)
AGEDUMMY	0.065	(0.15)	0.030	(0.52)
BOIDUMMY	0.136	(0.01)	0.179	(0.00)
ISIC 1810 Dummy	16.316	(0.00)	15.391	(0.00)
ISIC 1820 Dummy+	17.656	(0.00)	16.139	(0.00)
ISIC 1911 Dummy	16.541	(0.00)	15.850	(0.00)
ISIC 1912 Dummy	16.049	(0.00)	15.124	(0.00)
ISIC 1920 Dummy	16.269	(0.00)	15.107	(0.00)
Observation	1,017		1,017	
R-Square	0.803		0.804	

TableB.17. The full result from regression Eq. 3-6 to Eq. 3-7 for manufacture of wearing apparel (ISIC 18), Luggage and footwear (ISIC 19)

	20-21			
	Two-Factor model		Four-Factor model	
ln(K)	0.233	(0.00)	0.235	(0.00)
(ln(K))2	0.001	(0.87)	-0.002	(0.77)
ln(L)	0.601	(0.00)	-	-
(ln(L))2	-0.048	(0.21)	-	-
(ln(K))*(ln(L))	-0.032	(0.36)	-	-
ln(SkillBlue)	-	-	0.244	(0.00)
ln(NonSkillBlue)	-	-	0.048	(0.00)
ln(White)	-	-	0.091	(0.00)
$(\ln(\text{SkillBlue}))^2$	-	-	0.020	(0.00)
$(\ln(\text{Nonskillblue}))^2$	-	-	0.011	(0.00)
$(\ln(\text{White}))^2$	-	-	0.012	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.008	(0.17)
(ln(K))*(ln(NonSk)	-	-	-0.003	(0.41)
(ln(K))*(ln(White))	-	-	-0.010	(0.01)
(ln(Sk))*(ln(NonSk))	-	-	-0.005	(0.21)
(ln(Sk))*(ln(White))	-	-	0.000	(0.93)
(ln(NonSkill))*(ln(White))	-	-	0.001	(0.65)
DMNC	0.208	(0.05)	0.245	(0.02)
SIZEDUMMY	1.003	(0.00)	1.005	(0.00)
AGEDUMMY	0.121	(0.02)	0.072	(0.16)
BOIDUMMY	0.116	(0.09)	0.074	(0.29)
ISIC 2010 Dummy	15.966	(0.00)	15.248	(0.00)
ISIC 2021 Dummy	16.730	(0.00)	15.942	(0.00)
ISIC 2022 Dummy	15.597	(0.00)	14.978	(0.00)
ISIC 2023 Dummy+	15.752	(0.00)	14.826	(0.00)
ISIC 2029 Dummy	15.007	(0.00)	14.137	(0.00)
ISIC 2101 Dummy	17.049	(0.00)	16.302	(0.00)
ISIC 2102 Dummy	16.487	(0.00)	15.777	(0.00)
ISIC 2109 Dummy	16.458	(0.00)	15.808	(0.00)
Observation	905		905	
R-Square	0.783		0.782	

TableB.18. The result from regression Eq. 3-6 to Eq. 3-7 for manufacture of wood products (ISIC 20), manufacture of paper and paper products (ISIC 21)

	24			
	Two-Factor model		Four-Factor model	
ln(K)	0.248	(0.00)	0.212	(0.00)
(ln(K))2	-0.023	(0.00)	-0.013	(0.05)
ln(L)	0.577	(0.00)	-	-
(ln(L))2	-0.047	(0.26)	-	-
(ln(K))*(ln(L))	0.000	(0.99)	-	-
ln(SkillBlue)	-	-	0.274	(0.00)
ln(NonSkillBlue)	-	-	0.041	(0.00)
ln(White)	-	-	0.120	(0.00)
$(\ln(SkillBlue))^2$	-	-	0.021	(0.00)
$(\ln(Nonskillblue))^2$	-	-	0.008	(0.00)
$(\ln(White))^2$	-	-	0.012	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	0.007	(0.41)
(ln(K))*(ln(NonSk)	-	-	0.000	(0.93)
(ln(K))*(ln(White))	-	-	-0.012	(0.01)
(ln(Sk))*(ln(NonSk))	-	-	-0.012	(0.03)
(ln(Sk))*(ln(White))	-	-	-0.011	(0.01)
(ln(NonSkill))*(ln(White))	-	-	-0.004	(0.01)
DMNC	0.231	(0.01)	0.212	(0.02)
SIZEDUMMY	1.058	(0.00)	1.147	(0.00)
AGEDUMMY	0.212	(0.00)	0.213	(0.00)
BOIDUMMY	0.012	(0.88)	0.024	(0.75)
ISIC 2411 Dummy	17.047	(0.00)	16.467	(0.00)
ISIC 2412 Dummy	15.616	(0.00)	14.710	(0.00)
ISIC 2413 Dummy	16.725	(0.00)	15.802	(0.00)
ISIC 2421 Dummy	16.373	(0.00)	15.836	(0.00)
ISIC 2422 Dummy	16.954	(0.00)	16.276	(0.00)
ISIC 2423 Dummy	16.840	(0.00)	16.304	(0.00)
ISIC 2424 Dummy	16.707	(0.00)	15.952	(0.00)
ISIC 2424 Dummy	16.563	(0.00)	15.854	(0.00)
ISIC 2430 Dummy +	18.273	(0.00)	17.358	(0.00)
Observation	767		767	
R-Square	0.776		0.775	

TableB.19. The result from regression Eq. 3-6 to Eq. 3-7 for manufacture of chemicals and chemical products (ISIC 24)

	25			
	Two-Factor model		Four-Factor model	
ln(K)	0.143	(0.00)	0.169	(0.00)
(ln(K))2	0.021	(0.01)	0.004	(0.42)
ln(L)	0.590	(0.00)	-	-
(ln(L))2	-0.035	(0.21)	-	-
(ln(K))*(ln(L))	-0.062	(0.02)	-	-
ln(SkillBlue)	-	-	0.244	(0.00)
ln(NonSkillBlue)	-	-	0.049	(0.00)
ln(White)	-	-	0.118	(0.00)
$(\ln(\text{SkillBlue}))^2$	-	-	0.019	(0.00)
$(\ln(\text{Nonskillblue}))^2$	-	-	0.013	(0.00)
$(\ln(\text{White}))^2$	-	-	0.018	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.016	(0.00)
(ln(K))*(ln(NonSk)	-	-	-0.006	(0.03)
(ln(K))*(ln(White))	-	-	-0.018	(0.00)
(ln(Sk))*(ln(NonSk))	-	-	-0.006	(0.03)
(ln(Sk))*(ln(White))	-	-	0.000	(0.93)
(ln(NonSkill))*(ln(White))	-	-	0.001	(0.21)
DMNC	0.202	(0.00)	0.238	(0.00)
SIZEDUMMY	1.042	(0.00)	1.016	(0.00)
AGEDUMMY	0.009	(0.83)	0.031	(0.45)
BOIDUMMY	0.147	(0.01)	0.136	(0.01)
ISIC 2511 Dummy	16.842	(0.00)	15.612	(0.00)
ISIC 2519 Dummy	16.627	(0.00)	15.638	(0.00)
ISIC 2520Dummy	16.323	(0.00)	15.444	(0.00)
Observation	1,162		1,162	
R-Square	0.784		0.773	

TableB.20. The result from regression Eq. 3-6 to Eq. 3-7 for manufacture of rubber and plastic products (ISIC 25)

	26			
	Two-Factor model		Four-Factor model	
ln(K)	0.218	(0.00)	0.231	(0.00)
(ln(K))2	0.030	(0.00)	0.004	(0.60)
ln(L)	0.731	(0.00)	-	-
(ln(L))2	-0.024	(0.51)	-	-
(ln(K))*(ln(L))	-0.077	(0.02)	-	-
ln(SkillBlue)	-	-	0.261	(0.00)
ln(NonSkillBlue)	-	-	0.037	(0.00)
ln(White)	-	-	0.091	(0.00)
$(\ln(SkillBlue))^2$	-	-	0.022	(0.00)
$(\ln(Nonskillblue))^2$	-	-	0.012	(0.00)
$(\ln(White))^2$	-	-	0.011	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.006	(0.45)
(ln(K))*(ln(NonSk)	-	-	-0.005	(0.22)
(ln(K))*(ln(White))	-	-	-0.006	(0.14)
(ln(Sk))*(ln(NonSk))	-	-	-0.006	(0.10)
(ln(Sk))*(ln(White))	-	-	-0.006	(0.02)
(ln(NonSkill))*(ln(White))	-	-	-0.002	(0.16)
DMNC	0.134	(0.28)	0.072	(0.58)
SIZEDUMMY	0.967	(0.00)	1.128	(0.00)
AGEDUMMY	-0.143	(0.02)	-0.110	(0.08)
BOIDUMMY	-0.039	(0.68)	0.000	(1.00)
ISIC 2610 Dummy	17.050	(0.00)	16.350	(0.00)
ISIC 2691 Dummy	15.998	(0.00)	15.087	(0.00)
ISIC 2692 Dummy	16.083	(0.00)	15.019	(0.00)
ISIC 2693 Dummy	15.238	(0.00)	14.179	(0.00)
ISIC 2694 Dummy	16.494	(0.00)	15.654	(0.00)
ISIC 2695 Dummy	16.116	(0.00)	15.260	(0.00)
ISIC 2696 Dummy	15.541	(0.00)	14.775	(0.00)
ISIC 2699 Dummy+	16.512	(0.00)	15.525	(0.00)
Observation	738		738	
R-Square	0.753		0.732	

TableB.21. The result from regression Eq. 3-6 to Eq. 3-7 for manufacture of other non-metallic mineral product (ISIC 26)

	27-28			
	Two-Factor model		Four-Factor model	
ln(K)	0.182	(0.00)	0.198	(0.00)
(ln(K))2	0.657	(0.00)	0.001	(0.79)
ln(L)	0.014	(0.08)	-	-
(ln(L))2	-0.002	(0.93)	-	-
(ln(K))*(ln(L))	-0.055	(0.03)	-	-
ln(SkillBlue)	-	-	0.277	(0.00)
ln(NonSkillBlue)	-	-	0.034	(0.00)
ln(White)	-	-	0.127	(0.00)
$(\ln(\text{SkillBlue}))^2$	-	-	0.025	(0.00)
$(\ln(\text{Nonskillblue}))^2$	-	-	0.008	(0.00)
$(\ln(\text{White}))^2$	-	-	0.019	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.012	(0.05)
(ln(K))*(ln(NonSk)	-	-	-0.008	(0.00)
(ln(K))*(ln(White))	-	-	-0.009	(0.00)
(ln(Sk))*(ln(NonSk))	-	-	0.001	(0.62)
(ln(Sk))*(ln(White))	-	-	-0.005	(0.03)
(ln(NonSkill))*(ln(White))	-	-	0.000	(0.73)
DMNC	0.142	(0.02)	0.144	(0.02)
SIZEDUMMY	0.982	(0.00)	1.069	(0.00)
AGEDUMMY	0.029	(0.43)	0.049	(0.18)
BOIDUMMY	0.113	(0.05)	0.113	(0.06)
ISIC 2710 Dummy	17.045	(0.00)	16.296	(0.00)
ISIC 2720 Dummy	16.877	(0.00)	16.126	(0.00)
ISIC 2731 Dummy	16.566	(0.00)	15.839	(0.00)
ISIC 2732 Dummy	15.919	(0.00)	15.164	(0.00)
ISIC 2811 Dummy	16.060	(0.00)	15.302	(0.00)
ISIC 2812 Dummy	16.405	(0.00)	15.855	(0.00)
ISIC 2813 Dummy	16.633	(0.00)	15.832	(0.00)
ISIC 2891 Dummy	15.782	(0.00)	15.158	(0.00)
ISIC 2892 Dummy	16.055	(0.00)	15.298	(0.00)
ISIC 2893 Dummy	15.901	(0.00)	15.083	(0.00)
ISIC 2899 Dummy	16.345	(0.00)	15.677	(0.00)
Observation	1,501		1,501	
R-Square	0.779		0.772	

TableB.22. The result from regression Eq. 3-6 to Eq. 3-7 for manufacture of basic metal (ISIC 27) and manufacture of fabricated metal (ISIC 28)

	29			
	Two-Factor model		Four-Factor model	
ln(K)	0.124	(0.00)	0.164	(0.00)
(ln(K))2	0.010	(0.47)	0.012	(0.15)
ln(L)	0.721	(0.00)	-	-
(ln(L))2	-0.043	(0.27)	-	-
(ln(K))*(ln(L))	-0.014	(0.74)	-	-
ln(SkillBlue)	-	-	0.315	(0.00)
ln(NonSkillBlue)	-	-	0.040	(0.00)
ln(White)	-	-	0.149	(0.00)
$(\ln(\text{SkillBlue}))^2$	-	-	0.023	(0.00)
$(\ln(\text{Nonskillblue}))^2$	-	-	0.005	(0.05)
$(\ln(\text{White}))^2$	-	-	0.019	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.011	(0.23)
(ln(K))*(ln(NonSk)	-	-	0.004	(0.26)
(ln(K))*(ln(White))	-	-	-0.016	(0.00)
(ln(Sk))*(ln(NonSk))	-	-	-0.013	(0.00)
(ln(Sk))*(ln(White))	-	-	-0.005	(0.11)
(ln(NonSkill))*(ln(White))	-	-	0.001	(0.49)
DMNC	0.166	(0.06)	0.192	(0.03)
SIZEDUMMY	0.726	(0.00)	0.727	(0.00)
AGEDUMMY	0.098	(0.11)	0.091	(0.14)
BOIDUMMY	0.291	(0.00)	0.282	(0.00)
ISIC 2911 Dummy	17.719	(0.00)	17.419	(0.00)
ISIC 2912 Dummy	16.666	(0.00)	16.119	(0.00)
ISIC 2913 Dummy	16.657	(0.00)	15.918	(0.00)
ISIC 2914 Dummy	15.847	(0.00)	15.411	(0.00)
ISIC 2915 Dummy	16.698	(0.00)	15.934	(0.00)
ISIC 2919 Dummy	16.790	(0.00)	16.034	(0.00)
ISIC 2921 Dummy	15.610	(0.00)	14.845	(0.00)
ISIC 2922 Dummy	16.293	(0.00)	15.642	(0.00)
ISIC 2923 Dummy	16.303	(0.00)	15.734	(0.00)
ISIC 2924 Dummy	15.890	(0.00)	15.396	(0.00)
ISIC 2925 Dummy	16.367	(0.00)	15.787	(0.00)
ISIC 2926 Dummy	16.171	(0.00)	15.746	(0.00)
ISIC 2927 Dummy	15.756	(0.00)	15.037	(0.00)
ISIC 2929 Dummy	15.952	(0.00)	15.347	(0.00)
ISIC 2930 Dummy	16.912	(0.00)	16.282	(0.00)
Observation	607		607	
R-Square	0.764		0.760	

