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Firm Ownership and Technical Efficiency: Production Frontier Analysis of Malaysian Manufacturing

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Abstract: *Using a new micro-based dataset of 8,472 firms covering 19 industries, this paper employs a stochastic production frontier analysis to compare time-varying technical efficiencies of foreign firms vis-à-vis local firms for the 2014 to 2019 period. The empirical findings indicate that on average, foreign firms are only marginally more (technically) efficient than local firms even after controlling for other firm characteristics. The productivity levels between foreign firms and local firms are also somewhat comparable for 'catalytic' industries, electrical and electronics, machinery, and chemicals. Together these results confirm that the high productivity gaps between the foreign firms and local firms in the Malaysian manufacturing sector seem to be a thing of the past.*

Keywords: Stochastic frontier analysis; Technical efficiency; Firm ownership; Manufacturing; Malaysia.
JEL Classification: D24, O14, F23

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1. Introduction

Malaysia has instituted liberal policies to attract foreign direct investment (FDI) into the manufacturing sector under its export-oriented industrialisation drive since the early 1980s. The sector then became heavily dependent on capital injections through FDI, exceeding 50% of total approved investments since the late 1980s. On average, the share of FDI in total approved investments in manufacturing increased from 54% in the 1990s to 60% in the 2000s (calculated from unpublished data from Malaysian Investment Development Authority, MIDA). In 2010, the FDI share accounted for 62% before increasing to 66% of total approved investments in 2019 (MIDA, 2022). The value-added of the Malaysian manufacturing sector remained low at an average of 27% and 28% of gross domestic product (GDP) in the 1990s and 2000s respectively, before declining to 22% in the 2010s (calculated from World Bank, 2021). The major reasons cited for the lagging performance of the manufacturing sector are the long over-reliance on factor inputs (labour, capital, and materials) rather than productivity (see Menon, 1998; Ramstetter, 1999; Ahmed, 2009; Kim et al., 2009; Lee, 2011; Shuhaimen et al., 2017; EPU, 2018). This raises the question on the effects of foreign participation in the manufacturing sector, that is, the efficiency of foreign firms in comparison to local firms.

Foreign firms, due to firm specific advantages, such as size (or scale), capital intensive production processes, technology- and export-intensity, are presumably more productive than local firms. In the Malaysian context, foreign firms are found to have much higher export propensities than their local counterparts (Ramstetter, 1999; Ramstetter & Ahmad, 2009; Lee, 2011) as they constitute multinational corporations (MNCs) with international linkages through production networks (Khalifah, 2013). The sluggish performance of the manufacturing sector in Malaysia in recent years, however, seems to suggest that the foreign/local distinction in terms of technical efficiency may be becoming less clear.

Previous studies conducted on productivity and technical efficiency in the Malaysian manufacturing sector (Abdullah & Hussein, 1993; Tham, 1997; Mahadevan, 2001; Oguchi et al., 2002; Jajri & Ismail, 2006; Khalifah et al., 2008; Radam et al., 2008; Kim et al., 2009; See & Coelli, 2012, 2013; Amin et al., 2017; Fahmy-Abdullah et al., 2019) have focused largely on firm size, and firm age effects, with limited studies on productivity comparisons by firm ownership (foreign versus local; see Menon, 1998; Oguchi et al., 2002; Okamoto, 1994; Khalifah et al., 2008; Khalifah & Adam, 2009; Khalifah, 2013; Dogan et al., 2013). Most of the productivity studies related to ownership in the Malaysian manufacturing sector are for earlier years, and therefore considerably dated; 1983-1990 (Okamoto, 1994), 1988-1992 (Menon, 1998); 1992-1996 (Oguchi et al., 2002), 2000-2004 (Khalifah & Adam, 2009; Khalifah, 2013). Since technical efficiency estimates are sensitive to the period of study, recency in ownership-efficiency evidence matters for understanding the productivity levels of foreign firms vis-à-vis their local counterparts in the manufacturing sector. Worth noting is that previous studies on Malaysia also did not consider the links between innovation inputs, such as research and development (R&D) and efficiency, due to the paucity of data.

Against this backdrop, this paper contributes to the existing productivity literature in the following ways. First, it utilises recent and rich cross-sectional micro-firm-level (unpublished) data from MIDA[1] to compare technical efficiency by firm ownership (local firms and foreign firms) to provide a more recent outlook (2014 to 2019) on productivity levels in the manufacturing sector. Second, it accounts for productivity levels by ownership from a disaggregated industry-level analysis, with emphasis on the 'catalytic'[2] industries of the manufacturing sector. With the identification of industry specific technical efficiency for both groups of firms, the paper offers important policy recommendations in terms of incentive schemes based on firm ownership and industrial targeting (Onder et al., 2003; Kim et al., 2009; Sharma, 2010). Such policy input is important to inform the current debate on the efficiency of foreign firms as Malaysia strives to balance FDI with domestic investments.

This paper is structured as follows. The next section provides a review of the related literature on ownership, productivity, and efficiency. Section 3 describes the model specification and firm characteristics of the sample dataset. The empirical results and discussion of findings are presented in Section 4. Section 5 concludes with some policy recommendations.

2. Firm Ownership and Productivity: Theoretical Considerations

The empirical results on productivity have largely been premised on the argument of firm-specific advantages. The conventional wisdom is that firm ownership makes a difference to productivity, that is, foreign firms outperform local firms. The superior performance of foreign firms is generally attributed to their firm-specific advantages, like higher physical capital, human capital and other innovation inputs, higher capacity utilisation given a higher ability to exploit economies of scale, superior management and marketing capabilities (Pfaffermayr & Bellak 2000; Siripaisalpipat & Hoshino 2000; Barbosa & Louri, 2005), established international linkages in the form of export contracts and multinationality (Bellak, 2004) or greater participation in global networks.

The literature on the influence of foreign ownership on efficiency, after controlling for other firm specific characteristics, is at best mixed. Recent studies, such as Pasali and Chaudhary (2020) and Walheer and Ming (2020), show that foreign ownership, overall, does give firms an edge on productivity. On the other hand, firm ownership is considered unimportant in explaining productivity in some other studies (Barbosa & Louri, 2005; Basti et al., 2011).

Findings specific to the Malaysian manufacturing sector generally provide support that foreign ownership is a significant determinant of technical efficiency. Early studies (Oguchi et al, 2002; Okamoto, 2004; Khalifah et al., 2008) based on total factor productivity (TFP) indicate that foreign firms were generally more productive than local firms since the mid-1990s to the mid-2000s (even in specific industries such as automobiles; see Khalifah et al., 2008) but observe a decline in productivity differentials between the two, with time. As such, some of these studies (Oguchi et al., 2002) find no significant productivity differentials between foreign firms and local firms. Khalifah and Adam (2009) confirm that the degree of foreign ownership in MNCs matter when examining the ownership-efficiency link. Their findings indicate that there is no significant link between the wholly owned foreign firms and productivity, while the majority and minority foreign-owned establishments were found to have significantly lower levels of productivity than locally owned establishments. Later studies, post-2010, report that foreignness *per se* is irrelevant for productivity. For example, Khalifah (2013) emphasises the effects of foreignness with specific characteristics, such as the degree of vertical integration and size of establishment, in driving productivity in some segments of the automotive industry. Likewise, Dogan et al. (2013) examine ownership by size and show that large-sized foreign firms are more productive than medium- and small-sized firms.

