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Article

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THE EFFECT OF FOREIGN DIRECT INVESTMENT ON LABOUR PRODUCTIVITY: EVIDENCE FROM FIVE INVESTOR COUNTRIES IN THE MALAYSIAN MANUFACTURING INDUSTRIES

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ABSTRACT

This study has utilised the Seemingly Unrelated Regression (SUR) estimator method to explore the spillover effects of "technology" and "knowledge" from foreign direct investment (FDI) on Malaysian labour productivity. The study focus was on Malaysian medium-low technology and low-technology industries from 2000 to 2018. The findings showed that the presence of FDI spillovers as diffusion channels that increased labour productivity were greater through "technology effects" compared to "learning effects" for both types of industries. A cross-comparison of the results on technological spillovers between investor countries revealed that Singaporean and Japanese multinational corporations (MNCs) contributed the most significant technological effects in increasing Malaysian labour productivity, with the effects being most noticeable was in low-technology industries. These findings seem to suggest that the spillover effects of FDI are still concentrated in sectors with low-capacity technologies that commensurate with the required level of workforce capability. The negative relationship between "knowledge" spillovers and productivity found in this study seems to illustrate that the absorptive capacity of local workers to absorb high-skill-based technology from MNCs is still at a low level in both types of industries. This study has recommended that strategies and mechanisms should be devised accordingly to assist MNCs in their effort to improve knowledge and technology transfers, while simultaneously acknowledging the constraints of human factors, absorptive capacity, competition for resources or ethical dilemmas and cultural barriers.

Keywords: Spillover effects, foreign direct investment, labour productivity, technology spillovers, knowledge spillovers.

INTRODUCTION

In Malaysia's progress towards developed nation status, the process of upgrading worker skill and adapting high technology to the manufacturing sector is also closely linked to spillover effects, either in the form of "technology" or "knowledge" brought in by multinational companies (MNCs). However, the effects of "knowledge" spillover from foreign direct investment (FDI) is still widely underestimated, as most studies still emphasize "technology" effects (Araújo et al., 2009; Yunus & Masron, 2020). Studies have shown that workers also have a higher level of difficulty absorbing "adaptive knowledge" compared to those in technical or technological fields in an industry (Giroud & Mirza, 2006).

Thus, investigating the effects of knowledge spillover gained by employees working in MNCs may be able to provide insights into the viability of exploring knowledge within the Malaysian manufacturing industry. Exploring knowledge on spillover effects as a result of the presence of foreign companies can also give an initial overview on how local firms can implement the appropriate mechanisms to reduce the challenges, barriers and uncertainties of exploring domains of knowledge that do not correspond to the level of knowledge and absorption of the workforce, thus affecting knowledge spillover mechanisms (Khordagui & Saleh, 2016; Yunus, 2020).

Given the lack of research examining the impact of FDI "technology" and "knowledge" spillovers simultaneously, this study intends to contribute to the study of how FDI spillovers impact labour productivity at the industry level from two aspects. Firstly, both effects of FDI spillover will be discussed in this study because their benefits on labour productivity, according to the countries that invest in the Malaysian manufacturing industry, are still relatively poorly discussed (Yunus & Wahob, 2021). Secondly, this study will perform an analysis of the effects of technology and knowledge spillovers from FDI according to Malaysian industry classifications, by separating labour productivity function into low and medium technology industries.

To enable the analysis of both industries, the use of similar data sets and methodologies will be applied in this study. By using this approach, it is hoped that the study will provide important findings on spillover effects of FDI in low-technology industries. This is because a comparative analysis can be done rather than just focusing on high-technology industries as in previous studies based on capital investment, where the knowledge spillover from MNCs through the "learning effects" may be more pronounced for high-technology industries (e.g. electrical & electronics, chemicals, machinery & equipment) than for medium and low-technology industries (Yunus et al., 2015; Yunus & Wahob, 2021).

Taking into account these findings from previous studies, this study will take a closer look at low-tech industries and determine whether it is the occurrence of technology or knowledge spillover effects of FDI that will increase labour productivity. This issue needs to be studied in detail to answer a question that remains a mystery, which is whether the FDI activity remains the same as it was in the 1990s. FDI activity in some manufacturing sub-industries remains focused on installation and testing, among the value-added components of lower industrial activities and where only low-skilled workforces are employed and involved (Yunus & Hamid, 2017; Yunus & Masron, 2020, Yunus et al., 2015). From current statistics, it seems that this situation has not changed, as in 2019 the number of highly skilled workers in the manufacturing sector was still low at only 12.1 percent, while 64.6 percent was made up of medium-low skilled workers. Meanwhile, the total stock of FDI in the country rose to RM691.6 billion as of the end of 2019, a rise of 9.6 percent compared to RM631.2 billion in 2018 (MIDA, 2020). This situation implies that the presence of technology spillovers seems to have been less successful in upgrading the skill levels of existing labour forces into a highly skilled workforce (Yunus & Hamid, 2019; Yunus, 2020). This will ultimately affect labour productivity[1].

Therefore, this study is aimed at contributing towards a long-term FDI policy, encouraging FDI inflows in industries that are relatively less receptive to FDI inflows that employ mainly low-skilled workers. More importantly, the results of this study on various inward FDI across countries may lead Malaysia to implement different FDI attraction policies according to the respective investor countries in each manufacturing industry. The present study is therefore, an attempt to answer the following main research questions:

(i) Do manufacturing industries reap real benefits from the presence of both technology and knowledge spillovers?

(ii) Which investor countries have greater potential to contribute both technology and knowledge spillover effects towards higher labour productivity in both manufacturing industries?

LITERATURE REVIEW

In line with the principles of evolutionary theory, Blomström et al. (2000) introduced four ways in which the impact of FDI technology and knowledge spillovers to local firms can affect host countries, and they are as follows:

(i) training effects that result in the mobility of skilled and trained staff who are working in foreign companies in local firms;
(ii) "demonstration - imitation effects" that take place through a long network of collaborations between local firms and MNCs, which then result in the ability of local companies to stand out in managing their own enterprises through the process of learning, management skills and technology assimilation acquired through this network of collaboration;
(iii) "competitive effects" from domestic companies when the competition that exists among MNCs forces domestic competitors to increase their competitiveness in order to remain

productive by applying high-technology production techniques; and

(iv) through "linkage effects", also known as the "export spillover effects", which provide an opportunity for domestic companies to learn about the techniques and processes of exporting from MNCs that operate in Malaysia.

