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## Global engagement and innovation activities: The case of Malaysian manufacturing firms

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**ADB Working Paper Series**

**GLOBAL ENGAGEMENT AND  
INNOVATION ACTIVITIES:  
THE CASE OF MALAYSIAN  
MANUFACTURING FIRMS**

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Lim Ee Shiang and Cassey Lee

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**Abstract**

This paper aims to examine how the diversity of global engagement is related to firms' participation in innovation input and output activities in the Malaysian manufacturing sector. The study uses firm-level data obtained from the World Bank's Enterprise Survey 2015. Firms are classified into four different groups based on their engagement in global activities, i.e., foreign trade and foreign direct investment. Incidences of innovation for ten innovation activities are computed. The incidence of innovation was used to examine the extent to which different global engagement groups participate in ten various types of innovation activities. Logit models are used to estimate the probability of engaging in innovation input and output activities for firms with differing global engagements. Generally, the results clearly highlight that globalized firms, i.e., firms engaging in global activities, participate in innovation activity more actively than their nonglobalized counterparts, despite there being some evidence that the pattern of engagement in innovation activity varies across globalized firms. Empirical findings propose that trade policies promoting exporting and policies attracting foreign direct investment may be useful in driving firms' participation in innovation activity. A number of export-related policies can be formulated to assist domestic firms in integrating into the global value chain. These include providing easier access to information about foreign markets, export marketing development assistance, and training programs. In addition, foreign direct investment liberalization policies may be used to attract selective foreign direct investments, and tax-related incentive policies may be formulated to encourage firms to set up in-house R&D activities for product development.

**Keywords:** exports, foreign ownership, global engagement, innovation, R&D

**JEL Classification:** F61, L60, O31

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## 1. INTRODUCTION

Innovation and technological advancement are essential for long-run economic growth. One of the key factors that facilitate innovation and technology transfer is the globalization of business. Firms may acquire technological knowledge and skills via their engagement in global business activities such as foreign direct investment, exporting, import of foreign inputs, cross-border worker mobility, and training (Goldberg et al. 2008). There is evidence from developed countries that firms engaging in global business activities tend to use more innovation input and generate more innovation output (Criscuolo, Haskel and Slaughter 2010). In addition, heterogeneity in innovation is observed across different forms of globalized firms (Criscuolo, Haskel and Slaughter 2010).

There is reason to believe that the relationship between global engagement and innovation in developing countries could be different from that in developed countries. The relationship between R&D and innovation (output) is well established in firm-level empirical studies in developed countries (Griffith et al. 2006; studies in OECD 2009). Nevertheless, firm-level empirical evidence from the developing countries on the relationship between R&D and innovation is mixed. Some find that investment in R&D/innovation activities will lead to a higher likelihood of introducing technological innovation (Chudnovsky, López and Pupato 2006; Raffo, Lhuillery and Miotti 2008). Some do not find that R&D statistically significantly affects the likelihood of product innovation (Alvarez, Bravo-Ortega and Navarro 2010), whereas some find that firms innovate without undertaking formal R&D activities (Cirera and Maloney 2017). Indeed, fewer firms in developing countries undertake formal R&D activities, and other innovation inputs such as imitation and technology acquisition appear to be more important than R&D and innovation (Cirera and Maloney 2017; Raffo, Lhuillery and Miotti 2008). Experiences from developing countries show that firms put more emphasis on physical capital investment for innovation (Gustavo and Pluvia 2010; Chudnovsky, López and Pupato 2006) and technology acquisition (Chudnovsky, López and Pupato 2006) than in-house R&D investment.

This highlights that the way firms organize their innovation activities in developing countries differs from that in developed countries. During the innovation process, firms in developing countries tend to depend on foreign direct investment and acquisition of external technology transfer rather than undertaking formal R&D activities (Osano and Koine 2016). Therefore, the findings obtained from developed countries may not be appropriate for generalizing to developing countries. In addition, the existing literature largely focuses on innovation activities such as R&D, and product and process innovations (for instance, Bratti and Felice 2010; Criscuolo et al. 2010). In comparison, other types of innovations such as logistics, marketing, and organizational innovations have been explored less and little is known about the role of global engagement in influencing firms' participation in innovation activity. Thus, it is pertinent to study the possible diversification of global engagement and various types of innovation activities in the context of a developing country. How is global engagement related to firms' participation in innovation input and output activities?

