



Third World MNEs and Its Spillover Effect: Evidence of Thai Manufacturing

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Abstract

The paper examines the technology spillovers of multinational enterprises (MNEs) using the Thai manufacturing as a case study with a view to informing prudential policies for host countries' governments to maximize the benefit from their presence. The four latest industrial censuses of Thailand (i.e., data for 2006, 2011, 2016, and 2021) are used in our inter-plant panel data regression analysis. The key finding is that the horizontal technology spillovers from MNE affiliates to indigenous firms within a given industry do not always take place, but are conditioned by the trade policy regime and the firms' absorptive capabilities. In the restrictive trade policy regime, the presence of MNE affiliates could adversely affect indigenous firms' productivity. The vertical technology spillover, particularly forward linkage from MNE affiliates, is negative as the restrictive trade policy regime discourages engagement between MNE affiliates and indigenous firms. Regardless of the origin of MNEs, their entry motivated by the presence of the proprietary asset could bring in the technology spillover. The extent to which host countries benefit from the spillover is determined by the absorptive capability and trade policy environment in the host countries.

Keywords: MNEs, TWMNEs, EMMNEs, Thai Manufacturing, FDI technology spillovers

1 Introduction

Countries around the globe compete fiercely to attract multinational enterprises (MNEs) to set up their affiliates. This is done with the hope that their direct investment could bring in various benefits to the host investment-receiving countries (henceforth referred to as host countries for brevity), such as additional capital, job creation, and advanced technologies and know-how. All could contribute to spur economic growth (Kohpaiboon, 2006a; Harding & Javorcik, 2011). Among these benefits, the technology spillovers¹ – MNE affiliates could enhance the productivity of indigenous firms – are arguably the most desired benefit developing countries want.

¹ Technological spillover refers to the productivity gain that indigenous firms benefit from the presence of MNE affiliates.

In the technology spillovers literature, one consensus argues that the spillovers do not always take place (Crespo & Fontoura, 2007; Rojec & Knell, 2017). The subsequent research direction is to gain a better understanding of factors in determining the technology spillovers. In some cases, the presence of MNE affiliates could lower indigenous firms' productivity, i.e., negative technology spillovers (e.g., Aitken & Harrison, 1999; Feinberg & Majumdar, 2001).

While there have been two key determinants of the technology spillovers, i.e. indigenous firms' absorptive capability, and the nature of trade policy (Crespo & Fontoura, 2007; Rojec & Knell, 2017), the latter has been overlooked in the empirical studies. This could be partly due to the difficulty in quantifying the nature of trade policy regimes across sectors. Interestingly, only the nature of trade policy can convincingly explain the found negative effect of MNE affiliates on indigenous firms' productivity in many host countries (Kohpaiboon, 2006a, 2006b).

In recent studies, linkages with these MNEs are claimed to be a more promising channel for technology spillovers than the others (Javorcik, 2004; Blalock & Gertler, 2008; Arif-Ur-Rahman & Inaba, 2021). The spillover through the linkage channel occurs as a result of the interaction between MNE affiliates and their indigenous firms in both upstream and downstream industries (i.e. backward and forward linkage channels, respectively). The spillover through the linkage channels is referred to as the vertical spillover (e.g., Blalock & Gertler, 2008; Arif-Ur-Rahman & Inaba, 2021). The empirical results examining the presence of the vertical spillover are found in some studies.

Another strand in the FDI determinant literature is the rise of MNEs from developing countries. It is often referred to as the third world MNEs or TWMNEs.² Until around the new millennium, MNEs from developed countries (often referred to as the first world MNEs or FWMNEs) played the dominant role as the direct investors. Since then, TWMNEs have gained their relative importance, especially China in the new millennium. The share of TWMNEs in the global direct investment surged, from 10 per cent in 2003 to 21 percent in 2021.³ Interestingly, the spillover from TWMNEs is expected to be different from FWMNEs, as argued in a number of empirical studies.⁴ Unlike FWMNEs, these TWMNEs might not own many proprietary assets before investing abroad. All other things being equal, the expected technology spillover would be less. By contrast, the technology gap between TWMNEs and indigenous firms could be narrower. This could facilitate the technology spillover to benefit the latter. Examining it is immensely policy relevant as the number of firms from developing countries investing abroad is growing, the empirical studies on this issue remains sparse and focused on TWMNEs' investment motivation. The exception is Amighini and Sanfilippo (2014).

