Productivity and Wage Spillovers from FDI in Thailand: Evidence from Plant-level Analysis

Thanapol Srithanpong*

Graduate School of Business and Commerce

Keio University, Japan

MANUSCRIPT - VERY PRELIMINARY

Abstract: This paper examines productivity and wage spillovers from Foreign Direct Investment (FDI) in Thai manufacturing, using a cross-sectional data from Industrial census 2007. Spillovers are examined at 2-digit and 4-digit industry level by spillover variables, foreign employment share and foreign output share. We find that increases in foreign participation lead to increases in labor productivity and average wages of domestic firms. The impact of FDI is also analyzed conditionally by plant size, location and form of organization and at regional level. The results suggest that foreign plants are more productive and pay higher wages than domestic plants in the whole sample but not for every industry. Caution is made regarding estimation based only on one spillover variable and at one industry level since results can be changed due to differences in research design and the quality of data.

JEL classification: F21, F23, D24

Keywords: FDI, spillovers, productivity, wage, Thailand

* I am grateful to Prof. Masahiro Endoh for his guidance and support, Prof. Hitoshi Hayami and Keio Economic Observatory (KEO) for providing the primary data set as well as members of International Trade and Investment seminar at Keio University. The opinions expressed and errors in this paper are the sole responsibility of the author.

Thanapol Srithanpong: legolassrithanpong@hotmail.com, Tel: 080-4473-2330

1. Introduction

Foreign Direct Investment (FDI) from multinational corporations/enterprises (MNCs/MNEs) has long been recognized as a major growth-enhancing factor in host countries. It can be considered as a significant way through which the international transfer of technology takes place.[1] With a view to attracting more FDI, authorities in many countries, especially developing countries, have liberalized their FDI regulations and adopted an investment-friendly policy in recent years.

On one hand, spillovers from the presence of foreign firms in the same industry are called horizontal spillovers. Horizontal spillovers occur through channels such as demonstration effect, competition effect and labor mobility. Demonstration effect allows domestic firms to acquire superior technologies, marketing and managerial practices used by foreign firms. Competition effect forces domestic firms to operate more efficiently and to introduce new technologies. Spillovers through labor mobility take place when employees of foreign firms establish their own businesses or move on to domestic firms. On the other hand, spillovers which occur with the diffusion of positive effects at inter-industry levels, benefiting from foreign suppliers or customers in the production chain, are called vertical spillovers. Specifically, vertical spillovers can take place through backward linkages and forward linkages. Backward linkages are relationships that domestic firms establish as suppliers of foreign firms and forward linkages are relationships that domestic firms establish as customers of intermediate inputs produced by foreign-owned firms.[2] When domestic firms in the host country have access to new technologies and skills introduced by inward FDI, this may lead to

[1] See Görg & Greenaway (2004) and Crespo & Fontoura (2007)
[2] See the recent review of literature in productivity spillovers in Erdogan (2011)

improvements in the host country's labor productivity and wage level of domestic firms. However, some local firms may also suffer from the competitive presence of the more efficient foreign counterparts, as they may be forced to reduce their output or stop their activities (Aitken and Harrison, 1999).

A large number of researches and studies have been succeeded to provide both the theoretical foundations and empirical results concerning the impact of FDI on the host country economy. The theoretical developments have encouraged many empirical investigations into the role that FDI has played in the transfer of technology both in developed and developing countries. Data at the levels of the industry, firm, or plant have been used in those studies. However, the results of these analyses are unclear and remain inconclusive. In addition to productivity spillovers, little effort has been spent on identifying other host-country benefits from FDI, namely wage spillovers. FDI may have effects on average wages. These effects, for example, operate through foreign firms paying higher wages than those paid by domestic firms functioning in the same sector, hence raising average wages. The conclusions from empirical studies on both productivity and wage spillovers from FDI are mixed. Nevertheless, it is broadly accepted that the entry of foreign firms has the potential to benefit the domestic firms by the spillover of their technological know-how, innovation capability, and marketing and management skills (World Bank, 1993). For Thai case, Kohpaiboon (2009) indicates that Thai manufacturing is a good example for the issue for at least two reasons. First, Thailand has been a large FDI recipient throughout the past decades and few studies have examined spillover effects in Thai manufacturing. Second, Thai manufacturing is broad-based as opposed to neighboring countries, covering a wide range of industries from traditional labor- intensive industries to several capital-intensive industries such as

automotive, electronics, and electrical appliances etc. Thus, evidence from Thai manufacturing concerning FDI should provide a lesson for other developing countries.

This paper examines the FDI spillover effects in productivity and wage in Thai manufacturing. A cross-sectional econometric analysis is conducted, using the Industrial Census 2007 which was conducted by the Thai National Statistical Office (NSO) in 2006. This is the most up-to-date and reliable plant census available so far in Thailand. In the empirical model, we follow the general practice in this research area, in which the productivity and wage equation of domestic plants in the manufacturing sector are estimated and the statistical relationship between plants' productivity or wage and the extent of foreign presence is examined. This paper contributes to the existing literature in three ways. Firstly, in our econometric analysis, the impact of foreign presence on productivity and wage are examined at both 2-digit and 4-digit ISIC industry level and observed by both foreign output share and foreign employment share. Secondly, we carefully examine the existence and strength of both productivity and wage spillovers under different conditions and characteristics of plants such as plant size, location, form of economic organization etc. Thirdly, we consider the effects of foreign presence in regional level and industry level to explore if the spillover effects are concentrated in the region or some industries.

The remainder of this paper is organized as follows. Section 2 presents a testable estimation strategy and econometric models. Next, section 3 presents the data and variable construction in detail. Estimation results are discussed in depth in section 4. Finally, section 5 concludes and provides some policy implications and suggestions.

2 Estimation framework and strategies: Econometric Models

Based on the brief review of literature above, it can be assumed that FDI is expected to bring to the host country superior technology, marketing and managerial practices and other intangible assets, which can "spill" to local partners and other domestic firms. The most commonly-used approach to test productivity spillovers to the locally-owned firms is by estimating an augmented Cobb-Douglas production function. Following Dimelis and Louri (2004), a simple form of an augmented production function for the manufacturing sector is used as starting point. For productivity spillovers, to estimate the presence of productivity spillovers, we follow the idea of Aitken and Harrison (1999) and estimate the following log linear production function:

$$\ln VAL_{ij} = \beta_0 + \beta_1 \ln KI_{ij} + \beta_2 \ln MI_{ij} + \beta_3 \ln L_{ij} + \beta_4 \ln LQ_{ij} + \beta_5 \ln Age_{ij} + \beta_6 BOI_{ij} + \beta_7 HERF_j + \beta_8 ERP_j + \beta_9 FOR_{ij} + \beta_k X_{ij} + \varepsilon_{ij} \qquad (4.1)$$

Here, i indexes the plant, j indexes the sector/industry. As for the variables, ***VAL*** is value added per worker of a plant, ***KI*** represents capital intensity, ***MI*** represents material input intensity, ***L*** represents labor inputs. ***LQ*** is labor quality defined as the share of skilled workers in the total workforce in each firm. ***FOR*** is the share of foreign ownership (percentage of capital equity held by foreign investors in firm *i) at the plant level, which varies from 0 to 1 (100 percent). BOI* is the Board of Investment dummy - promotion status of a plant (equal to 1 if a plant is investment promoted and zero otherwise). ***HERF*** is the Herfindahl index for industry concentration. ***ERP*** is the

effective rate of protection in industry reflecting trade policies implemented in that industry. ***X*** is the vector of other control variables which affect labor productivity.

Similarly, to examine the presence of wage spillovers, we also follow the standard practice in the literature and use:

$$\ln AvrRemu_{ij} = \beta_0 + \beta_1 \ln KI_{ij} + \beta_2 \ln MI_{ij} + \beta_3 \ln L_{ij} + \beta_4 \ln LQ_{ij} + \beta_5 \ln Age_{ij} + \beta_6 GOV_{ij} + \beta_7 HERF_j + \beta_8 TECH_j + \beta_9 FOR_{ij} + \beta_k X_{ij} + \varepsilon_{ij} \quad (4.2)$$

Here, i indexes the plant, j indexes the sector/industry. As for the variables, ***AvrRemu*** is average wage per worker of a plant. ***GOV*** is the form of legal organization of a plant (equal to 1 if plants are state-enterprises or cooperatives and zero otherwise). ***TECH*** is the technology gap between foreign firm and domestic firm. ***X*** is the vector of other control variables including; 1) capacity utilization, 2) export and import status (equal to 1 if plants are exporting or importing and zero otherwise), 3) municipal area dummy (equal to 1 if plants are in municipal area), 4) central area dummy (equal to 1 if plants are in central area - Bangkok and central region), 5) nationality of FDI- Japanese, Chinese, US. For plant characteristics, control variables include product development dummy (equal to 1 if product development is reported, and zero otherwise), improved production technology dummy (equal to 1 if improved production is reported, and zero otherwise), form of economic organization dummy (equal to 1 if plants are Head Branch type and zero if they are Single Unit type).