TableB.23. The result from regression Eq. 3-6to Eq. 3-7 for manufacture of machinery and equipment (ISIC 29)

	30-33			
	Two-Factor model		Four-Factor model	
ln(K)	0.188	(0.00)	0.231	(0.00)
(ln(K))2	0.009	(0.44)	-0.003	(0.69)
ln(L)	0.598	(0.00)	-	-
(ln(L))2	0.010	(0.75)	-	-
(ln(K))*(ln(L))	-0.043	(0.21)	-	-
ln(SkillBlue)	-	-	0.289	(0.00)
ln(NonSkillBlue)	-	-	0.035	(0.00)
ln(White)	-	-	0.120	(0.00)
$(\ln(\text{SkillBlue}))^2$	-	-	0.020	(0.00)
$(\ln(\text{Nonskillblue}))^2$	-	-	0.008	(0.00)
$(\ln(\text{White}))^2$	-	-	0.017	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.002	(0.78)
(ln(K))*(ln(NonSk)	-	-	-0.003	(0.32)
(ln(K))*(ln(White))	-	-	-0.013	(0.00)
(ln(Sk))*(ln(NonSk))	-	-	0.000	(0.90)
(ln(Sk))*(ln(White))	-	-	-0.014	(0.00)
(ln(NonSkill))*(ln(White))	-	-	-0.002	(0.17)
DMNC	0.063	(0.41)	0.107	(0.17)
SIZEDUMMY	0.909	(0.00)	0.888	(0.00)
AGEDUMMY	0.042	(0.51)	0.001	(0.99)
BOIDUMMY	0.141	(0.07)	0.139	(0.08)
ISIC 3000 Dummy	17.853	(0.00)	17.046	(0.00)
ISIC 3110 Dummy	17.114	(0.00)	16.605	(0.00)
ISIC 3120 Dummy	16.879	(0.00)	16.332	(0.00)
ISIC 3130 Dummy	17.567	(0.00)	16.973	(0.00)
ISIC 3140 Dummy	17.246	(0.00)	16.720	(0.00)
ISIC 3150 Dummy	16.604	(0.00)	15.919	(0.00)
ISIC 3190 Dummy	17.157	(0.00)	16.561	(0.00)
ISIC 3210 Dummy	17.850	(0.00)	17.035	(0.00)
ISIC 3220 Dummy	17.292	(0.00)	16.742	(0.00)
ISIC 3230 Dummy	17.475	(0.00)	16.758	(0.00)
ISIC 3311 Dummy	16.501	(0.00)	15.907	(0.00)
ISIC 3312 Dummy	16.559	(0.00)	16.308	(0.00)
ISIC 3313 Dummy	17.536	(0.00)	17.302	(0.00)
ISIC 3320 Dummy	18.090	(0.00)	17.394	(0.00)
ISIC 3330 Dummy	17.544	(0.00)	16.889	(0.00)
Observation	679		679	
R-Square	0.812		0.812	

TableB.24. The result from regression Eq. 3-6 to Eq. 3-7 for electrical machinery (ISIC 30 to ISIC 33)

	34			
	Two-Factor model		Four-Factor model	
ln(K)	0.151	(0.00)	0.184	(0.00)
(ln(K))2	0.015	(0.30)	0.026	(0.01)
ln(L)	0.802	(0.00)	-	-
(ln(L))2	-0.051	(0.35)	-	-
(ln(K))*(ln(L))	-0.008	(0.88)	-	-
ln(SkillBlue)	-	-	0.405	(0.00)
ln(NonSkillBlue)	-	-	0.049	(0.00)
ln(White)	-	-	0.197	(0.00)
$(\ln(SkillBlue))^2$	-	-	0.023	(0.00)
$(\ln(Nonskillblue))^2$	-	-	0.016	(0.00)
$(\ln(White))^2$	-	-	0.024	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.032	(0.12)
(ln(K))*(ln(NonSk)	-	-	0.004	(0.47)
(ln(K))*(ln(White))	-	-	-0.009	(0.19)
(ln(Sk))*(ln(NonSk))	-	-	-0.030	(0.00)
(ln(Sk))*(ln(White))	-	-	-0.012	(0.08)
(ln(NonSkill))*(ln(White))	-	-	-0.005	(0.03)
DMNC	-0.024	(0.83)	-0.019	(0.86)
SIZEDUMMY	0.797	(0.00)	0.630	(0.00)
AGEDUMMY	0.061	(0.48)	0.116	(0.19)
BOIDUMMY	0.214	(0.05)	0.196	(0.08)
ISIC 3410 Dummy	17.863	(0.00)	17.175	(0.00)
ISIC 3420 Dummy	16.282	(0.00)	15.297	(0.00)
ISIC 3430 Dummy	17.152	(0.00)	16.024	(0.00)
Observation	343		343	
R-Square	0.83		0.823	

TableB.25. The result from regression Eq. 3-6 to Eq. 3-7 for manufacture of motor vehicle and part (ISIC 34),

	3610,3692 to 3694			
	Two-Factor model		Four-Factor model	
ln(K)	0.200	(0.00)	0.206	(0.00)
(ln(K))2	-0.038	(0.03)	0.012	(0.30)
ln(L)	0.534	(0.00)	-	-
(ln(L))2	-0.003	(0.95)	-	-
(ln(K))*(ln(L))	0.004	(0.92)	-	-
ln(SkillBlue)	-	-	0.240	(0.00)
ln(NonSkillBlue)	-	-	0.038	(0.00)
ln(White)	-	-	0.127	(0.00)
$(\ln(\text{SkillBlue}))^2$	-	-	0.022	(0.00)
$(\ln(\text{Nonskillblue}))^2$	-	-	0.013	(0.00)
$(\ln(\text{White}))^2$	-	-	0.019	(0.00)
(ln(K))*(ln(SkillBlue))	-	-	-0.034	(0.00)
(ln(K))*(ln(NonSk)	-	-	-0.011	(0.02)
(ln(K))*(ln(White))	-	-	-0.034	(0.00)
(ln(Sk))*(ln(NonSk))	-	-	0.001	(0.78)
(ln(Sk))*(ln(White))	-	-	0.004	(0.21)
(ln(NonSkill))*(ln(White))	-	-	-0.001	(0.51)
DMNC	0.383	(0.00)	0.345	(0.00)
SIZEDUMMY	1.064	(0.00)	1.058	(0.00)
AGEDUMMY	0.060	(0.37)	-0.014	(0.83)
BOIDUMMY	-0.180	(0.04)	-0.174	(0.03)
ISIC 3610 Dummy	16.031	(0.00)	15.120	(0.00)
ISIC 3692 Dummy+	15.938	0.000	15.477	0.000
ISIC 3693 Dummy	16.913	(0.00)	15.978	(0.00)
ISIC 3694 Dummy	16.876	(0.00)	15.940	(0.00)
Observation	549		549	
R-Square	0.751		0.781	

TableB.26. The results from regression Eq. 3-6 to Eq. 3-7 for manufacture of other manufacturing (ISIC 3610, 3692, 3693 and 3694), except manufacture of jewelry and related articles (ISIC 3691)

Appendix C

Appendix to Testing for FDI externalities in Thailand: A plant-level analysis of horizontal and vertical spillovers

C.1. Regression for testing for the effects on local plants labor' productivity

For the direct effects on TFP of local plant, the review of firm level TFP estimation paper could be further found in (Beveren 2010), the comparison of different TFP estimation techniques are graphically illustrated in this study. In which, the results from standard OLS estimation for firm's TFP is relatively similar to the results from other methods.

To test for the effect of foreign presence on local plant's labor productivity, the following regression is adjusted from the regression 4-2, with three types of labors, in the main content.

C-1

$$ln(V/L)_{ij}^{Local} = \beta_0 + \beta_1.\ln(K/L)_i + \beta_2.\ln\left(\frac{SkillBlue}{L}\right)_i + \beta_3.\ln(\frac{NonSkillBlue}{L})_i + \beta_4.ln(\frac{White}{L})_i] + \beta_5.Horizontal_j + \beta_6.Spillfromdown_j + \beta_7.Spillfromup_j + \beta_8.dSize_i + \beta_9.dAge_i + \beta_{10}.dBOI_i + \epsilon_i$$

Further added with industry dummy variables

C-2

$$ln(V/L)_{ij}^{Local} = \beta_0 + \beta_1.\ln\Big(K/L)_i + \beta_2.\ln\left(\frac{SkillBlue}{L}\right)_i + \beta_3.\ln\left(\frac{NonSkillBlue}{L}\right)_i + \beta_4.\ln\left(\frac{White}{L}\right)_i\Big] + \beta_5.Horizontal_j + \beta_6.Spillfromdown_j + \beta_7.Spillfromup_j + \beta_8.dSize_i + \beta_9.dAge_i + \beta_{10}.dBOI_i + \sum_k^n \beta_k(ISIC_{ik}) + \epsilon_i$$

The measurements of variables are the same as the listed in the content.

C.2. Foreign presence through other measurements

In addition to the foreign plant's output share as the measurement of foreign presence, the following measurements are also used in order to test for the horizontal spillover through other mean of spillover channels.

Type of Spillover	Labor mobility	Demonstration Effect
Horizontalspill$_j$	$\left[\dfrac{Labor^{MNC}}{Labor^{All}}\right]_j$	$\left[\dfrac{R\&D^{MNC}}{R\&D^{All}}\right]_j$

TableC.1. Other measurement of foreign presence, horizontal spillover effect

C.3. Detailed results

The results of these additional two channels of spillover are further combined with the baseline output share measurements of spillover effect, and the results are depicted in the following table.

	Eq.C-1					
	Output		Labor		RD	
	coefficient	p-value	Coefficient	p-value	coefficient	p-value
[Va/L] as dependent variable						
C	4.2484	(0.00)	4.2473	(0.00)	4.3709	(0.00)
ln(K/L)	0.2320	(0.00)	0.2324	(0.00)	0.2296	(0.00)
ln(SkillBlue/L)	0.0104	(0.00)	0.0103	(0.00)	0.0103	(0.00)
ln(NonSkillBlue/L)	0.0003	(0.87)	0.0003	(0.88)	0.0002	(0.90)
ln(White/L)	0.0309	(0.00)	0.0310	(0.00)	0.0309	(0.00)
Foreign presence	**0.0060**	**(0.00)**	**0.0077**	**(0.00)**	**0.0020**	**(0.00)**
SIZEDUMMY	0.5820	(0.00)	0.5862	(0.00)	0.5706	(0.00)
AGEDUMMY	0.0411	(0.02)	0.0402	(0.02)	0.0474	(0.01)
BOIDUMMY	-0.0054	(0.81)	-0.0185	(0.42)	0.0029	(0.90)
Adjusted R-square	0.2464		0.2499		0.2373	
No. of Observation	9,569		9,569		9,482	

TableC.2. Results from regression A3-1 through various measurement of foreign presence.

	Eq.C-2					
	Output		Labor		RD	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
(Va/L) as dependent variable						
ln(K/L)	0.2331	(0.00)	0.2335	(0.00)	0.2345	(0.00)
ln(SkillBlue/L)	0.0100	(0.00)	0.0100	(0.00)	0.0096	(0.00)
ln(NonSkillBlue/L)	0.0002	(0.89)	0.0003	(0.89)	0.0000	(0.99)
ln(White/L)	0.0302	(0.00)	0.0303	(0.00)	0.0303	(0.00)
Foreign presence	-0.0030	(0.00)	-0.0014	(0.11)	-0.0008	(0.03)
SIZEDUMMY	0.5639	(0.00)	0.5666	(0.00)	0.5717	(0.00)
AGEDUMMY	0.0357	(0.04)	0.0357	(0.04)	0.0354	(0.04)
BOIDUMMY	0.0146	(0.52)	0.0124	(0.58)	0.0041	(0.86)
ISIC 15 dummy	4.5383	(0.00)	4.5105	(0.00)	4.5143	(0.00)
ISIC 17 dummy	3.9315	(0.00)	3.8784	(0.00)	3.8842	(0.00)
ISIC 18 dummy	4.1950	(0.00)	4.1469	(0.00)	4.1228	(0.00)
ISIC 19 dummy	4.3337	(0.00)	4.3115	(0.00)	4.2876	(0.00)
ISIC 20 dummy	4.1306	(0.00)	4.1044	(0.00)	4.1036	(0.00)
ISIC 21 dummy	4.7912	(0.00)	4.7183	(0.00)	4.7018	(0.00)
ISIC 24 dummy	4.9514	(0.00)	4.8663	(0.00)	4.8652	(0.00)
ISIC 25 dummy	4.6178	(0.00)	4.5506	(0.00)	4.5181	(0.00)
ISIC 26 dummy	4.4435	(0.00)	4.4129	(0.00)	4.4181	(0.00)
ISIC 27 dummy	4.9842	(0.00)	4.9258	(0.00)	4.9121	(0.00)
ISIC 28 dummy	4.6464	(0.00)	4.5602	(0.00)	4.5581	(0.00)
ISIC 29 dummy	4.8872	(0.00)	4.7634	(0.00)	4.7220	(0.00)
ISIC 30 dummy	5.3472	(0.00)	5.2401	(0.00)	5.2225	(0.00)
ISIC 31 dummy	4.9759	(0.00)	4.8710	(0.00)	4.8558	(0.00)
ISIC 32 dummy	5.0721	(0.00)	4.9384	(0.00)	4.9039	(0.00)
ISIC 33 dummy	5.0678	(0.00)	4.9432	(0.00)	4.8155	(0.00)
ISIC 34 dummy	4.9167	(0.00)	4.8080	(0.00)	4.7694	(0.00)
ISIC 36 dummy	4.3376	(0.00)	4.2891	(0.00)	4.2856	(0.00)
Adjusted R square	0.3107		0.3098		0.3110	

TableC.3. Results from regression A3-2 through various measurement of foreign presence

C.3. Detailed results on industry dummy variable

The following section depicts the coefficients and p-value of the industry dummy variables which have been augmented to regression eq. (A3-2), (4-6) and (4-7). The coefficients of other variables are shown in the main content.