Through the ways in which the presence of MNCs help domestic firms become viable as mentioned above, these positive moves will result in what is known as "spillover effects". It is seen as a positive spillover effect as it helps local firms increase competitiveness and the productivity of local firms, forcing them to operate efficiently by turning acquired knowledge into practical and commercial uses.

The positive effects of FDI spillover on the productivity of the host country's industry workers can generally be achieved through management skills and techniques, technology formation and capital on domestic companies (Liu et al., 2001). Nonetheless, it is important to note that the FDI literature has revealed that the empirical evidence of technology spillovers of FDI is largely limited to "technology" effects itself, and furthermore the fact remains that the spillover effects of technology are also still poorly studied in the developing countries. Likewise, the majority of previous literature that also studied technology spillover effects have only given attention to firm productivity, yielding diverse results. For instance, a study by Castellani and Zanfei (2003) showed that there was a positive technology spillover effect, which was in improving performance and productivity in the manufacturing sector in Italy, while there was a negative spillover effect in Spanish firms, and no effect at all in French firms. Even so, there were other studies that found no significant technology effects that spilled over from FDI in the Turkish, Uruguayan, Moroccan and Venezuelan manufacturing industries, nor did these effects affect the firm's productivity (Aslanoglu, 2000; Kokko et al., 1996; Aitken & Harrison, 1999; Haddad & Harrison, 1993).

Current studies on labour productivity through spillover effects from FDI are, however, found to be still poorly studied. Therefore, this subject has still been of great interest, especially in developing countries and are investigated using industrial-level data (Slaughter, 2002; Liu et al., 2001). Surprisingly though, this issue has received very limited attention because the average FDI study is more interested in examining the effects of FDI spillovers from the angle of backward and forward effects, their effects on employment, productivity growth, total factor productivity and economic growth (Elia et al., 2009; Liu et al., 2016; Yunus et al., 2015).

Similarly, the effects of knowledge spillover from MNCs and a firm's performance is rarely explored. Based on careful research, this study has only found several other studies that examined the relationship between the effect of knowledge spillovers and firm productivity. For example, Feinberg and Majumdar (2001) examined the extent to which the impact of knowledge spillovers from R&D activities carried out by MNCs in local firms brought profits to domestic companies in the Indian pharmaceutical industry during the period 1980-1994. However, it is quite disappointing to report that the R&D activities carried out only benefit the MNCs alone. This study had emphasized that the absence of a government R&D development policy was a major barrier for MNCs to transfer knowledge in the Indian pharmaceutical industry.

Osabutey et al. (2014) explored the impact of technology and knowledge transfer to host countries in Ghana's construction industry. Their study showed that there were weaknesses that occurred during the process of technology and knowledge transfer across industry sub-sectors and between other and local companies. The study showed that the weakness was exacerbated in the absence of government supported technology and a coherent knowledge expansion policy. Liu et al. (2010) investigated whether the spillover effects of innovation from Chinese technology companies occurred for entrepreneurs and employees in local Chinese companies. The results of the study reported that there was an overflow of innovation that provided a positive overflow to local companies. This positive knowledge overflow occurred through employee mobility that benefitted both the MNCs and local enterprises. The researchers suggested that the involvement of entrepreneurs also succeeded in supporting innovation activities in domestic firms. The study concluded that the overflow of international technology and internal R&D efforts were both found to determine innovation performance in Chinese high-technology firms.

The emperical evidence has thus far shown that the spillover effects of FDI inflows by investors countries have been relatively concentrated on the firm's productivity (Zhang et al., 2010). For example, Hu and Jefferson (2002) investigated the impact of FDI inflows from Hong Kong, Macau, Taiwan and the Organisation for Economic Co-operation and Development (OECD) on the productivity and sales levels of domestic firms in China's electronics and textile industries. Similar findings as reported by Aitken and Harrison (1999) showed a significant negative impact of FDI spillovers on domestic firms in the electronics industry, but not for the textile industry. The study also revealed that FDI firms increased the productivity of FDI receiving firms, but suppressed non-FDI domestic firms in the short term. Conversely, the study also reported that the initial productivity advantage of individual FDI receiving firms seemed to disappear in the long run for both electronic and textile industries. These findings indicated that the resilience of some domestic Chinese firms in facing competition from FDI firms seemed to be the determinant in capturing some of the technology and know-how introduced to the industry from abroad.

Zhang et al. (2014) examined spillover effects of investors from South Korea, Singapore, Hong Kong, the G7 nations, Macau and Taiwan on the technical efficiency and productivity of China's enterprises from 1998 to 2012. The overall results showed that the technology spillover effects of FDI from various investor countries statistically and significantly influenced China's productivity. They found that the effects of technology spillovers were greater from South Korean, Singaporean and other countries' MNCs compared to those of the MNCs from G7, Hong Kong, Macao and Taiwan. The results also reported that larger spillover effects were found in Eastern China than in Western China. This study also performed a threshold effects analysis, and the results showed that the presence of FDI from G7 nations needed the highest threshold values of marketization degree and human capital level, while the FDI from South Korea could maximize the improvement of technology spillover effects with the lowest threshold values of marketization degree and human capital level. The study concluded that provinces in China should attract high-quality foreign investment to ensure smooth and transcending impetus in the technical efficiency of domestic enterprises.

The literature review has clearly shown that there are still gaps in previous studies that examine the impact of labour productivity because of the spillover effects generated by investor countries in host countries. For example, a study by Wang and Mu (2012) on

41 developing countries for the period between 2005 and 2008 has emphasized that although there is a relationship between technology spillovers and labour productivity in developing countries, these positive results still depend on estimation techniques and model specifications used during the time the analysis was performed. The data used in the above study was able to show a clear relationship between technology overflow and workforce productivity, but when more dynamic panel data was used in estimating the model, it failed to show any effect of FDI overflow. The results of their analysis also showed that the import variable acted as an effective spillover to affect labour productivity. Liu et al. (2001) reported that the presence of foreign companies in 41 subsectors of China's electronics industry provided a positive impact towards increasing employee productivity. Their study has emphasized that in order to reap more benefits from FDI, it is clear that local firms should also have large-capacity technology in their own firms in order to speed up the process of foreign technology transfer from MNCs happening rapidly.