Especially, for spillover variables, these variable measures spillover effects which will be used to capture the impact and effects of foreign presence on both productivity and wage spillovers. They are defined as follows:

FORshare = The share of foreign ownership (percentage of capital equity held by foreign investors in a firm*)* at the plant level

EFOR4 = Proxy for foreign presence, defined as the ratio of the *employment* of foreign firms to total employment in each subsector at the *4-digit* ISIC (narrowly defined industry level)

YFOR4 = Proxy for foreign presence, defined as the ratio of the *output* of foreign firms to total output in each subsector at the *4-digit* ISIC (narrowly defined industry level)

EFOR2 = Proxy for foreign presence, defined as the ratio of the *employment* of foreign firms to total employment in each subsector at the *2-digit* ISIC (broadly defined industry level)

YFOR2 = Proxy for foreign presence, defined as the ratio of the *output* of foreign firms to total output in each subsector at the *2-digit* ISIC (broadly defined industry level)

REG_YFOR = Foreign ownership in regional level measured by foreign employment participation (more broadly defined)

REG_EFOR = Foreign ownership in regional level measured by foreign output participation (more broadly defined)

FOR_EFOR (2 or 4) = The interaction term between Plant FDI and sector FDI measured by employment at 2-digit or 4-digit ISIC

FOR_YFOR (2 or 4) = The interaction term between Plant FDI and sector FDI measured by output at 2-digit or 4-digit ISIC

FOR_REG_EFOR (or YFOR) = The interaction term in regional level for both EFOR and YFOR measure

3 Data and variable construction

In our econometric investigation into the effects of FDI on labor productivity and average wages, we use a detailed data set at plant level from the Industrial census 2007. This data set was conducted by Thailand's National Statistical Office (NSO) which surveyed all establishments in the whole kingdom in 2006. The information is the newest and most extensive set of Thai industrial census data. The original sample size consists of 73,931 observations, of which about 71,154 observations are domestic plants, and 2,777 observations are foreign plants.[3] The census covers 34,625 firms, belonging to 127 4-digit industries of International Standard Industrial Classification of All Economic Activities (ISIC Rev3.0). Of these, enumerated observations are 62,623 (plants which still existed by the time the census was conducted). Due to missing information on some key variables, the census was cleaned up by firstly deleting plants which had not responded to one or more the key questions and which had provided seemingly unrealistic information such as the negative value added and inputs used and total employment which is less than one. As described in more detail (Ramstetter, 2004 and Kohpaiboon, 2008), there are some duplicated records in both the data from manufacturing surveys and industrial census, presumably because plants belonging to the same firm filled the questionnaire using the same records. The procedure followed in dealing with this problem was to treat the records that report the same value of the seven key variables of interest in this study, as one record.[4] Industries that are either to

[3]In this study, if the foreign investment in a firm is reported, we consider the firm as foreign firm and if there is no report of foreign equity participation, we consider the firm to be domestic firm.
[4] See detail in Ramstetter (2004) footnote 5. In addition, there are the near-duplicate records. A careful treatment to maximize the coverage of the samples is used as described in more detail in Ramstetter (2004: p.9-10).

serve niches in the domestic market in the service sector or explicitly preserved for local enterprises are excluded.[5] As a result, the final dataset contains 49,432 plants (1,931 foreign-owned plants and 47,501 domestic-owned plants) in 115 industries at 4-digit ISIC industry level and 22 industries at 2-digit ISIC industry level.

The data set contains information of individual plants in the manufacturing sector on employment (skilled and unskilled workers), wages and salaries, input materials used, labor inputs (men and women), fixed assets, ownership, number of days worked, years of operation, detailed receipts and cost of establishments etc. The explanatory variables adopted in the econometric investigation basically follow the theoretical and empirical literature reviewed in section 2 and 4. However, in this study, two different spillover variables are used with regard to the presence of foreign firms. The explanation of important explanatory variables is described as follows.

KI - Capital intensity, measured as the ratio of fixed assets to total number of employees in each plant, indicates average physical capital stock per worker. *MI* - Material input intensity defined as the ratio of raw material input purchases of each plant to total number of workers in that plant. *L* - Labor inputs employed in each establishment. *FORshare* is the share of foreign ownership (percentage of capital equity held by foreign investors in a plant). A statistically significant and positive coefficient suggests that establishments with foreign ownership enjoy higher labor productivity or average wage gains than their domestically-owned counterparts. The Herfindahl (*HERF*) index of industry concentration is constructed using the industrial census at the 4-digit ISIC classification. Following Kohpaiboon (2008), for measuring labor quality, the supervisory and management workers are defined as employees not directly engaged

[5] See details in Kohpaiboon and Ramstetter (2008)

in production or other related activities. The actual number of supervisors and management workers are not available in the census. So the number of non-production workers reported would also include clerical and administrative staff. *TECH* is the technology gap for each firm as the percentage difference between firms' labor productivity and that of the average of foreign firms in the same industry. Data on Effective rate of protection, (*ERP)* all estimates are obtained from Kohpaiboon (2009).[6] Finally, concerning the type and nature of the data set, although panel data analysis is preferred when we estimate spillover effects from FDI, the sample coverage in Thai manufacturing surveys from NSO is so low and inconsistent that it is difficult to consider these samples representative (Ramstetter 2009). Moreover, as we can see later that, on the contrary, the more enriched data of Industrial census is appropriate for this paper since we analyze productivity and wage spillovers from FDI in various aspects.

As indicated before, cross-sectional data are used for the analysis of spillovers from foreign to domestically owned firms. Heteroskedasticity is often present when cross-sectional data are used. For this reason, statistical diagnostic tests are of vital importance to determine the appropriate statistical models and estimation techniques to avoid misleading econometric results. Before reviewing our econometric results, we perform several tests including normality of variables and residuals, test for heteroskedasticity, test for multicollinearity, and Ramsey's regression specification error (RESET) for functional form misspecification.[7] In appendix, a statistic summary of key variables and some robust regression results can be found in Table A1, Table A2 and Table B1, Table B2 for both the analysis of productivity and wage spillovers.

[6] See the source of the data and the method used to calculate ERP in detail in Kohpaiboon (2009)
[7] Statistical diagnostic tests are not included the paper but all can be shown upon request

4 Estimation results

To examine the spillover effects from FDI in this study, a cross-sectional econometric procedure is applied. A well-known limitation of the standard OLS estimator compared to its fixed or random effect counterpart is that it may yield inconsistent and biased estimates if the unobserved fixed effects are correlated with the remaining component of the error term. However, as suggested and indicated in Kohpaiboon (2009) for the case of Thai FDI panel analysis, unobserved effects are relatively unimportant in the data and model. Besides, since the panel analysis has already been explored for Thai data, our estimation here would be more interesting and worthwhile when applying other methods, with newer data and consider various aspects and levels of the analysis which would be the heart of our paper. The results of our analysis can be divided into eight small parts as shown beneath.

4.1) The impact of Foreign Ownership/Presence on Value-added per worker (Labor Productivity spillovers)

=== Table 1 here ===

Table 1 presents the basic results from estimating equation (4.1) on the Thai Industrial census 2007 data. The main findings can be summarized as follows. **First**, we observe a positive own-plant effect. The coefficients on FORshare are all positive and statistically significant (foreign presence at plant level has positive effects on labor productivity of domestic firms). **Second**, an increase in the share of FDI measured by

foreign output (YFOR4) leads to an increase in labor productivity (positive horizontal spillovers from FDI to domestic firms at 4-digit industry level). **Third**, for plants with foreign equity participation, the interaction terms show negative spillovers from FDI (Joint ventures benefit from FDI in plant level, but not from FDI in other plants within the same sector). **Fourth**, an increase in the share of FDI measured by foreign employment (EFOR2) leads to an increase in labor productivity (positive horizontal spillovers from FDI to domestic firms at 2-digit industry level). Furthermore, when we consider the spillover effects at 2-digit and 4-digit industry level simultaneously, we only observe weak positive spillovers at 2-digit industry level (EFOR2). **Fifth**, when we include other control variables and consider the spillover effects at 2-digit and 4 digit industry level at the same time, we find no previous positive spillovers from FDI at 2-digit industry level (a positive sign on EFOR2 disappears). **Sixth**, it seems that labor productivity does not rely on export status and the nationality of FDI and it is highly correlated with capacity utilization, import status, municipal area and central area dummy, product development dummy and form of econ organization dummy variable.