To shed light on the impact of globalization on firms' innovation activity, this paper contributes to the literature on the relationship between global engagement and innovation in developing countries. This paper aims to examine how the diversity of global engagement is related to firms' participation in innovation input and output activities using firm-level data from the Malaysian manufacturing sector. Malaysia is a middle-income developing country with high exposure to globalization. The country's

economy is highly integrated into the global economy – the value of its 2021 KOF Globalisation Index for economic dimension<sup>1</sup> is 76.1 points (KOFGI 2021), which is much higher than the global average value of 58.5 points.

The paper contributes to the firm-level empirical literature on global engagement and innovation in two key aspects. First, the paper examines how the innovation behavior varies across firms with different involvement in international business activity. Second, this paper attempts to study the relationship between globalization and innovation within the context of a comprehensive set of innovation indicators from both the input and output stages of the innovation process. The current paper includes a total of ten innovation indicators, including those rarely considered in the existing empirical literature; hence, this provides a better understanding of the innovation pathway that firms pursue in the context of a developing country.

The rest of the paper is organized as follows. Section 2 provides a brief review of empirical firm-level literature regarding the relationship between innovation and globalization-related variables, namely exporting, foreign ownership, and global engagement. Section 3 presents the methodology of the paper. This includes the framework used to examine the role of global engagement in the decision to participate in innovation activity. Section 4 presents the results for innovation input and output, and ends by integrating the results from both innovation input and output. Section 5 discusses key findings and their policy implications. Section 6 concludes the paper.

## 2. EMPIRICAL LITERATURE ON GLOBALIZATION AND INNOVATION

Globalization is one of the factors that facilitate innovation and technology transfer. Empirical studies often associate innovation with firms' international trade and investment activities. There has been a vast number of firm-level empirical studies on the relationship between innovation indicators, such as the propensity to innovate and the tendency to engage in in-house R&D, the level of innovation expenditure, and individual globalization-related factors such as exporting and/or foreign ownership (e.g., Lee 2004; Lim, Lee and Nagaraj 2012). Most empirical studies examine the relationship between globalization, using individual globalization-related factors (such as foreign ownership and exporting), and firms' participation in innovation activity. To date, there is only one study examining the relationship between innovation and globalization using a composite globalization indicator (referred to as "global engagement"<sup>2</sup> indicator hereafter) and innovation participation (Table 1).

So far, empirical studies using microdata at the firm level that examine the relationship between globalization-related factors and the different types of innovation have been rather limited (Table 1). The types of innovation often considered in this literature include: (i) product innovation (e.g., Bratti and Felice 2010; Palangkaraya 2013; Criscuolo, Haskel and Slaughter 2010; Branstetter, Goldberg and Kuriakose 2008; Raffo, Lhuillery and Miotti 2008; Chudnovsky, López and Pupato 2006), (ii) process innovation (e.g., Palangkaraya 2013; Criscuolo, Haskel and Slaughter, 2010; Branstetter, Goldberg and Kuriakose 2008; Chudnovsky, López and Pupato 2006); and (iii) R&D activity (e.g., Alvarez, Bravo-Ortega and Navarro 2010; Criscuolo, Haskel and

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<sup>1</sup> An index that takes into account two aspects, i.e., the flows of international trade and investment between Malaysia and other countries, as well as the restrictions on international trade and investment (KOFGI 2020).

<sup>2</sup> The term "global engagement" was introduced by Criscuolo, Haskel and Slaughter (2010).

Slaughter 2010; Raffo, Lhuillery and Miotti 2008). A few studies have considered other indicators such as the acquisition of new production technology (Branstetter, Goldberg and Kuriakose 2008) and product license agreements (Branstetter, Goldberg and Kuriakose 2008).

**Table 1: Summary of Firm-Level Empirical Studies on the Relationship between Globalization-Related Factors and the Type of Innovation**