In terms of empirical analysis, most of the studies on productivity stem from the growth accounting framework of the Cobb-Douglas production function. Accordingly, the literature on productivity or firm efficiency has predominantly identified tangible assets, such as capital (or fixed assets), labour, land, raw materials, and energy (fuel), as standard determinants of productivity (Battese & Coelli, 1988; 1992; Cornwell et al., 1990; Cuesta, 2000; Radam et al., 2008; Kim et al., 2009). Moving away from the general production function, some studies have considered additional quality-based inputs to investigate technical efficiency, such as human capital (education and skill levels, expenditure on training; see Fahmy-Abdullah et al., 2019), expenditures on R&D (see Schmidt and Sickles, 1984; Dilling-Hansen et al., 2003; Pattnayak and Chadha, 2008; Badunenko et al., 2008; Barassa et al., 2019) and information and communication technology (ICT).

3. Methodology

Early studies have defined productivity as a measurement of the transformation of inputs into outputs. It is a ratio of how efficiently resources are utilised, in terms of cost savings of the factors of production. Productivity can therefore be measured in terms of the relationship between factors of production and output. Though productivity and efficiency are often used interchangeably, there are nuanced differences between the two concepts, that is, although a firm is technically efficient, the level of productivity can still be increased to an optimal level. As such, most studies have used technical efficiency (the gap between potential output and actual output) as an indication of productivity of firms.

3.1 Model specification

The estimation of frontiers and efficiency using the stochastic frontier analysis (SFA) is considered appropriate as TFP growth can be decomposed into technological progress and technical efficiency variation. Early studies of Aigner et al. (1977) and Meeusen and van der Broeck (1977) introduced the stochastic frontier production function by expanding on the Cobb-Douglas production form. As the model includes two random variables, strong assumptions are needed for the distribution of those variables and it is also assumed that that the level of inputs that go into the production are not partial to the level of technical inefficiency (Amsler et al., 2009). Expanding on earlier methods of obtaining average technical inefficiencies (Aigner et al., 1977; Schmidt & Lovell, 1979), Jondrow et al. (1982) proposed a method of separating the random variables through the application of half-normal and exponential methods, which allows for the estimation of technical inefficiency of each observation. These methods can be applied to cross sectional data.

To analyse productivity growth of firms based on ownership structure in the Malaysian manufacturing sector, the SFA approach is employed (see also Kim et al., 2009; Coelli, 2012; 2013; Fahmy-Abdullah et al., 2019). The Battese and Coelli (1995; hereafter BC95) model is utilised to estimate technical inefficiency of firms. The BC95 is also considered suitable as it estimates the effects of technical inefficiency for each firm at its own frontier, with the assumption of independently non-negative truncated normal distribution of errors for technical inefficiency.

The Cobb-Douglas production function is given below:

$$\ln y_{it} = \beta_0 + \beta_1 \ln k_{it} + \beta_2 \ln l_{it} + v_{it} - u_{it} \tag{1}$$

where y_{it} is the value-added for the ith firm within the period of observation t, and k, l are capital and labour inputs, respectively.

Technical inefficiency effects are given by

$$u_{it} = \delta_0 + \delta_1 (Size_{it}) + \delta_2 (Export_{it}) + \delta_3 (R\&D_{it}) + \delta_4 (lnHS_{it}) + w_{it} \tag{2}$$

where,

$Size_{it}$: share of firm employment to industry employment (relative size)
$Export_{it}$: share of export sales to output (export orientation or intensity)
$R\&D_{it}$: share of R&D expenditure to gross sales (R&D intensity)
$lnHS_{it}$: share of high-skilled employees in total employment (labour quality)

3.2 Data description

This paper utilises rich firm-level data obtained from annual surveys conducted by MIDA. MIDA's annual surveys cover all firms approved for manufacturing licenses and/or incentives under the Industrial Coordination Act (ICA) 1975 and/or Promotion of Investments Act (PIA) 1986. The response rate is about 60% to 70% of approximately 6,000 companies surveyed yearly by MIDA. The firms in the database have been classified based on MIDA's internal requirements, principally guided by the latest Malaysia Standard Industrial Classification (MSIC) 2008 version 1.0 (Department of Statistics Malaysia (DOSM), 2008). Covering 19 industries, the balanced panel data for this study spans six years over the 2014 to 2019[3] period, yielding a sample of 8,472 observations. Of the 8,472 observations, 64.6% are local firms, and the remaining 35.4% are foreign firms. The yearly sample comprises a consistent number of 1,412 firms[4] (local firms and foreign firms) or 24.1% of the total annual population of 5,851 firms surveyed.

Value-added proxy output is calculated as the sales of manufactured goods made during the reference year minus costs incurred by the firm for raw materials/ components/parts used to produce finished goods. Labour refers to the number of full-time employees (employed for at least six hours a day, 20 days a month) engaged by the firm. Capital, represented by fixed assets, includes a firm's tangible, non-current assets (land, plant/ factory/ building and other fixed assets such as machinery/equipment) that are used in its business operation. The output data are deflated into real terms by using the GDP deflator at constant 2015 prices and the capital data by the gross fixed capital formation (GFCF) deflator at constant 2015 prices. Table A.1 in the Appendix presents the descriptive statistics.

This paper applies ownership criteria according to the DOSM's definition of foreign affiliates in Malaysia. DOSM defines a foreign affiliate as a firm with foreign equity ownership of more than 50%[5] (a majority stake, which provides control over key aspects of a firm's operations allowing for the exploitation of firm specific assets). The same equity ownership principle is applied to identify a local firm. Firms with joint-venture ownership (equity of 50% local and 50% foreign) are excluded since the focus is on the performance of local firms vis-à-vis foreign firms. In the case of skill classification, the Malaysia Standard Classification of Occupation (MASCO) is adopted for the study (Ministry of Human Resources, MOHR, 2013). Accordingly, high-skilled labour is defined as managerial, professionals (engineers), and professionals and executives (non-engineers).