Against this backdrop, the paper examines the technology spillovers of MNEs, where both horizontal and vertical technology spillovers are incorporated in our analysis. In the former, both absorptive capabilities of indigenous firms and the nature of trade policy regimes are hypothesized as the key determinant factors. In addition, FDI will be further decomposed into FWMNEs and TWMNEs to examine the possible difference of FDI spillovers to host countries.

² Recently, they have been alternatively referred to as emerging market MNEs (EMMNEs) (Xia et al., 2024).

³ The share of foreign direct investment data is from UNCTAD.

⁴ See, for example, Wells (1977, 1978), Lecraw (1977), Luo & Tung, (2007, 2018), Deng (2009), and Mathews (2006, 2017).

2 Analytical Framework

The issue in hand is related to two strands of FDI literature, i.e. FDI technology spillovers and third world MNEs (TWMNEs). In the FDI technology spillover literature, it is widely recognized that presence of MNEs in the host countries could potentially enhance productivity of indigenous firms. When decided to set up affiliates abroad, MNEs often transfer advanced technologies to their affiliates to ensure their business survival in host countries. Since technology is quasi public goods as it can be partially excludable and non-rivalrous, these advanced technologies could not fully be internalized. Therefore, presence of MNEs' affiliates could create positive externalities that benefit indigenous firms' productivity, i.e., presence of technology spillover (Javorcik, 2004; Keller, 2004).

The technology spillovers from MNE affiliates can take place to indigenous firms within the same industry and those in the upstream and downstream industries, known as the horizontal and vertical spillover, respectively. In the former, the presence of MNE affiliates could add competitive pressure, so these local firms must enhance their productivity to survive. The latter occurs through the linkage between MNE affiliates in each industry and indigenous firms in its upstream and downstream industries. The linkage could force their indigenous supplier to meet the demand for certain quality, on-time delivery, and be more innovative by MNEs' affiliates, and enhance their productivity. Similarly, MNE affiliates could supply previously unavailable inputs and introduce new production processes and technologies, thereby improving the productivity of their customers (Jindra et al., 2009; Kohpaiboon & Jongwanich, 2013).

Empirical studies found that the horizontal spillovers are not always found, depending on the absorptive capability of indigenous firms and the trade policy regime. The role of the former is straight forward. The greater the absorptive capability, the greater the spillovers, all other things being equal (Cohen & Levinthal, 1989; Narula & Marin, 2003; Okunade et al., 2022). By contrast, the role of trade policy regime is rather complicated, derived from the immiserizing growth theory postulated by Bhagwati (1973), modified by Kohpaiboon (2006a). In the restrictive trade policy regime, MNEs are enticed by highly protected domestic markets and compete directly with their indigenous counterparts. In this environment, it is more difficult for the latter to learn from the former. Instead, the highly protected domestic market could encourage the local firm to produce products not directly competitive with those being produced by the foreign affiliate and to enjoy economic rents induced by the regime (Kokko, 1994). By contrast, in the more liberal trade policy regime, MNEs want to set up affiliates and make use of the host countries' comparative advantage for exports. In this circumstance, advanced technologies associated with these affiliates are more in line with the host country's comparative advantage (Moran, 2001). All other things being equal, it is less costly for indigenous firms to benefit from these advanced technologies. Under these circumstances, the horizontal spillovers are expected to be higher.

Nonetheless, the previous empirical studies have been lopsided, solely focusing on the absorptive capability as the key determinant of the horizontal spillovers (Crespo & Fontoura, 2007; Rojec & Knell, 2017). This could be partly due to the difficulty in quantifying the nature of trade policy regimes across sectors. Nonetheless, focusing solely on the absorptive capability seems unsatisfactory to explain the found negative horizontal spillover in many cases (e.g., Aitken & Harrison, 1999; Feinberg & Majumdar, 2001). When the absorptive capabilities are limited, indigenous firms would not benefit from the presence of MNE affiliates, i.e., zero spillover.

Since the new millennium, the vertical spillovers have gained research attention especially backward linkages. Given the mechanism through which vertical spillovers occur, both

MNEs and their suppliers jointly benefit from the suppliers' productivity improvements. The argument is applicable to the case of the forward linkage. Therefore, MNEs have no incentive to prevent such spillovers from occurring. This contrasts with the horizontal spillovers whose mechanism is not such clear as the vertical spillover. However, the positive vertical spillovers are found in Newman et al. (2015) and Fujimori and Sato (2015) for Romania, Vietnam, and India, respectively, but not in Barge-gil et al. (2020) and Mei (2021), in the case of Spain and the panel of 32 countries, respectively.