Meanwhile in the context of Malaysia, the research by Masron et al. (2012) studied the effects of FDI spillover from the FDI inflows in Malaysia. They examined the possible existence of spillover effects in each manufacturing sector in Malaysia from 1994 to 2004. Using correlation analysis, their study aimed to look at the impact on output on each manufacturing industry from each investor country. The results of this analysis showed that there was a possibility of positive and negative spillover effects on each manufacturing sector in Malaysia. It should be noted that these findings require more support from specific studies and methodologies since correlation analysis essentially only examines the relationships between variables without telling the direction of the relationship.

Regarding studies that directly examined the effects of FDI spillovers and labour productivity, the present study has found only two relevant researches, namely the studies by Sulaiman et al. (2016) and Yunus and Hamid (2019). However, their analyses stand only at an aggregate level. Sulaiman et al. (2016) investigated the impact of globalisation, proxies by FDI, the degree of openness of the economy and foreign labour on the Malaysian services sector. Both a random effects model and the Generalized Method of Moments (GMM) dynamic panel model will provide similar results, which means that the FDI has positive effects and is significant in influencing labour productivity.

The study thus recommends that FDI inflows should be increased, especially for large-scale investments with a relatively cheaper cost. The study by Yunus and Hamid (2019) explored both the effects of technology and knowledge overflow on labour productivity in the Malaysian manufacturing sector. They found that when both FDI spills from the influence of “knowledge” and “technology” were considered in examining labour productivity functions, R&D investment showed a positive and significant effect on worker productivity. These results indicate that FDI inflows will increase R&D and innovation activities of the host country, thus potentially increasing labour productivity. Knowledge spillover effects allow domestic companies to learn and use efficient production technology, as well as management and organisational skills. The latest study by Yunus (2021) also examined both spillover effects by investor countries during the period 2000-2018, but the focus of this study was done according to the classification of labour skills. The study found that the presence of Japanese, Singaporean and US companies could contribute to the productivity of high- and medium-skilled workers. The study also emphasised that an effective policy needed to be implemented to increase the opportunities for local firms to apply technological production techniques from FDI. Similarly, the knowledge pool from workers working in foreign firms could be extended to workers working in the local manufacturing sector. Therefore, to contribute additional knowledge to the literature, the present study is an attempt to look at the effects of FDI spillovers in terms of technology and knowledge with respect to a country’s labour productivity and its relation to other explanatory variables. These issues have not been fully investigated in the medium and low technology manufacturing sector in Malaysia.

METHODOLOGY

This section is divided into three parts. The first part discusses the data description and scope of the study. The next part focuses on the model specification, which explains the main variables of interest, both the technology and knowledge spillover effects, and the control variables used in the model. This section concludes with a discussion on the method used in the study, namely the use of the Seemingly Unrelated Regression (SUR) estimator, which fits the requirement of the previously mentioned model.

Data Description and Scope of Study

The main data sources in this study, which was based on a manufacturing survey on industries, came from the Department of Statistics, Malaysia (DOSM) and the Malaysian Industry and Development Authority (MIDA). The 2-digit industry labour productivity data was completely provided by the Malaysian Productivity Corporation (MPC). The data gathered from the DOSM were on total employment, production and non-production workers, research and development (R&D) investment and the cost of training (TRAIN). The data gathered from the MIDA comprised two variables, namely the shares of foreign capital investment (TECH) and the shares of local employees working in multinational companies (EMP), which included those from Japan (EMP_J), Singapore (EMP_S), China (EMP_C), Taiwan (EMP_T), and the United States (EMP_{US}). The results of the descriptive statistics for the variables and their corresponding abbreviations, along with the unit of analysis used in this study on the two industries classified, are as listed in Appendix A.

To balance out the panel data between industries and variables, this study used a sample of 10 manufacturing industries at the 2-digit industry level. The manufacturing sector is divided into two industries, medium-low-technology and low-technology[2]. Medium-low-technology industries consist of five industries, namely Rubber (25), Manufacture of other non-metallic mineral products (26), Basic metal (27), Manufacture of fabricated metal products except machinery and equipment (28), and Manufacture of other non-metallic mineral products including coke, refined petroleum products, and nuclear fuel (23). Meanwhile, low-technology industries also comprise five industries, namely Food and Beverage (15), Textiles (17), Wood (20), Publishing, Paper and Printing (21), and Furniture (36). These industries have been chosen because the overflow of technology from the FDI is still occurring and both industries continue to be supported by private investment. Furthermore, the regulatory framework changes from time to time in order to attract domestic and foreign investment, thus potentially contributing to economic growth and labour productivity (MIDA, 2020).

The present study attempts to fill the gap in the field by focusing on the influx of FDI from the major investor countries in Malaysia.

These countries are Japan, the United States (US), Singapore, China and Taiwan. These countries have been selected because they have traditionally been Malaysia's main trading partners and part of the Malaysian industrial process, and also continue to be among the top contributors of FDI in Malaysia's manufacturing industries (Ismail, 2001). The completed FDI inflow data into the Malaysian manufacturing sector in 2019 showed that the largest investors (with their total investments in parenthesis) were from the People's Republic of China (PRC) (RM15.30 billion), followed by the US (RM14.23 billion), Singapore (RM5.61 billion), Taiwan (RM5.24 billion), and Japan (RM3.79 billion) (MIDA, 2020).

The present study chose to study the impact of FDI spillovers between 2000 and 2018, because it had been reported that the FDI inflows increased sharply during that period. Hence, the number of local employees employed in MNC companies also increased, particularly after the launch of the Eighth Malaysian Plan (2000–2006) and the Eleventh Malaysian Plan (2016–2020)[3].