Industry dummy variables	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model Eq.(4-6)		4 Factor model Eq.(4-7)	
	coefficient	p-value	Coefficient	p-value	coefficient	p-value
ISIC 15 dummy	4.6601	(0.00)	16.5794	(0.00)	15.7443	(0.00)
ISIC 17 dummy	4.0989	(0.00)	16.1759	(0.00)	15.3936	(0.00)
ISIC 18 dummy	4.3920	(0.00)	16.5117	(0.00)	15.8027	(0.00)
ISIC 19 dummy	4.4699	(0.00)	16.4480	(0.00)	15.6637	(0.00)
ISIC 20 dummy	4.4237	(0.00)	16.0947	(0.00)	15.3793	(0.00)
ISIC 21 dummy	4.9226	(0.00)	16.9300	(0.00)	16.2603	(0.00)
ISIC 24 dummy	5.1557	(0.00)	17.0832	(0.00)	16.4400	(0.00)
ISIC 25 dummy	4.9310	(0.00)	16.9727	(0.00)	16.2451	(0.00)
ISIC 26 dummy	4.6973	(0.00)	16.3509	(0.00)	15.6323	(0.00)
ISIC 27 dummy	5.2665	(0.00)	17.1493	(0.00)	16.4738	(0.00)
ISIC 28 dummy	4.7556	(0.00)	16.3229	(0.00)	15.7248	(0.00)
ISIC 29 dummy	5.0999	(0.00)	16.9037	(0.00)	16.2784	(0.00)
ISIC 30 dummy	5.7269	(0.00)	18.4990	(0.00)	17.5878	(0.00)
ISIC 31 dummy	5.2942	(0.00)	17.6177	(0.00)	16.9591	(0.00)
ISIC 32 dummy	5.5011	(0.00)	18.5529	(0.00)	17.6371	(0.00)
ISIC 33 dummy	5.4461	(0.00)	17.7457	(0.00)	17.0829	(0.00)
ISIC 34 dummy	5.1779	(0.00)	17.6166	(0.00)	16.9479	(0.00)
ISIC 36 dummy	4.5751	(0.00)	16.5137	(0.00)	15.8323	(0.00)

TableC.4. The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacturing sector

ISIC 15	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model Eq.(4-6)		4 Factor model Eq.(4-7)	
	Coefficient	p-value	Coefficient	p-value	coefficient	p-value
ZZZ15111	5.2608	(0.00)	16.9903	(0.00)	16.1404	(0.00)
ZZZ15114	4.9749	(0.00)	16.6352	(0.00)	15.8384	(0.00)
ZZZ15121	5.0044	(0.00)	16.9859	(0.00)	16.3410	(0.00)
ZZZ15131	4.7941	(0.00)	16.6401	(0.00)	15.9132	(0.00)
ZZZ15139	4.6510	(0.00)	16.6445	(0.00)	16.2624	(0.00)
ZZZ15201	4.9984	(0.00)	17.2471	(0.00)	16.4918	(0.00)
ZZZ15311	6.2737	(0.00)	18.1063	(0.00)	17.8684	(0.00)
ZZZ15321	5.7988	(0.00)	17.6565	(0.00)	17.1633	(0.00)
ZZZ15331	5.0937	(0.00)	17.0022	(0.00)	16.5185	(0.00)
ZZZ15332	4.9228	(0.00)	16.8859	(0.00)	16.5191	(0.00)
ZZZ15339	5.1305	(0.00)	17.1022	(0.00)	16.6494	(0.00)
ZZZ15411	5.6193	(0.00)	17.5109	(0.00)	17.0949	(0.00)
ZZZ15413	5.8101	(0.00)	17.8535	(0.00)	17.2150	(0.00)
ZZZ15421	6.1960	(0.00)	18.1404	(0.00)	17.8506	(0.00)
ZZZ15431	7.5479	(0.00)	19.5304	(0.00)	19.2412	(0.00)
ZZZ15511	5.3608	(0.00)	17.1969	(0.00)	16.4482	(0.00)
ZZZ15514	4.8138	(0.00)	16.6495	(0.00)	16.1918	(0.00)
ZZZ15515	6.0266	(0.00)	17.8214	(0.00)	17.3013	(0.00)
ZZZ15521	4.8337	(0.00)	16.6088	(0.00)	15.9406	(0.00)
ZZZ15611	6.4711	(0.00)	17.6705	(0.00)	17.4021	(0.00)
ZZZ15612	5.6297	(0.00)	16.9845	(0.00)	16.5615	(0.00)
ZZZ15613	5.5932	(0.00)	16.9481	(0.00)	16.7370	(0.00)
ZZZ15614	6.0690	(0.00)	17.3333	(0.00)	16.8893	(0.00)
ZZZ15615	5.6004	(0.00)	17.1172	(0.00)	16.8225	(0.00)
ZZZ15621	6.1254	(0.00)	19.2749	(0.00)	17.9213	(0.00)
ZZZ15622	5.6005	(0.00)	17.7296	(0.00)	17.5026	(0.00)
ZZZ15711	5.4637	(0.00)	17.4809	(0.00)	16.8207	(0.00)
ZZZ15712	5.2447	(0.00)	17.1387	(0.00)	16.8738	(0.00)
ZZZ15721	5.3951	(0.00)	17.3794	(0.00)	16.7568	(0.00)
ZZZ15811	5.4440	(0.00)	17.3618	(0.00)	16.8107	(0.00)
ZZZ15821	4.9018	(0.00)	16.8608	(0.00)	16.2803	(0.00)
ZZZ15831	5.7849	(0.00)	18.4163	(0.00)	18.0628	(0.00)
ZZZ15841	5.7056	(0.00)	16.8855	(0.00)	16.4035	(0.00)
ZZZ15842	5.1935	(0.00)	16.3219	(0.00)	15.8935	(0.00)
ZZZ15851	5.5387	(0.00)	16.8406	(0.00)	16.4719	(0.00)
ZZZ15861	5.4456	(0.00)	17.0832	(0.00)	16.3819	(0.00)
ZZZ15871	5.0643	(0.00)	16.5545	(0.00)	15.9921	(0.00)
ZZZ15872	5.3957	(0.00)	16.9257	(0.00)	16.2638	(0.00)
ZZZ15881	4.9994	(0.00)	16.5200	(0.00)	16.0109	(0.00)
ZZZ15891	5.0494	(0.00)	16.5790	(0.00)	16.1335	(0.00)
ZZZ15892	4.9665	(0.00)	16.3781	(0.00)	15.8829	(0.00)
ZZZ15911	5.8154	(0.00)	18.5834	(0.00)	18.2970	(0.00)
ZZZ15921	5.8060	(0.00)	18.5099	(0.00)	17.9054	(0.00)
ZZZ15951	3.1793	(0.00)	15.3762	(0.00)	15.7080	(0.00)
ZZZ15961	5.5274	(0.00)	18.9594	(0.00)	18.8009	(0.00)
ZZZ15971	6.4945	(0.00)	21.0223	(0.00)	19.1293	(0.00)
ZZZ15981	5.7716	(0.00)	17.5537	(0.00)	17.2991	(0.00)

TableC.5. The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacturer of food product and beverage (ISIC 15)

ISIC17	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model Eq.(6)		4 Factor model Eq.(7)	
	Coefficient	p-value	coefficient	p-value	coefficient	p-value
ZZZ17102	5.8302	(0.00)	19.1777	(0.00)	19.2348	(0.00)
ZZZ17103	5.2807	(0.00)	19.1763	(0.00)	18.6307	(0.00)
ZZZ17104	5.6476	(0.00)	19.4439	(0.00)	19.0954	(0.00)
ZZZ17105	5.7333	(0.00)	19.4961	(0.00)	19.0781	(0.00)
ZZZ17106	6.0515	(0.00)	19.3155	(0.00)	19.1685	(0.00)
ZZZ17201	5.2743	(0.00)	18.7610	(0.00)	18.7717	(0.00)
ZZZ17202	5.2799	(0.00)	18.8577	(0.00)	18.6565	(0.00)
ZZZ17203	5.5714	(0.00)	19.2624	(0.00)	18.8882	(0.00)
ZZZ17204	5.1956	(0.00)	18.9403	(0.00)	18.5583	(0.00)
ZZZ17301	5.9253	(0.00)	19.7689	(0.00)	19.7007	(0.00)
ZZZ17302	5.8751	(0.00)	19.7378	(0.00)	19.6231	(0.00)
ZZZ17303	6.0574	(0.00)	20.0418	(0.00)	19.7943	(0.00)
ZZZ17304	5.7870	(0.00)	19.8562	(0.00)	19.6515	(0.00)
ZZZ17401	5.3623	(0.00)	19.0070	(0.00)	18.7396	(0.00)
ZZZ17402	4.9712	(0.00)	18.5926	(0.00)	18.3922	(0.00)
ZZZ17511	5.9911	(0.00)	17.7343	(0.00)	16.4289	(0.00)
ZZZ17521	4.9552	(0.00)	18.4827	(0.00)	17.9812	(0.00)
ZZZ17522	5.8736	(0.00)	17.4174	(0.00)	16.5481	(0.00)
ZZZ17531	5.5124	(0.00)	19.1502	(0.00)	19.5533	(0.00)
ZZZ17541	5.6850	(0.00)	19.3414	(0.00)	19.2061	(0.00)
ZZZ17543	5.8708	(0.00)	19.4440	(0.00)	19.2970	(0.00)
ZZZ17601	5.5460	(0.00)	19.3045	(0.00)	18.8935	(0.00)
ZZZ17711	5.4263	(0.00)	19.1731	(0.00)	18.9836	(0.00)
ZZZ17721	6.1062	(0.00)	19.6889	(0.00)	19.4651	(0.00)

TableC.6. The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacture of textiles (ISIC 17)

ISIC 20-21	Value added/ Labor		Value added			
			2 Factor model Eq.(4-6)		4 Factor model Eq.(4-7)	
	coefficient	p-value	coefficient	p-value	coefficient	p-value
ZZZ20101	6.3869	(0.00)	21.7310	(0.00)	21.7336	(0.00)
ZZZ20102	6.5339	(0.00)	21.8061	(0.00)	21.7779	(0.00)
ZZZ20103	6.3836	(0.00)	21.7667	(0.00)	21.7711	(0.00)
ZZZ20104	5.9504	(0.00)	21.2167	(0.00)	21.2970	(0.00)
ZZZ20109	5.7786	(0.00)	21.1399	(0.00)	20.7966	(0.00)
ZZZ20201	6.0402	(0.00)	21.5416	(0.00)	21.6192	(0.00)
ZZZ20202	6.6118	(0.00)	22.1118	(0.00)	22.1150	(0.00)
ZZZ20301	6.2340	(0.00)	20.7622	(0.00)	20.9251	(0.00)
ZZZ20401	6.5765	(0.00)	21.6756	(0.00)	21.7855	(0.00)
ZZZ20511	6.1087	(0.00)	21.1693	(0.00)	21.2386	(0.00)
ZZZ20521	5.1550	(0.00)	20.1455	(0.00)	20.7093	(0.00)
ZZZ21111	7.0418	(0.00)	24.3379	(0.00)	24.5699	(0.00)
ZZZ21121	7.7185	(0.00)	24.9579	(0.00)	25.4922	(0.00)
ZZZ21122	7.0977	(0.00)	24.3164	(0.00)	24.7085	(0.00)
ZZZ21123	7.1059	(0.00)	24.3124	(0.00)	24.2324	(0.00)
ZZZ21125	7.1728	(0.00)	24.4187	(0.00)	24.8174	(0.00)
ZZZ21126	7.2000	(0.00)	24.5511	(0.00)	25.1003	(0.00)
ZZZ21211	7.2064	(0.00)	24.0106	(0.00)	24.4536	(0.00)
ZZZ21221	7.7593	(0.00)	24.7151	(0.00)	25.2186	(0.00)
ZZZ21231	7.7480	(0.00)	24.7566	(0.00)	25.2009	(0.00)
ZZZ21241	7.8752	(0.00)	24.9027	(0.00)	25.2680	(0.00)
ZZZ21251	7.2435	(0.00)	24.2001	(0.00)	24.5645	(0.00)

Dependent variables (spanning header over all coefficient columns)

TableC.7. The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacture of woods and paper products (ISIC 20-21)