3.3 Firm characteristics of sample dataset

Table 1 shows that local firms dominated the sample dataset, as also mentioned in the preceding section. They made up 64.6% of the total number of firms in the sample. The overall sample comprised an almost equal distribution of small (37.2%), medium (31.6%)[6] and large-sized (37.2%) firms. Within groups, local firms were inherently small (42.3%) and medium sized (30.8%), while 39% of the foreign firms were large-sized. Typically, local firms had lower fixed assets per firm and lower numbers of high-skilled labour in total employment relative to foreign firms. In terms of export orientation, only 35% of the firms had exported 50% or more of their gross sales, with considerably much lower export orientation in local firms relative to foreign firms (see Table 1). Distinctively, though many in number, the R&D expenditure by local firms were lower than that for foreign firms. In fact, only 30% of the total number of firms in the sample had engaged in R&D expenditure. On a yearly basis, there was a decline in firms engaged in R&D in 2019 to 20.1% (2014: 20.4%), in line with findings from the National Survey of Research and Development in Malaysia conducted by the Malaysian Science and Technology Information Centre (MASTIC, 2020), which also found a decline in gross expenditure on R&D. Within the group, the share of local firms with R&D expenditure was only marginally lower at 17% relative to 22% for the foreign firm group.

Table 1: Characteristics of Sample Firms, by Ownership, 2014-2019

	2014	**2015**	**2016**	**2017**	**2018**	**2019**
All firms						
Number of firms	1,412	1,412	1,412	1,412	1,412	1,412
Value added (RM billion)	88.86	97.95	137.02	124.67	119.04	104.01
Fixed assets (RM billion)	79.71	79.10	84.50	81.02	99.12	91.20
Number of employees	386,029	383,910	388,051	403,299	411,422	427,055
Export sales (% of gross sales)	35.05	38.87	45.26	42.70	38.17	35.05
R&D spending (RM billion)	2.38	2.16	2.27	2.55	3.12	3.06
High-skilled labour (% of total employment)	14.65	16.06	15.52	15.60	15.63	15.48

	2014	2015	2016	2017	2018	2019
Local firms						
Number of firms	903	907	921	914	918	914
Value added (RM billion)	42.38	46.70	78.33	53.37	51.05	43.23
Fixed assets (RM billion)	42.62	44.87	45.59	43.13	48.44	44.40
Number of employees	178,919	186,291	183,883	182,709	187,839	185,084
Export sales (% of gross sales)	25.77	39.97	37.80	38.70	29.24	26.90
R&D spending (RM billion)	0.19	0.25	0.26	0.30	0.29	0.46
High-skilled labour (% of total employment)	12.87	14.97	13.23	13.53	13.63	13.50
Foreign firms						
Number of firms	509	505	491	498	494	498
Value added (RM billion)	46.49	51.24	58.69	71.30	67.99	60.78
Fixed assets (RM billion)	37.08	34.23	38.91	37.89	50.68	46.80
Number of employees	207,110	197,619	204,168	220,590	223,583	241,971
Export sales (% of gross sales)	51.52	36.91	59.26	50.04	54.77	50.03
R&D spending (RM billion)	2.18	1.90	2.01	2.24	2.83	2.60
High-skilled labour (% of total employment)	16.18	17.10	17.58	17.31	17.31	17.00

Source: Calculated from MIDA surveys (2021).

A *t*-test was conducted to compare the differences in the means for the two groups of firms. The results indicate that the two-group means are different at the 5% significance level for all variables, except for the R&D expenditure. The insignificant mean differences for R&D expenditure, also noted by Ramstetter and Ahmad (2009), is not surprising since both local firms and foreign firms report similar mean R&D expenditures with low dispersion rates (see Table A.1).

By industry (see Table 2), electrical and electronics (E&E)[7] was the major contributor to manufacturing value-added, capital and labour for all years. On average, for the 2014 to 2019 period, the three catalytic industries, E&E, machinery and equipment (M&E), and chemicals, made up 38.4%, 38.6%, and 41.3% of the total manufacturing value-added, capital and labour respectively. Conversely, textiles, wood and furniture recorded lower contributions to manufacturing value-added. Looking at R&D expenditure as a proportion to gross sales by industry,[8] the E&E recorded the highest share among the 19 industries. In terms of labour composition by industry, M&E and chemicals had relatively higher shares of high-skilled labour at 26.6% and 23.5% of total employment, respectively.

Table 2: Industrial Contributions to Value-Added, Capital and Labour (%)

	Value-added share						Capital share						Labour share					
Industry	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Electrical and electronics	23.71	20.32	33.27	28.86	19.66	34.20	20.61	22.13	34.69	33.51	21.21	35.69	27.32	29.36	35.39	30.03	21.92	37.03
Machinery & equipment	4.52	2.54	4.01	4.25	2.69	3.89	3.60	3.18	3.64	3.51	2.95	3.81	3.67	2.32	3.99	3.69	2.19	3.94
Chemicals and chemical products	8.15	11.39	4.21	9.23	10.88	4.37	11.83	11.06	4.38	4.39	6.95	4.22	6.85	11.06	4.37	8.20	11.73	4.39
Transport equipment	19.32	10.57	8.83	16.93	8.82	8.71	18.13	8.87	8.12	12.26	9.28	7.77	21.48	8.13	7.76	12.67	9.62	7.75
Food manufacturing	10.98	7.55	7.56	6.98	6.56	7.48	6.78	5.99	7.83	8.79	6.67	7.86	8.55	6.07	8.08	9.72	6.52	8.37
Petroleum products (including petrochemicals)	6.43	17.91	1.02	6.33	17.65	1.10	4.20	16.91	0.96	11.27	17.60	1.18	6.52	13.59	1.16	5.41	15.88	1.10
Non-metallic mineral products	3.12	3.73	2.87	3.98	5.98	2.89	17.66	5.57	2.91	3.18	5.89	2.68	3.14	4.61	2.49	3.04	4.69	2.22
Basic metal products	3.36	4.52	2.99	3.75	4.56	2.87	3.09	4.28	2.98	3.62	4.40	2.86	2.89	3.61	2.88	4.72	4.11	2.74
Plastic products	2.54	3.36	4.16	2.64	3.32	4.64	2.12	3.01	4.53	3.85	3.58	4.59	3.57	3.16	4.76	3.32	3.62	4.56