Types of Innovation	(I) Exporting	(II) Foreign Ownership	(III) Global Engagement
Product innovation	Chudnovsky, López and Pupato (2006) Palangkaraya (2013) Bratti and Felice (2010, 2018)	Chudnovsky, López and Pupato (2006) Raffo, Lhuillery and Miotti (2008)	Criscuolo, Haskel and Slaughter (2010)
Process innovation	Chudnovsky, López and Pupato (2006) Palangkaraya (2013)	Chudnovsky, López and Pupato (2006)	Criscuolo, Haskel and Slaughter (2010)
Product or process innovation	Branstetter, Goldberg and Kuriakose (2008) Gustavo and Pluvia (2010)	Branstetter, Goldberg and Kuriakose (2008) Gustavo and Pluvia (2010)	
R&D	Alvarez, Bravo-Ortega and Navarro (2010)	Branstetter, Goldberg and Kuriakose (2008) Raffo, Lhuillery and Miotti (2008)	Criscuolo, Haskel and Slaughter (2010)
Others (acquisition of new production technology, product license agreement)	Branstetter, Goldberg and Kuriakose (2008)	Branstetter, Goldberg and Kuriakose (2008)	

## Exporting

The first strand of empirical studies analyzes the relationship between exporting and the type of innovation. Engaging in exporting allows firms to access foreign knowledge related to new technologies, new products, and the imitation of their foreign competitors' products. Firms that are active in the international market may have better access to foreign researchers' knowledge (Bratti and Felice 2010), and are likely to acquire foreign knowledge about new advanced technologies and products (Branstetter, Goldberg and Kuriakose 2008). In addition, firms producing for global markets are more likely to introduce product innovation (compared to those producing for the domestic market) due to the intense competition in the global market (Bratti and Felice 2010). Domestic firms that venture into the global market have to improve or modify their existing products to meet the requirements of their foreign customers (Bratti and Felice 2010). Stronger competitive pressure encourages firms to invest in R&D activity (Branstetter, Goldberg and Kuriakose 2008). For innovation input, Alvarez, Bravo-Ortega and Navarro (2010), in a study on Chile, did not find any statistically significant relationship between export intensity and the probability of investing in R&D and the intensity of R&D. The evidence from empirical studies on the relationship between exporting and innovation output is mixed. Some studies find a positive relationship between exporting and participation in innovation output. These include exporters that have a higher likelihood of introducing product innovation (Bratti and Felice 2010). Firms with higher export intensity and those that sell to multinationals are also found to be more likely to introduce new products (Branstetter, Goldberg and Kuriakose 2008). Firms producing for foreign buyers introduce product innovation more frequently than those producing for domestic buyers (Bratti and Felice 2018). Firms that engage in exporting have a higher probability of undertaking product innovation and process innovation (Chudnovsky, López and Pupato 2006). In contrast, Palangkaraya (2013) finds engaging in export activity leads to a higher likelihood of



introducing process innovation among small and medium enterprises, but this similar corresponding influence is not observed for engaging in product innovation, in the manufacturing sector. Gustavo and Pluvia (2010) observe heterogeneous results regarding the influence of exporting on the likelihood of innovation output participation across countries. They find that export-oriented firms have a higher likelihood of introducing product or process innovation in Costa Rica, but have a lower corresponding likelihood in Chile and Colombia.

### **Foreign Ownership**

The second strand of literature relates innovation to the structure of foreign ownership. It is commonly argued that foreign firms are in a better position to access foreign knowledge and resources for innovation activity than domestically owned firms (Raffo, Lhuillery and Miotti 2008). Foreign firms tend to be more technologically intensive and are able to offer higher-quality products than their domestic counterparts (Branstetter, Goldberg and Kuriakose 2008). Foreign ownership may have a positive impact on R&D activity when there is a substantial size and growth of markets (Raffo, Lhuillery and Miotti 2008).

Empirical evidence on the relationship between foreign ownership and R&D activity tends to differ across countries. Raffo, Lhuillery and Miotti (2008) find that firms belonging to a foreign group of companies have a higher likelihood of engaging in internal R&D activities in France and Brazil, but a lower corresponding likelihood in Spain, and no significant corresponding influence in the case of Switzerland, Argentina, and Mexico. Firms that have joint ventures with MNCs tend to have a higher likelihood of acquiring new technology licenses, while majority-owned foreign firms have a lower likelihood of doing so (Branstetter, Goldberg and Kuriakose 2008).

As for innovation output, Gustavo and Pluvia (2010) observe that foreign firms have a higher probability of introducing product or process innovation in Chile, but a lower corresponding probability in Argentina, Colombia, and Panama. Some studies have not found a statistically significant relationship between foreign ownership and firms' participation in innovation output activity (Branstetter, Goldberg and Kuriakose 2008; Chudnovsky, López and Pupato 2006). One likely explanation is that foreign firms might have acquired a high level of technology soon after the acquisition, and hence are less likely to introduce product or process innovation (Branstetter, Goldberg and Kuriakose 2008).