ISIC 24	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model Eq.(4-6)		4 Factor model Eq.(4-7)	
	Coefficient	p-value	coefficient	p-value	coefficient	p-value
ZZZ24111	8.2964	(0.00)	21.0083	(0.00)	23.0903	(0.00)
ZZZ24121	8.7265	(0.00)	21.1357	(0.00)	23.0992	(0.00)
ZZZ24122	8.3260	(0.00)	21.0667	(0.00)	23.1517	(0.00)
ZZZ24131	8.1977	(0.00)	20.8947	(0.00)	22.9648	(0.00)
ZZZ24132	8.4183	(0.00)	21.2545	(0.00)	23.3319	(0.00)
ZZZ24133	8.3730	(0.00)	21.0401	(0.00)	23.1715	(0.00)
ZZZ24134	8.6221	(0.00)	21.3074	(0.00)	23.4795	(0.00)
ZZZ24135	7.4110	(0.00)	20.1719	(0.00)	22.2793	(0.00)
ZZZ24141	8.5001	(0.00)	21.0979	(0.00)	22.9276	(0.00)
ZZZ24142	7.7458	(0.00)	20.4881	(0.00)	22.5901	(0.00)
ZZZ24143	8.3597	(0.00)	21.3327	(0.00)	23.5410	(0.00)
ZZZ24144	8.0909	(0.00)	21.0682	(0.00)	23.2563	(0.00)
ZZZ24145	8.4425	(0.00)	21.3800	(0.00)	23.5007	(0.00)
ZZZ24146	7.9139	(0.00)	20.5148	(0.00)	22.5611	(0.00)
ZZZ24147	7.5502	(0.00)	20.5885	(0.00)	22.7108	(0.00)
ZZZ24151	8.4708	(0.00)	20.6973	(0.00)	23.0280	(0.00)
ZZZ24152	9.2708	(0.00)	21.7225	(0.00)	23.7442	(0.00)
ZZZ24153	8.9961	(0.00)	21.4995	(0.00)	23.5643	(0.00)
ZZZ24154	8.4997	(0.00)	20.8401	(0.00)	23.4786	(0.00)
ZZZ24155	8.4386	(0.00)	21.0812	(0.00)	23.0661	(0.00)
ZZZ24156	8.2091	(0.00)	20.8065	(0.00)	22.9296	(0.00)
ZZZ24158	8.6414	(0.00)	21.1972	(0.00)	23.3474	(0.00)
ZZZ24161	7.8104	(0.00)	20.9075	(0.00)	23.2254	(0.00)
ZZZ24162	8.2692	(0.00)	21.4041	(0.00)	23.4153	(0.00)
ZZZ24164	9.7686	(0.00)	22.8344	(0.00)	24.7751	(0.00)
ZZZ24165	8.0327	(0.00)	21.0984	(0.00)	23.1647	(0.00)
ZZZ24166	8.0951	(0.00)	21.0025	(0.00)	23.2881	(0.00)
ZZZ24171	7.8424	(0.00)	20.8275	(0.00)	22.6783	(0.00)
ZZZ24201	8.7820	(0.00)	21.5872	(0.00)	24.0145	(0.00)
ZZZ24301	8.5282	(0.00)	21.1364	(0.00)	23.1733	(0.00)
ZZZ24302	8.3439	(0.00)	20.9845	(0.00)	23.0121	(0.00)
ZZZ24411	8.2118	(0.00)	21.3400	(0.00)	23.4335	(0.00)
ZZZ24412	9.3014	(0.00)	22.3083	(0.00)	24.3277	(0.00)
ZZZ24414	8.0588	(0.00)	21.1849	(0.00)	23.3943	(0.00)
ZZZ24415	8.5905	(0.00)	21.6887	(0.00)	23.7185	(0.00)
ZZZ24416	8.1646	(0.00)	21.2274	(0.00)	23.2072	(0.00)
ZZZ24421	8.5508	(0.00)	21.6773	(0.00)	23.7247	(0.00)
ZZZ24422	8.0487	(0.00)	21.1780	(0.00)	23.2132	(0.00)
ZZZ24512	6.5792	(0.00)	19.3400	(0.00)	21.0323	(0.00)
ZZZ24513	6.5977	(0.00)	19.5425	(0.00)	21.2360	(0.00)
ZZZ24514	7.3397	(0.00)	20.1091	(0.00)	21.8857	(0.00)
ZZZ24521	6.7513	(0.00)	19.6009	(0.00)	21.2996	(0.00)
ZZZ24611	7.6962	(0.00)	20.6144	(0.00)	22.8593	(0.00)
ZZZ24621	8.3154	(0.00)	21.0357	(0.00)	22.9093	(0.00)
ZZZ24631	8.1425	(0.00)	20.7945	(0.00)	22.9836	(0.00)
ZZZ24651	7.8074	(0.00)	20.8501	(0.00)	22.9389	(0.00)
ZZZ24661	6.5630	(0.00)	19.9420	(0.00)	22.0936	(0.00)
ZZZ24663	8.6228	(0.00)	21.3669	(0.00)	23.7938	(0.00)
ZZZ24664	7.9885	(0.00)	20.8796	(0.00)	22.7467	(0.00)
ZZZ24701	8.5494	(0.00)	22.5454	(0.00)	24.2688	(0.00)

TableC.8. The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacture of chemical product (ISIC 24)

Industry dummy variables	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model (4-6)		4 Factor model (4-7)	
	Coefficient	p-value	Coefficient	p-value	coefficient	p-value
ZZZ26111	6.2443	(0.00)	17.6185	(0.00)	17.0222	(0.00)
ZZZ26121	5.6286	(0.00)	17.1717	(0.00)	16.7275	(0.00)
ZZZ26131	5.6804	(0.00)	17.2873	(0.00)	16.8872	(0.00)
ZZZ26141	5.6951	(0.00)	17.0639	(0.00)	16.6589	(0.00)
ZZZ26151	5.6813	(0.00)	17.1153	(0.00)	16.9200	(0.00)
ZZZ26152	5.5662	(0.00)	16.9908	(0.00)	17.3149	(0.00)
ZZZ26211	4.8376	(0.00)	16.1851	(0.00)	15.6088	(0.00)
ZZZ26221	5.1974	(0.00)	16.6206	(0.00)	16.1485	(0.00)
ZZZ26231	4.5719	(0.00)	15.7582	(0.00)	15.3585	(0.00)
ZZZ26241	4.9698	(0.00)	16.2612	(0.00)	15.3347	(0.00)
ZZZ26251	4.8696	(0.00)	16.1407	(0.00)	15.4699	(0.00)
ZZZ26261	5.3026	(0.00)	16.6202	(0.00)	15.9166	(0.00)
ZZZ26301	4.9731	(0.00)	16.1704	(0.00)	15.1202	(0.00)
ZZZ26401	4.1156	(0.00)	15.0368	(0.00)	14.2603	(0.00)
ZZZ26511	4.8682	(0.00)	16.1213	(0.00)	15.3928	(0.00)
ZZZ26521	5.0035	(0.00)	16.2396	(0.00)	15.5447	(0.00)
ZZZ26531	5.8508	(0.00)	17.1087	(0.00)	16.3020	(0.00)
ZZZ26611	4.8302	(0.00)	16.0173	(0.00)	15.3446	(0.00)
ZZZ26612	4.9966	(0.00)	16.2030	(0.00)	15.5111	(0.00)
ZZZ26621	4.6487	(0.00)	15.7797	(0.00)	15.2488	(0.00)
ZZZ26631	5.2969	(0.00)	16.5099	(0.00)	15.7886	(0.00)
ZZZ26651	5.3449	(0.00)	16.3446	(0.00)	16.3112	(0.00)
ZZZ26661	5.0007	(0.00)	16.1595	(0.00)	15.4396	(0.00)
ZZZ26701	4.9879	(0.00)	15.9921	(0.00)	15.4358	(0.00)
ZZZ26811	5.6258	(0.00)	16.8307	(0.00)	16.1792	(0.00)
ZZZ26821	6.2351	(0.00)	17.5351	(0.00)	16.9093	(0.00)

TableC.9. The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacture of non-metallic products (ISIC

ISIC 27-28	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model (4-6)		4 Factor model (4-7)	
	coefficient	p-value	Coefficient	p-value	coefficient	p-value
ZZZ27101	6.7423	(0.00)	19.2794	(0.00)	18.6960	(0.00)
ZZZ27102	5.9836	(0.00)	18.5258	(0.00)	17.9119	(0.00)
ZZZ27104	6.0424	(0.00)	18.6057	(0.00)	17.9800	(0.00)
ZZZ27105	5.9903	(0.00)	18.5118	(0.00)	17.7115	(0.00)
ZZZ27106	6.3491	(0.00)	18.7694	(0.00)	18.2897	(0.00)
ZZZ27107	6.0044	(0.00)	18.4392	(0.00)	17.7903	(0.00)
ZZZ27109	6.2253	(0.00)	18.6794	(0.00)	17.7312	(0.00)
ZZZ27211	5.6711	(0.00)	18.2215	(0.00)	17.7057	(0.00)
ZZZ27212	5.7123	(0.00)	18.2501	(0.00)	17.6960	(0.00)
ZZZ27221	6.2777	(0.00)	18.8250	(0.00)	18.1629	(0.00)
ZZZ27222	5.8071	(0.00)	18.3862	(0.00)	17.7281	(0.00)
ZZZ27311	6.3722	(0.00)	18.8744	(0.00)	18.3601	(0.00)
ZZZ27312	6.3942	(0.00)	18.8268	(0.00)	18.1163	(0.00)
ZZZ27313	6.3096	(0.00)	18.9126	(0.00)	18.3607	(0.00)
ZZZ27321	6.4397	(0.00)	18.9451	(0.00)	18.1105	(0.00)
ZZZ27331	5.7490	(0.00)	18.2601	(0.00)	17.6409	(0.00)
ZZZ27341	6.2882	(0.00)	18.8445	(0.00)	17.9819	(0.00)
ZZZ27355	6.9860	(0.00)	19.2649	(0.00)	18.6706	(0.00)
ZZZ27356	5.6266	(0.00)	18.1120	(0.00)	17.3020	(0.00)
ZZZ27357	5.4543	(0.00)	17.9427	(0.00)	17.1579	(0.00)
ZZZ27412	4.3271	(0.00)	16.4839	(0.00)	16.1866	(0.00)
ZZZ27415	6.5757	(0.00)	18.8928	(0.00)	18.6650	(0.00)
ZZZ27416	5.7620	(0.00)	18.0185	(0.00)	17.5056	(0.00)
ZZZ27421	5.7796	(0.00)	18.1257	(0.00)	17.7740	(0.00)
ZZZ27422	5.7808	(0.00)	18.2482	(0.00)	17.7676	(0.00)
ZZZ27431	5.6403	(0.00)	18.0333	(0.00)	17.7334	(0.00)
ZZZ27432	5.6383	(0.00)	18.0374	(0.00)	17.5750	(0.00)
ZZZ27442	5.9921	(0.00)	18.3814	(0.00)	17.9521	(0.00)
ZZZ27452	5.2804	(0.00)	17.7338	(0.00)	17.7471	(0.00)
ZZZ27453	5.8417	(0.00)	18.2114	(0.00)	17.7749	(0.00)
ZZZ27511	5.5384	(0.00)	17.8930	(0.00)	17.4923	(0.00)
ZZZ27521	5.7139	(0.00)	18.0665	(0.00)	17.5953	(0.00)
ZZZ27531	5.4496	(0.00)	17.8226	(0.00)	17.4343	(0.00)
ZZZ27541	5.7903	(0.00)	18.1932	(0.00)	17.7246	(0.00)

TableC.10. The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacture of basic metal (ISIC 27)

ISIC 27-28	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model (4-6)		4 Factor model (4-7)	
	coefficient	p-value	Coefficient	p-value	Coefficient	p-value
ZZZ28111	6.2845	(0.00)	19.0336	(0.00)	17.9740	(0.00)
ZZZ28112	5.6881	(0.00)	18.2997	(0.00)	17.5488	(0.00)
ZZZ28119	5.9925	(0.00)	18.6117	(0.00)	17.7596	(0.00)
ZZZ28121	5.7380	(0.00)	18.3395	(0.00)	17.5839	(0.00)
ZZZ28211	5.7847	(0.00)	18.5900	(0.00)	18.0068	(0.00)
ZZZ28219	5.5924	(0.00)	18.2993	(0.00)	17.6440	(0.00)
ZZZ28221	6.2288	(0.00)	19.0619	(0.00)	18.5928	(0.00)
ZZZ28229	6.0644	(0.00)	18.7584	(0.00)	18.0037	(0.00)
ZZZ28301	5.9827	(0.00)	18.9576	(0.00)	18.0234	(0.00)
ZZZ28401	5.7158	(0.00)	18.0914	(0.00)	17.4726	(0.00)
ZZZ28511	5.5767	(0.00)	18.0453	(0.00)	17.4581	(0.00)
ZZZ28512	5.5398	(0.00)	17.9597	(0.00)	17.3777	(0.00)
ZZZ28521	5.6571	(0.00)	18.0865	(0.00)	17.3996	(0.00)
ZZZ28611	5.0559	(0.00)	17.4978	(0.00)	16.8985	(0.00)
ZZZ28621	5.4330	(0.00)	17.7434	(0.00)	17.0791	(0.00)
ZZZ28622	5.1853	(0.00)	17.5897	(0.00)	16.9116	(0.00)
ZZZ28623	5.5294	(0.00)	18.0134	(0.00)	17.6206	(0.00)
ZZZ28624	4.7145	(0.00)	16.9821	(0.00)	16.5881	(0.00)
ZZZ28625	5.3278	(0.00)	17.7727	(0.00)	17.0412	(0.00)
ZZZ28631	5.1247	(0.00)	17.6395	(0.00)	16.9920	(0.00)
ZZZ28711	5.7401	(0.00)	18.2291	(0.00)	17.6085	(0.00)
ZZZ28721	5.7463	(0.00)	18.2904	(0.00)	17.8067	(0.00)
ZZZ28722	5.9039	(0.00)	18.3859	(0.00)	17.8960	(0.00)
ZZZ28731	6.0315	(0.00)	18.4755	(0.00)	17.9711	(0.00)
ZZZ28741	5.8123	(0.00)	18.2830	(0.00)	17.7930	(0.00)
ZZZ28742	5.3762	(0.00)	17.8723	(0.00)	17.4589	(0.00)
ZZZ28751	5.7630	(0.00)	18.2851	(0.00)	17.8326	(0.00)
ZZZ28752	5.6450	(0.00)	18.1301	(0.00)	17.5736	(0.00)