4.2) The impact of FOR by Plant size (Small, Large) / Location (Central, Municipal) /Form of Economic Organization (Head Branch, Single Unit)

=== Table 2 here ===

We further the analysis of FDI spillovers by imposing various aspects and conditions on the equation (4.1) to seek more information about the source of productivity spillovers from FDI. To our knowledge, no known researchers which use

Thai data have ever attempted this kind of analysis, so our results here is the first and may give an insight regarding productivity spillovers from FDI in Thai case from various aspects. The main results are shown in Table 2 and should be interpreted as follows. **First**, we discover FDI positive effects at plant level in every case except for plants which are not in central region both from employment and output spillover variables. This suggests that, when considering for the plant location, only in central region do foreign plants exhibit higher labor productivity. **Second**, almost in all cases, EFOR4, YFOR4 are not statistically significant (no horizontal spillovers at 4-digit industry level, but we find some weak evidence when looking at foreign employment share-YFOR4). **Third**, there is strong evidence for negative spillovers from FDI in other foreign plants within the same 4-digit industry level, especially for large plants, plants in the central region and plants which are "Single Unit" type.

From Table 1 and Table 2, we can learn that considering both EFOR and YFOR when observing spillover effects is very important to cross-check the results since results may differ and conclusions may change. This gives a crucial warning not to rely the estimation and analysis solely on one spillover variable and at one industry level since results can be changed due to differences in research design and the quality of data. Besides, since the spillover effects can occur through both foreign employment share and foreign output share in the industry, it is essential to ensure that we fully estimate and observe results by both spillover variables.

4.3) Effects of Foreign ownership on Labor Productivity in the Region

=== Table 3 here ===

To test whether there is the possibility that spillovers are transferred at regional level, we broaden our analysis to include both regional and industrial foreign share variables in the same regression. Table 3 reports the estimated results which can be discussed in the following fashion. **First**, there seems to be no clear evidence that foreign presence in the region has a large and positive effect on labor productivity in this year. We almost find no evidence from regional FDI. However, we find weak evidence for negative spillovers for joint ventures in the same region (They do not benefit from FDI in other plants within the same region). **Second**, if a proxy for regional productivity (regional average remuneration - ReAvrRemu) is excluded; the coefficients on REG_EFOR and REG_YFOR are not statistically significant. When the proxy for regional productivity is included, the coefficients on REG_EFOR and REG_YFOR are still insignificant. However, the coefficients on FOR_EFOR4 and FOR_YFOR4 become statistically insignificant (negative spillovers at industry level disappear when ReAvrRemu is included).[8] Interestingly, variations in the real wage for skilled workers across regions could reflect locational advantages such as infrastructural differences, local agglomeration economies, or unobserved differences in the quality of labor. James E. Rauch (1991), for example, provides empirical evidence for the United States that variations in human capital accumulation across cities are reflected in higher wages for individuals. **Third**, ReAvrRemu is highly and positively correlated with individual plant productivity. This suggests that foreign investment is likely to locate in regions with highly productive workers (workers with high ReAvrRemu).

[8] Atiken and Harrison (1999) use real skilled wage and energy price as regional controls but the data in census does not provide enough observations for skilled wages and information on energy prices. (The observations will be sharply reduced if we use skilled wages and energy prices for regional control variables).

4.4) The impact of Foreign Ownership/Presence within each industry level (Labor Productivity spillovers in each 2-digit ISIC industry level)

=== Table 4 here ===

Notes on Table 4 are: All – samples of all plants, large – samples of large plants with total employment > 50 employees. All t-statistics are reported in parenthesis and all standard errors are corrected for heteroscedasticity. Other independent variables (not reported here) include LnKI, LnMI, LnL, LnLQ, LnAge, BOI, LnERP. Coefficients come from ordinary least square estimates of each equation in plant-level cross sections for samples of all plants and large plants in each industry.

When we analyze deeper and look carefully in each industry, Table 4 yields an important result that is broadly consistent with results from previous studies. Although foreign presence and foreign employment/output share (or participation) seems to have some positive effects in overall industries and foreign MNCs appear to have had higher labor productivity than domestic plants, they do not appear to have higher labor productivity when we consider carefully for each industry. Our findings from Table 4 and the previous results from Table 1 suggest that foreign firms are more productive than domestic firms when we consider for the whole sample (the overall-nationwide effect in the sample). Nonetheless, when we consider separately for each industry, we only find some evidence for FDI positive effects at plant level in some industries, namely; food products, paper products, publishing and printing, rubber and plastics, non-metallic and mineral products and machinery and equipment. We also observe negative horizontal spillovers in almost all industries (except for chemicals) which

report statistically significant spillover variables (negative signs on EFOR and YFOR indicate that an increase in the share of FDI in the industry results in a decrease in labor productivity in that industry). This is surprising since we observe some positive horizontal spillovers when considering the whole sample (Table1). In contrast, we observe negative horizontal spillovers in each separate industry. This gives us a warning how to interpret our results since our analysis is conducted based on the static analysis of cross-sectional data, when we use panel analysis the result is possible to change. Overall, we can still learn that for almost every industry, foreign plants tend to have higher labor productivity and generate (negative) spillovers with in the industry.

4.5) Impact of Foreign Ownership/Presence on Wage per worker (Wage spillovers)

This section reports results on the effects of FDI on wage spillovers in domestic firms obtained by estimating equation (4.2). So far, to our knowledge, there have been few studies analyzing wage spillovers in the case of Thai manufacturing. Therefore, our analysis is among the first attempt in using the Industrial census data to extensively analyze and explore the effects of FDI on wage spillovers in Thai manufacturing sector. The main findings can be summarized from Table 5 as follows.

=== Table 5 here ===

First, in the analysis of wage spillovers, we observe a positive own-plant effect, the same as in the case of productivity spillovers. The coefficients on FORshare are all positive and statistically significant (foreign presence at plant level has positive effects

on average wages of domestic firms). **Second**, an increase in the share of FDI (by EFOR4 and YFOR4) leads to an increase in average wages of domestic plants (positive horizontal spillovers from FDI to domestic firms at 4-digit industry level). **Third**, plants with foreign equity participation show negative spillovers from FDI (Joint ventures benefit from FDI at plant level, but not from FDI in other plants within the same industry at 4-digit level). **Fourth**, an increase in the share of FDI (by foreign employment, EFOR2) leads to an increase in average wages at industry level (positive horizontal spillovers from FDI to domestic firms at 2-digit level). When we consider the spillover effects at 2-digit and 4-digit industry level simultaneously, we only observe positive spillovers at 2-digit level from foreign employment share (EFOR2), and not from foreign output share (YFOR2). **Fifth**, when we include other control variables and consider the spillover effects at 2-digti and 4-digit industry level at the same time, we find that previous positive spillovers from FDI at 4-digit level become negative but weakly significant (the sign on the coefficients of EFOR4 changes from positive to negative). **Sixth**, average wages do not rely on export status and the nationality of FDI. This is the case for both productivity and wage spillovers. Wage per worker is highly correlated with import status dummy, municipal area and central area dummy, product develop dummy, form of econ organization dummy variable. With regard to Table 1 and Table 5, we find nearly the same results for the effects of control variables.

4.6) Impact of FOR by Plant size (Small, Large) / Location (Central or not) Improved Production Technology / Economic Form (Head Branch, Unit)

=== Table 6 here ===

As can be seen from Table 6, the main findings can be discussed in the similar manner as in the case of productivity spillovers. **First**, we notice FDI positive effects at plant level in every case except for the case which plants are not in central region, both from foreign employment share and foreign output share. **Second**, we observe the positive sign on the coefficients of EFOR4 and YFOR4, and almost all are strongly and statistically significant except for the case which plants are not in central region and plants which are "Head Branch" type (Positive horizontal wage spillovers at 4-digit industry level). **Third**, we find strong evidence for negative wage spillovers from FDI in other plants within the same 4-digit industry level, especially for small plants, plants in central region, plants with no report of improved production technology, and plants which are "Single Unit" type. Similar to the case of productivity spillovers, from Table 5 and Table 6, we learn again that considering both EFOR and YFOR when observing spillover effects is very important to cross-check the results. Once again, a warning should be made not to base the analysis only on one spillover variable and at one industry level since results can be changed due to differences in research design and the quality of data.