### **Global Engagement**

Global engagement in terms of ownership structure and trade has also been examined as a driver of innovation. Criscuolo, Haskel and Slaughter (2010) examined the relationship between global engagement and innovation activity in the UK. They classified firms into four distinct groups: (a) multinational parents, (b) multinational affiliates (hereafter both (a) and (b), multinational firms), (c) nonmultinational exporters (hereafter exporters), and (d) purely domestic firms (hereafter domestic firms). They found that multinational firms use more innovation input. The amount of R&D investment was higher among multinational firms than nonmultinational exporters and the lowest amount was observed among purely domestic firms. Similarly, the shares of R&D workers in the total number of workers are higher among multinational firms and exporters than in domestic firms. In addition, a higher proportion of firms applying for or using patent protection is observed among multinational firms and exporters than domestic firms. This shows the importance of the heterogeneity of innovation input between globalized firms and nonglobalized firms as well as across globalized firms. Globalized firms produce more innovation output, and a higher proportion of firms

engaging in product or process innovations is observed among globalized firms such as multinational firms and exporters than among domestic firms (Criscuolo, Haskel and Slaughter 2010).

### **3. METHODOLOGY**

#### **3.1 Data**

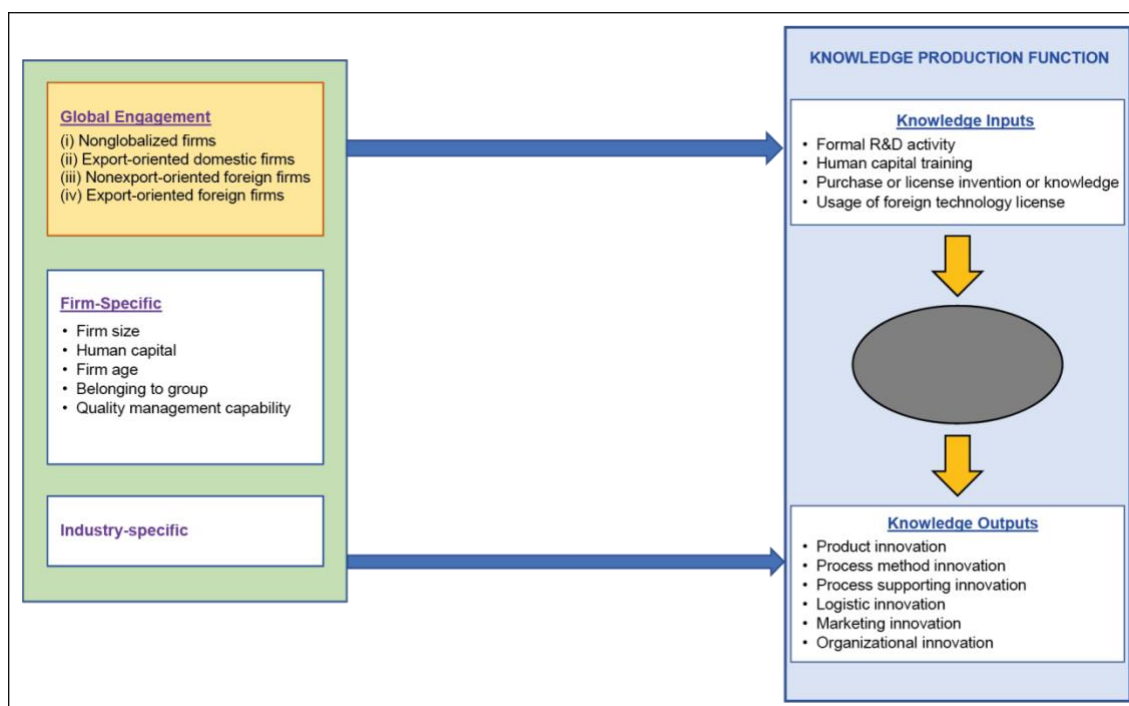
The Department of Statistics Malaysia collects firm-level manufacturing data but the raw data are not publicly available to researchers. As such, this study relies on the latest publicly available firm-level Malaysian manufacturing data, which are from the World Bank's Enterprise Survey 2015 (WBES 2015) (World Bank, 2015). The final sample consists of 564 observations after removing observations with missing information on foreign ownership and/or export orientation. Nevertheless, it is worth noting that the number of observations used in estimating various innovation activities varies from one innovation activity to another due to missing values of some of the explanatory variables.