TWMNEs are not new, firstly mentioned in the early 1990s, referred to differently in the FDI literature, such as emerging market multinational enterprises (EMNEs), Global South MNEs. They all reflect multinational enterprises from developing economies setting up affiliates abroad (Wells, 1983; Xia et al., 2024). It began with firms from Newly Industrialized Economies in East Asia (Korea, Taiwan, and Singapore) in the 1990s, followed by China in the new millennium. As a result, TWMNEs accounted for 31% of total FDI outflows, averaged out from 2021 to 2023, from less than 10% in the early 2000s.⁵

Motivations of TWMNEs are diverse, including acquiring strategic assets and strengthen their proprietary assets, natural resource seeking, as well as politics. With the variety of motivation, the horizontal spillovers from TWMNEs could be different from FWMNEs (Yang & Zheng, 2021; Knoerich, 2024). On the one hand, TWMNEs' technologies transferred to their affiliates might be less advanced comparing to those from FWMNEs. In this situation, the spillover from TWMNEs can be less compared to FWMNEs, all other things being equal (Wells, 1977, 1978; Lecraw, 1977; Cui et al., 2014). However, this implies that the technology gap between TWMNEs' affiliates and indigenous firms could be narrower. Such a gap might be beneficial to indigenous firms in the host country to benefit from them. Hence, the spillover from TWMNE affiliates could be greater than that from FWMNEs. On the one hand, these MNEs have yet to develop a sophisticated system for transferring management skills and rely heavily on the expatriate staff for maintaining control (Kumar & Kim, 1981; Lecraw, 1977). In this circumstance, the process of employing nationals might be slow, and they are not likely to provide a continuous flow of upgraded technologies to their affiliates.

Nonetheless, the empirical studies examining the possible spillovers of TWMNEs remain sparse. Many, such as Pananond (2007, 2013) as well as Pananond and Zeithaml (1998) for Thailand, and Luo and Tung (2018) and Mathews (2017) for other countries, focused on their characteristics, motivations, and behavior. The exception is Amighini and Sanfilippo (2014), which explicitly compare the impact of North-South and South-South flows and find that their effects are different. So far, these two strands of the literature have not been systematically combined under a common analytical framework. As the race of competing for investment flows of MNEs and the increasing importance of TWMNEs are expected to continue in the foreseeable future. Combining them is crucial for designing prudential policies that maximize the benefits of MNEs.

3 Empirical Analysis

3.1 The Empirical Model

According to the standard practice in the FDI technology spillover literature, the productivity equation of indigenous firms is estimated with MNE presences included as one of the

⁵ Data are from UNCTAD available at <https://unctadstat.unctad.org/datacentre/dataviewer/US.FdiFlowsStock> retrieved by 19 December 2024.

explanatory variables. Its corresponding coefficient indicates the presence of spillover. Guided by well-relevant theories, a set of firms and industry-specific factors is also controlled. It is expressed in Equation 1;

$$Prod_{i,j,t} = f(HFOR_{j,t}, VFOR_{j,t}, F_{i,j,t}, I_{j,t}) \quad (1)$$

$Prod_{i,j,t}$ = Productivity of indigenous firm i^{th} of industry j^{th} at time t

$HFOR_{j,t}$ = Foreign presence in industry j^{th} at time t , i.e. horizontal FDI

$VFOR_{j,t}$ = Foreign presence in industries linking with industry j^{th} at time t , i.e. vertical FDI.

$F_{i,j,t}$ = Firm specific controlling factors of firm i^{th} in industry j^{th} at time t

$I_{j,t}$ = Industry specific controlling factors of industry j^{th} at time t

In this study, indigenous firms' productivity ($Prod_{i,j,t}$) is measured by total factor productivity (TFP). The Levinsohn and Petrin (LP) approach (Levinsohn & Petrin, 2003) is used to estimate total factor productivity (TFP) of indigenous firms while taking into consideration the endogeneity of input choices. According to the LP approach, intermediate inputs are used as a proxy for the unobserved determinants. MNE affiliates are plants with a foreign ownership share greater than or equal to 10 per cent. This is in line with the standard practice used by IMF (2009) and OECD (2008). The output share of foreign firms is used to measure foreign presence.⁶ $HFOR_{j,t}$ foreign presence in industry j^{th} at time t , is measured by the output share of foreign firms to all firms.

As argued above, spillover from $HFOR_{j,t}$ depends on 2 factors: (1) absorptive capability ($QL_{i,j,t}$) and (2) trade policy regime ($TP_{j,t}$). Hence the interaction term between $HFOR_{j,t}$ and them are introduced, i.e., $HFOR_{j,t} * QL_{i,j,t}$ and $HFOR_{j,t} * ERP_{j,t}$. The ERP formula is as in Equation 2:

$$ERP_{j,t} = \frac{t_{j,t} - \sum_{i=1}^n a_{i,j,t}^* t_{i,t}}{1 - \sum_{i=1}^n a_{i,j,t}^*} \quad (2)$$

Where

$t_{j,t}$ = Tariff on product j at time t

$t_{i,t}$ = Tariff on product i at time t

$a_{i,j,t}^*$ = Share of product i used in producing product j at time t .