TableC.11. The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacture of fabricated metal (ISIC 28)

ISIC 29	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model (4-6)		4 Factor model (4-7)	
	coefficient	p-value	Coefficient	p-value	coefficient	p-value
ZZZ29111	3.4654	(0.10)	14.7187	(0.00)	12.0777	(0.00)
ZZZ29121	1.9325	(0.30)	13.9171	(0.00)	9.8534	(0.00)
ZZZ29122	2.4117	(0.18)	14.3204	(0.00)	10.3759	(0.00)
ZZZ29123	2.1587	(0.24)	14.0075	(0.00)	9.9771	(0.00)
ZZZ29124	2.2053	(0.23)	14.0164	(0.00)	9.9522	(0.00)
ZZZ29129	2.9158	(0.11)	14.5999	(0.00)	10.5614	(0.00)
ZZZ29131	2.4948	(0.17)	14.2215	(0.00)	10.5003	(0.00)
ZZZ29132	2.6278	(0.15)	14.6198	(0.00)	10.4248	(0.00)
ZZZ29141	2.7458	(0.15)	14.7703	(0.00)	10.3759	(0.00)
ZZZ29142	1.9022	(0.31)	13.6175	(0.00)	9.8130	(0.00)
ZZZ29143	2.2715	(0.21)	14.1458	(0.00)	10.0363	(0.00)
ZZZ29211	2.2061	(0.22)	13.3396	(0.00)	9.7391	(0.00)
ZZZ29219	1.6287	(0.38)	12.8639	(0.00)	8.7214	(0.00)
ZZZ29221	2.6322	(0.14)	14.3900	(0.00)	10.1386	(0.00)
ZZZ29229	2.6783	(0.15)	14.4317	(0.00)	10.2615	(0.00)
ZZZ29231	2.6324	(0.14)	14.4910	(0.00)	10.4313	(0.00)
ZZZ29232	2.1661	(0.23)	14.0625	(0.00)	9.7396	(0.00)
ZZZ29233	2.4607	(0.17)	14.3122	(0.00)	10.2577	(0.00)
ZZZ29239	2.6400	(0.15)	14.4116	(0.00)	10.3900	(0.00)
ZZZ29241	2.2048	(0.23)	13.9621	(0.00)	10.0493	(0.00)
ZZZ29242	2.6837	(0.14)	14.4489	(0.00)	10.2561	(0.00)
ZZZ29243	1.7528	(0.36)	13.6111	(0.00)	9.2359	(0.00)
ZZZ29244	2.4021	(0.20)	14.1916	(0.00)	10.1397	(0.00)
ZZZ29245	2.3194	(0.20)	14.1962	(0.00)	10.1441	(0.00)
ZZZ29247	2.6908	(0.15)	14.4157	(0.00)	10.3347	(0.00)
ZZZ29249	2.5315	(0.16)	14.4176	(0.00)	10.2670	(0.00)
ZZZ29252	1.4739	(0.42)	12.7421	(0.00)	8.8658	(0.00)
ZZZ29311	1.3504	(0.44)	12.5678	(0.00)	9.4017	(0.00)
ZZZ29312	1.2535	(0.48)	12.4346	(0.00)	9.1746	(0.00)
ZZZ29319	2.1642	(0.22)	13.3034	(0.00)	9.9183	(0.00)
ZZZ29321	1.4044	(0.40)	12.6195	(0.00)	9.4838	(0.00)
ZZZ29322	1.5881	(0.38)	12.9970	(0.00)	9.4585	(0.00)
ZZZ29323	1.3202	(0.47)	12.6963	(0.00)	9.2069	(0.00)
ZZZ29325	2.8497	(0.11)	13.9358	(0.00)	11.0097	(0.00)
ZZZ29326	2.6565	(0.12)	13.9627	(0.00)	10.6534	(0.00)
ZZZ29327	1.8045	(0.29)	13.1606	(0.00)	9.7884	(0.00)
ZZZ29329	1.1639	(0.50)	12.4058	(0.00)	9.1852	(0.00)
ZZZ29401	2.8465	(0.03)	13.8718	(0.00)	10.9611	(0.00)
ZZZ29402	2.9850	(0.01)	14.1100	(0.00)	11.0373	(0.00)
ZZZ29403	3.2602	(0.01)	14.2960	(0.00)	11.5111	(0.00)
ZZZ29404	2.6264	(0.03)	13.6829	(0.00)	10.8476	(0.00)
ZZZ29405	4.1285	(0.00)	14.8952	(0.00)	12.5850	(0.00)
ZZZ29406	3.9080	(0.00)	14.9912	(0.00)	12.0933	(0.00)
ZZZ29407	3.4521	(0.00)	14.4758	(0.00)	11.7192	(0.00)
ZZZ29409	2.4545	(0.03)	13.4107	(0.00)	10.6109	(0.00)

TableC.12. The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacture of general machinery (ISIC 29)

Industry dummy variables	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model (4-6)		4 Factor model (4-7)	
	coefficient	p-value	Coefficient	p-value	Coefficient	p-value
ZZZ29511	3.4556	(0.03)	14.7929	(0.00)	11.4782	(0.00)
ZZZ29519	2.3448	(0.15)	13.8268	(0.00)	10.5426	(0.00)
ZZZ29521	2.4067	(0.19)	13.7190	(0.00)	10.0325	(0.00)
ZZZ29523	3.0826	(0.10)	14.2181	(0.00)	10.5417	(0.00)
ZZZ29524	2.2574	(0.21)	13.4580	(0.00)	9.5479	(0.00)
ZZZ29526	2.1292	(0.24)	13.4072	(0.00)	9.5122	(0.00)
ZZZ29529	1.9899	(0.29)	13.1067	(0.00)	9.1219	(0.00)
ZZZ29531	2.4444	(0.17)	13.8870	(0.00)	10.0752	(0.00)
ZZZ29532	2.2683	(0.21)	13.7032	(0.00)	9.8411	(0.00)
ZZZ29539	2.9869	(0.10)	14.5121	(0.00)	10.5870	(0.00)
ZZZ29541	2.0870	(0.26)	13.8139	(0.00)	10.2081	(0.00)
ZZZ29542	1.8702	(0.31)	13.6896	(0.00)	9.9883	(0.00)
ZZZ29543	1.9999	(0.29)	13.6946	(0.00)	10.2501	(0.00)
ZZZ29544	1.9724	(0.28)	13.6912	(0.00)	9.8998	(0.00)
ZZZ29545	2.7042	(0.16)	14.4182	(0.00)	10.8812	(0.00)
ZZZ29551	1.8483	(0.31)	13.2930	(0.00)	9.3871	(0.00)
ZZZ29559	1.4190	(0.44)	12.9775	(0.00)	8.9079	(0.00)
ZZZ29561	2.1929	(0.23)	13.6819	(0.00)	9.7073	(0.00)
ZZZ29562	2.1397	(0.23)	13.5629	(0.00)	9.6939	(0.00)
ZZZ29569	1.6185	(0.37)	13.1903	(0.00)	9.2114	(0.00)
ZZZ29601	1.6783	(0.36)	13.2610	(0.00)	9.3233	(0.00)
ZZZ29711	0.6794	(0.75)	12.0209	(0.00)	9.2397	(0.00)
ZZZ29712	0.7525	(0.72)	12.0313	(0.00)	9.3656	(0.00)
ZZZ29713	1.2194	(0.57)	12.5326	(0.00)	9.6779	(0.00)
ZZZ29721	0.9173	(0.67)	12.1833	(0.00)	9.5652	(0.00)
ZZZ29722	1.1388	(0.59)	12.4251	(0.00)	9.5980	(0.00)

TableC.13. (Continue from A3.12). The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacture of general machinery (ISIC 29: continue)

Industry dummy variables	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model (4-6)		4 Factor model (4-7)	
	coefficient	p-value	Coefficient	p-value	Coefficient	p-value
ZZZ30011	0.6164	(0.38)	2.8699	(0.00)	2.5618	(0.00)
ZZZ30012	0.4671	(0.60)	2.5654	(0.00)	3.0213	(0.00)
ZZZ30021	0.7719	(0.13)	2.9866	(0.00)	3.1109	(0.00)
ZZZ30029	0.8447	(0.34)	3.1706	(0.00)	3.4085	(0.00)
ZZZ31101	1.1962	(0.02)	4.6250	(0.00)	4.6696	(0.00)
ZZZ31102	0.5197	(0.31)	4.1492	(0.00)	4.3633	(0.00)
ZZZ31103	0.8206	(0.16)	4.3460	(0.00)	4.3801	(0.00)
ZZZ31104	1.2752	(0.01)	4.8860	(0.00)	5.0802	(0.00)
ZZZ31105	1.2933	(0.01)	4.8672	(0.00)	5.0657	(0.00)
ZZZ31106	1.0474	(0.03)	4.5965	(0.00)	4.7616	(0.00)
ZZZ31109	1.3689	(0.01)	4.8724	(0.00)	5.2092	(0.00)
ZZZ31201	1.3342	(0.00)	4.7417	(0.00)	4.9698	(0.00)
ZZZ31202	0.5049	(0.28)	3.7914	(0.00)	4.0422	(0.00)
ZZZ31203	0.8143	(0.09)	4.1937	(0.00)	4.2479	(0.00)
ZZZ31204	0.8780	(0.07)	4.2211	(0.00)	4.3565	(0.00)
ZZZ31209	1.8776	(0.04)	5.0378	(0.00)	5.2045	(0.00)
ZZZ31301	1.3949	(0.00)	4.5672	(0.00)	4.3357	(0.00)
ZZZ31401	2.8116	(0.25)	16.0386	(0.00)	15.4581	(0.00)
ZZZ31402	2.4378	(0.32)	15.6908	(0.00)	15.2944	(0.00)
ZZZ31403	2.1563	(0.40)	15.2570	(0.00)	14.7300	(0.00)
ZZZ31501	-0.4091	(0.55)	1.1568	(0.09)	1.2920	(0.08)
ZZZ31502	0.3753	(0.52)	1.8586	(0.00)	1.9101	(0.00)
ZZZ31503	-0.1964	(0.75)	1.2996	(0.03)	1.4042	(0.04)
ZZZ31504	-0.3720	(0.58)	1.2036	(0.08)	1.4149	(0.06)
ZZZ31611	-0.5374	(0.49)	1.3124	(0.10)	1.3376	(0.12)
ZZZ31612	-0.0086	(0.99)	1.9387	(0.00)	2.2186	(0.00)
ZZZ31621	0.2524	(0.66)	2.1349	(0.00)	2.3305	(0.00)
ZZZ32101	-0.1242	(0.86)	1.6508	(0.02)	1.7220	(0.03)
ZZZ32102	0.0065	(0.99)	1.8449	(0.02)	1.9996	(0.02)
ZZZ32103	-0.5981	(0.47)	1.3801	(0.09)	1.5477	(0.08)
ZZZ32104	-1.7084	(0.04)	0.2007	(0.81)	0.2427	(0.78)
ZZZ32106	0.1381	(0.85)	1.8115	(0.01)	1.8606	(0.02)
ZZZ32107	-0.5339	(0.44)	1.2992	(0.06)	1.4534	(0.06)
ZZZ32108	-0.0374	(0.96)	1.4587	(0.07)	1.5051	(0.08)
ZZZ32201	0.6007	(0.43)	1.5259	(0.04)	1.7998	(0.03)
ZZZ32202	-0.4578	(0.54)	0.4577	(0.54)	0.9371	(0.24)
ZZZ32203	-0.5704	(0.45)	0.3286	(0.66)	0.6379	(0.43)
ZZZ32301	-0.2741	(0.74)	1.2294	(0.14)	1.0961	(0.23)
ZZZ32302	0.0193	(0.98)	0.9539	(0.28)	1.2550	(0.19)
ZZZ32303	0.1579	(0.83)	1.4542	(0.06)	1.7671	(0.04)
ZZZ32304	-1.1011	(0.15)	0.1538	(0.84)	0.1884	(0.82)
ZZZ32305	-0.8271	(0.25)	0.3794	(0.59)	0.6317	(0.42)
ZZZ32309	-0.4002	(0.65)	0.9019	(0.31)	1.5066	(0.11)

TableC.14. The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacture of electrical machinery and precious instruments (ISIC 30-33)

Industry dummy variables	Dependent variables					
	Value added/ Labor		Value added			
			2 Factor model (4-6)		4 Factor model (4-7)	
	coefficient	p-value	Coefficient	p-value	Coefficient	p-value
ZZZ33101	0.5372	(0.25)	2.9710	(0.00)	3.1654	(0.00)
ZZZ33102	0.0711	(0.91)	2.4673	(0.00)	2.7283	(0.00)
ZZZ33109	1.1749	(0.19)	3.6940	(0.00)	3.8472	(0.00)
ZZZ33203	-0.8038	(0.37)	1.7654	(0.05)	2.4184	(0.01)
ZZZ33204	1.1172	(0.11)	3.4079	(0.00)	3.8372	(0.00)
ZZZ33206	0.0448	(0.96)	2.4821	(0.01)	2.9469	(0.00)
ZZZ33208	0.8076	(0.37)	3.1176	(0.00)	3.3277	(0.00)
ZZZ33209	2.9213	(0.00)	5.4652	(0.00)	6.0113	(0.00)
ZZZ33301	1.4794	(0.03)	4.3496	(0.00)	4.7239	(0.00)
ZZZ33402	0.9185	(0.13)	1.2125	(0.05)	1.1254	(0.07)
ZZZ33403	0.3969	(0.45)	0.5139	(0.34)	0.4677	(0.39)
ZZZ33501	0.2761	(0.59)	0.2385	(0.64)	0.1914	(0.72)

TableC.15. (continue from C.14) The result from regression Eq. 4-6 to Eq. 4-7 on industry dummy variables for manufacture of electrical machinery and precious instruments (ISIC 30-33: continue)

C.4. Matching between ISIC 4 digits and IO 180*180 code

The following table revealed the matching between ISIC 4 digits code classification (National statistic organization) with IO 180*180 Table (NESDB).