#### **3.2 Analytical Framework**

Figure 1 illustrates the analytical framework that is used to examine the relationship between different forms of global engagement and participation in different types of innovation activities. Innovation is viewed as a process in which knowledge input is transformed into knowledge output. Firms undertake various types of innovation activities during the innovation process. The underlying idea of segregating knowledge indicators into input and output stages is inspired by Griliches's (1979) knowledge production function. Activities such as R&D, human capital training related to innovation, and acquisition of external knowledge (technology or know-how) are considered inputs or (investments) to the innovation process (OECD/Eurostat 2018) and hence serve as knowledge input indicators. In addition, the study also considers the usage of foreign technology as an input indicator. Product innovation, process innovation, marketing innovation, and organizational innovation are among the knowledge outputs or outcomes of the innovation process (OECD/Eurostat 2005). The inclusion of innovation activities in the current study is largely constrained by the data obtained from the World Bank's Enterprise Survey 2015.

To understand better firms' engagement in the innovation process, it is therefore pertinent to capture how firms engage in the input and output stages of the innovation process by examining their participation in various types of innovation input and output activities. The study uses ten indicators from the following two groups of innovation indicators: innovation input indicators: (i) investment in formal R&D, (ii) human capital training, (iii) purchase or license invention or knowledge, (iv) the usage of foreign technology licenses; and innovation output indicators: (v) product innovation, (vi) process method innovation, (vii) logistic process innovation, (viii) process supporting innovation, (ix) marketing innovation, and (x) organizational innovation.

Inspired by Criscuolo, Haskel and Slaughter (2010), this study introduces a set of proxies for global engagement by juxtaposing the two individual globalization-related variables, i.e., foreign ownership and market orientation. Therefore, the classification of global engagement groups in this study is not directly comparable to that of Criscuolo, Haskel and Slaughter (2010) except for purely domestic firms, which are relatively close to nonexport-oriented domestic firms in this study.

**Figure 1: The Analytical Framework of the Study**

Following the immediate direct investment criteria set by the International Monetary Fund (2009), a firm is classified as foreign-owned if foreigners directly own at least 10% of the firm's ordinary equity shares. The extent to which firms are exposed to globalization may also be affected by their import flows. Nevertheless, this study does not include import flows in the above classification as the data contained a large number of responses indicating "don't know" or no response to the question regarding the direct imported raw material inputs or supplies. In addition, it has been argued that import flows are more diversified, and hence this reflects both diversification and novelty. In comparison, export flows are drawn on scale economies and comparative advantages, thus they tend to be less diversified than import flows (Nilsson and Johansson 2007). Hence, this study uses export flows instead of import flows to measure the extent of exposure to globalization. Firms that engage in direct export and/or indirect exports<sup>3</sup> are identified as export-oriented firms.

Based on their engagement in global activities, firms are classified into the four following groups to capture the plausible diversity of global engagement in their participation in innovation activity:

- a) export-oriented domestic firms: domestically owned firms with export activity;
- b) export-oriented foreign firms: foreign-owned firms with export activity;
- c) nonexport-oriented foreign firms: foreign-owned firms that focus entirely on the domestic market (i.e., firms with 100% sales from the domestic market); and
- d) nonglobalized firms: domestically owned firms that focus entirely on the domestic market.

<sup>3</sup> firms that are involved in indirect exports refer to those that sell their outputs domestically to export-oriented firms.

In addition to global engagement variables, the firm-specific control variables that are used in this study include size of firm (the number of employees), human capital (the quality of employees), age of firm, belonging to a group, and quality management capability. Larger firms are expected to innovate more. The use of more human capital is likely to enhance firms' participation in innovation activity. A firm's quality management capability is proxied by a firm's adoption of recognized international quality certification. The adoption of international quality certification implies that the international technical best standard of quality control and improvement is practised and fostered within the boundaries of firms (Goldberg et al. 2008), and this may enhance firms' ability to participate in innovation activity. Finally, the model also controls for possible differences across industries by including industry dummy variables.