⁶ The econometric results remain robust when the employment and capital shares are employed. The results are available from the author upon request.

According to the literature, there are several proxies for absorptive capability ($QL_{i,j,t}$), such as the skill composition of the workers (Girma, 2005) and R&D intensity (Cohen & Levinthal, 1990). Following the literature, this study uses the ratio of supervisory and management workers to total employment, as supervisory and management workers are regarded as skilled labor. A higher ratio reflects higher labor quality and, consequently, a greater ability to absorb external knowledge, thereby indicating higher absorptive capability. Hence, the sign of the coefficient corresponding to $QL_{i,j,t}$ is hypothesized to be positive.⁷

The trade policy regime⁸ ($TP_{j,t}$) is proxied by $ERP_{j,t}$. The higher the ERP, the more restrictive the trade policy regime, and thereby the negative sign of the coefficient is expected. The calculation of ERP requires both tariff data from the WTO website and Thailand's input-output tables from NESDC. The variable is constructed using the input-output tables of 2005, 2010, 2015, and 2020, together with tariff data of 2006, 2011, 2016, and 2021, respectively. The data used are either before or the same year as the industrial censuses. The lag nature of the ERP variable could mitigate the simultaneity in the regression analysis to a certain extent. In the process, a harmonized system (HS) to I-O code conversion is implemented to align the classification of tariffs with the I-O code. Subsequently, another conversion (I-O code to ISIC rev 4) is then applied to match the ERP to the census classification.

In this study, $VFOR_{j,t}$ is further separated into backward and forward linkages, i.e., $VBFOR_{j,t}$ and $VFFOR_{j,t}$, respectively. Input-output coefficients from Thailand's input-output table are used. In line with the standard practice in the literature (Blalock, 2001; Javorcik, 2004; and Blalock & Gertler, 2008), the backward linkage of foreign presence of industry j^{th} ($DBFOR_{j,t}$) is measured by $\sum_{i=1}^n a_{i,j} * HFOR_{i,t}$ where $a_{i,j}$ indicates derived demand for units of industry i^{th} 's output from producing a unit of industry j^{th} 's output. Similarly, the forward linkage of foreign presence of industry j^{th} ($DFFOR_{j,t}$) is measured by $\sum_{k=1}^n a_{j,k} * HFOR_{k,t}$.

To examine the possible difference of the spillovers from FWMNEs and TWMNEs, $HFOR_{j,t}$ is further divided into developed and developing countries.⁹

The first set of firm-specific factors captures the effect of the extent to which firms are exposed to the world. This includes whether a plant under consideration exports its output ($mkt_{i,j,t}$) or uses imported raw material ($imp_{i,j,t}$). The second set is the firms' effort to increase productivity, such as R&D investment ($RD_{i,j,t}$) and the skill intensity ($QL_{i,j,t}$). Firms' productivity is positively affected by these variables in theory.

⁷ In theory, the firm's R&D intensity ($RDS_{i,j,t}$) is potential alternative proxy for absorptive capability. Such an option is not feasible in the current study due to the data quality problem. When R&D expenditures were collected in the industrial censuses, they are vaguely defined, covering not only research cost but also expenditures on planning, development, and hiring experts. This would explain the estimation results based on R&D intensity are not economically sensible, i.e., its corresponding coefficient turns out to be negative.

⁸ Note that Thailand has been relied less on non-tariff measures especially for the manufacturing products. Hence, this study will solely focus on the tariff measures.

⁹ Gross national income in 2006 is used to identify the developed vs developing country status. According to the World Bank. (2007) World Development Report 2008, developed countries are those whose gross national income (GNI) per capita exceeded \$11,116 USD.

Four industry-specific factors. The export–output ratio ($XOR_{j,t}$) and import penetration ratio ($MPR_{j,t}$) are included to capture the effect of international competitive pressure on firms’ productivity. To capture the domestic competitive pressure, the sales concentration ratio is used ($HHF_{j,t}$). All of them are expected to attain a positive relationship with productivity.