	Value-added share						Capital share						Labour share					
Industry	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Rubber products	2.06	2.84	4.67	2.45	3.08	4.76	1.93	3.01	5.12	2.72	3.40	5.07	3.02	3.10	4.94	3.92	4.16	5.06
Fabricated metal products	3.46	2.99	5.16	2.93	3.69	5.08	2.06	3.36	4.83	2.46	3.75	4.79	2.46	3.06	4.67	3.00	3.39	4.64
Paper, printing and publishing	2.35	3.12	3.21	2.29	3.19	3.19	1.72	3.36	3.18	1.66	3.47	3.13	2.06	3.04	2.99	2.22	3.27	2.96
Textiles and textile products	1.80	1.83	3.54	1.93	2.02	3.27	1.71	1.80	3.57	1.67	2.46	3.25	2.17	1.92	3.01	1.70	1.98	2.69
Scientific and measuring equipment	1.57	3.50	4.11	1.83	3.94	3.57	1.56	4.01	3.59	1.74	4.31	3.56	1.95	3.62	3.56	2.03	3.26	3.47
Beverages and tobacco	2.13	0.50	0.54	1.28	0.52	0.48	0.27	0.29	0.46	1.58	0.55	0.45	0.71	0.52	0.72	2.34	0.56	0.46
Furniture and fixtures	1.37	1.22	4.13	1.36	1.25	4.23	1.07	1.24	4.06	1.24	1.34	4.08	1.23	1.23	4.37	1.47	1.37	4.12
Wood and wood products	1.33	1.56	3.98	1.37	1.66	3.60	1.08	1.48	3.57	1.20	1.52	3.45	1.29	1.13	3.35	1.12	1.25	3.03
Leather and leather products	0.03	0.02	0.12	0.02	0.02	0.12	0.02	0.02	0.11	0.02	0.02	0.11	0.02	0.01	0.11	0.04	0.01	0.11
Miscellaneous	1.76	0.54	1.62	1.58	0.53	1.55	0.54	0.42	1.46	1.31	0.63	1.45	1.10	0.45	1.40	1.35	0.48	1.35
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Calculated from MIDA surveys (2021).

The differences in industrial contributions (value-added, labour and capital) and other structural characteristics (firm size, export orientation, R&D expenditure, and high-skilled labour shares) justify the industrial perspective on technical efficiency. The characteristics of the sample of firms are also reflective of that of the manufacturing sector, in that, foreign firms in Malaysia are large-sized, capital- skill- and export-intensive relative to local firms.

4. Results and Discussions

4.1 Panel estimates

The panel unit root tests are conducted, and the results are reported in Table 3. Since all variables across the four tests reported in Table 3 have p-values less than 0.05, the null hypothesis of unit root is rejected; indicating that there is some stationarity in the panel. Based on the log likelihood ratio test statistic, the null hypothesis is rejected at the 5% level of significance indicating that technical inefficiency effects exist.

Table 3: Panel Unit Root Test Results

	P	Z	L*	*Pm*
$\ln y_{it}$	9342.002***	-26.157***	-49.581***	86.730***
$\ln k_{it}$	8904.339***	-11.893***	-37.427***	80.906***
$\ln l_{it}$	6348.520***	-9.295***	-22.851***	46.898***
$Size_{it}$	6544.343***	-9.665***	-23.726***	49.504***
$Export_{it}$	6055.552***	-39.877***	-42.372***	43.000***
$R\&D_{it}$	3314.492***	-20.962***	-39.893***	6.527***
HS_{it}	6893.428***	-17.843***	-34.158***	54.149***

Notes: P: Inverse chi-squared, Z: Inverse normal; L*: Inverse log t; *Pm*: Modified inverse chi squared. ***, **, and * refer to significance levels at 1%, 5% and 10% respectively.
Source: Authors' own estimations.

Having established the stationarity of the variables and the appropriateness of the SFA approach, the production function is estimated using the BC95 model. The BC95 model is specified with the inclusion of technical inefficiency effects, defined by firm size, export orientation, share of R&D expenditure, and high-skilled labour.

Table 4 presents the maximum likelihood (ML) panel estimates for the production function for local firms, and foreign firms. The frontier estimates are all significant at the 1% level, and the output elasticity of capital is found to be much lower than the output elasticity of labour. This is not surprising as Khalifah and Adam (2009) note that even wholly owned foreign firms in Malaysia are labour intensive. For domestic firms, though all firm-specific factors are negatively related to technical inefficiency, only high-skilled labour and export orientation are significant (albeit weak significance for export orientation). This indicates that domestic firms with higher skilled employees are more efficient. The results lend support to the explanation that high-skilled labour can adapt more easily to new technology and innovate (Fahmy-Abdullah, 2017) and firms with higher export capabilities have more resources in obtaining technology, leading to increased technical efficiency. In the case of foreign firms, only high-skilled labour has a negative and significant relationship with technical inefficiency, again suggesting that having more high-skilled employees entails higher efficiency. Contrary to expectations, despite the higher export propensities of foreign firms relative to local firms, on average (see Table A.1), such orientation does not seem to be a significant source of efficiency.

Table 4: Maximum Likelihood Panel Estimates of Production Model, by Ownership

	Domestic firms	**Foreign firms**
β_0	11.196***	9.950***
(constant)	(0.106)	(0.169)
β_1	0.214***	0.310***
(ln *k*)	(0.007)	(0.012)
β_2	0.596***	0.576***
(ln *l*)	(0.016)	(0.021)
Inefficiency model (*mu*)		
δ_0	-324.925	-420.852***
(constant)	(0.000)	(93.520)
δ_1	-357.875	67.467
(Size)	(4464.748)	(2298.425)
δ_2	-35.878*	7.165
(Export)	(13.355)	(4.782)
δ_3	-101.871	-626.399
(R&D)	(304.790)	(614.477)

	Domestic firms	Foreign firms
δ_4	-151.645***	-103.067***
(HS)	(20.850)	(25.586)
Variance parameters		
σ_u^2	30.048***	29.767***
	(0.999)	(3.158)
σ_v^2	0.898***	0.813***
	(0.013)	(0.016)
Λ	33.450***	36.598***
Log likelihood	-9974.699	-5164.698
N	5477	2995

Notes: Standard errors are presented in parentheses. ***, ** and * refer to significant levels at 1%, 5% and 10% respectively.
Source: Authors' own estimations.

Tables 5 and 6 further report the industry-level[9] (panel) estimates of the ML for the production model for local firms and foreign firms, respectively. For local firms and foreign firms, the frontier estimates of capital and labour are positive and significant at the 5% level of significance for most industries. However, the output elasticity of capital is found to be higher than that for labour for local firms and foreign firms in some industries. Similar findings on capital intensity driving productivity in the Malaysian manufacturing sector for the 1997 to 2004 period were also reported by Lee (2011). Local firms (Table 5) in the petroleum, non-metallic mineral, and rubber products have higher elasticities of capital relative to labour. For petroleum, the results reflect the nature of investments in the industry, which are capital intensive (Abdullah, 2012), and dominated by domestic investors. As for foreign firms (Table 6), as expected, there is more evidence of significant and higher output elasticities of capital relative to labour across the manufacturing industries (namely for M&E, transport equipment, food, non-metallic mineral, basic metal, and textiles).