### 3.3 The Empirical Model

A logit model is used to formulate a firm's decision to engage in a particular type of innovation activity. The general specification of the logit model is expressed as follows:

$$\ln\left(\frac{P}{1-P}\right) = \alpha + \beta_i X_i + \beta_j Y_j + \mu_i \quad (1)$$

where

$P$  = the probability of a firm engaging in innovation activity

$(1 - P)$  = the probability of a firm not engaging in innovation activity

$X_i$  = global engagement variables

$Y_i$  = firm- and industrial-specific variables

$\beta_i, \beta_j$  = the coefficients for the explanatory variables

$\ln\left(\frac{P}{1-P}\right)$  represents the log of odds, i.e., the ratio of the probability of engaging in the given type of innovation activity to the probability of not engaging in the given type of innovation activity. The dependent variable is a dummy variable that takes the value of 1 if a firm has reported that it engaged in a particular type of innovation activity. A separate logit model is estimated for each type of innovation activity.

Table 2 summarizes the list of variables in the statistical model and their measurement. For the dependent variable, a total of ten innovation activities are considered. These include four innovation input indicators (formal R&D activity, human capital training, purchase or license inventions and knowledge, and usage of foreign technology license) and six innovation output indicators (product innovation, process method innovation, process supporting innovation, logistics process innovation, marketing innovation, and organizational innovation). During the innovation process, firms might undertake in-house R&D activities or completely outsource their R&D activities. This activity is captured by the indicator of formal R&D activity. Moreover, firms may also opt for engaging in extramural innovation activities such as using foreign technology licenses, procuring or licensing inventions and knowledge such as machinery, technology, patents, etc. A firm's participation in innovation activity is measured using a dummy variable that takes the value of 1 if the firm has engaged in innovation activity, and zero otherwise.

**Table 2: List of Variables in the Statistical Model**

<b>Variables (Variable Name)</b>	<b>Measurement of Variables</b>
<b>Innovation Input</b>	
Formal R&D activities (R&D)	=1 if spent on formal research and development activities, either in-house or contracted with other companies (excludes market research surveys)
Human capital training for innovation (product and process innovation) (TRAINING)	=1 if provided formal training to any of its employees specifically for the development and/or introduction of new or significantly improved products and processes
Purchase or license inventions and knowledge for innovation (product and process innovation) (PURCHASE INV)	=1 if purchased or licensed any patented or nonpatented inventions, or other types of knowledge for the development of new or significantly improved products and processes.
Usage of foreign technology license (USE_FOREIGN)	=1 if presently use of technology licensed from a foreign-owned company, excluding office software at present
<b>Innovation Output</b>	
Product innovation (PRODUCT)	=1 if introduced new or significantly improved products
Process method innovation (METHOD)	=1 if introduced new or significantly improved methods of manufacturing products
Process supporting innovation (SUPPORT)	=1 if introduced new or significantly improved supporting activities for processes, such as maintenance systems or operations for purchasing, accounting, or computing
Logistic innovation (LOGISTIC)	=1 if introduced new or significantly improved logistics, delivery, or distribution methods for inputs, products, or services
Marketing innovation (MARKETING)	=1 if introduced new or significantly improved marketing methods
Organizational innovation (ORGANIZATIONAL)	=1 if introduced new or significantly improved organizational structures or management practices.
<b>Global Engagement</b>	
Export-oriented domestic firm (EXPORT_DOMESTIC)	=1 if domestically owned firm engages in export activities
Export-oriented foreign firm (EXPORT_FOREIGN)	=1 if foreign-owned firm engages in export activities
Nonexport-oriented foreign firm (N-EXPORT_FOREIGN)	=1 if foreign-owned firm does not engage in export activities
<b>Firm-specific Characteristics</b>	
Size (large firms) (LARGE)	=1 if employs 200 or more full-time workers
Human capital (HC)	The proportion of skilled workers in the workforce
Age (AGE)	Number of years established
Belonging to group (GROUP)	=1 if part of a larger firm
Quality management capability (QUALITY)	=1 if possesses internationally recognized quality certification

The global engagement variables are proxied using three dummy variables, each of which will take the value of 1 if a firm is identified for export-oriented domestic firms, export-oriented foreign firms, or nonexport-oriented foreign firms, respectively. The base group is nonexport-oriented domestic firms or nonglobalized firms. The percentage distribution of sample firms according to global engagement is 36% export-oriented domestic firms, 20% export-oriented foreign firms, 5% nonexport-oriented foreign firms, and the balance of 39% is comprised of nonexport-oriented domestic firms. For firm-specific characteristics, factors such as firm size (large firms), firm age, human capital, belonging to a group, and quality management capability are included in the statistical model. Firm size is proxied by a dummy variable for firms of 200 workers and above, and the base group is small and medium-sized firms with fewer than