4.7) Effects of Foreign ownership on Wage/Remunerations in the Region

=== Table 7 ===

Apart from the analysis at plant and industry level, we extend our analysis to region level, the same as in the case of productivity spillovers. As can be shown in Table 7, there is no clear evidence that foreign presence in the region has a large and

positive effect on average wages of domestic plants in this year. We almost find no evidence from regional FDI. Still, we find weak evidence for negative wage spillovers for joint ventures in the same region. (They do not benefit from FDI in other plants within the same region). Next, if a proxy for regional productivity (regional average remuneration - ReAvrRemu) is excluded; the coefficients on REG_EFOR and REG_YFOR are not statistically significant. When the proxy for regional productivity is included, the coefficients on REG_EFOR and REG_YFOR are still insignificant. However, the coefficients on FOR_EFOR4 and FOR_YFOR4 become statistically insignificant (negative spillovers at industry level disappear). The interaction terms, identical to the case of productivity spillovers, (FOR_REG_EFOR, FOR_REG_YFOR) become statistically significant after including a regional control. The same conclusion cab be made that ReAvrRemu is highly and positively correlated with plants' average wages. For Table 7, We can notice that when including REG_EFOR and REG_YFOR, the coefficients on EFOR4 and YFOR4 become statistically insignificant, this means that when we look at the spillover effects in plant level, (4-digit) industry level, and regional level simultaneously, we only observe strong positive effects at plant level, weakly negative horizontal spillovers at industry level and find no clear evidence for effects in regional level. However, caution should be made once again that results might be changed if we employ panel data analysis.

4.8) The impact of Foreign Ownership/Presence within each industry level

(Wage spillovers in each 2-digit ISIC industry level)

=== Table 8 here ===

Notes on Table 6 are: Other independent variables (not reported here) include LnKI, LnMI, LnL, LnLQ, LnAge, LnHERF, TECH and GOV. Coefficients come from ordinary least square estimates of each equation in plant-level cross sections for samples of all plants and large plants in each industry.

Table 8 gives an important result that is broadly consistent with results from previous studies. Foreign firms do not appear to have higher wage per worker when we consider carefully in each industry. Our findings from Table 8 and Table 5 suggest that a greater presence of foreign firms is positively associated with higher average wages of domestic firms when we consider for the whole sample (the overall-nationwide effect in the sample). This suggests that the presence of foreign firms causes a shift in labor demand leading to upward pressure on wages faced by both foreign firms and domestic firms. Nevertheless, when we consider separately for each industry, we only find some evidence for FDI positive effects at plant level in some industries, namely; food products, textiles, rubber and plastics, non-metallic and mineral products, metal product, machinery and equipment, communication equipment, motor vehicles and furniture.

In contrast to the case of productivity spillovers, we observe positive horizontal spillovers in almost all industries which report statistically significant spillover variables (positive signs on EFOR and YFOR indicate that an increase in the share of FDI in the industry results in an increase in average wages in that industry). Comparing Table 5 and Table 8, we can find positive horizontal spillovers both in the whole sample and the samples for each industry. The finding is in line with the previous study of Ramstetter (2004) which indicates that the relationship between labor productivity and foreign ownership in general is rather weak but the relationship between wages and foreign ownership is somewhat stronger in Thai manufacturing.

5 Concluding remarks

This paper analyzes productivity and wage spillovers from FDI in Thailand using many plant-level analyses. It is one of the few papers to study productivity and wage spillovers simultaneously and combine various methods necessary for the analysis and examine a wide range of spillover features regarding the impact and effects of FDI on productivity and wage spillovers. The main contribution of this paper is as follows. **Firstly**, we consider the impact of foreign ownership (FORshare) on labor productivity and average wages which is observed by both foreign employment share and foreign output share at both 2-digit and 4-digit industry level. **Secondly**, we consider the impact of foreign presence conditioned by plant size, location and form of organization etc. and extend the effects of foreign presence into regional level. **Thirdly**, we examine the effects of foreign presence in each industry for both productivity and wage spillovers.

Our major finding is that increases in foreign equity participation (foreign presence) are positively correlated with increases in labor productivity and average wages of domestic firms. The impact of FDI on labor productivity and average wages in Thai manufacturing sector is examined on the basis of a number of relevant variables such as capital intensity, material and labor inputs, labor equality, years of operation of establishment, investment promotion status from BOI (Thai Board of Investment), and trade policy effect by effective rate of protection (ERP) etc. Two proxies for the presence of foreign owned enterprises are used as it has been expected that such presence could be reflected in terms of either the employment or output level. Several statistical diagnostic tests are carried out to avoid misleading econometric results. The analysis shows that the coefficients of the two proxy variables for the influence of

foreign plants are significant on average, signifying that FDI plays a positive role in enhancing labor productivity and average wages in the Thai manufacturing sector. Similarly, capital intensity, material and labor inputs, labor equality, years of operation of establishment, investment promotion status from BOI are all shown to positively affect domestic labor productivity. Moreover, other control variables such as capacity utilization, import status, and location dummies are also shown to positively affect labor productivity and average wages. On the other hand, as expected, ERP seems to negatively affect labor productivity and form of legal organization (Government) and technology gap also seem to negatively affect average wages of domestic plants.

This study allows us to draw attention to some policy implications for Thai government representatives and business managers. Since, on balance, FDI has a positive impact on productivity and wage, the country's investment-friendly policy should continue to be adopted and implemented so that more inward FDI might be attracted. It would be desirable to examine the issue of spillovers more closely in the Thai case, especially for wage spillovers which there are few studies at the moment, to provide more solid evidence concerning the impact of FDI on productivity and wage.

One important caution should be made here with regard to the study and analysis of FDI spillover effect. Apart from considering both horizontal and vertical spillovers, we should also pay careful attention to the spillover variables, the control variables and some conditions when estimating the spillover effects. Since spillovers can occur through both foreign employment participation and foreign output participation in many channels of domestic environment and at various industry levels, we should not consider results based on one sample of plants from one methodology and from one period of time as a conclusive fact.

Table A1: Statistical Summary of the Key variables for productivity spillovers

Variable	Unit	Obs	Mean	Std. Dev.	Min	Max
LnVAL	(ln) baht	49432	11.192	1.678	2.562	19.282
LnKI	(ln) baht	49432	11.508	1.894	1.222	20.218
LnMI	(ln) baht	49432	10.722	2.195	-5.497	20.100
LnL	(ln) workers	49432	2.362	1.411	0.693	9.262
LnLQ	(ln) workers	49432	0.597	0.191	0.000	0.693
LnAge	(ln) years	49432	2.057	0.862	0.000	4.595
LnHERF	(ln) proportion	49432	0.063	0.073	0.005	0.640
LnERP	(ln) proportion	49432	0.125	0.127	-0.357	0.457
BOI	zero-one dummy	49432	0.068	0.251	0.000	1.000
LnFORshare	(ln) proportion	49432	0.018	0.096	0.000	0.693
LnCapacity	(ln) proportion	49432	0.562	0.114	0.010	1.099
LnReAvrRemu	(ln) baht	49432	10.555	0.606	9.904	11.486
LnEFOR2	(ln) proportion	49432	0.012	0.064	0.000	0.589
LnYFOR2	(ln) proportion	49432	0.015	0.078	0.000	0.614
LnEFOR4	(ln) proportion	49432	0.012	0.067	0.000	0.646
LnYFOR4	(ln) proportion	49432	0.015	0.078	0.000	0.685
EX	zero-one dummy	49432	0.078	0.268	0.000	1.000
IM	zero-one dummy	49432	0.084	0.278	0.000	1.000
MUN	zero-one dummy	49432	0.438	0.496	0.000	1.000
Central	zero-one dummy	49432	0.439	0.496	0.000	1.000
JAP	zero-one dummy	49432	0.016	0.124	0.000	1.000
TCS	zero-one dummy	49432	0.011	0.104	0.000	1.000
US	zero-one dummy	49432	0.002	0.045	0.000	1.000
Product	zero-one dummy	49432	0.031	0.174	0.000	1.000
FormEcon	zero-one dummy	49432	0.070	0.256	0.000	1.000

Table A2: Robust Regression: Comparison of robust estimators for productivity

LnVAL	(1) reg	(2) rreg	(3) qreg	(4) mmreg
LnKI	0.210***	0.191***	0.190***	0.178***
LnMI	0.504***	0.537***	0.532***	0.550***
LnL	0.153***	0.138***	0.133***	0.130***
LnLQ	0.0553*	0.0679**	0.0856***	0.0810***
LnAge	0.0651***	0.0522***	0.0506***	0.0414***
LnHERF	0.179**	0.225***	0.198**	0.245***
LnERP	-0.368***	-0.289***	-0.305***	-0.236***
BOI	0.0620***	0.0587**	0.0621**	0.0628***
LnFORshare	0.200***	0.160***	0.153**	0.122**
Observations	48841	48841	48841	48841
Adjusted R-sq	0.708	0.725		

Notes: the above values are estimated results and ***,**, * indicates a statistical significance at 1, 5, 10 percent level, respectively.
Sources: Author's calculation