The last industry-specific factor is the protection. The effect of ERP on plant productivity is ambiguous (e.g., Corden, 1974; Topalova & Khandelval, 2011). While protection could provide economic rents that can be used for productivity-improving activities, it can also be the opposite in practice. Because protecting firms from foreign competition tends to induce producers to become ‘unresponsive’ to improve technological capability as well as their quality and price (De Melo & Urata, 1986; Moran, 2001). This results in a general deterioration of technological and management skills. The protection can be proxied by the effective rate of protection (ERP).

All in all, the empirical model is as follows;

$$TFP_{i,j,t} = \alpha_0 + \alpha_1 HFOR_{j,t} + \alpha_2 HFOR_{j,t} * ERP_{j,t} + \alpha_3 HFOR_{j,t} * QL_{i,j,t} + \alpha_4 DFFOR_{j,t} + \alpha_5 DBFOR_{j,t} + \alpha_6 QL_{i,j,t} + \alpha_7 RDD_{i,j,t} + \alpha_8 imp_{i,j,t} + \alpha_9 mkt_{i,j,t} + \alpha_{10} ERP_{j,t} + \alpha_{11} HHF_{j,t} + \alpha_{12} XOR_{j,t} + \alpha_{13} MPR_{j,t} + \varepsilon_{i,j,t} \quad (3)$$

Tables 1 presents the statistical summary of the key variables used in the analysis.

Table 1: Statistical summary of the key variables

Variable	Obs	Mean	Std. Dev.	Min	Max
$TFP_{i,t}$	12556	10.05	1.32	3.18	18.10
$HFOR_{i,t}$	12684	0.17	0.14	0	0.69
$TWMNE_{i,t}$	12684	0.03	0.05	0	0.57
$DFFOR_{i,t}$	12656	0.23	0.19	0.01	1.16
$DBFOR_{i,t}$	12656	0.23	0.27	0	1.36
$QL_{i,t}$	12684	0.47	0.22	0	0.69
$RDD_{i,t}$	12684	0.34	0.48	0	1.00
$RDS_{i,t}$	12684	0.00	0.02	0	1.53
$imp_{i,t}$	12684	0.07	0.16	0	0.69
$mkt_{i,t}$	12684	0.08	0.19	0	0.69
$MPR_{i,t}$	12684	0.04	0.18	0	4.09
$XOR_{i,t}$	12684	0.04	0.17	0	3.30
$CR4_{i,t}$	12559	0.26	0.12	0.05	0.69

Variable	Obs	Mean	Std. Dev.	Min	Max
HHF_{it}	12684	0.05	0.06	0	0.68
ERP_{it}	12512	0.24	0.24	-0.54	1.15
$output_{it}$	12653	11.21	1.19	3.14	14.56

Note: All variables are expressed in logarithmic form, except for the dummy variables $RDD_{i,j,t}$.
Source: Authors' computations.

3.2 Econometric Procedure

The standard panel data econometric analysis is undertaken to examine whether indigenous firms' productions were affected by the presence of MNE affiliates. Both fixed- and random-effect estimations are first undertaken to illustrate the nature of unobserved heterogeneity — differences across entities (e.g., firms, industries, years) that cannot be directly observed, but affect the dependent variable. The Hausman test is used to examine the nature of unobserved heterogeneity.

As pronounced in the previous empirical studies in examining FDI technology spillover, the standard panel regression analyses above are subject to severe endogeneity problems. The revealed statistical relationship between foreign presence, both horizontally and vertically, and productivity of indigenous firms could simply reflect the effect of these unobserved factors on them instead of their causal relationship. To guard against such an endogeneity problem, the instrumental variable high-dimensional fixed effects are employed (IVHDFE).

Due to the nature of plant-level datasets, the cross-sectional variability is considerably large and makes the heteroskedasticity problem severe (Juhl & Sosa-Escudero, 2014). The problem is worsened in the presence of the aggregate industry or public policy variables as the controlling variables. The variance of the residuals in the datasets is derived from not only intra-group but also inter-group ones. As a result, residuals could exhibit clustering patterns. To address the heteroskedasticity problem, the standard errors based on VCE (Variance-Covariance Estimation) clustering by firm are used (Moulton, 1990; Bertrand et al., 2004; Stock & Watson, 2008; Woodridge, 2010).

4 Results

Our analysis starts with the standard panel regression estimations, i.e., fixed- and random-effect models¹⁰ (FE and RE models, respectively) (Table 2). They are reported in Column 2.1 and 2.2, respectively. The results are quite different between the FE and RE models. The result of the Hausman test, which is rejected at the 1 per cent level of statistical significance, suggests the FE model is preferable in the estimation.