It appears that firm specific advantages generally do not significantly matter for driving technical efficiencies across industries in the case of local ownership. As for foreign ownership, there is some (albeit limited) evidence on the importance of high-skilled labour and export orientation for influencing technical efficiency. The technical efficiency effects of high-skilled labour are apparent for M&E and transport equipment (see

Table 5: Maximum Likelihood Panel Estimates of Production Model (BC95) for Local Firms, by Industry

	E&E	M&E	Chemicals	Transport	Food	Petroleum	NMM	BM	Plastic	Rubber	FM	PPP	Textiles	Furniture	Wood
$\beta_{0\,(Constant)}$	13.014*** (0.258)	12.738*** (0.311)	10.756*** (0.368)	9.805*** (0.509)	11.080*** (0.375)	11.107*** (1.182)	4.618*** (0.651)	10.081*** (0.519)	11.704*** (0.303)	6.651*** (0.63)	12.510*** (0.197)	11.527*** (0.503)	11.085*** (0.474)	11.966*** (0.323)	7.813*** (0.471)
$\beta_{1\,(\ln k)}$	0.115*** (0.019)	0.112*** (0.0182)	0.248*** (0.0241)	0.254*** (0.0353)	0.184*** (0.0234)	0.416*** (0.0514)	0.689*** (0.0213)	0.283*** (0.0434)	0.152*** (0.022)	0.641*** (0.0388)	0.0500*** (0.0141)	0.0993*** (0.0254)	0.138*** (0.0307)	0.0995*** (0.0203)	0.389*** (0.0343)
$\beta_{2\,(\ln l)}$	0.548*** (0.051)	0.659*** (0.0524)	0.590*** (0.0568)	0.783*** (0.0788)	0.712*** (0.0421)	0.118 (0.117)	0.223* (0.147)	0.594*** (0.0906)	0.587*** (0.0469)	0.043 (0.107)	0.788*** (0.0343)	0.864*** (0.097)	0.771*** (0.0583)	0.69*** (0.0479)	0.597*** (0.0394)
Inefficiency model (mu)															
$\delta_{0(Constant)}$	-101.344 (184.266)	-320.56 (382.926)	-43.943 (36.255)	-276.188 (304.784)	-142.959 (100.0344)	-121.785 (356.338)	-12.944 (62.218)	-200.576 (298.235)	-79.44*** (23.246)	7.887 (32.653)	-558.346 (449.818)	-282.859 (0.000)	-55.347 (231.385)	-227.556 (276.398)	-177.621 (235.793)
$\delta_{1(Size)}$	-3.069 (248679.8)	27.169 (0.000)	0.423 (22667.33)	-54.429 (0.000)	-26 (0.000)	-58.996 (0.000)	-6.837 (28757.88)	-16.538 (0.000)	-114.383 (3523.565)	-33.23 (0.000)	-16.325 (0.000)	-23.508 (27535.75)	31.379 (0.000)	-0.0516 (12211.03)	-56.413 (0.000)
$\delta_{2(Export)}$	-26.195 (54.667)	-212.501 (293.84)	-346.394 (0.000)	-351.379 (419.849)	-612.11*** (68.184)	7.0087 (40.185)	-0.751 (11.662)	15.208 (21.258)	-1130.65 (0.000)	-407.919 (526.13)	16.887 (13.435)	-504.063 (0.000)	-53.631 (201.245)	-11.477 (23.606)	7.285 (11.865)
$\delta_{3(R\&D)}$	-92.644 (1613.522)	93.335 (991.874)	-366.897 (874.386)	-327.644 (749.939)	-178.876 (2965.022)	21.329 (5505.147)	409.908 (1000.092)	-48.907 (0.000)	-302.63 (669.544)	-18.944 (3286.191)	-502.682 (946.511)	-1.236 (131346.3)	-382.829 (0.000)	-222.758 (671.966)	-147.247 (0.000)
$\delta_{4(HS)}$	-276.033 (495.617)	-122.809 (156.29)	-103.389* (57.299)	-63.27 (72.062)	-70.909 (52.629)	-90.995 (285.81)	-44.391 (190.284)	-189.676 (259.018)	-1.146 (6.52)	-97.123 (125.029)	40.177 (37.304)	-30.623 (49.187)	-141.473 (532.529)	-55.907 (66.397)	-50.473 (71.77)
σ_u^2 *Sigma u*	32.403 (27.91)	29.672* (17.766)	19.338*** (4.501)	27.499** (14.784)	20.514 (6.84)	21.591 (32.143)	6.927 (13.202)	26.753 (18.215)	12.736*** (1.454)	16.04* (10.466)	22.571*** (8.993)	24.777*** (3.031)	21.551 (40.341)	18.756 (11.112)	15.348* (10.085)
σ_v^2 *Sigma v*	0.682*** (0.0378)	0.852*** (0.0489)	1.030*** (0.0459)	1.201*** (0.0652)	0.883*** (0.0405)	1.020*** (0.15)	0.848*** (0.0509)	0.826*** (0.0485)	0.751*** (0.0355)	1.190*** (0.0714)	0.523*** (0.0269)	0.796*** (0.052)	0.640*** (0.0582)	0.514*** (0.041)	0.503*** (0.0414)
λ	47.516	34.826	18.771	22.888	23.229	21.177	8.174	32.401	16.961	13.484	43.131	31.136	33.684	36.525	30.536
Log likelihood	-801.998	-919.317	-863.171	-804.918	-966.201	-144.349	-349.496	-559.459	-807.73	-373.903	-845.279	-508.532	-287.911	-445.313	-365.82

Notes: NMM: Non-metallic mineral; BM: Basic metal; FM: Fabricated metal; PPP: Paper, printing and publishing. Excluding beverages and tobacco (25 firms), scientific and measuring equipment (50 firms), leather (size firms), and miscellaneous manufacturing (65 firms) due to the small sample size. Standard errors are presented in parentheses. ***, ** and * refer to significant levels at 1%, 5% and 10% respectively.

Source: Authors' own estimations.

Table 6: Maximum Likelihood Panel Estimates of Production Model (BC95) for Foreign Firms, by Industry