200 workers. In addition, to capture a firm's ability to absorb technology and knowledge, the model includes a proxy to measure the intensity of knowledge labor, i.e., the proportion of skilled workers in the workforce. Firm age is proxied by the number of years the firm has been established. Belonging to a group is measured by a dichotomous variable that equals to 1 if the firm is part of a corporate group and zero otherwise. Quality management capability is proxied by the possession of internationally recognized quality certification. The model also accounts for possible differences across industry sectors by including ten industry dummies.

## 4. RESULTS

### 4.1 Sample Characteristics

Table 3 summarizes the descriptive statistics of all variables used in the statistical model for the overall manufacturing sample. The final sample consists of 564 observations. However, due to the missing information, the number of observations differs from one variable to another, and this also leads to differences in the number of observations used for the estimation of statistical models for the different types of innovation activities. In terms of firm-specific variables, 35.9% are large firms employing 200 workers or more, 24.1% belong to a group of firms, and 41.0% secure internationally recognized quality certification.<sup>4</sup> The average age of overall sample firms is 20 years, and the average proportion of skilled workers in the workforce is approximately 50.2%.

**Table 3: Descriptive Statistics of Variables in the Statistical Models**

Variable	No. of Observations	Mean	Standard Deviation	Min	Max
Belonging to group	564	0.241	0.428	0	1
Size (large firms)	560	0.359	0.480	0	1
Human capital (share of skilled workers)	549	50.178	8.758	0	83.3
Age	557	19.688	9.506	3	76
Quality management (internationally recognized quality certification)	536	0.410	0.492	0	1

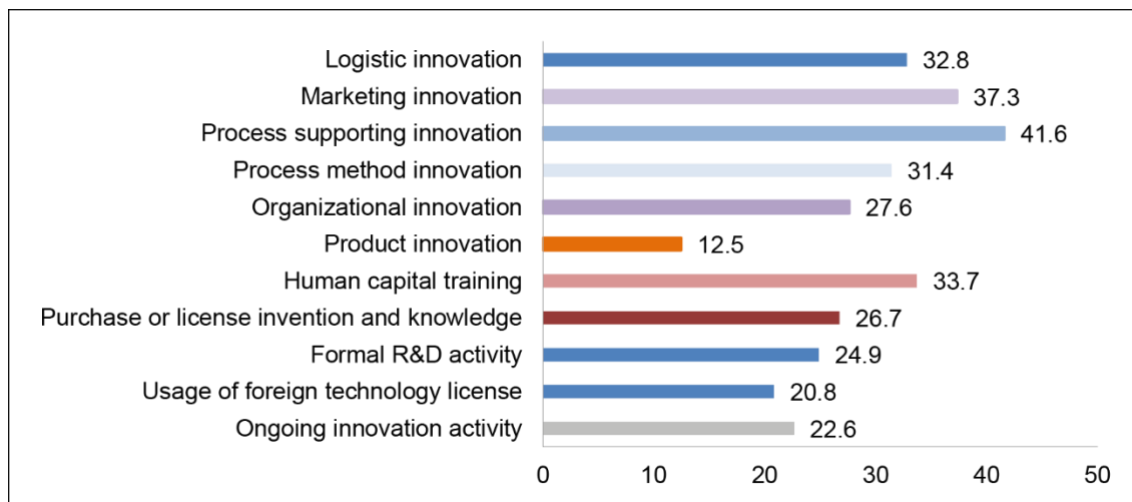
### 4.2 Incidence of Innovation

This section presents the descriptive findings on the incidence of innovation for all manufacturing firms and four global engagement groups. The incidence of innovation is proxied by the percentage of firms engaging in innovation activity  $k$  within the group. This indicator measures the extent to which innovation activity  $k$  is undertaken by a particular global engagement group. Figure 2 depicts the incidence of innovation for the overall manufacturing firms. Among the innovation input, human capital training for innovation is the most frequently invested-in activity by firms with the highest incidence of innovation (33.7%), and this is followed by investment in purchasing or licensing patents (26.7%). For innovation output, process logistic innovation (41.6%) is the

<sup>4</sup> It is worth noting that the 2015 WBES data set is biased toward large firms. A comparison of the distribution of manufacturing firms between the 2015 WBES and Malaysian Manufacturing Census 2015 reveals that the differences in the percentage points for medium-sized and large-sized firms were 14.0% and 14.3%, respectively. This suggests that there is an overrepresentation of medium-sized and large-sized firms in the WBES's data set.

activity most frequently engaged in by firms. This is followed by marketing (37.3%), process supporting (32.8%), and process method (31.4%) innovations. The lowest incidence was recorded for product innovation (12.5%). The results indicate that Malaysian manufacturing firms emphasize less embracing product development strategies compared to other innovation activities.