Model Specification

This section will estimate the impact of FDI technology and knowledge spillovers on labour productivity for the period 2000-2018. This study uses the model specification by Yunus and Wahob (2021) and Liu et al. (2001) to analyse the impact of FDI spillovers from technology and knowledge sources, along with other relevant control variables in influencing labour productivity. The present study contributes to the empirical studies literature by including human capital factors, R&D, ICT, firm size and direct domestic investments, and linking these to the spillover effects (knowledge and technology). Both spillovers were further dissected according to investor countries and embedded into the model as a comparison to measure which investor countries were the most influential towards higher labour productivity. The SUR model for labour productivity written as a single equation in the medium-low-technology (ML) and low-technology (LT) industries can be expressed as Equation (1):

$$lnLP_{it=}lnA_{it} + B_1 ln\left(\frac{K}{L}\right)_{it} + B_2 lnTECH_{itj} + B_3 lnEMP_{itj} + B_4 lnEDU_{it} + B_5 lnTrain_{it} + B_6 lnRD_{it} + B_7 lnDI_{it} + B_8 lnICT_{it} + B_9 lnFS_{it} + \varepsilon_{it} \tag{1}$$

where: i is an index of the industry including, Rubber (25), Manufacture of other non-metallic mineral products (26), Basic metal (27), Manufacture of fabricated metal products except machinery and equipment (28), and Manufacture of other non-metallic mineral products including coke, refined petroleum products, and nuclear fuel (23); low-technology industries include five industries, Food and Beverage (15), Textiles (17), Wood (20), Publishing, Paper and Printing (21) and Furniture (36); t is the time index and j is an index of a country's spillovers (Japan, Unites of States, China, Singapore, and Taiwan); LP refers to labour productivity; $\frac{K}{L}$ is the ratio of capital to worker or capital intensity, which is measured by gross investments in fixed capital per worker (Corvers, 1997); $TECH$ refers to the amount of capital investment invested by major investor countries[4]; Knowledge Effects (EMP) is measured as the number of local employees in MNCs by investor countries (Blonigen & Slaughter, 2001; Figini & Görg, 1999; Girma et al., 2001, Yunus & Wahob, 2021); other control variables commonly considered in the literature influencing labour productivity are *EDU* (level of education)[5], *TRAIN* (cost of training per employee in the manufacturing industry), *RD* (R&D investment), *DI* (total investment from domestic investors), *ICT* (ICT investment) (Belorgey et al., 2006) , and *FS* and ε_{it} denoting firm size (industrial sales revenue in the sub-sector divided by the number of total industries (Ballot et al., 2001); and ε is an error term that captures the productivity shocks and time varying between industries.

Estimation Method: Seemingly Unrelated Regression Estimator

In this study, SUR is the best method to be applied. SUR is a way of estimating panel data models that are long (large T), but not wide (small N). In the context of long and narrow panel data as in this study's case, where total industries (N) = 10 is smaller than year (T) = 19 (190 observations) (Zellner, 1962; 1963).[6] The SUR method provides more efficient estimates to account for potential heterogeneity in the slopes and accounts for cross equation dependence (Mućk, 2018).

In applying the SUR method to estimate the labour productivity function for both industries, this study has arranged the data as a time series (not a panel), and the variables used in this study have also been listed separately. In the basic SUR model, errors are considered homoscedastic and linearly independent in each equation. The SUR approach used in analysing the effect of FDI spillovers on employee productivity has found that the correlation of fault terms across equations leads to better predictions of future values for the dependent variables. The lowest standard error of the parameters estimated with the SUR method can provide the highest estimation accuracy (Zellner, 1962, 1963).

RESULT AND DISCUSSION

This section is divided into two parts. Section I details the preliminary test used in the study. Section II elaborates on the results, followed by a discussion on labour productivity as an outcome of technology spillover effects from FDI according to types of manufacturing industries.

Preliminary Test

Before estimating the SUR model, a preliminary test was conducted, which was a correlation matrix to ensure the normality of the series for the analysis. Appendix B1 and B11 provide the correlation analysis results of this study for both industriese. After taking logs between the independent variables, the results of the correlation analysis showed a better picture than the segregated information. The correlation value for all variables indicated less than 0.8, proving that there was no existing multicollinearity in the model used in this study (Gujarati & Porter, 2012). Also, multicollinearity did not appear to be a serious concern since the variance inflation factors (VIFs) for these variables were below 3.0 (Hair et al., 1995).

The validity of the use of the SUR application will be determined before the outcome of the SUR estimation is discussed. The ordinary least square method (OLS) was performed to test the presence of contemporaneous correlation. The contemporaneous correlation can be understood by referring to the concept of time-specific heterogeneity, where there is a possibility that all sectors could be affected by the same event at the same time (Masron & Hassan, 2016). The results presented in Appendix C also confirmed that there was a contemporaneous correlation through the Breusch-Pagan Lagrange Multiplier (BP-LM) test and therefore, the use of the SUR approach has been deemed valid. However, the results presented in Appendix C also provided further support for the finding that most of the variables were inconsistent with the main model and provided weak evidence or were inconsistent with the main finding (SUR model). This study has considered the difference in the results because of the existing time-specific heterogeneity issues in the main model. Hence, the application of the SUR as the main model in this study was the right choice to estimate the labour productivity function.

Estimated Results of Labour Productivity Using Seemingly Unrelated Regression Analysis

In this section, the estimated results of labour productivity as an outcome of spillover effects from FDI according to manufacturing industry classifications are discussed. The analysis of the results will begin by evaluating the impact of technology spillovers, followed by knowledge effects by investor countries across industry classification. The results revealed that the technology effects from Japanese MNCs were significant in increasing Malaysian labour productivity in both industries. Based on the coefficient value, the findings clearly showed that the positive technology spillovers from Japanese MNCs only applied to low-technology industries. It means that the capital investment from FDI facilitated the firm's access to FDI technology, thus positively affecting labour productivity growth in low-technology industries. These findings clearly indicate that the spillover effects of FDI still give priority to industries with low-capacity technology, where it is appropriate to the level of capability and skills of the workforce required. Nonetheless, based on the findings of the present study, it has been suggested that there were structural patterns in manufacturing firms where there had been a tendency for reallocation of labour among the sectors in Malaysia, particularly where low-skilled labour shifted from high-productivity sectors to low ones, based on their capacity to access the technology spillovers of FDI (Yunus & Wahob, 2021).