	E&E	M&E	Chemicals	Transport	Food	Petroleum	NMM	BM	Plastic	Rubber	FM	PPP	Textiles	Furniture	Wood
$\beta_{0\,(Constant)}$	10.738*** (0.269)	12.436*** (1.109)	11.8885*** (0.488)	15.713 (78.884)	6.507*** (0.828)	-355.0926 (0.000)	4.09*** (0.432)	6.13*** (0.863)	12.366*** (0.47)	11.433*** (0.805)	9.538*** (0.489)	9.49 (0.000)	12.461*** (1.473)	10.996*** (0.727)	5.6*** (0.782)
$\beta_{1\,(ln\,k)}$	0.165*** (0.0208)	0.576*** (0.0292)	0.19*** (0.0344)	0.441*** (0.0498)	0.629*** (0.0443)	-6290.778 (0.000)	0.745*** (0.0195)	0.573*** (0.0682)	0.0161*** (0.031)	0.0651 (0.0764)	0.229*** (0.0339)	-1.279 (0.000)	0.238** (0.0663)	0.00312 (0.0629)	0.399*** (0.0487)
$\beta_{2\,(ln\,l)}$	0.833*** (0.0352)	-0.46*** (0.149)	0.669*** (0.0771)	-0.297 (0.219)	0.138 (0.120)	-1499.578 (0.000)	0.241*** (0.0952)	0.389*** (0.863)	0.587*** (0.0973)	0.957*** (0.0764)	0.859*** (0.0733)	0.562 (0.000)	0.426*** (0.190)	1.0785*** (0.0783)	0.905*** (0.0884)
Inefficiency model (mu)															
$\delta_{0(Constant)}$	-90.927*** (37.043)	5.071*** (5.071)	-352.738 (335.034)	6.91 (78.866)	71.329 (206.979)	-41.730*** (9.47E-27)	-410.96 (432.132)	-23.15 (103.741)	-98.664 (168.394)	-344.429 (430.719)	-408.917 (789.136)	-11584.46 (0.000)	3.0237*** (0.778)	-336.463 (401.931)	39.402 (44.187)
$\delta_{1(Size)}$	66.647 (0.000)	-225.418** (95.866)	35.505 (0.000)	-4.589 (54.621)	-9.763 (39065.87)	1.625*** (1.03E-24)	1.206 (16190.15)	45.715 (0.000)	23.599 (0.000)	-26.281 (0.000)	2.0387 (59407.98)	-149.251 (0.000)	-61.355 (67.857)	-11.435 (0.000)	-18.484 (14811.2)
$\delta_{2(Export)}$	2.379* (1.271)	-0.00251 (0.048)	-335.687 (314.833)	0.112 (0.120)	-136.627 (440.0019)	-26.735*** (4.6E-27)	20.87 (25.710)	13.786 (22.885)	11.665 (17.657)	-22.507 (78.599)	-192.0924 (366.132)	-3712.017 (0.000)	-0.0582 (0.0769)	5.581 (13.72)	-978.784*** (12.685)
$\delta_{3(R\&D)}$	-1049.479* (725.116)	2.283 (3.581)	-247.265 (0.000)	6.095 (5.983)	-199.34 (1840.929)	0.884 (0.000)	-3.346 (0.000)	-44.674 (0.000)	-184.15 (1699.623)	-61.501 (0.000)	-279.0358 (994.851)	-574.719 (0.000)	-29.742 (88.917)	23.306 (0.000)	-178.266 (0.000)
$\delta_{4(HS)}$	-14.385* (9.147)	-0.629*** (0.108)	13.557 (26.078)	-0.871*** (0.188)	-197.438 (641.592)	-5.858*** (2.30e-27)	43.461 (5.754)	-187.371 (299.750)	-169.915 (267.679)	-22.507 (50.113)	-31.318 (64.726)	5163.447 (0.000)	-0.424*** (0.161)	44.49 (56.16)	-96.05 (89.184)
σ_u^2 *Sigma u*	12.611*** (2.607)	0.759*** (0.118)	24.036** (11.208)	0.223 (17.938)	18.657 (30.974)	3.95e-21 (0.000)	16.185* (8.571)	18.769 (15.448)	26.197 (20.33)	22.775* (14.079)	24.483 (23.022)	2.22E-47 (0.000)	0.507*** (0.126)	12.774* (7.605)	9.218** (4.00113)
σ_v^2 *Sigma v*	0.752*** (0.0279)	0.575*** (0.127)	0.616*** (0.067)	1.243 (3.221)	1.197*** (0.0775)	1.25e-08*** (6.7e-104)	0.43*** (0.072)	0.716*** (0.0604)	0.738*** (0.058)	0.449*** (0.0617)	0.648*** (0.048)	0.0000263 (0.000)	0.328*** (0.130)	0.255*** (0.051)	0.562*** (0.056)
λ	16.761	1.32	39.018	0.18	15.582	3.16E-13	37.614	26.219	35.49	50.705	37.776	8.43E-43	1.546	50.134	16.411
Log likelihood	-1275.218	-287.74	-407.019	-214.845	-332.461	3.64E+29	-145.294	-199.161	-418.569	-159.213	-470.144	2.67E+84	-57.642	-64.93	-74.775

Notes: Refer to Table 5 for the definition of the abbreviations. Standard errors are presented in parentheses. ***, ** and * refer to significant levels at 1%, 5% and 10% respectively.

Source: Authors' own estimations.

also Khalifah et al., 2008), while export orientation matters for the wood industry. R&D expenditure, an indicator of firms' innovative activity, do not significantly contribute to technical efficiency across all industries. The results hold true not just for local firms but also foreign firms, as MNCs tend to concentrate their innovative activities in their home countries. Hence, the lack of influence of R&D expenditure on productivity may be related to the relatively low investments in R&D by all firms, both local and foreign (Lee, 2008; Ramstetter & Ahmad, 2009; *The Sun Daily*, 21 April, 2021).

The ML results for the production model from the aggregate manufacturing (Table 4) and the industry-level analysis (Tables 5 and 6) support the fact that productivity in the manufacturing sector in Malaysia continues to be driven primarily by the standard inputs of labour and capital, irrespective of firm ownership.

4.2 Cross -section estimates

For robustness checks, cross-section estimations of the production model are conducted for all firms. Table 7 presents the cross-sectional ML estimates for the production function for the six-year period. The ML cross-sectional results in Table 7 are robust to the findings of the panel estimates of Table 4, in that the manufacturing productivity is found to be significantly driven by labour and capital and relies heavily on labour relative to capital (except for 2016). It seems that the argument of an input-driven manufacturing sector, weighed in the 1990s (Menon, 1998), still holds. Again, it shows that only high-skilled labour influences productivity, while firm size, export orientation and R&D expenditure did not affect productivity. The main qualitative conclusions therefore remain the same as the panel estimates.