Table 1: Impact of Foreign Ownership (FOR) on Value-added per worker (Labor Productivity spillovers: Dependent Variable; Value-added per worker)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LnFORshare	0.200***	0.703***	0.608***	0.607***	0.587***	0.562***	0.553***	0.198***
	(4.67)	(8.42)	(5.79)	(6.90)	(5.36)	(5.93)	(4.89)	(3.33)
LnEFOR4		0.162		-0.951		-0.909		
		(1.15)		(-1.82)		(-1.80)		
LnFOR_EFOR4		-1.256***		-0.251		-0.306		
		(-6.18)		(-0.33)		(-0.41)		
LnYFOR4			0.307**		0.186		-0.0149	
			(2.66)		(0.36)		(-0.03)	
LnFOR_YFOR4			-1.090***		-1.049		-0.973	
			(-5.40)		(-1.34)		(-1.29)	
LnEFOR2				1.275*		1.057		
				(2.31)		(1.94)		
LnFOR_EFOR2				-0.993		-0.545		
				(-1.22)		(-0.69)		
LnYFOR2					0.131		0.173	
					(0.25)		(0.34)	
LnFOR_YFOR2					-0.0165		0.221	
					(-0.02)		(0.29)	
LnCapacity						0.454***	0.453***	0.453***
						(12.50)	(12.48)	(12.46)
EX						0.0361	0.0349	0.0364
						(1.11)	(1.07)	(1.11)
IM						0.0461**	0.0459**	0.0461**
						(2.88)	(2.86)	(2.88)
MUN						0.216***	0.216***	0.216***
						(26.33)	(26.29)	(26.28)
Central						0.397***	0.397***	0.398***
						(42.34)	(42.42)	(42.45)
JAP						-0.0151	-0.00887	0.0101
						(-0.35)	(-0.20)	(0.26)
TCS						-0.0679	-0.0694	-0.0190
						(-1.50)	(-1.50)	(-0.47)
US						0.0772	0.0660	0.0890
						(1.00)	(0.86)	(1.18)
Product						0.0593**	0.0605**	0.0632**
						(2.81)	(2.86)	(2.99)
FormEcon						0.199***	0.201***	0.202***
						(12.23)	(12.29)	(12.40)
Observations	48841	48841	48841	48841	48841	48841	48841	48841
Adjusted R-sq	0.708	0.708	0.708	0.708	0.708	0.727	0.727	0.727

Notes: t-statistics in parentheses and ***,**, * indicates a statistical significance at 1, 5, 10 percent level, respectively.
Sources: Author's calculation

Table 2: Impact of FOR by Plant size (Small, Large) / Location (Central, Municipal) /Economic Form (Head Branch, Unit)

- **Measured by EFOR (Foreign employment share)**

	Small	Large	Central	Not Central	Municipal	Not Municipal	Head	Single
LnKI	0.211***	0.252***	0.153***	0.205***	0.136***	0.232***	0.229***	0.206***
	(68.43)	(29.50)	(34.70)	(53.43)	(31.92)	(58.07)	(20.24)	(69.75)
LnMI	0.509***	0.424***	0.442***	0.501***	0.458***	0.502***	0.373***	0.507***
	(124.00)	(41.53)	(87.91)	(93.32)	(86.87)	(95.35)	(32.30)	(128.13)
LnL	0.196***	0.0195	0.152***	0.111***	0.173***	0.156***	0.00125	0.152***
	(35.45)	(1.74)	(29.90)	(17.38)	(30.52)	(29.36)	(0.11)	(35.59)
LnLQ	0.102***	0.0770	-0.0804*	-0.0166	-0.113**	0.0119	0.0962	0.0635**
	(4.03)	(1.70)	(-2.50)	(-0.57)	(-3.11)	(0.43)	(1.42)	(2.74)
LnAge	0.0683***	0.0767***	0.00179	0.0867***	0.0330***	0.0637***	0.0467**	0.0670***
	(12.68)	(5.41)	(0.25)	(12.85)	(4.60)	(9.08)	(2.61)	(12.78)
BOI	0.235***	0.115***	0.0365*	0.254***	0.0292	0.0891***	0.0865**	0.0781***
	(7.90)	(5.61)	(1.98)	(6.40)	(1.29)	(3.40)	(2.95)	(3.63)
LnHERF	0.196***	0.427**	0.203**	0.216**	0.0374	0.299***	0.351	0.172**
	(3.32)	(2.87)	(2.80)	(2.84)	(0.46)	(4.19)	(1.91)	(3.01)
LnERP	-0.371***	-0.205*	-0.284***	-0.368***	-0.198***	-0.486***	-0.524***	-0.348***
	(-10.56)	(-2.29)	(-5.71)	(-8.80)	(-4.10)	(-11.22)	(-4.45)	(-10.23)
LnFORshare	0.873***	0.515***	0.745***	0.382	0.901***	0.566***	0.524***	0.738***
	(5.08)	(5.77)	(8.47)	(1.78)	(7.69)	(4.77)	(4.13)	(7.11)
LnEFOR4	0.367	0.0596	0.0730	0.401	0.0801	0.248	-0.0297	0.281
	(1.23)	(0.41)	(0.52)	(0.95)	(0.42)	(1.24)	(-0.13)	(1.68)
LnFOR_EFOR4	-0.988*	-0.664**	-1.128***	-1.133*	-1.319***	-1.225***	-0.444	-1.429***
	(-2.09)	(-3.15)	(-5.37)	(-2.00)	(-4.53)	(-4.38)	(-1.33)	(-5.82)
Observations	42534	6307	21571	27270	21470	27371	3457	45384
Adjusted R-sq	0.665	0.705	0.639	0.646	0.619	0.734	0.583	0.685

Notes: t-statistics in parentheses and ***,**, * indicates a statistical significance at 1, 5, 10 percent level, respectively.
Sources: Author's calculation

- **Measured by YFOR (Foreign output share)**

	Small	Large	Central	Not Central	Municipal	Not Municipal	Head	Single
LnFORshare	0.765***	0.390***	0.665***	0.0218	0.807***	0.427**	0.345*	0.635***
	(3.62)	(3.42)	(6.04)	(0.08)	(5.44)	(2.88)	(2.07)	(4.94)
LnYFOR4	0.471	0.173	0.199	0.871*	0.297	0.331*	0.140	0.408**
	(1.91)	(1.47)	(1.73)	(2.41)	(1.85)	(2.09)	(0.80)	(2.88)
LnFOR_YFOR4	-0.818	-0.488*	-0.956***	-0.959	-1.219***	-0.925***	-0.253	-1.218***
	(-1.88)	(-2.27)	(-4.59)	(-1.68)	(-4.13)	(-3.36)	(-0.73)	(-5.04)
Observations	42534	6307	21571	27270	21470	27371	3457	45384
Adjusted R-sq	0.665	0.705	0.639	0.646	0.618	0.734	0.583	0.685

Notes: t-statistics in parentheses and ***,**, * indicates a statistical significance at 1, 5, 10 percent level, respectively. Other independent variables (not reported here) are the same as in the case of EFOR above.
Sources: Author's calculation

Table 3: Effects of Foreign ownership on Labor Productivity in the Region

	(1)	(2)	(3)	(4)
LnKI	0.209***	0.191***	0.210***	0.191***
	(72.93)	(68.24)	(72.97)	(68.26)
LnMI	0.504***	0.471***	0.504***	0.471***
	(133.51)	(126.24)	(133.54)	(126.26)
LnL	0.154***	0.112***	0.153***	0.111***
	(39.57)	(29.03)	(39.43)	(28.88)
LnLQ	0.0563*	-0.0193	0.0558*	-0.0199
	(2.54)	(-0.90)	(2.52)	(-0.93)
LnAge	0.0649***	0.0469***	0.0650***	0.0469***
	(12.82)	(9.58)	(12.83)	(9.58)
BOI	0.0592***	0.0896***	0.0581***	0.0881***
	(3.41)	(5.30)	(3.34)	(5.20)
LnHERF	0.197***	0.241***	0.192***	0.237***
	(3.60)	(4.54)	(3.50)	(4.44)
LnERP	-0.376***	-0.361***	-0.371***	-0.357***
	(-11.44)	(-11.33)	(-11.30)	(-11.21)
LnFORshare	0.598**	0.876***	0.528*	0.714***
	(2.98)	(4.59)	(2.33)	(3.31)
LnEFOR4	-0.231	-0.444		
	(-0.86)	(-1.70)		
LnFOR_EFOR4	-0.745*	-0.303		
	(-2.08)	(-0.88)		
LnREG_EFOR	0.521	0.485		
	(1.76)	(1.70)		
LnFOR_REG_EFOR	-0.436	-1.249*		
	(-0.76)	(-2.30)		
LnReAvrRemu		0.415***		0.415***
		(55.53)		(55.54)
LnYFOR4			0.457	-0.0692
			(1.71)	(-0.27)
LnFOR_YFOR4			-1.302***	-0.478
			(-3.47)	(-1.32)
LnREG_YFOR			-0.143	0.178
			(-0.54)	(0.70)
LnFOR_REG_YFOR			0.488	-0.738
			(0.93)	(-1.47)
Observations	48841	48841	48841	48841
Adjusted R-sq	0.708	0.726	0.708	0.726