On the matter of knowledge spillovers, this study has found that the Japanese MNCs spillovers showed positive effects and only applied to workers in medium-low industries, where their labour productivity increased by 1.60 percent. This finding indicates that if foreign companies actively include local workers in their full-fledged R&D activities executed in Malaysia, the workers' technical skills will be continuously improved (Ismail, 2001).[7]

Table 1

Result of Seemingly Unrelated Regression Analysis by Industry in the Malaysian Manufacturing Sector, 2000-2018 (Dependent Variable= Labour Productivity)

Independent Variables	Model (1) Medium-Low Industry	Model (2) Low-Technology Industry
Capital/labour	0.194 (0.0349)**	0.0959*(0.0598)
Technology Spillover Effects		
Japan	-0.006 (0.028)*	0.055 (0.025)**
United States	-0.002 (0.020)*	-0.012(0.018)*
Singapore	0.031 (0.032)**	0.095*(0.049)
Taiwan	-0.056 (0.039)	-0.042(0.031)
China	0.022(0.014)	0.031(0.035)
Knowledge Spillover Effects		
Japan	0.016(0.036)*	-0.082(0.044)*
United States	-0.017(0.024)*	-0.105(0.053)***
Singapore	-0.052(0.016)*	-0.027(0.055)**
Taiwan	0.033(0.042)	0.032(0.047)
China	0.027(0.035)	0.050(0.059)
Control Variables		
Share of workers with degree holder	0.586(0.324)*	0.450(0.039)*
Share of workers with diploma holder	-0.409(0.129)**	-0.435 (0.027)***
Share of Middle Certificate of Education/Vocational (MCE/MCEV) holder	0.015(0.154)	0.161(0.135)
Cost of Training	0.051(0.113)	0.088(0.077)
R&D Investment	0.089(0.061)*	0.183(0.055)***
Firm Size	0.272(0.003)***	0.308(0.142)**
Domestic Investment	0.068(0.064)	0.018(0.053)
ICT investment	0.015(0.079)***	0.011(0.053)**
Constant	8.903(0.039)*	9.414(0.051)***
Observations	95	95
R-squared	0.761	0.862

Notes. All variables are transformed into natural log. Bootstrapped standard errors for SUR in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

The next main investor country studied was the United States. This study has found that the value of the coefficient of "technology" and "knowledge" effect spillovers from American MNCs has the significant effect of increasing labour productivity in both industries. Although the relationship between the spillover effects of American MNCs and labour productivity appears to be negative, at only less than 0.2 percent, it does mean that there are still many unskilled workers at various levels of production in the manufacturing sector, and the low absorption capacity of local companies limits the ability of workers to assimilate technological knowledge.

It is interesting to report that the results of the analysis of the technology spillover effects from Singaporean MNCs in influencing labour productivity have been similar to those of Japanese MNCs. Both countries have shown technological influence in the increase of labour productivity compared to other country's spillovers. Surprisingly, the high magnitude of technology transfer from the MNCs of both countries remained greater in the low-technology industries as indicated in Model (2) in Table 1. The results thus, imply that the presence of both Singaporean and Japanese MNCs might have increased skill-biased technological change and contributed to increased productivity of about 9.5 percent and 5.5 percent through "competition effects" and "demonstration-imitation effects", respectively. The coefficient value pointed to the pattern of technology transfer appearing to be significantly more advanced in Singaporean MNCs compared to Japanese MNCs. This discrepancy was likely due to the differences in certain organisational and cultural aspects between these two countries.

Meanwhile, the effects of knowledge spillover from Singaporean MNCs were seen as similar to that found for American MNCs in both industries. The spillover from both countries has shown statistically negative significance in influencing labour productivity in the medium-low industry and low-technology industry. These results are contrary to the findings reported in Yunus and Wahab (2021), in which it was found that both MNCs showed positive findings and were able to improve labour skills and productivity in high-tech manufacturing industries. Thus, a negative correlation indicates that labour productivity growth in both industries will fall according to the value of the coefficient. In other words, the ability of the manufacturing sector to increase productivity or reduce bad skills is somewhat less successful.

Before delving into the spillover effects from Chinese and Taiwanese MNCs, the discussion at this point would like to highlight the negative correlation found between spillover effects of FDI and labour productivity. The results of this study have found that almost all investor countries selected for this study showed negative spillovers, either from technology or knowledge, and these only varied according to industry classification. The possible explanations for the negative spillover effects that occurred have been very closely related to the ability of the host country to absorb knowledge. Previous studies have shown support for the claim that rapid technological change in an economy is highly dependent on the innovative and social capabilities of the host country, along with the absorption capabilities of other enterprises in the country (Girma & Görg, 2005; Yunus et al., 2015). Similarly, Awang et al. (2008) have argued that success in knowledge transfer would depend on the ability of employees to apply acquired knowledge, the learning environment within the organisation and the level of willingness and openness of foreign expatriates in MNCs to transfer knowledge to local workers. Similarly, the study revealed that adaptive knowledge absorbed by workers was more difficult than production systems (Giroud & Mirza, 2006).

Another possible reason for negative spillovers is the negative competition effect from multinational companies abroad not accommodated by positive spillovers, though this appears to be more prevalent at the local level (Girma & Görg, 2005). While this explanation seems appealing, it is however, not possible to determine the reasons for such negative spillover effects from FDI outside the country using the current data made available in this study. The findings in this study on the spillover effects from Chinese and Taiwanese MNCs are surprisingly inconsistent with the findings of Buckley et al. (2007), in which it was claimed that higher productivity could be generated through increased foreign capital participation. This study, however, has found that Chinese and Taiwanese MNCs in Malaysia were statistically insignificant in influencing Malaysian labour productivity across all industries. This result has suggested that the technology and knowledge transferred from the MNCs of these countries to the local firms were less successful in enhancing skill upgrades of workers in these industries. Previous studies also supported the finding that Chinese investment could not be less significant in influencing productivity and employability (Auzairy et al., 2020; Rizvi & Nishat, 2009). In the case of Malaysia, this might be due to the negative backward and forward spillover effects brought about by Chinese sector investment into the manufacturing sector in Malaysia. (Dogan et al., 2017, Yunus, 2021). Moreover, the industrial sector has often been influenced by Chinese infrastructure projects and contract sourcing behaviour (Abd Rahman, 2019; Corkin, 2012).