Table 7: Maximum Likelihood Cross Section Estimates of Production Model

	2014	**2015**	**2016**	**2017**	**2018**	**2019**
β_0	11.266***	10.228***	5.472***	11.222***	11.038***	10.855***
(constant)	(0.013)	(0.208)	(0.278)	(0.204)	(0.208)	(0.231)
β_1	0.176***	0.252***	0.587***	0.192***	0.245***	0.244***
(ln *k*)	(0.013)	(0.015)	(0.018)	(0.013)	(0.015)	(0.016)
β_2	0.691***	0.631***	0.438***	0.706***	0.543***	0.609***
(ln *l*)	(0.013)	(0.029)	(0.032)	(0.030)	(0.031)	(0.033)

	2014	2015	2016	2017	2018	2019
			Inefficiency model (*mu*)			
δ_0	1.025***	0.804***	0.089	1.365***	1.983***	1.691***
(constant)	(0.156)	(0.178)	(0.198)	(1.365)	(0.159)	(0.151)
δ_1	17.223	20.016	-38.991	-23.421	-31.673	-2.810
(Size)	(15.287)	(16.444)	(28.825)	(15.954)	(20.091)	(13.370)
δ_2	0.250	0.060*	-0.254	-0.250	-0.013	0.008
(Export)	(0.000)	(0.020)	(0.108)	(0.000)	(0.018)	(0.015)
δ_3	-1.451	-7.976	-3.312	-8.701	-6.354	-0.109
(R&D)	(1.411)	(6.102)	(3.301)	(4.442)	(3.328)	(0.181)
δ_4	-0.302***	-0.492***	0.037	-0.054***	-0.556***	-0.319***
(HS)	(0.053)	(0.065)	(0.076)	(0.538)	(0.057)	(0.050)
σ_u^2	1.136***	0.826***	1.376***	1.457***	1.301***	1.526***
	(0.046)	(0.038)	(0.056)	(0.052)	(0.049)	(0.057)
σ_v^2	0.858***	0.837***	1.107***	0.856***	0.856***	0.891***
	(0.024)	(0.023)	(0.032)	(0.025)	(0.024)	(0.282)
Log likelihood	-2429.276	-2198.48	-2807.579	-2615.203	-2491.297	-2679.190
N	1412	1412	1412	1412	1412	1412

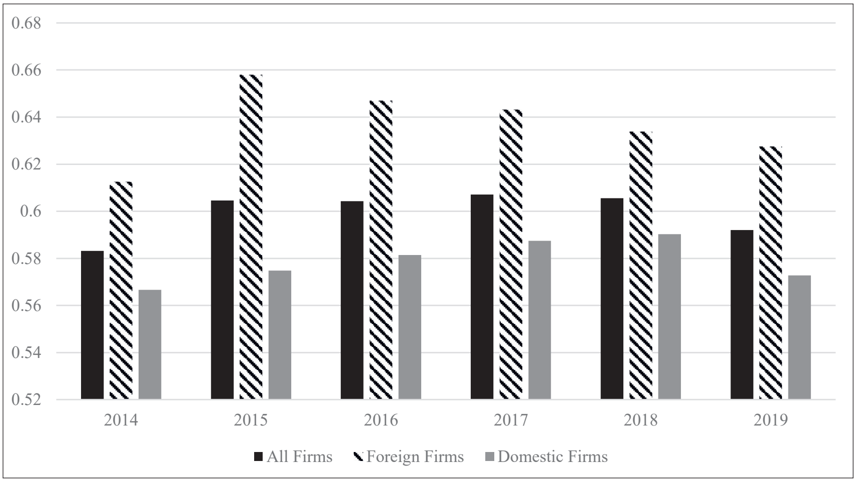
Notes: Standard errors are presented in parentheses. ***, ** and * refer to significant levels at 1%, 5% and 10% respectively.

Source: Authors' own estimations.

4.3 Technical efficiency

The level of technical efficiency for manufacturing for the 2014 to 2019 period average is estimated at 0.599. On average, local firms recorded a marginally lower level of technical efficiency (0.579) compared to foreign firms at 0.637 (see also Khalifah et al., 2008). As shown in Figure 1, the technical efficiency for local firms increased steadily between 2014 and 2018 (except for the drop in 2019), while that for foreign firms appeared have been on a gradual decline since 2015. Shuhaimen et al. (2017) and Bank Negara Malaysia (BNM, 2018) found that the benefits of FDI to the economy to be shrinking, with reduced expenditure of R&D by foreign companies. Importantly, the findings imply that productivity (or technical efficiency) can no longer be considered less pronounced in local firms compared to foreign firms (see also Ramstetter, 1993; 1999; Oguchi et al. 2002; Dogan et al., 2013).

Figure 1: Average Annual Technical Efficiency of Firms, by Ownership, 2014-2019



Source: Authors' own estimations.

From an industry perspective, the levels of technical efficiency for local firms also fall short of that for foreign firms, except for beverages and tobacco, furniture and fixtures, and petroleum (see Table 8). The level of technical efficiency of local firms is considerably low (TE < 0.5) in the leather products industry. As for foreign firms, it is low in the furniture and fixtures industry. Overall, technical efficiencies for all firms are highest in petroleum (see also Oguchi et al., 2002), followed by machinery and equipment, beverages and tobacco, and chemicals. The results support the policy focus of positioning Malaysia as a hub for the oil and gas (upstream and downstream) under the Economic Transformation Programme (ETP). As for M&E and chemicals, the relatively high technical efficiencies (see also Kim et al., 2009) of firms in these two industries corroborate with them being identified as catalytic industries under the 11th Malaysia Plan (11MP) to move towards high value added and complex products.

Table 8: Average Annual Technical Efficiency of Firms, by Ownership and Industry, 2014-2019

Industry	Panel estimates			Cross-section estimates (all firms)					
	All firms	Domestic firms	Foreign firms	2014	2015	2016	2017	2018	2019
Electrical and electronics Products	0.619	0.598	0.631	0.514	0.611	0.606	0.457	0.519	0.433
Machinery and equipment	0.670	0.652	0.714	0.539	0.605	0.625	0.477	0.509	0.464
Chemicals and chemical products	0.660	0.627	0.722	0.558	0.590	0.604	0.504	0.535	0.477
Transport equipment	0.600	0.564	0.711	0.510	0.570	0.562	0.434	0.494	0.413
Food manufacturing	0.599	0.591	0.624	0.500	0.568	0.563	0.450	0.481	0.457
Petroleum products (including petrochemicals)	0.726	0.759	0.680	0.633	0.651	0.603	0.608	0.645	0.603
Non-metallic mineral products	0.592	0.588	0.602	0.487	0.581	0.559	0.451	0.450	0.416
Basic metal products	0.606	0.595	0.630	0.501	0.578	0.568	0.461	0.468	0.444
Plastic products	0.576	0.546	0.634	0.471	0.535	0.555	0.409	0.441	0.409
Rubber products	0.552	0.538	0.580	0.394	0.532	0.533	0.413	0.472	0.409
Fabricated metal products	0.587	0.570	0.616	0.475	0.549	0.571	0.410	0.432	0.387
Paper, printing and publishing	0.552	0.528	0.604	0.452	0.542	0.545	0.392	0.451	0.410
Textiles and textile products	0.564	0.521	0.675	0.429	0.521	0.548	0.403	0.460	0.418
Scientific and measuring equipment	0.584	0.573	0.593	0.427	0.572	0.610	0.447	0.556	0.465
Beverages and tobacco	0.670	0.671	0.669	0.539	0.605	0.625	0.477	0.509	0.464
Furniture and fixtures	0.500	0.517	0.421	0.385	0.461	0.561	0.367	0.392	0.345
Wood and wood products	0.520	0.511	0.553	0.392	0.460	0.568	0.374	0.405	0.334
Leather and leather products	0.514	0.469	0.536	0.337	0.361	0.730	0.397	0.485	0.415
Miscellaneous	0.574	0.521	0.653	0.480	0.566	0.589	0.452	0.441	0.422
Total	0.599	0.579	0.637	0.489	0.564	0.579	0.441	0.478	0.426

Source: Authors' own estimations.