Notes: t-statistics in parentheses and ***,**, * indicates a statistical significance at 1, 5, 10 percent level, respectively. Model 2 is when a regional control variable (LnReAvrRemu) is included for EFOR case and Model 4 is for YFOR case. For the regional control variable, we use LnReAvrRemu as a regional control variable because the data in census does not provide enough observations for skilled wages and information on energy prices (The observations will be sharply reduced).
Sources: Author's calculation

Table 4: Impact of FOR on Labor productivity spillovers at 2-digit industry level (Notes: t-statistics in the parenthesis, Sources: Author's calculation)

Variables, R^2	Food products		Tobacco products		Textiles		Apparel		Leather and Footwear		Wood products		Paper products		Publishing and Printing		Chemicals		Rubber and Plastics	
	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large
	FDI Spillovers measured foreign employment share / foreign output share																			
LnFORshare	0.92	0.66	-1.35	-11.25	0.29	0.43	0.09	-0.13	0.29	0.13	0.62	-0.07	1.21	1.24	0.64	1.70	0.00	0.07	0.53	0.52
	(3.26)	(2.29)	(-1.65)	(-1.58)	(1.04)	(1.47)	(0.17)	(-0.31)	(0.56)	(0.24)	(0.80)	(-0.09)	(2.37)	(1.94)	(1.50)	(3.79)	(0.00)	(0.32)	(2.79)	(2.41)
EFOR	-1.94	-2.24	-1.70	-0.57	0.83	-0.24	-0.05	-0.35	-0.72	-0.97	0.59	7.81	-1.60	-1.48	-1.94	-2.50	0.02	0.13	-0.08	-0.02
	(-2.76)	(-3.00)	(-0.54)	(-0.04)	(1.25)	(-0.32)	(-0.04)	(-0.33)	(-0.74)	(-1.00)	(0.06)	(0.82)	(-2.22)	(-1.57)	(-2.06)	(-3.71)	(0.06)	(0.42)	(-0.26)	(-0.04)
Observations	12408	877	123	10	4519	488	2653	437	844	155	3287	266	745	208	1686	172	1844	457	1906	634
R^2	0.66	0.77	0.67	0.99	0.76	0.79	0.57	0.55	0.57	0.43	0.76	0.77	0.72	0.61	0.56	0.41	0.86	0.83	0.53	0.52
LnFORshare	0.00	0.29	-1.35	-11.25	0.15	0.49	0.09	-0.13	-0.03	-0.08	0.17	-0.28	1.15	1.19	0.82	1.92	-0.19	-0.29	0.46	0.54
	(0.01)	(0.93)	(-1.65)	(-1.58)	(0.46)	(1.47)	(0.17)	(-0.31)	(-0.06)	(-0.16)	(0.25)	(-0.53)	(2.20)	(1.81)	(1.27)	(2.73)	(-0.72)	(-1.14)	(2.15)	(2.15)
YFOR	0.81	-0.61	-5.90	-1.99	0.58	-0.21	-0.03	-0.21	0.01	-0.41	2.64	4.24	-0.76	-0.71	-2.84	-3.29	0.27	0.61	0.04	-0.05
	(1.49)	(-1.18)	(-0.54)	(-0.04)	(1.29)	(-0.44)	(-0.04)	(-0.33)	(0.01)	(-0.40)	(0.90)	(1.50)	(-2.00)	(-1.41)	(-1.48)	(-1.71)	(0.87)	(2.00)	(0.14)	(-0.13)
Observations	12408	877	123	10	4519	488	2653	437	844	155	3287	266	745	208	1686	172	1844	457	1906	634
R^2	0.66	0.77	0.67	0.99	0.76	0.79	0.57	0.55	0.57	0.43	0.76	0.77	0.72	0.61	0.56	0.39	0.86	0.83	0.53	0.52

Variables, R^2	Non-metallic mineral products		Basic metals		Metal products		Machinery and equipment		Electrical machinery		Communication equipment		Medical instruments		Motor vehicles		Transport equipment		Furniture	
	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large
	FDI Spillovers measured foreign employment share / foreign output share																			
LnFORshare	0.58	0.35	-0.23	-0.27	0.31	0.55	0.73	0.07	0.10	0.25	-0.18	-0.08	0.71	-0.32	0.19	0.41	0.82	0.48	0.12	0.34
	(1.68)	(0.91)	(-0.70)	(-0.71)	(1.15)	(1.74)	(2.78)	(0.29)	(0.26)	(0.60)	(-0.49)	(-0.20)	(0.76)	(-0.83)	(0.58)	(1.21)	(1.32)	(0.62)	(0.58)	(1.53)
EFOR	-1.84	-1.03	0.21	0.33	0.28	-0.16	-0.64	0.27	-0.20	-0.17	0.12	0.10	-0.73	0.30	0.18	-0.03	0.30	0.20	0.01	-0.08
	(-2.13)	(-1.13)	(0.42)	(0.52)	(0.64)	(-0.32)	(-2.50)	(0.98)	(-0.59)	(-0.48)	(0.39)	(0.31)	(-0.88)	(0.91)	(0.58)	(-0.10)	(0.71)	(0.49)	(0.04)	(-0.30)
Observations	4262	349	679	151	5159	428	1495	256	493	190	330	197	159	45	579	241	198	53	4609	601
R^2	0.62	0.52	0.71	0.76	0.60	0.49	0.63	0.47	0.65	0.49	0.60	0.54	0.58	0.49	0.69	0.67	0.67	0.73	0.68	0.63
LnFORshare	0.59	0.37	-0.33	-0.32	0.05	0.47	0.38	-0.13	-0.33	-0.19	-0.48	-0.33	0.76	-0.35	0.23	0.40	0.82	0.47	-0.04	0.26
	(1.61)	(0.88)	(-0.99)	(-0.89)	(0.17)	(1.24)	(1.25)	(-0.44)	(-0.82)	(-0.45)	(-1.50)	(-0.96)	(0.76)	(-0.85)	(0.70)	(1.18)	(1.34)	(0.62)	(-0.18)	(1.00)
YFOR	-1.58	-0.93	0.26	0.28	0.54	0.00	-0.13	0.38	0.20	0.25	0.44	0.39	-0.66	0.28	0.10	-0.01	0.19	0.13	0.20	0.03
	(-2.05)	(-1.15)	(0.74)	(0.71)	(1.50)	(0.00)	(-0.64)	(1.69)	(0.65)	(0.74)	(1.56)	(1.20)	(-0.81)	(0.95)	(0.42)	(-0.05)	(0.73)	(0.51)	(0.85)	(0.12)
Observations	4262	349	679	151	5159	428	1495	256	493	190	330	197	159	45	579	241	198	53	4609	601
R^2	0.62	0.52	0.71	0.76	0.60	0.49	0.62	0.48	0.65	0.50	0.60	0.55	0.58	0.50	0.69	0.67	0.67	0.73	0.68	0.63

Table B1: Statistical Summary of the Key variables for wage spillovers

Variable	Unit	Obs	Mean	Std. Dev.	Min	Max
LnAvrRemu	(ln) baht	37867	10.624	0.952	6.137	12.889
LnKI	(ln) baht	37867	11.637	1.911	2.069	20.218
LnMI	(ln) baht	37867	11.182	1.922	-4.094	20.100
LnL	(ln) workers	37867	2.713	1.357	0.693	9.262
LnLQ	(ln) workers	37867	0.570	0.208	0.000	0.693
LnAge	(ln) years	37867	2.109	0.854	0.000	4.595
LnHERF	(ln) proportion	37867	0.062	0.073	0.005	0.640
TECH	proportion	37867	4.571	17.944	-0.998	838.901
Government	zero-one dummy	37867	0.154	0.361	0.000	1.000
LnFORshare	(ln) proportion	37867	0.023	0.109	0.000	0.693
EX	zero-one dummy	37867	0.101	0.301	0.000	1.000
IM	zero-one dummy	37867	0.109	0.311	0.000	1.000
MUN	zero-one dummy	37867	0.471	0.499	0.000	1.000
Central	zero-one dummy	37867	0.506	0.500	0.000	1.000
JAP	zero-one dummy	37867	0.020	0.141	0.000	1.000
TCS	zero-one dummy	37867	0.014	0.118	0.000	1.000
US	zero-one dummy	37867	0.003	0.051	0.000	1.000
ProTech	zero-one dummy	37867	0.036	0.185	0.000	1.000
FormEcon	zero-one dummy	37867	0.091	0.287	0.000	1.000

Table B2: Robust Regression: Comparison of robust estimators for wage spillovers

LnAvrRemu	(1) reg	(2) rreg	(3) qreg	(4) mmreg
LnKI	0.0521***	0.0427***	0.0444***	0.0348***
LnMI	0.157***	0.130***	0.145***	0.122***
LnL	0.224***	0.212***	0.210***	0.198***
LnLQ	0.0660***	0.0902***	0.0928***	0.108***
LnAge	0.0174***	0.0103**	0.0100*	0.00745
LnHERF	-0.0662	0.0465	-0.0179	0.0885
TECH	-0.0102***	-0.0362***	-0.0183***	-0.0509***
Government	-0.621***	-0.523***	-0.617***	-0.529***
LnFORshare	0.136***	0.166***	0.150***	0.175***
Observations	37867	37867	37867	37867
Adjusted R-sq	0.604	0.756		

Notes: the above values are estimated results and ***,**, * indicates a statistical significance at 1, 5, 10 percent level, respectively.