ISIC 4 digit code		IO 180*180	ISIC 4 digit code		IO 180*180
1511	----------	42-43	2310-2320	--------------	93-94
1520	----------	44	2519	--------------	95-97
1513	----------	45	2511	--------------	96
1512	----------	46	2520	--------------	98
1514	----------	47-48	2692	--------------	99
1531	----------	49	2610-2691	--------------	100
1532	----------	50-52	2693	--------------	101
1541	----------	53	2694	--------------	102
1544	----------	54	2695	--------------	103
1542	----------	55	2696-2699	--------------	104
1543	----------	56	2710	--------------	105
1549	----------	57-60	2720-2731	--------------	106
1533	----------	61	2732	--------------	107
1551-1553	----------	62-63	2893-2922	--------------	108
1554	----------	64	2899	--------------	109
1600	----------	65-66	2811-2813	--------------	110
1711	----------	67-68	2891-2892	--------------	111
1712	----------	69	2911	--------------	112
1721	----------	70	2921	--------------	113
1730	----------	71	2923	--------------	114
1729-1810	----------	72	2912-2919,2924-2929	--------------	115
1722	----------	73	3000	--------------	116
1723	----------	74	3110-3120,3313	--------------	117
1820-1911	----------	75	3210-3230	--------------	118
1912	----------	76	2930	--------------	119
1920	----------	77	3130	--------------	120
2010	----------	78	3140	--------------	121
2023-2029	----------	79	3150-3190	--------------	122
2021-2022,3610	----------	80	3511-3512	--------------	123
2101-2102	----------	81	3520	--------------	124
2109	----------	82	3410-3430	--------------	125
2211-2230	----------	83	3591-3599	--------------	126
2411	----------	84	3530	--------------	128
2412-2421	----------	85	3311-3312	--------------	129
2413	----------	86	3320	--------------	130
2422	----------	87	3330	--------------	131
2423	----------	88	3691	--------------	132
2424	----------	89-90	3692-3693	--------------	133
2429-2430	----------	91-92	3694	--------------	134

TableC.16. The matching between ISIC 4 digit and 180*180 IO code

ISIC 4 digits	Industry description
1511	Production of meat and meat products
1512	Processing and preserving of fish and fish Products
1513	Processing of fruit and vegetables
1514	Manufacture of vegetable and animal oils and fats
1520	Manufacture of dairy products
1531	Manufacture of grain mill products
1532	Manufacture of starches and starch products
1533	Manufacture of prepared animal feeds
1541	Manufacture of bakery products
1542	Manufacture of sugar
1543	Manufacture of cocoa, chocolate and sugar confectionery
1544	Manufacture of macaroni, noodles, couscous and similar farinaceous products
1549	Manufacture of other food products n.e.c.
1551	Distilling, rectifying and blending of spirits; ethylalcohol production from fermented materials
1552	Manufacture of wines
1553	Manufacture of malt liquors and malt
1554	Manufacture of soft drinks; bottling of mineral waters
1600	Manufacture of tobacco products
1711	Preparation and spinning of textile fibres; weaving of textiles
1712	Finishing of textiles
1721	Manufacture of made-up textile articles, except apparel
1722	Manufacture of carpets and rugs
1723	Manufacture of cordage, rope, twine and netting
1729	Manufacture of other textiles n.e.c.
1730	Manufacture of knitted and crocheted fabrics and articles
1810	Manufacture of wearing apparel, except fur apparel
1820	Dressing and dyeing of fur; manufacture of articles of fur
1911	Tanning and dressing of leather
1912	Manufacture of luggage, handbags and the like, saddlery and harness
1920	Manufacture of footwear
2010	Sawmilling and planting of wood
2021	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board and other panels and boards
2022	Manufacture of builders' carpentry and joinery
2023	Manufacture of wooden containers
2029	Manufacture of other products of wood; manufacture of articles of cork, straw and painting materials
2101	Manufacture of pulp, paper and paperboard
2102	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
2109	Manufacture of other articles of paper and paperboard
2211	Publishing of books, brochures, musical books and other publications
2212	Publishing of newspapers, journals and periodicals
2213	Publishing of recorded media

ISIC 4 digits	Industry description
2219	Other publishing
2221	Printing
2222	Service activities related to printing
2230	Reproduction of recorded media
2310	Manufacture of coke oven products
2320	Manufacture of refined petroleum products
2330	Processing of nuclear fuel
2411	Manufacture of basic chemicals, except fertilizers nitrogen compounds
2412	Manufacture of fertilizers and nitrogen compounds
2413	Manufacture of plastics in primary forms and of nitrogen compounds synthetic rubber
2421	Manufacture of pesticides and other agro-chemical products
2422	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
2423	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
2424	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
2429	Manufacture of other chemical products n.e.c.
2430	Manufacture of man-made fibers
2511	Manufacture of rubber tires and tubes; retreading and rebuilding of rubber tyres
2519	Manufacture of other rubber products
2520	Manufacture of plastic products
2610	Manufacture of glass and glass products
2691	Manufacture of non-structural non-refractory ceramic ware
2692	Manufacture of refractory ceramic products
2693	Manufacture of structural non-refractory clay products
2694	Manufacture of cement, lime and plaster
2695	Manufacture of articles of concrete, cement and plaster
2696	Cutting, shaping and finishing of stone
2699	Manufacture of other non-metallic mineral products n.e.c.
2710	Manufacture of basic iron and steel
2720	Manufacture of basic precious and non-ferrous metals
2731	Casting of iron and steel
2732	Casting of non-ferrous metals
2811	Manufacture of structural metal products
2812	Manufacture of tanks, reservoirs and containers of metal
2813	Manufacture of steam generators, except central heating hot water boilers
2891	Forging, pressing, stamping and roll-forming of metal; powder metallurgy
2892	Treatment and coating of metals; general mechanical engineering on a fee or contract basis
2893	Manufacture of cutlery, hand tools and general hardware
2899	Manufacture of other fabricated metal products n.e.c.

ISIC 4 digits	Industry description
2911	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
2912	Manufacture of pumps, compressors, taps and valves
2914	Manufacture of ovens, furnaces and furnace burners
2915	Manufacture of lifting and handling equipment
2919	Manufacture of other general purpose machinery
2921	Manufacture of agricultural and forestry machinery
2922	Manufacture of machine-tools
2923	Manufacture of machinery for metallurgy
2924	Manufacture of machinery for mining, quarrying and construction
2925	Manufacture of machinery for food, beverage and tobacco processing
2926	Manufacture of machinery for textile, apparel and leather production
2927	Manufacture of weapons and ammunition
2929	Manufacture of other special purpose machinery
2930	Manufacture of domestic appliances n.e.c.
3000	Manufacture of office, accounting and computing machinery
3110	Manufacture of electric motors, generators and transformers
3120	Manufacture of electricity distribution and control apparatus
3140	Manufacture of accumulators, primary cells and primary batteries
3150	Manufacture of electric lamps
3190	Manufacture of other electrical equipment n.e.c.
3210	Manufacture of electronic valves and tubes and other electronic components
3220	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
3230	Manufacture of television and radio receivers and associated consumer goods
3311	Manufacture of medical and surgical equipment and or orthopedic appliances
3312	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
3313	Manufacture of industrial process control equipment
3320	Manufacture of optical instruments and photographic equipment
3330	Manufacture of watches and clocks
3410	Manufacture of motor vehicles
3420	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
3430	Manufacture of parts and accessories for motor vehicles and their engines
3511	Building and repairing of ships
3512	Building and repairing of pleasure and sporting boats
3520	Manufacture of railway and tramway locomotives and rolling stock
3530	Manufacture of aircraft and spacecraft
3591	Manufacture of motorcycles
3592	Manufacture of bicycles and invalid carriages

ISIC 4 digits	Industry description
3599	Manufacture of other transport equipment n.e.c.
3610	Manufacture of furniture
3691	Manufacture of jewelry and related articles
3692	Manufacture of musical instruments
3693	Manufacture of sports goods
3694	Manufacture of games and toys
3699	Other manufacturing n.e.c.
3710	Recycling of metal waste and scrap
3720	Recycling of non-metal waste and scrap

TableC.17. ISIC 4 digit classification, definition of each ISIC 4 digit industries

IO 180*180 code	Industry description	IO 180*180 code	Industry description
042	Slaughtering	106	Secondary Steel Products
043	Canning Preserving of Meat	107	Non-ferrous Metal
044	Dairy Products	108	Cutlery and Hand Tools
045	Canning of Fruits and Vegetables	109	Furniture and Fixtures Metal
046	Canning Preserving of Fish	110	Structural Metal Products
047	Coconut and Palm Oil	111	Other Fabricated Metal Products
048	Other Vegetable Animal Oils	112	Engines and Turbines
049	Rice Milling	113	Agricultural Machinery
050	Tapioca Milling	114	Wood and Metal Working Machinery
051	Drying and Grinding of Maize	115	Special Industrial Machinery
052	Flour and Other Grain Milling	116	Office and Household Machinery
055	Sugar	117	Electrical Industrial Machinery
053	Bakery Products	118	Radio and Television
054	Noodles and Similar Products	119	Household Electrical Appliances
056	Confectionery	120	Insulated Wire and Cable
057	Ice	121	Electric Accumulator & Battery
058	Monosodium Glutamate	122	Other Electrical Aparatuses & Supplies
059	Coffee and Tea Processing	125	Motor Vehicle
060	Other Food Products	126	Motorcycle, Bicycle & Other Carriages
061	Animal Feed	127	Repairing of Motor Vehicle
062	Distilling Blending Spirits	123	Ship Building
063	Breweries	124	Railway Equipment
064	Soft Drinks	128	Aircraft
065	Tobacco Processing	075	Tanneries Leather Finishing
066	Tobacco Products	076	Leather Products
067	Spinning	077	Footwear Except Rubber
068	Weaving	078	Saws Mills
069	Textile Bleaching and Finishing	079	Wood and Cork Products
070	Made-up Textile Goods	080	Furniture and Fixtures Wood
071	Knitting	129	Scientific Equipments
072	Wearing Apparels Except Footware	130	Photographic & Optical Goods
073	Carpets and Rugs	131	Watches and Clocks
074	Cordage Rope and Twine Products	132	Jewelry & Related Articles
081	Pulp Paper and Paperboard	133	Recreational and Athletic Equipment
082	Paper Products	134	Other Manufacturing Goods
083	Printing and Publishing		
084	Basic Industrial Chemicals		
086	Synthetic Resins and Plastics		
085	Fertilizer and Pesticides		
087	Paints Varnishes and Lacquers		
088	Drugs and Medicines		
089	Soap and Cleaning Preparations		
090	Cosmetics		
091	Matches		

IO 180*180 code	Industry description
092	Other Chemical Products
093	Petroleum Refineries
094	Other Petroleum Products
095	Rubber Sheets and Block Rubber
096	Tyres and Tubes
097	Other Rubber Products
098	Plastic Wares
102	Cement
103	Concrete and Cement Products
099	Caramic and Earthen Wares
100	Glass and Glass Products
101	Structural Clay Products
104	Other Non-metallic Products

TableC.18. 180*180 IO industry classifications, each industry definition

Appendix D

Appendix to Testing for Export Performance differential and FDI externalities on local export performance

D.1. Note on Sample Selection model.

As suggested by Anwar and Nguyen (2011), regressed export share of the plant with a set of control variables through simple OLS could potentially yield biased coefficients estimation because sample selection bias[41].

Rewrite both export intensity and export probability regression as following simplified term

$$Y_i^* = X_i\pi + u_i$$
$$Dex_i^* = Z_i\beta + v_i$$

With

$$Y_i = Y_i^* \quad if\ Dex_i = 1$$
$$Y_i = 0 \quad if\ Dex_i = 0$$

and

$$Dex_i = 1 \quad if\ \ Dex_i^* > 0$$
$$Dex_i = 0 \quad if\ Dex_i^* \leq 0$$

Where $Y_i^*$is the export ratio of the plant i while X_i is a vector of controlled variables. Dex_i^* is dichotomous variable 1 if plant export, 0 if plant does not export. Z_i is a vector of control variable as presented in equation 1. Equation (3) is perceived as stage 2 while equation (4) is classified as stage 1 when plant plan for their export strategies. As the previous studies, error terms in equation 3 and 4 are suspected to be related ($\rho \neq 0$). If $\rho \neq 0$, Kneller and Pisu (2007) interpreted that that two regressions are related; as, the unobservable(s) in equation (3) are related to the unobservable(s) in equation (4). Hence, the selection of observation to equation 3 is the not a random process, operating equation (3) alone could lead to biased coefficients' estimation. In order to avoid this problem, both equations must be

[41] For further technical information, reader are invited to explore the sample selection model in Green (2008), Woodridge (2002)

estimated through Heckman sample selection model. For more information, please see (Heckman 1979).

D.2. Further note on testing on firm's foreign exchange exposure

D.2.1. Review of empirical literatures

By employing a survey of derivative use by U.S. non-financial firms, and the information derived from firm's financial statements, (Bodnar 2001) found that the absolute value of foreign exchange exposure are between 0 and 1 which is relative low in most of the firms. This empirical finding is in line with the previous large no. of literatures which employs (Adler 1984) and (Adler 1984) 's framework in the previous section.