The ownership-efficiency results from the industry-level analysis suggest that it is important to consider the industry to which the foreign firms belong. As foreign firms are found to be closer to the frontier for specific industries, market incentives also need to be industry focused. This point is taken up in the conclusion section.

5. Conclusion

The time varying technical efficiency model was selected to compare the technical efficiencies for foreign and local firms within the manufacturing sector, for the 2014 to 2019 period. The key findings of the study are: First, the manufacturing firms in Malaysia are still driven by basic inputs of labour and capital, and it is more labour dependent relative to capital. Second, with the exception for high-skilled labour, other sources of technical efficiency, namely firm size, export orientation and R&D expenditure, remain insignificant. Though there is evidence of the quality of labour (high-skilled) driving technical efficiency for overall manufacturing, its influence is mainly observed in foreign firms operating in specific industries. Worth noting is that high-skilled labour influences productivity in M&E, but not in the other two catalytic industries. Third, the levels of technical efficiency of local firms are somewhat close to that for foreign firms, as the efficiency levels for the latter have been on a downward trend since 2015. Contrary to earlier findings in the 1990s (Oguchi et al., 2002), technical efficiency levels of the leading E&E industry are comparably much lower than M&E and chemicals.

Overall, the findings on technical efficiency effects in local firms and foreign firms in the manufacturing sector are robust with respect to the industries where firms operate. The implications of the findings can be broadly summarised as follow. First, contrary to earlier empirical evidence for Malaysia, the findings of the study suggest that ownership ties no longer make a huge difference to productivity levels in the manufacturing sector. The high productivity gaps between the foreign firms and local firms may therefore seem to be a thing of the past. Second, the combined importance of firm- and industry-specific characteristics for influencing technical efficiency seems established in the case of foreign ownership relative to local firms. The study posits that manufacturing firms are likely to realise higher efficiency through high-skilled labour, which is a critical finding considering the abundance of semi-skilled and unskilled labour in the Malaysian manufacturing sector. Third, it can no longer be assumed that innovative activities, be it in foreign firms, influence productivity. The results indicate that R&D expenditure does not seem to be working for firm productivity, thereby supporting prevailing evidence of a low magnitude of R&D expenditure by firms (*The Sun Daily*, 21 April 2021), and lower-end technology investments by foreign firms in Malaysia (see also Amin et al., 2017).

However, the distinction between the types of R&D (i.e., in-house or external) is important in studying the effects of R&D on productivity (Bonte, 2003) and as noted by Lokshin et al. (2007), a positive relationship between external R&D exists only with the availability of enough in-house R&D. As granularity in terms of the type of R&D is not captured by this survey, it can be further explored in future studies to provide more conclusive evidence on the relationship between R&D and productivity.

The findings suggest an important policy implication for the Malaysian manufacturing sector. With the declining levels of technical efficiency among foreign firms, foreign investment promotion policies need now more than ever to be more industry focused (see also United Nations Conference on Trade and Development (UNCTAD), 2000) and selective (or quality-based) to sustain productivity in the manufacturing sector. This calls for coordinated policies to encourage quality FDI into production with higher value-added activities and complexities, especially in the catalytic industries such as the E&E where technical efficiency is comparatively lower. Quality investments refer to investments that build inputs related to absorptive capacity (high-skilled labour) and innovation process (R&D expenditure) to bolster technical efficiency. To initiate FDI with such firm-specific assets, there should be R&D conditions[10] tied to the existing FDI incentive packages, such as income tax holidays (either pioneer status or investment tax allowance), import duty exemptions and subsidised industrial infrastructure (free trade zones and licensed manufacturing warehouses), in addition to existing conditions on the number of managerial, technical, and supervisory levels (MTS) staffs and capital investment per employee (CIPE). This is particularly important in the context of the Malaysian manufacturing sector that is reliant on FDI but has a low human capital base and lacks R&D compared to other regional high-income nations.

Notes

[1] MIDA is the government's principal agency to oversee and drive investment into the manufacturing and services sectors in Malaysia.

[2] The E&E, M&E, and chemicals are designated as "catalytic" industries in the 11th Malaysia Plan (11MP, 2016-2020), to revitalise the manufacturing sector given their strong linkages with other supporting industries.

[3] Latest MIDA survey data available at the time of study.

[4] The dataset is cleaned for inconsistencies and missing values on the variables of interest. For the six-year period, the proportions of common firms sampled for the two groups of local firms and foreign firms are 98% and 100% respectively.

[5] Prior to June 2003, the equity policy for manufacturing was tied to export conditions of the foreign firm. Since June 2003, foreign investors can hold 100% of the equity in all investments in new projects, as well as investments in expansion/diversification projects by existing companies, irrespective of the level of exports.

[6] According to the definition for SME in the Malaysian manufacturing sector, small firms are those with five to less than 75 full-time employees, while medium-sized firms are those with 75 employees to 200 employees.

[7] The E&E industry has also consistently been the largest recipient of FDI in manufacturing. In 2021, the industry accounted for 76% of total approved investments in manufacturing (MIDA, 2022).

[8] Data not presented in the paper in want of space.

[9] Some industries are excluded in the industry-level analyses of Tables 5 and 6 due to the small sample size of firms in those industries.

[10] For example, some MNCs are given conditions to create a certain number of high-paying jobs after being in operation for a specific number of years.

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Appendix

Table A1: Descriptive Statistics

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
		Local firms			
y (RM million)	5477	57.523	388.380	0	20108.600
κ (RM million)	5477	48.202	246.324	0	6211.068
l	5477	201.700	358.003	0	8791.000
Size	5477	0.002	0.004	Neg.	0.094
Export (RM million)	5477	28.512	208.798	0	11048.180
R&D (RM million)	5477	0.322	3.575	0	208.996
HS	5477	27.490	72.626	0	2510.000
		Foreign firms			
y (RM million)	5477	119.026	443.640	0	13314.440
κ (RM million)	5477	80.315	290.398	0	9248.384
l	5477	432.401	947.911	2.000	13762.000
Size	5477	0.003	0.008	Neg.	0.136
Export (RM million)	5477	147.284	609.981	0	10003.120
R&D (RM million)	5477	4.599	37.625	0	1139.234
HS	5477	73.859	194.817	0	2676.000

Note: Neg. - negligible.

Source: Authors' own estimation.