¹⁰ One key firm-specific variable, QL_{ijt} , is not included in our analysis simply because including it causes many key variables in our analysis to be statistically insignificant. This could be a result of the severe multicollinearity problem with its interaction terms with $HFOR_{it}$. As our main research focus is the spillover, QL_{ijt} is therefore dropped from the estimation.

The FE model is re-estimated by HDFE estimation, where more dimensions of the fixed effects are controlled (Column 2.3).¹¹ The reported standard error is also based on the variance-covariance matrix (VCE) clustering by firm.¹² The main difference between FE and HDFE estimation results is that the coefficients corresponding to most of the industry-specific factors ($XOR_{j,t}$, $MPR_{j,t}$, $HHF_{j,t}$) turn out to be statistically insignificant. Their effect on the FE estimation result would be captured by the industry fixed effect in the HDFE estimation, so that their statistical significance in the latter disappears.

Table 2: Estimation results of panel data analysis

	2.1 FE		2.2 RE		2.3 HDFE	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
$HFOR_{i,t}$	-0.084	0.339	0.167	0.184	-0.035	0.436
$HFOR_{i,t} * ERP_{i,t}$	-0.162	0.704	0.533	0.153	-0.450	0.336
$HFOR_{i,t} * QL_{i,t}$	0.024	0.442	-0.249	0.053*	0.047	0.390
$DFFOR_{i,t}$	-0.137	0.173	-0.094	0.195	-0.494	0.018**
$DBFOR_{i,t}$	-0.012	0.453	0.274	0.000***	-0.271	0.072*
$RDD_{i,t}$	0.142	0.000***	0.199	0.000***	0.257	0.000***
$imp_{i,t}$	0.070	0.221	0.393	0.000***	0.114	0.092*
$mkt_{i,t}$	0.317	0.000***	0.745	0.000***	0.327	0.000***
$ERP_{i,t}$	0.130	0.241	-0.087	0.297	0.286	0.035**
$HHF_{i,t}$	-0.146	0.263	0.113	0.285	-0.092	0.374
$XOR_{i,t}$	1.010	0.010**	0.600	0.045**	0.859	0.149
$MPR_{i,t}$	-1.082	0.003***	-0.611	0.031**	-0.749	0.138
Year fixed effects	-		-		Yes	
Firm fixed effects	Yes		No (Random effects)		Yes	
Industry fixed effects	-		-		Yes	

¹¹ Alternative specifications of $HHF_{i,t}$ and $RDD_{i,t}$ using the cumulative share of top-4 firms' sales to total sales of a given industry ($CR4_{i,t}$) and the firm's R&D intensity ($RDS_{i,t}$), were also examined. Since $CR4_{i,t}$ yields results similar to $HHF_{i,t}$, and $RDS_{i,t}$ produces effects opposite to those expected in the literature and lacks statistical significance, $HHF_{i,t}$ and $RDD_{i,t}$ are retained as the main measures. These results are available from the author upon request.

¹² The overall results estimated without clustering remain largely unchanged. However, to account for potential heteroskedasticity, which may be substantial, the clustered standard errors are retained. The results estimated without clustering are available from the author upon request.

	2.1 FE		2.2 RE		2.3 HDFE	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Clustered SE	No		No		Firm	
No. of observations	11,150		11,150		10,999	
No. of groups	3,094		3,094		2,945	
Prob > F	0.0000		-		0.0000	
Wlad chi2 (prob>chi2)	-		0.0000		-	
R ² -within	0.011		0.007		0.011	
R ² -between	0.016		0.149		-	
R ² -overall	0.016		0.068		-	
R ²	-		-		0.647	
Adj R ²	-		-		0.508	
Hausman test	0.0000				-	

*** $p < .01$, ** $p < .05$, * $p < .1$

Note: All variables are expressed in logarithmic form, except for the dummy variable $RDD_{i,j,t}$

Source: Authors' computations

Given the potential endogeneity of the key explanatory variable (horizontal and vertical foreign presence), the analysis proceeds with an instrumental variable framework. In this study, the lagged values of all endogenous variables, i.e., $HFOR_{j,t}$, $HFOR_{j,t} * ERP_{j,t}$, $HFOR_{j,t} * QL_{i,j,t}$, $DFFOR_{j,t}$, $DBFOR_{j,t}$, are used as the key instrumental variables together with the market size ($output_{j,t}$) and the export orientation ($XOR_{j,t}$), guided by the FDI determinant literature.¹³ This is in line with the practice in FDI spillover literature (e.g. Javorcik, 2004; Gao, 2023; Faruq, 2023).

Results based on IVHDFE estimation together with the diagnostic tests of the instrumental regression are in Table 3, Column 3.1. The standard error reported in the IVHDFE model is based on VCE clustering by firm.