(Bodnar 1993) also found low level of exposure in Canada, Japan and United States[42], and they hypothesized that the insignificant results are due to (1) Offsetting the activities(operation hedge) which firms undertake to minimize the exposure (2) the use of financial derivative by the firms[43]. In their subsequent work, (Bodnar 1993)'s results are in line with most previous works; however there is one interesting aspect of the model, one period lagged changes in the foreign exchange variable are significant in explaining abnormal returns implying it does take time for investors to incorporate changes in exchange rate in stock prices. However, (He 1998) find little effect of lagged changes on the stock returns of Japanese MNCs.

(Carter, 2001 #75) further investigate this claim and they found strong evidence which presents that the MNCs are using both operation hedge and financial hedge to migrate from foreign exchange exposure. This immunity is the main explanation of the insignificant foreign exchange exposure of the firms in previous study. (Choi, 1995 #76) examine the exchange rate risk sensitivity of 409 U.S. foreign- invested firms during the 1978-1989, and their result is only a 15% of those firms with significant

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[42] Only 20% to 35% of industries in Canada, Japan, and the United States have significant exchange rate exposure.

[43] Both of this insignificant explanation is also derive by Dominguez and Tesar (2006)

exchange risk sensitivity. Apart from the low level of foreign exchange exposure in the previous mentioned studies, Dominguez and (Tesar, 2006 #73) with firms in 8 countries as their sample, found that considerable fraction of firms statistically expose to the foreign exchange risk, and firm accordingly adjust their behavior in response to this exchange rate risk.

Since this dissertation has focused on the performances of the plants or firms in the manufacturing industries, only listed firms in industrial sector and agriculture industries are analyzed in this paper. In the next section, we discussed the testing methodologies.

D.2.2. Methodologies, data and measurement

In basic CAPM, the expected rate of return on an investment is a function of the risk free rate plus a risk premium for the stock's systematic risk. Mathematically;

$$r_i = r_{rf} + \beta_i(r_m - r_{rf}) \qquad \text{(D-1)}$$

Where r_i is the rate of return for the i_{th} security, r_{rf} is the risk free rate of return, β_i is the beta of asset I (an asset with higher beta are more sensitive to the market than an asset with lower beta) and r_m is rate of return of market.

Then, with the manipulation of S6-1 and adding ε, we obtain

$$r_i - r_{rf} = \beta_i(r_m - r_{rf}) + \varepsilon_i \qquad \text{(D-2)}$$

Where $E[\varepsilon_i] = 0$, $Cov\,[r_m, \varepsilon_i] = 0$

The purpose of adding the ε_i is to represents the non-systematic component, while the term $\beta_i\,(r_m - r_{rf})$ reveals the systematic component of the difference between firm's rate of return and risk free rate of return.

From equation D-2 we can write

$$\underbrace{Var\,[r_i]}_{\text{Total exposure}} = \overbrace{\beta_i^2 Var[r_m]}^{\text{Systematic exposure}} + \overbrace{Var[\varepsilon_i]}^{\text{Non-Systematic exposure}} \qquad \text{(D-3)}$$

As illustrate in the above equation, systematic risk is only part of the firm's total exposure. If CAPM is the true model for asset pricing than the variability of firm's return must be explained by the variability of the market return (systematic exposure); hence the exchange rate exposure should be listed in non-systematic term, which its expected value is 0.

Under strong market efficiency, total rate of return of particular stock is calculated from the difference of the price of that stock at different time; hence we should further adapt the above CAPM to test for the relationship between the change in prices of share and change in exchange rate.

(Adler 1984): "exposure is a regression coefficient"

In (Adler 1984) estimate the exposure of an asset by regressing its domestic currency market price on the contemporaneous foreign exchange rate based on the following foundation. Let P is a local currency denominated price of a risky asset, and S = {S_1,....,S_n} is the vector of state variable, and S_i is in this vector.

$$Exposure\ of\ P\ to\ S_i = E\left(\frac{\partial p}{\partial S_i}\right)$$

Holding effect from other state variables constant, exposure of P to si could be defined as the current expectation across future states of nature of the partial sensitivity of P to Si. Let g(P) is the pricing of a contingent claim on P , then the exposure term could be defined as

$$E\left(\frac{\partial P}{\partial S}\right) = E\left\{\frac{\partial E[g(P)|S]}{\partial S}\right\} \qquad \text{(D-4)}$$

$$= \frac{cov[g(P), S]}{Var\ (S)}$$

and $$\mathrm{Cov}[g(p), S] = \mathrm{E}[g'(p)]\ \mathrm{Cov}(p,s) \qquad \text{(D-5)}$$

$$E\left(\frac{\partial P}{\partial S}\right) = E[g'(P)]\varphi_{p|s}$$

When P and S are jointly normal, this exposure becomes the partial regression coefficient of S_i in a linear regression of P on S, and $\varphi_{p|s}$ is the regression coefficient of P on S.

Assume that the pricing of contingent claim on P equals to the price of risk asset (P), hence $g'(P)$ equals to one. Then

$$E\left(\frac{\partial P}{\partial S}\right) = \varphi_{P|S}$$

Without doubt, the share of the firm is a risky asset to the shareholder, hence the stock price (P) is qualified to be tested by CAPM model, and (Adler 1984) has plug the exchange rate (π) as a state variable then we can derive the following regression.

Replacing state variable S with exchange rate π then

$$E\left(\frac{\partial P}{\partial \pi}\right) = \varphi_{P|\pi} \qquad \text{(D-6)}$$

Exposure of the price of particular share to exchange rate is captured by the term $\varphi_{P|\pi}$

With linear regression, the particular security price P_{it} is illustrated as

$$P_{it} = \alpha_i + \varphi_{P_i|\pi_t}\pi_t + \varepsilon_i \qquad \text{(D-7)}$$

To avoid the non stationary series, Later in (Adler 1984) 's work, he suggest using stock return and exchange rate changes in order to obtain the stationary series than equation A4-6 becomes.

$$R_{it} = \alpha_i + \varphi_i\hat{\pi}_t + \varepsilon_{it} \qquad \text{(D-8)}$$

Where R_{it} is the total return (change in stock price) of firm i in period t, and $\hat{\pi}_t$ is the change in exchange rate at time t, hence the coefficient φ_i represents foreign exchange rate exposure of firm i. Under efficient capital market, the exchange rate exposure φ_i express the overall effect of exchange rate risk on the value of the firms, which is now represented through firm's return.

The Adler regression model in equation D-8 could overestimate the degree of exposure because it does not control other macroeconomic factors which could affect the stock return, hence the foreign exchange exposure must be overestimated, (Jorion 1990) introduce the following model.

$$R_{it} = \alpha_i + \varphi_{1i}R_{mt} + \varphi_{2i}\hat{\pi}_t + \varepsilon_{it} \qquad \text{(D-9)}$$

Additionally, R_{mt} is the overall stock market return period t, and then φ_{1i} shows firm i' s return sensitivity to market risk (market beta). If CAPM were the true model for asset pricing, the coefficient on the change in exchange rate (φ_{2i}) should be statistically indifferent from zero which states the firm's total risk exposure should be explained by firm's systematic risk only. The significant of φ_{2i} imply that CAPM does not hold or the change in exchange rate can statistically affect the firm's return.

Even until now, (Jorion 1990)'s model has been widely used in to capture the foreign exchange exposure due to its simplicity. I would further discuss the choice of the variables of this (Jorion 1990)'s model at the end of this section.

Extending the base model

Since there are many factors which could explain the return of the firms, We further review the work conducted by (Wongbangpo P. and Sharma C. S., 2002 #100) work, their work particularly investigate the relationship of stock return and macroeconomic fundamental in ASEAN trading block. (Wongbangpo P. and Sharma C. S., 2002 #100) include the percentage change GNP, CPI, Money supply, nominal interest rate, market indices and exchange rate. I further enlarge the basic regression by augment change in GNP, % change in CPI, change in nominal interest rate, and percentage change in money supply; as a result the base (Jorion 1990) equation is enlarged to the following.

$$R_{it} = \alpha_i + \varphi_{1i}R_{mt} + \varphi_{2i}\hat{\pi}_t + \varphi_{3i}IPI_t + \varphi_{4i}CPI_t + \varphi_{5i}MLR_t + \varphi_{6i}\,MS + \varepsilon_{it} \qquad \text{(D-10)}$$

Where R_{it} is the return % of firm i in period t, and $\hat{\pi}_t$ is the percentage change in exchange rate at time t, hence the coefficient and R_{mt} is the overall stock market return period t, IPI_t is the change in industrial production index[44], CPI_t is the inflation rate, while MLR is change in minimum lending rate, and MS is change in narrowly defined money supply. The basic rational for the additional four variables is the linkage among markets, the goods market, and the money market. The inclusion of the goods market is necessary since Thailand has been considered as trade oriented nation [Wongbangpo P. and Sharma C. S., 2002 #100], hence change in IPI (change in industrial production index as proxy) and change in consumer price index are recognize in this new regression. Change in minimum lending rate and change in money supply could statistically influence the firm's stock performance as the main mechanism in money market; hence these two factors are included in the above equation.

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[44] Since the GNP data is not monthly published, the industrial production index is being used instead.

Since the model is retrieved from CAPM model, the marker price of the firms and panel data are required. Hence, we mainly adopt the firm level data from Stock exchange of Thailand, SET. The data description is presented in the first stage regression are mainly obtained from the information web portal of stock exchange of Thailand, and the bank of Thailand, the following table could explain source and type of data for the base model.

Based model			
Variable	Categories/Explanation	Interval	Source
R_{it}	Firm's market return (change in price)	Monthly	Setsmart.com
R_{mt}	Total market return (change in SET index)	Monthly	Setsmart.com
$\hat{\pi}_t$	Change in relevant exchange rate (US$)	Monthly	Setsmart.com
IPI_t	Change in industrial production index	Monthly	Bank of Thailand
CPI_t	CPI	Monthly	Bank of Thailand
MLR_t	Minimum lending rate	Monthly	Bank of Thailand
MS_t	% change in narrowly defined money supply	Monthly	Bank of Thailand.

TableD.1. Variable, interval and source of data in FX exposure testing

Each type of data would have 70 series, which encompassed monthly data from January 2005 till October 2010 regression testing. Most of the macro-economic data are obtained from the Bank of Thailand, while the SET smart web portal is the primary source of data for firm level data.

> Selecting a proxy for exchange rate: What exchange rate should be use as π_t?:

The specification of the exchange rate factor plays a significant role in the estimation of currency exposure. Replacing ex_t with a particular bilateral exchange rate[45] However this assumption is not agreed by most literatures, since there is heterogeneity across the firms in international trading and investment.

Trade weighted index exchange rate was used in many literature (for example, (Jorion 1990), (Bodnar 1993), (Amihud 1994), (Choi 1995) ; however as (Reuer 1998) stated that the use of nation trade weighted index exchange rate disregards the problem of low or even negative correlation among exchange over time, as a result,

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[45] The most frequently used bilateral exchange is the price of US dollar with respect to home currency.

a weighted index may underestimate the exposure, since a particular firm might have different pattern of their international activities from the norm (Tesar 2006)

Instead of using a single trade weighted index or single bilateral exchange rate, many of the researches introduce more currency to the equation (For example, H., 2003 #95, Miller and Reuer; 1998, and the frequently used criteria to recruit the relevant currency in the regression is based on nation's trading partner's currency.

(Christos 2004) found that the no. of firm with foreign exchange exposure increase as we include more currencies. Similarly (Reuer 1998) use factor analysis techniques to screen for firm's related exchange rate.

To make the index most relevant to the firms, ex_t should be replaced with firm's weighted exchange rate index, which is constructed from firm's international activities (Blenman L., 2006 #67), (Ihrig, 2001 #85) due to the availability of the information, this firm's specific index is not easily to be constructed. To find the unanticipated change in exchange rate Blenma, Lee and walker also suggest a trade weighted forward premium/discount, and ARIMA residual. However the availability of the data on activities of Thai listed firm's international is not accessible.

Another issue in selecting the exchange rate, due to the information asymmetric between the investor and firms, and there is the difficulty for the investor to interpret and compare the data from multitude disclosure methods (Hodder 1982), it take time for the investor to evaluate the relationship between exchange rate changes and firm future cash flows, and eventually firm value. These rational lead many authors to use the lagged variable in their model specification. Because of the failure of market efficiency in the capital market and the complexity of the relationship between exchange rate movement and firm value, the estimated exposure coefficient vary. However, not all of the produced result support this rational; for example, (He 1998) found that the inclusion of lagged exchange rate changes has no significant impact on the explanation power of the model.

To compare the result with the previous literature which has been constructed in Thailand, I hereby aim to construct firm's specific weighted exchange rate; however the main obstacle for this constructing of the index is the availability of the data. With the current disclosure of data set by SET, the firm's specific weighted exchange rate has not potential to be constructed. **US dollar exchange rate** is used as in the list of exchange rate variable; since, the nation trade weighted index might include the currencies which are irrelevance to the firms' trading structure, and this inclusion could lead to the underestimation of firm's foreign exchange exposure.

>Selecting a proxy for market index: Which index should be used to calculate R_{mt}?

Majority of the literature which I had reviewed use local stock index as the control variable in the main equation; however, (Tesar 2006) also try the international index as the proxy for market index, and they found that the no. of firm with significant foreign exchange exposure sharply increase however the equation R^2 considerably falls, and there is a associated multicollinearity problem in the estimation between this factor and exchange rate when international index is used. Hence as used in other previous literature, the local market index is employed to as the R_{mt} in the second equation. (He 1998) pointed out that there is a multicollinearity between the overall market return and the exchange rate index; hence (He 1998) generally suggest that the overall market return should be replaced with the market return that cannot be explained by exchange rate changes.