Although China is known as its largest business partner, in addition to having dominant business operations – from the processing of raw materials, supply chain, production to sales – it is still complicated when it comes to the establishment of a cooperative network between Chinese investors and local firms. As the findings in this study has revealed, Chinese investors did not engage local workers in their activities, thus ultimately not contributing to the upgrading of local workers' skills. The monitoring of the inflows of the FDI is therefore, crucial and we believe there is a need for Malaysia to increase the amount of local content in the global chain as the Malaysian manufacturing sector remains heavily concentrated in backward linkages with lower value-added contributions. In the case of China, however, factors such as Malaysia-China relations, Malaysian political and ethnic economic instability, China's economic downturn, investor motives and the geopolitics of the South China Sea might have influenced the results found in this study (Kong, 2017; Yong et al., 2016). Therefore, this study would like to emphasize that it is extremely important for local authorities and business partners to be more careful before signing a business contract with any investor country. Lastly, as expected, the control variables included in the SUR analysis have demonstrated the anticipated signs influencing labour productivity for both industries. Both industries produced similar results, which showed that the effects of the cost of training and domestic investment from local investors have completely failed to affect worker productivity. This study has been supported by the findings in Yunus and Wahob (2021) and Yunus and Masron (2020), which revealed that less focus had been given to providing training investment to workers related to technological improvement in both industries, as compared to high-medium industries.

CONCLUSION AND POLICY IMPLICATIONS

This study, in examining the technology and knowledge spillover effects of MNCs in Malaysia, stands out as one of the leading studies in the area of FDI spillovers. Specifically, this study seeks to provide new evidence for the role of the "technology" and "knowledge" spillover effects in increasing labour productivity when there has been an influx of FDI into the manufacturing industry. Both spillover effects were studied in the major investor countries in Malaysia.

In the comparative analysis between the effects of technology and knowledge spillovers, it was clearly shown that the Malaysian workers in MNCs from all investor countries in the manufacturing industry were more likely to assimilate the effects of technology rather than the effects of knowledge. A cross-comparison of the results on technological spillover between investor countries by industry classification revealed that Singaporean MNCs contributed the most significant technological effects in increasing Malaysian labour productivity, with the effects being most noticeable in the low-technology industries. Investment by Singaporean MNCs facilitated low-technology industries' access to foreign technology and led to an increase of 9.5 percent in labour productivity.

In terms of the effect of FDI knowledge spillover, the results of the study have been very surprising, for example there was no positive spillover effects from all investor countries in increasing labour productivity in both industries (except Japanese MNCs in medium-low technology industries). Furthermore, the coefficient results significantly indicated more negative effects found in the industry from the presence of FDI by major investor countries in most industries. The exit of less productive domestic companies might be the reason for such negative impacts and low spillover effects from investors. Thus, to avoid the phenomenon of crowding-out continuously occurring among domestic private investors, this study would like to suggest that Malaysia should focus on devising a strategy to develop the competitiveness of local investors.

This study has also highlighted the finding that both technology and knowledge spillovers from China and Taiwan FDI did not significantly increase productivity or leave a desirable impact on Malaysia's economic and stock market performance. This unexpected finding might be due to the selected data timeline of 2000-2018. This period of data collection might not have been an accurate depiction of China's investment in Malaysia, as its investment only started booming in recent years, i.e., around 2015 to 2017 (MIDA, 2018). It might also suggest that the model specifications and estimation techniques used might have been highly sensitive, or less appropriate in explaining the relationship between technological and knowledge spillover effects and labour productivity. Therefore, it would seem appropriate that the present study should extend its scope by using data from 2020 and beyond in the hope of extracting the real impact of investment from China as well as Taiwan.

Through the values of the coefficients obtained, this study has concluded that the difference in total technology capacity and the knowledge transferred by foreign companies to local firms between investor countries, is highly dependent on investor motives, traded technology transfer practices and the employee absorption capacity of both FDI spillover effects. Thus, this study would like to suggest that in order to increase the capacity of employee absorption, the involvement of local managers in MNC activities would help the process of transferring technologies to Malaysian manufacturing industries. This study also suggests that the upgrading of skills for Malaysians working in MNCs, particularly among skilled workers, can be developed through the learning and training programs provided by the MNCs in line with the current industry's demands, for example, by international travel and by enabling better communication between people involved in the project.

Lastly, this study highlights that the results of the spillover effects of FDI could be a mix of both positive and negative effects, likely due to the different sectors in the economy. The different results obtained might be due to the heterogeneous and disaggregated data used between countries or sectors (Gu et al., 2016). Hence, for future research, this paper suggests conducting a survey to determine the various aspects of technology and knowledge transfer, taking into account the multidimensionality, increasing complexities and strong knowledge-based character of technology in manufacturing firms.

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ENDNOTES

1. Although the productivity of the Malaysian workforce has increased at a rate of 3-4 percent in recent years, its relative global position and the use of highly skilled labour has not grown. National labour productivity growth from 2018 to 2020 was only 2.9 percent. Meanwhile, globally, Malaysia's labour productivity was only ranked 44th in 2016, a position that has not changed since 2009. The relative share of highly skilled labour still shows a declining trend, even if there was only a one percent decrease from 19 percent in 2010 to 18 percent in 2017 (MITI, 2018).

2. The classification of the manufacturing industry in this study is done according to the 2011 OECD classifications, which is based on the intensity of R&D.

3. The latest data of the investigative study in the manufacturing sector released by the statistics department has covered the period until 2018.

4. Foreign capital investment (*TECH*) is well recognized as a channel of spillover effects through "technology" (Bwalya, 2006; Bandick & Hansson, 2009). Foreign capital investment is computed using the following formula:

$$TECH_{itj} = \sum_{j \neq i} \frac{f_{ij}}{k_j}$$

Where: f_{ij} is the flow of FDI from country j towards industry i, and k_j is the gross fixed capital formation of country j.

5. The data provided by the DOS, defining workers is based upon their level of educational attainment (University degree and above; Diploma/HSC or equivalent; and Middle Certificate Education/Vocational (MCE/MCEV or equivalent).