(In the previous Table A2 and this table, **reg**: OLS with robust Standard Errors, **rreg**: Robust regression and the command computes a highly efficient M-estimator, **qreg**: Median regression and this estimator does protect against vertical outliers but not against bad leverage points, **mmreg**: the command computes a MM-estimator that combine high –breakdown point and high efficiency.)

Sources: Author's calculation

Table 5: Impact of Foreign Ownership (FOR) on Wages per worker (Wage spillovers: Dependent Variable; Remunerations per worker)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LnFORshare	0.136***	0.354***	0.324***	0.281***	0.262***	0.261***	0.264***	0.0991**
	(5.00)	(6.27)	(4.56)	(4.59)	(3.46)	(4.09)	(3.50)	(2.61)
LnEFOR4		0.360***		-0.522		-0.547*		
		(3.88)		(-1.78)		(-1.96)		
LnFOR_EFOR4		-0.897***		-0.0902		0.0674		
		(-6.48)		(-0.21)		(0.17)		
LnYFOR4			0.369***		-0.000343		-0.172	
			(4.80)		(-0.00)		(-0.62)	
LnFOR_YFOR4			-0.783***		-0.644		-0.447	
			(-5.91)		(-1.47)		(-1.06)	
LnEFOR2				1.009***		0.934**		
				(3.33)		(3.18)		
LnFOR_EFOR2				-0.801		-0.728		
				(-1.82)		(-1.75)		
LnYFOR2					0.399		0.467	
					(1.39)		(1.67)	
LnFOR_YFOR2					-0.0700		-0.0933	
					(-0.16)		(-0.22)	
EX						-0.0164	-0.0168	-0.0154
						(-1.51)	(-1.55)	(-1.42)
IM						0.0743***	0.0742***	0.0757***
						(7.39)	(7.38)	(7.52)
MUN						0.165***	0.165***	0.165***
						(26.56)	(26.57)	(26.59)
Central						0.356***	0.356***	0.357***
						(50.43)	(50.50)	(50.54)
JAP						-0.0562*	-0.0511	-0.00872
						(-2.02)	(-1.83)	(-0.34)
TCS						-0.0232	-0.0237	0.0383
						(-0.81)	(-0.81)	(1.51)
US						-0.0769	-0.0762	-0.0393
						(-1.29)	(-1.28)	(-0.68)
ProTech						-0.000334	-0.000372	0.000716
						(-0.02)	(-0.03)	(0.05)
FormEcon						0.0418***	0.0425***	0.0432***
						(4.24)	(4.32)	(4.40)
Observations	37867	37867	37867	37867	37867	37867	37867	37867
Adjusted R-sq	0.604	0.604	0.604	0.604	0.604	0.643	0.642	0.642

Notes: t-statistics in parentheses and ***,**, * indicates a statistical significance at 1, 5, 10 percent level, respectively. The same as in the case of productivity spillovers (Table 1), other independent variables (not reported here) are LnKI, LnMI, LnL, LnLQ, LnAge, LnHERF, and BOI and LnERP for productivity spillovers and TECH and Government for wage spillovers.
Sources: Author's calculation

Table 6: Impact of FOR by Plant size (Small, Large) / Location (Central or not) / Improved Production Technology (Yes, No) / Economic Form (Head Branch, Unit)

- **Measured by EFOR (Foreign employment share)**

	Small	Large	Central	Not Central	ProTech	No ProTech	Head	Single
LnKI	0.0592***	0.0458***	0.0309***	0.0708***	0.0395***	0.0524***	0.0429***	0.0538***
	(22.82)	(9.54)	(11.32)	(20.24)	(4.01)	(21.78)	(7.68)	(21.47)
LnMI	0.155***	0.107***	0.121***	0.154***	0.0997***	0.157***	0.0911***	0.158***
	(46.70)	(19.68)	(38.33)	(32.20)	(9.87)	(51.37)	(14.24)	(48.93)
LnL	0.333***	0.0425***	0.181***	0.213***	0.0785***	0.230***	0.0671***	0.243***
	(73.79)	(6.72)	(57.49)	(43.92)	(7.09)	(78.40)	(11.15)	(74.31)
LnLQ	0.112***	0.108***	0.0796***	0.0505*	0.170*	0.0681***	0.180***	0.0743***
	(5.95)	(3.78)	(4.27)	(2.13)	(2.56)	(4.09)	(4.51)	(4.28)
LnAge	0.0105*	0.0729***	0.00883	0.0237***	0.0766***	0.0161***	0.0663***	0.0143***
	(2.42)	(8.07)	(1.80)	(3.99)	(3.95)	(3.92)	(6.03)	(3.37)
LnHERF	-0.0280	0.0999	0.0274	-0.110	0.109	-0.0652	0.208	-0.0799
	(-0.55)	(1.23)	(0.57)	(-1.53)	(0.73)	(-1.39)	(1.86)	(-1.64)
TECH	-0.0104***	-0.00823***	-0.00939***	-0.0101***	-0.0120**	-0.0102***	-0.00902	-0.0102***
	(-13.33)	(-5.61)	(-8.07)	(-11.86)	(-3.21)	(-14.20)	(-1.65)	(-14.16)
Government	-0.658***	-0.820***	-0.852***	-0.367***	-0.504**	-0.620***	-0.833***	-0.615***
	(-45.03)	(-14.58)	(-19.70)	(-22.39)	(-3.04)	(-45.10)	(-3.54)	(-44.20)
LnFORshare	0.692***	0.236***	0.386***	0.157	0.425**	0.337***	0.393***	0.307***
	(6.89)	(4.49)	(7.05)	(1.07)	(3.18)	(5.64)	(4.23)	(4.57)
LnEFOR4	0.703***	0.307***	0.301***	0.478	0.402*	0.404***	0.212	0.495***
	(3.92)	(3.55)	(3.42)	(1.51)	(2.26)	(3.93)	(1.56)	(4.38)
LnFOR_EFOR4	-0.954**	-0.250*	-0.749***	-0.712	-0.647*	-0.934***	-0.535*	-0.987***
	(-3.04)	(-2.04)	(-5.70)	(-1.71)	(-2.27)	(-6.15)	(-2.49)	(-5.91)
Observations	31664	6203	19143	18724	1345	36522	3430	34437
Adjusted R-sq	0.558	0.512	0.51	0.491	0.331	0.596	0.302	0.583

Notes: t-statistics in parentheses and ***,**, * indicates a statistical significance at 1, 5, 10 percent level, respectively.
Sources: Author's calculation

- **Measured by YFOR (Foreign output share)**

	Small	Large	Central	Not Central	ProTech	No ProTech	Head	Single
LnFORshare	0.724***	0.149*	0.381***	0.0749	0.470**	0.278***	0.351**	0.254**
	(5.95)	(2.23)	(5.56)	(0.38)	(2.83)	(3.68)	(3.00)	(3.02)
LnYFOR4	0.605***	0.293***	0.291***	0.573*	0.335*	0.414***	0.198	0.506***
	(4.11)	(4.05)	(4.00)	(2.15)	(2.25)	(4.86)	(1.78)	(5.39)
LnFOR_YFOR4	-0.888**	-0.0997	-0.664***	-0.663	-0.622*	-0.774***	-0.399	-0.848***
	(-3.27)	(-0.84)	(-5.33)	(-1.62)	(-2.30)	(-5.32)	(-1.93)	(-5.30)
Observations	31664	6203	19143	18724	1345	36522	3430	34437
Adjusted R-sq	0.558	0.513	0.51	0.491	0.331	0.596	0.301	0.583

Notes: t-statistics in parentheses and ***,**, * indicates a statistical significance at 1, 5, 10 percent level, respectively. Other independent variables (not reported here) are the same as in the case of EFOR above.
Sources: Author's calculation