The overall F-test is statistically significant, suggesting these explanatory variables have explanatory power.¹⁴ In addition, the IV estimation performs well in all standard diagnostics of the IV estimation, including overidentification, underidentification, and weak identification tests. They indicate that the instrumental variables used in the model are jointly exogenous, satisfy the rank condition, and are sufficiently strong, respectively. The following discussion is based on the estimation result of the IVHDFE estimation.

¹³ See, for example, Saini and Singhania (2018).

¹⁴ It is commonly found in the HDFE estimation that the reported centered and uncentered R-squared values are low or even negative. This is because fixed effects soak up the large portions of the variation, whereas the remaining identifying variation is within-group, reflected by the statistical significance of the explanatory variables. As noted by Wooldridge (2010), R-squared is not an informative measure of model fit in the presence of fixed effects and endogenous regressors. Hence, many empirical studies, such as Silva and Tenreiro (2006), no longer report R-squared.

All the firm-specific variables but $imp_{i,j,t}$ reach the theoretically expected signs and are statistically significant. The positive coefficient associated with $mkt_{i,j,t}$ suggests that firms engaging with external trade (export) exhibit higher productivity than those domestically oriented, all other things being equal. The magnitude of the coefficient of $RDD_{i,j,t}$ indicates that local firms that have committed to R&D investment have 27.80% more productivity than those that have not committed. While the coefficient corresponding to $ERP_{j,t}$ is positive and statistically significant at 10 per cent, its effect on firms' productivity must be interpreted together with its interaction with $HFOR_{j,t}$. The mild statistical significance of the negative coefficient to the interaction term suggests that the highly protected industry could negatively affect firms' productivity in the presence of MNE affiliates. Evaluated at the mean value of $ERP_{j,t}$, a 1% increase in foreign presence when protection is high is associated with a decrease in the local firm's productivity by 2.05%. This seems to be in line with the market-stealing effect proposed by Aitken and Harrison (1999). The high protection entices MNEs to set up their affiliates for the domestic market and benefit from the economic rent induced by the protection. The entry of these MNE affiliates will steal domestic demand away from these indigenous firms and make the latter less likely to achieve economies of scale in production. This would worsen the latter's productivity, all other things being equal.

Regarding the horizontal FDI spillovers ($HFOR_{j,t}$), both $HFOR_{j,t} * ERP_{j,t}$ and $HFOR_{j,t} * QL_{i,j,t}$ exhibit the theoretical expected signs, i.e. negative and positive, respectively. The coefficient corresponding to $HFOR_{j,t}$ turns out to be statistically insignificant. The result is in line with the previous studies that horizontal technology spillover from FDI is not automatic but conditioned by firms' absorptive capabilities and trade policy regimes (Narula & Marin, 2003; Okunade et al., 2022; Kohpaiboon, 2009; Mishrif & Khan, 2024). The interpretation of the found positive and statistically significant coefficient to $HFOR_{j,t} * QL_{i,j,t}$ is straight forward. The higher the firms' absorptive capabilities, the greater the horizontal spillover. Specifically, a 1% increase in foreign presence leads to a 0.49% increase in local firm's productivity at the mean value of absorptive capabilities. Despite mild statistically significant, the negative coefficient to $HFOR_{j,t} * ERP_{j,t}$ points to the spillover would be less in the restrictive trade policy regime. The negative spillover effect is consistent with the market stealing hypothesis above. Under the more liberalizing trade policy regime, the entry of MNEs is likely to be efficient seeking, based on the existing comparative advantage of the host country. Hence, indigenous firms are more likely to benefit from their entry. By contrast, the restrictive trade policy regime would entice MNEs to the highly protected domestic market. In this circumstance, MNE affiliates are likely to directly compete with indigenous firms for the domestic market thereby causing the market stealing effect.

In the case of vertical spillover, the coefficients of direct backward ($DBFOR_{j,t}$) linkages are found to be positive and statistically significant, suggesting that a 1% increase in foreign firm's reliance on locally sourced inputs improves local firm's productivity by 2.17%. This is consistent with the literature that indigenous suppliers are pressured by foreign firms to adapt to meet the demand for a certain quality. By contrast, the coefficient of direct forward linkage indicates a decrease in the local firm's productivity when foreign firms supply to local firms; however, the effect is not different from zero statistically. The found negative effects reflect the effects of the cascading tariff structure that has long intact in Thailand in

the past four decades. In this situation, MNEs tend to enter with market-seeking intention. As a result, their technology and level of quality will be just sufficient to compete with indigenous firms. Moreover, since those products were protected by a tariff, they could be sold at a price higher than they should have been. Thus, in addition to not receiving much better quality, the indigenous firms in the downstream industry also have to pay higher prices.