6. It is important to note that before we selected the SUR as the best method to analyse the results in this study, several model selection tests were carried out and they included the following: Ordinary Least Square (OLS), Generalized Method of Moments (GMM), Random Effect, and Fixed Effect Model. However, we could not yield the best results. It is well-known

that ordinary least squares, which ignore the correlation patterns across blocks, may yield inefficient estimators. For the GMM, the condition to perform the GMM is that the number of observations (*N*) must be greater than *T*. As for the Random Effect estimator, we cannot establish small sample properties. The Ffixed-Effect model, even though it has been widely recognised as a convenient and powerful tool for longitudinal data analysis, there are limitations in the model. The primary limitation is unobserved heterogeneity due to unmeasured characteristics that vary over time. The problem is that fixed-effects coefficients are biased in a conservative fashion when the data are characterised by a small number of panels (Allison, 2009). In this case, the present study also found that standard errors for fixed-effects coefficients are often larger than those for other methods, especially when the predictor variable has little variation over time.

7. In the early 1990s, Matsushita established three companies – Matsushita Air-Conditioning R&D Center Sdn. Bhd., Matsushita Compressor and Motor R&D Center Sdn. Bhd., and Matsushita Home Appliance R&D Center Sdn. Bhd. These establishments employed 130 employees in R&D activities, of which only 20 were Japanese.

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APPENDICES

Appendix A

Definition of Variables and Summary Statistics in the Medium-Low Technology and Low-technology Industries, 2000-2018

Variables	Definition of Variables	Unit	Medium-Low Technology Industry					Low-technology Industry				
			Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
LP	Labour productivity (added Value (RM Billion) / Employment ('000 Persons))	Ratio	95	11.054	0.346	9.868	11.704	95	11.287	0.790	10.213	12.738
KL	Capital/labour	Ratio	95	2.905	0.514	2.163	4.176	95	2.631	0.471	1.338	3.852
EMP_J	No. of Malaysian workers in Japanese MNCs	000'	95	5.261	1.313	2.303	7.353	95	4.674	1.252	0.000	7.691
EMPs	No. of Malaysian workers in Singaporean MNCs	000'	95	6.323	1.421	0.693	8.335	95	5.799	1.166	2.708	8.236
EMP_T	No. of Malaysian workers in Taiwanese MNCs	000'	95	5.177	0.927	2.890	7.319	95	4.788	1.010	1.609	7.406
EMP_{US}	No. of Malaysian workers in American MNCs	000'	95	4.446	1.331	2.079	8.358	95	4.211	0.835	1.792	6.052
EMP_C	No. of Malaysian workers in Chinese MNCs	000'	95	4.665	1.363	0.000	7.520	95	4.691	1.226	0.000	6.752
FDI_J	Japan Foreign Investment	RM'000	95	18.085	1.557	14.564	21.430	95	16.744	1.814	11.549	19.972
FDI_S	Singapore Foreign Investment	RM'000	95	18.225	1.241	14.193	20.256	95	17.439	1.579	12.046	20.809

(continued)

Variables	Definition of Variables	Unit	Medium-Low Technology Industry					Low-technology Industry				
FDI_T	Taiwan Foreign Investment	RM'000	95	16.820	1.012	14.326	18.458	95	15.999	1.548	11.112	19.917
FDI_{US}	US Foreign Investment	RM'000	95	17.411	1.673	13.122	20.669	95	16.300	1.753	11.534	19.892
FDI_C	China Foreign Investment	RM'000	95	-0.467	2.157	-6.198	4.012	95	-0.036	2.298	-5.264	7.828
DEG	Share of workers with degree education level from total employment	Percentage	95	1.798	0.920	1.064	5.509	95	1.458	1.008	0.146	5.677
DIP	Share of workers with diploma education level from total employment	Percentage	95	2.606	1.296	2.005	8.064	95	2.308	1.329	1.147	9.059
MCE	Share of workers MCE/MCEV education level from total employment	Percentage	95	4.362	0.407	1.836	4.496	95	4.404	0.383	1.575	4.561
TRAIN	Cost of training per employee	RM000'	95	9.548	0.628	8.449	10.838	95	9.064	1.033	7.295	11.874
RD	RD Expenditure	RM000'	95	10.531	1.064	8.598	12.833	95	9.566	1.650	6.973	14.064
FS	Firm size. Industrial sales revenue of the sub-sector divided by the number of total firms	Ratio	95	12.276	0.602	11.099	13.447	95	12.825	0.789	11.762	14.713
DDI	Direct Domestic Investment from local investors	RM0000'	95	20.328	0.715	18.662	21.983	95	19.830	0.994	16.701	21.936
ICT	Share of ICT to Gross Domestic product (GDP)	percentage	95	9.493	0.651	7.524	10.800	95	8.768	1.346	6.080	12.526