Table 7: Effects of Foreign ownership on Wages/Remunerations in the Region

	(1)	(2)	(3)	(4)
LnKI	0.0518***	0.0508***	0.0519***	0.0509***
	(22.04)	(22.81)	(22.09)	(22.83)
LnMI	0.156***	0.132***	0.156***	0.132***
	(52.55)	(46.15)	(52.57)	(46.16)
LnL	0.224***	0.184***	0.224***	0.184***
	(80.38)	(69.89)	(80.28)	(69.77)
LnLQ	0.0658***	0.0347*	0.0656***	0.0345*
	(4.04)	(2.20)	(4.03)	(2.19)
LnAge	0.0172***	0.00857*	0.0172***	0.00857*
	(4.25)	(2.25)	(4.27)	(2.25)
LnHERF	-0.0586	-0.00166	-0.0613	-0.00350
	(-1.29)	(-0.04)	(-1.35)	(-0.08)
TECH	-0.0102***	-0.0103***	-0.0102***	-0.0103***
	(-14.26)	(-14.55)	(-14.26)	(-14.55)
Government	-0.620***	-0.437***	-0.620***	-0.436***
	(-45.47)	(-31.58)	(-45.46)	(-31.56)
LnFORshare	0.465**	0.828***	0.444**	0.722***
	(3.19)	(6.73)	(2.82)	(5.41)
LnEFOR4	0.127	-0.0520		
	(0.75)	(-0.33)		
LnFOR_EFOR4	-0.589*	-0.195		
	(-2.49)	(-0.90)		
LnREG_EFOR	0.274	0.257		
	(1.50)	(1.52)		
LnFOR_REG_EFOR	-0.649	-1.617***		
	(-1.63)	(-4.68)		
LnReAvrRemu		0.379***		0.380***
		(69.46)		(69.49)
LnYFOR4			0.429*	-0.0522
			(2.41)	(-0.33)
LnFOR_YFOR4			-0.851***	-0.0986
			(-3.36)	(-0.43)
LnREG_YFOR			-0.0778	0.239
			(-0.45)	(1.54)
LnFOR_REG_YFOR			-0.169	-1.520***
			(-0.44)	(-4.60)
Observations	37867	37867	37867	37867
Adjusted R-sq	0.604	0.648	0.604	0.647

Notes: t-statistics in parentheses and ***,**, * indicates a statistical significance at 1, 5, 10 percent level, respectively. Model 2 is when a regional control variable (LnReAvrRemu) is included for EFOR case and Model 4 is for YFOR case. For the regional control variable, we use LnReAvrRemu as a regional control variable because the data in census does not provide enough observations for skilled wages and information on energy prices (The observations will be sharply reduced).
Sources: Author's calculation

Table 8: Impact of FOR on Wage spillovers at 2-digit industry level (Notes: t-statistics in the parenthesis, Sources: Author's calculation)

Variables, R^2	Food products		Tobacco products		Textiles		Apparel		Leather and Footwear		Wood products		Paper products		Publishing and Printing		Chemicals		Rubber and Plastics	
	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large
	FDI Spillovers measured foreign employment share / foreign output share																			
LnFORshare	0.44	-0.02	-1.12	N/A	0.07	0.35	-0.25	-0.12	-0.23	-0.32	0.46	0.52	0.36	0.46	0.21	0.30	-0.17	0.13	0.33	0.41
	(2.06)	(-0.13)	(-1.41)	N/A	(0.46)	(2.38)	(-0.68)	(-0.44)	(-0.72)	(-1.03)	(0.97)	(0.99)	(1.19)	(1.44)	(0.78)	(1.03)	(-1.20)	(0.89)	(3.28)	(3.58)
EFOR	-1.02	-0.35	1.34	N/A	0.43	0.43	0.79	0.82	0.38	0.30	-5.72	-2.49	-0.77	-0.83	-1.14	-0.17	0.29	0.03	0.10	-0.15
	(-1.79)	(0.52)	(0.59)	N/A	(1.01)	(1.06)	(0.89)	(1.07)	(0.54)	(0.40)	(-1.27)	(-0.76)	(-1.32)	(-1.25)	(-1.33)	(-0.21)	(1.11)	(0.10)	(0.47)	(-0.66)
Observations	8318	878	77	N/A	3775	478	2153	435	680	153	2213	257	685	207	1386	172	1571	448	1864	641
R^2	0.55	0.62	0.67	N/A	0.68	0.70	0.53	0.51	0.47	0.26	0.65	0.60	0.62	0.35	0.52	0.15	0.78	0.69	0.38	0.25
LnFORshare	-0.07	-0.11	-1.12	N/A	0.08	0.37	-0.25	-0.12	-0.27	-0.38	0.37	0.58	0.37	0.49	0.18	-0.07	-0.06	0.19	0.14	0.27
	(-0.34)	(-0.52)	(-1.41)	N/A	(0.43)	(1.97)	(-0.68)	(-0.44)	(-0.85)	(-1.17)	(0.72)	(1.07)	(1.23)	(1.53)	(0.43)	(-0.17)	(-0.40)	(1.31)	(1.20)	(2.14)
YFOR	0.63	-0.01	4.45	N/A	0.18	0.15	0.49	0.51	0.44	0.41	-1.69	-1.39	-0.44	-0.50	-1.15	1.17	0.04	-0.07	0.44	0.14
	(1.35)	(-0.03)	(0.59)	N/A	(0.60)	(0.49)	(0.89)	(1.07)	(0.65)	(0.57)	(-1.08)	(-0.99)	(-1.34)	(-1.33)	(-0.72)	(0.69)	(0.20)	(-0.33)	(2.26)	(0.61)
Observations	8318	878	77	N/A	3775	478	2153	435	680	153	2213	257	685	207	1386	172	1571	448	1864	641
R^2	0.55	0.62	0.67	N/A	0.68	0.70	0.53	0.51	0.47	0.26	0.65	0.60	0.62	0.35	0.52	0.16	0.78	0.69	0.38	0.24

Variables, R^2	Non-metallic mineral products		Basic metals		Metal products		Machinery and equipment		Electrical machinery		Communication equipment		Medical instruments		Motor vehicles		Transport equipment		Furniture	
	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large	All	Large
	FDI Spillovers measured foreign employment share / foreign output share																			
LnFORshare	0.71	0.39	0.31	0.09	-0.22	-0.06	0.22	0.01	0.10	0.27	-0.29	-0.36	0.50	0.13	0.43	0.55	-0.29	0.10	-0.02	0.17
	(2.86)	(1.41)	(1.47)	(0.43)	(-1.14)	(-0.34)	(1.30)	(0.08)	(0.51)	(1.54)	(-1.36)	(-1.91)	(1.48)	(0.27)	(2.11)	(2.64)	(-0.84)	(0.24)	(-0.17)	(1.21)
EFOR	-0.74	-0.15	0.16	0.62	0.45	0.56	-0.23	0.41	-0.06	0.10	0.49	0.50	-0.55	-0.26	-0.27	-0.35	0.56	0.43	0.59	0.40
	(-1.33)	(-0.24)	(0.44)	(1.35)	(1.28)	(1.63)	(-1.05)	(1.97)	(-0.25)	(0.44)	(2.34)	(2.66)	(-1.25)	(-0.46)	(-0.92)	(-1.18)	(1.24)	(0.96)	(3.01)	(1.83)
Observations	3620	350	619	151	4428	428	1329	256	463	190	317	197	139	45	556	240	176	53	3423	590
R^2	0.52	0.34	0.56	0.44	0.53	0.19	0.52	0.24	0.52	0.26	0.49	0.33	0.49	0.45	0.52	0.27	0.63	0.50	0.61	0.66
LnFORshare	0.59	0.36	0.45	0.24	-0.42	-0.25	0.10	-0.08	0.02	0.19	-0.29	-0.40	0.27	0.12	0.39	0.51	-0.29	0.10	-0.09	0.14
	(2.27)	(1.25)	(2.05)	(1.04)	(-1.99)	(-1.24)	(0.51)	(-0.49)	(0.10)	(1.05)	(-1.52)	(-2.23)	(0.64)	(0.25)	(1.91)	(2.49)	(-0.85)	(0.23)	(-0.58)	(0.82)
YFOR	-0.31	-0.05	-0.09	0.20	0.64	0.72	-0.04	0.43	0.04	0.18	0.57	0.63	-0.19	-0.22	-0.16	-0.23	0.39	0.30	0.61	0.39
	(-0.60)	(-0.09)	(-0.35)	(0.59)	(2.28)	(2.50)	(-0.21)	(2.18)	(0.21)	(0.89)	(2.68)	(3.06)	(-0.38)	(-0.41)	(-0.71)	(-1.00)	(1.26)	(0.98)	(2.91)	(1.58)
Observations	3620	350	619	151	4428	428	1329	256	463	190	317	197	139	45	556	240	176	53	3423	590
R^2	0.52	0.34	0.56	0.43	0.53	0.20	0.52	0.25	0.52	0.27	0.49	0.34	0.49	0.45	0.52	0.27	0.63	0.50	0.61	0.66

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