Table 3, Column 3.2, presents the results when HFOR is interacted with TWMNEs to examine the possible difference in their technology spillovers. The coefficients corresponding to these interaction terms with TWMNEs indicate the possible difference effect of TWMNEs as opposed to FWMNEs.

Overall, the decomposition does not affect the results significantly as the results of most of the key explanatory variables are largely consistent with those in Column 3.1. Interestingly, the coefficients corresponding to all $TWMNE_{j,t}$ variables are not different from zero statistically, implying that in the case of Thai manufacturing sectors, the effects from the entry of TWMNEs are not statistically different from FWMNEs.

Table 3: Estimation results of IVHDFE analysis

	3.1 IVHDFE		3.2 IVHDFE TWMNEs	
	Coefficient	P-value	Coefficient	P-value
$HFOR_{jt}$	0.952	0.216	0.955	0.228
$HFOR_{jt} * TWMNE_{jt}$	-	-	9.446	0.260
$HFOR_{jt} * ERP_{jt}$	-8.541	0.105*	-8.63	0.101*
$HFOR_{jt} * ERP_{jt} * TWMNE_{jt}$	-	-	-21.724	0.573
$HFOR_{jt} * QL_{ijt}$	1.050	0.063*	1.469	0.043**
$HFOR_{jt} * QL_{ijt} * TWMNE_{jt}$	-	-	-16.804	0.142
$DFFOR_{jt}$	-0.564	0.374	-0.289	0.436
$DBFOR_{jt}$	2.171	0.096*	1.804	0.132
RDD_{ijt}	0.245	0.000***	0.247	0.000***
imp_{ijt}	-0.053	0.346	-0.057	0.335
mkt_{ijt}	0.253	0.027**	0.256	0.028**
ERP_{jt}	0.829	0.105*	0.905	0.077*
Year fixed effects	Yes		Yes	
Firm fixed effects	Yes		Yes	
Industry fixed effects	Yes		Yes	

	3.1 IVHDFE		3.2 IVHDFE TWMNEs	
	Coefficient	P-value	Coefficient	P-value
Clustered SE	Firm		Firm	
No. of observations	8,162		8,162	
No. of groups	2820		2820	
Prob > F	0.0007		0.0024	
Centered R ²	-0.0535		-0.054	
Uncentered R ²	-0.0535		-0.054	
Overidentification test (Hansen J test)	0.4394		0.5419	
Underidentification test (Kleibergen-Paap rk LM statistic)	0.0000		0.0000	
Weak identification test (Kleibergen-Paap rk Wald F statistic)	13.435		8.733	

*** $p < .01$, ** $p < .05$, * $p < .1$

Note: All variables are expressed in logarithmic form, except for the dummy variable $RDD_{i,j,t}$

Source: Authors' computations

5 Conclusion and Policy Inferences

The paper examines the MNE technology spillovers, using the Thai manufacturing as a case study with a view to informing prudential policies to maximize the technology spillovers from their presence. The latest four censuses of Thai manufacturing are formulated to be the panel data set for our analysis. While our regression results are in line with the consensus in the FDI spillover literature that the technology spillovers from MNE affiliates do not always take place, our study points to the important role of the trade policy regime. Including it in the regression analysis provides a convincing explanation of the found negative horizontal and vertical spillover effect. In the highly restrictive regime (i.e., ERP is positive), the horizontal spillovers can be negative because of the stronger market-stealing effect. The technology spillover through the linkage channel could also be negative under the restrictive trade policy regime, where the incentive to create linkage is distorted. In addition, our results suggest spillover effect from TWMNEs is not much different from FWMNEs.

Three policy inferences can be drawn from the study. Firstly, to maximize the gain from FDI, creating a conducive business environment is the key. While many studies point to the role of the absorptive capabilities of indigenous firms, the liberal trade policy regime is another highlighted in this paper. A more liberal trade policy regime would entice MNE affiliates that aligned with the host country's comparative advantage.

Secondly, it would be risky to overemphasize the importance of the vertical spillovers over the horizontal ones. In fact, both have the potential to enhance the productivity of indigenous firms. This is immensely policy-relevant in the current revitalization of industrial policy, especially the use of local content requirements.

Thirdly, regardless of the origin of MNEs, their entry motivated by the presence of the proprietary asset could bring in the technology spillover. The extent to which host countries benefit from the spillover is conditioned by absorptive capability and trade policy environment.

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