The overall local market return R_{mt} has been empirically verified in the (Tesar 2006) work is superior in explaining power than the international market index; and the multicollinearity problem between this variable and exchange rate is less than when international market index is used. Hence I decided to use the overall return of Stock exchange of Thailand as the R_{mt} in the (Jorion 1991) regression model.

Selecting an interval for horizontal return: Which return, weekly, monthly or quarterly return? Many of the empirical literatures which use lagged exchange rate support the argument that the impact of exchange rate movements on firm value is delayed until information regarding past performance, asset and liabilities of the firm is disseminated by the investors; hence, the specification for firm's return should be carefully assessed. Most of the studies used a monthly return; however, (Tesar 2006) compare the use weekly, monthly and annul return in their regression, and they found that a the exposure is increasing in the return horizon (the no. of firms with significant exposure are more when the quarterly return is used instead of weekly or monthly return). However the effective exchange rate index is not constructed in weekly basis; hence I decided to employ monthly data to all variable in the testing.

D.2.3. Further Results

First, the summary of the coefficients of relevant change in exchange rate, which reflects firm's foreign exchange rate exposure, is shown as follow.

	With significant foreign exchange exposure parameter [0.05 level of significant]	With insignificant foreign exchange exposure parameter	Total
Number of listed firms	7 (6 with negative parameters)	97	104
Mean of absolute value FX parameter	1.1937	0.6998	0.7318

TableD.2. Summary of foreign exchange's coefficients, firms in agribusiness and industrial sectors.

Only 7 listed firms out of 104 from agribusiness and industrial industries are reported with significant foreign exchange parameter. As discussed earlier, foreign exchange exposure of the firm is represented by the absolute value of foreign exchange exposure. In addition the magnitude of influence from a group of firms with foreign exchange exposure is relatively highest among other group of firms

As there are only 7 significant foreign exchange coefficients, the second stage regression which is designed to investigate the determinants of firm's foreign exchange exposure could not be conducted. Hence, the comparison between foreign exchange parameter of foreign-invested firms and local-operated firms are made instead. The summary of comparison is illustrated as follow.

With 0.05 level of significant	Foreign-controlled listed firms			Local-controlled listed firms		
	With FX exposure	Without FX exposure	Total	With FX exposure	Without FX exposure	Total
Number of listed firms	5 (4 with negative par.)	32	37	2 (1 with negative par.)	69	71
Mean of absolute value FX parameter	0.82896			2.1055		

TableD.3. FX exposure [at0.05 level of significance] of foreign-controlled vs local-controlled listed firms in agribusiness and industrial sectors.

The number of MNC listed firms with significant foreign exchange exposure is 13.51% of the MNC listed firm in Agribusiness and Industrial sector. While only 2.8% of the local-operated firms are exposed to this FX exposure. However, if we compare the average magnitude of the FX exposure of the exposing listed MNC and listed local firms. The average value of parameters is lower in the sample of foreign-exposing firms. To further enhance the comparison, we adopt the 0.10 level of significance instead of 0.05 level of significance, the following comparison table can be revealed.

With 0.10 level of significant	Foreign-controlled listed firms			Local-controlled listed firms		
	With FX exposure	Without FX exposure	Total	With FX exposure	Without FX exposure	Total
Number of listed firms	6 (5 with negative par.)	31	37	8 (5 with negative par.)	63	71
Mean of absolute value FX parameter	1.3393			0.70990		

TableD.4. FX exposure [at 0.10 level of significance] of foreign-controlled vs local-controlled listed firms in agribusiness and industrial sectors.

With low confidence interval, more listed firms are reported with significant foreign exchange exposure, 42.8% of those firms are foreign-listed companies, and all of these exposing firms are from industrial industries. Five out of eight listed local companies, which are illustrated with significant foreign exchange exposure, are from the same industries. In contrast to the previous table, the mean value of foreign-listed firm's foreign exposure is higher than the mean value of their local counterpart's foreign exchange exposure.

In addition, the following table summarizes the foreign exchange exposure of exporting and non-exporting firms, and foreign exposure of firm with large market capitalization.

	% of listed companies			
	With FX exposure		Without FX exposure	
	0.05 level of sig.	0.10 level of sig.	0.05 level of sig	0.10 level of sig
MNC	13.5%	16.2%	86.5%	83.8%
Non-MNC	2.82%	11.27%	97.18%	88.73%
Exporting	7.40%	14.82%	92.6%	85.18%
Non-Exporting	8.57%	17.14%	91.43%	82.86%
SET 50 (Large cap)	14.28%	14.28%	85.72%	85.72%
Non-SET 50	5.95%	11.88%	94.05%	88.12%

TableD.5. Percentage of exposing listed firms and non-exposing firms in agribusiness and industrial sectors.

The summary of firms with significant foreign exchange's coefficients which shown in the above table indicate that only 14.82% of exporting firms are significantly expose to FX volatility, while 17.14% for the case of non-exporting firms. This results conforms witht the natural hedging, as firm with international activities had either take the natural heading or financial hedging to minimize their FX exposure. However, the comparison of FX exposure from the studies in these two industries does indicate that the percentage of firms with significant FX exposure is larger in the group of firms with large market capitalization value than the non-set 50 firms (small market capitalization firms). Our study found only a small fraction of listed firms in agribusiness and industrial sector significantly expose to foreign exchange rate risk. With 0.05 level of significance, only seven listed companies are expressed with significant foreign exchange exposure. While the number of listed companies increase to 14 listed companies, when 0.10 significant level is adopted. To further investigate the determinants of firms' foreign exchange exposure, coefficients of firm's foreign exchange which are significant are needed. Hence, fourteen significant coefficients are not sufficient. In order to pursue the objective of the chapter, the comparison between two groups of MNC and Non-MNC are made; and, a higher portion of firms with significant foreign exchange coefficients is found in a group of foreign-invested firms; but, the magnitude of FX exposure is less in this group of multinational controlled firms. In addition, we also found that the portion of firms with foreign exchange exposure is less in the group of exporter in relatively to non-exporter.

The limitation of this part is inherently the scope of the dissertation which focuses on manufacturing sector. The extension to service and retail, and technology sector could enable subsequent researches to conduct the investigation for the determinants of firm's foreign exchange exposure.

D.3. Probit and OLS results

In this section we report the result from Probit and OLS models, only the results from industries with insignificant RHO figure are reported. For industries with significant RHO, please refer to main content in chapter 5

	ISIC 15				ISIC 17			
	Probit model		OLS		Probit model		OLS	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	-2.0616	(0.00)	-8.9994	(0.00)	-2.6340	(0.00)	-9.3252	(0.00)
LOG(K/L)	0.0519	(0.34)	0.0030	(0.90)	0.0512	(0.45)	0.0294	(0.42)
LOG(Sk/L)	0.0502	(0.04)	0.0193	(0.05)	0.0241	(0.52)	0.0027	(0.86)
PRODUCTIVTY	0.0103	(0.88)	-0.0043	(0.90)	0.1667	(0.05)	0.1126	(0.04)
DMNC	0.3577	(0.21)	0.4157	(0.00)	0.8474	(0.00)	0.8396	(0.00)
ADEDUMMY	0.0298	(0.82)	0.0009	(0.98)	0.5527	(0.00)	0.2946	(0.01)
SIZEDUMMY	0.3168	(0.05)	0.1470	(0.10)	0.7768	(0.00)	0.7583	(0.00)
BOIDUMMY	4.1043	(0.00)	7.7012	(0.00)	4.1363	(0.00)	7.1490	(0.00)
PRODUCTDEV	0.4694	(0.00)	0.1740	(0.06)	-0.2892	(0.39)	-0.3103	(0.12)
R-Square	0.8056		0.8586		0.7598		0.7997	
Observation	1,719				854			

	ISIC 18- ISIC 19				ISIC 24			
	Probit model		OLS		Probit model		OLS	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	-1.5375	(0.00)	-8.6288	(0.00)	-1.8410	(0.00)	-8.8908	(0.00)
LOG(K/L)	0.1176	(0.05)	0.1197	(0.09)	0.0203	(0.78)	0.0310	(0.50)
LOG(Sk/L)	0.0062	(0.78)	0.0011	(0.96)	0.0455	(0.32)	0.0307	(0.19)
PRODUCTIVTY	0.0430	(0.52)	0.0672	(0.36)	-0.0354	(0.70)	-0.0218	(0.74)
DMNC	0.6549	(0.17)	0.7331	(0.01)	0.1763	(0.54)	0.4175	(0.02)
ADEDUMMY	0.2798	(0.02)	0.3419	(0.02)	0.3450	(0.05)	0.1511	(0.21)
SIZEDUMMY	0.5047	(0.00)	0.7000	(0.00)	0.1473	(0.51)	0.1244	(0.42)
BOIDUMMY	3.5565	(0.00)	7.0271	(0.00)	4.2198	(0.00)	6.4634	(0.00)
PRODUCTDEV	0.3690	(0.26)	0.1383	(0.66)	0.4043	(0.02)	0.2074	(0.10)
R-square	0.6331		0.6981		0.7600		0.7831	
Observation	1,017				905			

TableD.6. Export performance differential results from Probit and OLS model of the industries with the report of insignificant Rho value (ISIC 15, 17, 18-19 and ISIC 24).

	ISIC 15				ISIC 17			
	Probit		OLS		Probit		OLS	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	-2.5837	(0.00)	-9.3292	(0.00)	-0.5264	(0.44)	-7.5014	(0.00)
LOG(K/L)	0.0742	(0.19)	0.0129	(0.53)	0.0972	(0.24)	0.0269	(0.45)
LOG(Sk/L)	0.0496	(0.05)	0.0188	(0.06)	0.0347	(0.49)	0.0007	(0.96)
PRODUCTIVTY	0.0336	(0.64)	0.0010	(0.75)	0.1200	(0.22	0.0739	(0.17)
Spilloverfromup	0.0072	(0.31)	0.0087	(0.01)	-0.0774	(0.00)	-0.0600	(0.00)
Horizontalspill	0.0060	(0.59)	-0.0003	(0.94)	0.0130	(0.35)	0.0767	(0.33)
Spilloverfromdown	0.0076	(0.56)	0.0045	(0.48)	0.0102	(0.54)	0.0070	(0.51)
ADEDUMMY	0.0561	(0.69)	0.0051	(0.94)	0.6381	(0.00)	0.3012	(0.00)
SIZEDUMMY	0.3184	(0.07)	0.1033	(0.28)	0.4383	(0.10)	0.4873	(0.00)
BOIDUMMY	4.1180	(0.00)	7.7002	(0.00)	3.9559	(0.00)	7.1545	(0.00)
PRODUCTDEV	0.5041	(0.00)	0.2024	(0.05)	0.1236	(0.72)	0.0388	(0.85)
R-square	0.7940		0.8474		0.7565		0.7911	
Observation	1,605				770			

	ISIC 18-19				ISIC 24			
	Probit		OLS		Probit		OLS	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
C	-51.288	(0.06)	-76.743	(0.00)	5.8665	(0.00)	-5.1022	(0.00)
LOG(K/L)	0.1268	(0.04)	0.1066	(0.14)	0.0088	(0.92)	0.0138	(0.78)
LOG(Sk/L)	0.0063	(0.78)	-0.0018	(0.94)	0.0489	(0.33)	0.0264	(0.28)
PRODUCTIVTY	0.0647	(0.34)	0.0790	(0.30)	-0.1898	(0.09)	-0.1214	(0.08)
Spilloverfromup	1.1207	(0.08)	0.0152	(0.01)	-0.2149	(0.00)	-0.0010	(0.00)
Horizontalspill	1.7896	(0.08)	0.0244	(0.02)	0.0599	(0.00)	0.0403	(0.00)
Spilloverfromdown	-0.8757	(0.08)	-0.0118	(0.02)	-0.0097	(0.57)	-0.0175	(0.11)
ADEDUMMY	0.2717	(0.04)	0.3657	(0.01)	0.5416	(0.00)	0.3329	(0.01)
SIZEDUMMY	0.5380	(0.00)	0.8433	(0.00)	0.3143	(0.21)	0.1870	(0.28)
BOIDUMMY	3.5865	(0.00)	7.1524	(0.00)	4.3531	(0.00)	6.2127	(0.00)
PRODUCTDEV	0.3377	(0.38)	0.0432	(0.90)	0.3716	(0.07)	0.2532	(0.08)
R-square	0.6198		0.6959		0.7509		0.7456	
Observation	942				648			

TableD.7.Export spill over results from Probit and OLS model of the industries with the report of insignificant Rho value. (ISIC 15, 17, 18-19, and 24)

	ISIC 30-33			
	Probit		OLS	
	Coefficient	P-value	Coefficient	P-value
C	-2.3939	(0.03)	-9.0144	(0.00)
LOG(K/L)	0.2211	(0.13)	0.1079	(0.04)
LOG(Sk/L)	-0.0134	(0.88)	-0.0139	(0.68)
PRODUCTIVTY	0.0317	(0.85)	0.0280	(0.65)
Spilloverfromup	0.0115	(0.68)	-0.0080	(0.13)
Horizontalspill	-0.0185	(0.49)	0.0020	(0.69)
Spilloverfromdown	0.0078	(0.79)	0.0016	(0.80)
ADEDUMMY	0.5815	(0.08)	0.1829	(0.13)
SIZEDUMMY	-0.2538	(0.64)	0.1363	(0.49)
BOIDUMMY	4.6182	(0.00)	7.6643	(0.00)
PRODUCTDEV	0.2584	(0.58)	-0.1004	(0.58)
R-square		0.8599	0.8921	
Observation		425		

TableD.8. Export spillover results from Probit and OLS model of the industries with the report of insignificant Rho value (ISIC 30-33).

VITA

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