Note: All variables are transformed into natural log

Appendix B1

Metric Correlation Analysis in the Medium-Low-Technology Industry

Variables	LP	KL	EMPJ	EMPs	EMP_T	EMP_{US}	EMP_C	FDI_J	FDI_S	FDI_T	FDI_{US}	FDI_C	DEG	DIP	MCE	TRAIN	RD	FS	DDI	ICT
LP	1.000																			
KL	0.684	1.000																		
EMP_J	-0.391	-0.340	1.000																	
EMPs	-0.464	-0.407	0.306	1.000																
EMP_T	-0.251	-0.131	0.263	0.278	1.000															
EMP_{US}	0.053	0.040	0.032	0.045	0.091	1.000														
EMP_C	0.303	0.300	-0.240	0.082	-0.070	0.391	1.000													
FDI_J	0.159	0.207	0.578	-0.132	-0.116	-0.019	-0.101	1.000												
FDI_S	-0.094	-0.158	0.062	0.650	0.072	0.100	0.286	-0.173	1.000											
FDI_T	-0.210	-0.031	0.196	0.182	0.704	-0.006	-0.228	-0.144	0.017	1.000										
FDI_{US}	0.141	0.027	-0.153	-0.017	0.023	0.597	0.356	-0.088	0.092	0.047	1.000									
FDI_C	0.280	0.154	-0.178	0.160	-0.120	0.252	0.813	-0.106	0.235	-0.094	0.269	1.000								
DEG	0.034	-0.006	-0.030	-0.092	-0.112	-0.091	0.018	0.040	-0.064	-0.072	-0.093	0.172	1.000							
DIP	-0.078	-0.089	0.038	-0.057	-0.089	-0.100	-0.038	0.043	-0.085	-0.053	-0.123	0.123	0.988	1.000						
MCE	0.081	0.044	-0.112	0.105	0.063	-0.007	0.092	-0.126	0.127	-0.004	-0.028	0.001	-0.817	-0.837	1.000					
TRAIN	0.296	0.273	-0.101	0.144	-0.050	0.193	0.450	0.020	0.353	-0.112	0.306	0.313	0.054	-0.009	-0.188	1.000				
RD	0.315	0.392	-0.049	0.158	-0.100	0.214	0.423	0.063	0.351	-0.138	0.269	0.255	-0.103	-0.167	0.035	0.767	1.000			
FS	0.787	0.657	-0.355	-0.329	-0.211	0.195	0.410	0.185	0.032	-0.165	0.309	0.299	-0.054	-0.175	0.138	0.486	0.516	1.000		
DDI	0.313	0.363	-0.113	0.166	0.014	0.285	0.529	0.016	0.513	-0.100	0.248	0.272	-0.130	-0.199	0.105	0.598	0.661	0.574	1.000	
ICT	0.324	0.308	0.023	0.014	-0.158	0.217	0.450	0.243	0.237	-0.190	0.212	0.360	0.339	0.284	-0.328	0.759	0.710	0.550	0.611	1.000

Note: All variables are transformed into natural log

Appendix B2

Metric Correlation Analysis in the Low-Technology Industry

Variables	LP	KL	EMPJ	EMPs	EMP_T	EMP_{US}	EMP_C	FDI_J	FDI_S	FDI_T	FDI_{US}	FDI_C	DEG	DIP	MCE	TRAIN	RD	FS	DDI	ICT
LP	1.000																			
KL	0.684	1.000																		
EMP_J	-0.391	-0.340	1.000																	
EMPs	-0.464	-0.407	0.306	1.000																
EMP_T	-0.251	-0.131	0.263	0.278	1.000															
EMP_{US}	0.053	0.040	0.032	0.045	0.091	1.000														
EMP_C	0.303	0.300	-0.240	0.072	-0.070	0.391	1.000													
FDI_J	0.159	0.207	0.578	-0.132	-0.116	-0.019	-0.101	1.000												
FDI_S	-0.094	-0.158	0.062	0.650	0.072	0.100	0.286	-0.173	1.000											
FDI_T	-0.210	-0.031	0.196	0.182	0.704	-0.006	-0.228	-0.144	0.017	1.000										
FDI_{US}	0.141	0.027	-0.153	-0.017	0.023	0.597	0.356	-0.088	0.092	0.047	1.000									
FDI_C	0.280	0.154	-0.178	0.160	-0.120	0.252	0.713	-0.106	0.235	-0.094	0.269	1.000								
DEG	0.034	-0.006	-0.030	-0.092	-0.112	-0.091	0.018	0.040	-0.064	-0.072	-0.093	0.172	1.000							
DIP	-0.078	-0.089	0.038	-0.057	-0.089	-0.100	-0.038	0.043	-0.085	-0.053	-0.123	0.123	0.788	1.000						
MCE	0.081	0.044	-0.112	0.105	0.063	-0.007	0.092	-0.126	0.127	-0.004	-0.028	0.001	-0.817	-0.837	1.000					
TRAIN	0.296	0.273	-0.101	0.144	-0.050	0.193	0.450	0.020	0.353	-0.112	0.306	0.313	0.054	-0.009	-0.188	1.000				
RD	0.315	0.392	-0.049	0.158	-0.100	0.214	0.423	0.063	0.351	-0.138	0.269	0.255	-0.103	-0.167	0.035	0.767	1.000			
FS	0.787	0.657	-0.355	-0.329	-0.211	0.195	0.410	0.185	0.032	-0.165	0.309	0.299	-0.054	-0.175	0.138	0.486	0.516	1.000		
DDI	0.313	0.363	-0.113	0.166	0.014	0.285	0.529	0.016	0.513	-0.100	0.248	0.272	-0.130	-0.199	0.105	0.598	0.661	0.574	1.000	
ICT	0.324	0.308	0.023	0.014	-0.158	0.217	0.450	0.243	0.237	-0.190	0.212	0.360	0.339	0.284	-0.328	0.759	0.710	0.550	0.611	1.00

Note: All variables are transformed into natural log

APPENDIX C

Ordinary Least Square (OLS) by Industry Classification, 2000-2019

Variables	Medium-Low Technology Industry	Low-Technology Industry
KL	0.204(0.105)*	-0.078(0.135)
EMP_J	0.0027(0.044)	-0.093(0.051)*
EMPs	-0.060(0.034)*	0.139(0.064)**
EMP_T	0.0412(0.052)	0.037(0.055)
EMP_{US}	0.027(0.029)	0.197(0.061)***
EMP_C	-0.068(0.054)	0.079(0.066)
FDI_J	0.003(0.034)	-0.055(0.029)*
FDI_S	0.051(0.039)	0.092(0.057)*
FDI_T	-0.066(0.049)	-0.042(0.036)
FDI_{US}	-0.002(0.025)	0.714(0.032)
FDI_C	0.051(0.029)	-0.051 (0.022)
DEG	0.475 (0.405)	0.391(0.272)
DIP	-0.344 (0.205)	-0.393(0.187)**
MCE	-0.016(0.189)	-0.146(0.213)
TRAIN	0.0436(0.139)	0.087(0.089)
RD	-0.015(0.075)	0.186(0.063)***
FS	0.260(0.127)**	-0.317(0.160)*
DDI	-0.043(0.082)	-0.064(0.071)
ICT	-0.054 (0.016)	0.302(0.093)***
Constant	9.431(2.356)***	10.842(2.043)***
Breusch and Pagan		
Lagrangian multiplier test	27.99	16.11
Prob>chi2	0.084	0.658
Observations	95	95
R-squared	0.771	0.866

Notes: All variables are transformed into natural log. Huber/white robust standard errors are in parentheses.

* p<0.05; ** p<0.1 ***p<0