**Figure 2: Incidence of Innovation (%) for Malaysian Manufacturing Firms**



Note: Own computation for the overall manufacturing sample.

The tendency of globalized firms to engage in innovation activity is higher than that among nonglobalized firms. The incidence of innovation for globalized firms, namely export-oriented domestic firms, export-oriented foreign firms, and nonexport-oriented domestic firms, was higher than that for nonglobalized firms. This finding is consistently observed for all types of innovation inputs and outputs (Table 4). The subsequent discussion mainly focuses on comparing the incidence of innovation to explore the possible difference in innovation behavior across globalized firms.

**Innovation Input**

Export-oriented firms are more likely to undertake formal R&D activities. The incidence of engaging in R&D activity was higher among export-oriented foreign firms (37.5%) and export-oriented domestic firms (34.0%) than in nonexport-oriented foreign firms (30.0%). Foreign firms engage more frequently in extramural innovation activities. The incidence of purchasing or licensing of inventions and knowledge was also relatively higher among export-oriented foreign firms (43.3%) than in other globalized firms. In addition, differences in the intensity of using foreign technology licenses were observed among foreign firms, whether nonexport-oriented (46.2%) or export-oriented (36.1%), compared to export-oriented domestic firms (23.0%). Firms that venture into foreign markets have a higher tendency to focus on training the labor force for innovation. A relatively high incidence of human capital training was observed among nonexport-oriented foreign firms (45.0%) and export-oriented domestic firms (42.0%). Foreign firms are more likely to engage in extramural innovation activities. The incidence of purchasing or licensing inventions and knowledge was higher among export-oriented foreign firms, while the incidence of using foreign technology was higher among nonexport-oriented foreign firms and export-oriented foreign firms than in export-oriented domestic firms.

## Innovation Output

Firms that venture into global markets are likely to introduce product and marketing innovations. The incidence of marketing innovation was higher among export-oriented domestic firms (48.5%) and export-oriented foreign firms (45.4%) than in foreign firms with a domestic market orientation (37.5%). Similarly, a relatively high incidence of product innovation was observed among export-oriented foreign firms (22.7%) and export-oriented domestic firms (19.8%). There is no obvious difference in the incidence of process method observed across different globalized firms. Nevertheless, the incidence of process method innovation appears to be higher than that of product innovation. It is worth noting that the differences between the incidences of product innovation and process method innovation tend to be higher among nonexport-oriented foreign firms than the corresponding differences observed for both export-oriented foreign and domestic firms. This suggests the relative importance of enhancing production efficiency over introducing product innovation among nonexport-oriented foreign firms. Foreign firms that venture into domestic markets are likely to undertake logistic and process supporting innovations. The incidence of process supporting innovation was relatively higher among nonexport-oriented foreign firms (51.2%) than export-oriented foreign firms (45.4%). A similar finding is observed for logistic innovation in which nonexport-oriented foreign firms have a relatively higher incidence of logistic innovation. Generally, the results highlight that the extent to which firms engage in innovation activities not only differs between nonglobalized firms and globalized firms, but also across globalized firms.

**Table 4: Incidence of Innovation by Global Engagement Groups**

Innovation Activity	Incidence of Innovation			
	Nonglobalized Firms	Export-oriented Domestic Firms	Export-oriented Foreign Firms	Nonexport-oriented Foreign Firms
<b>Innovation Input</b>				
Formal R&D activity	13.4	34.0	37.5	30.0
Human capital training	24.3	42.0	39.2	45.0
Purchase of license or invention	15.1	33.3	43.3	32.5
Usage of foreign technology	9.4	23.0	36.1	46.2
<b>Innovation Output</b>				
Product Innovation	4.7	19.8	22.7	7.5
Process method innovation	20.6	39.8	41.2	42.5
Process supporting innovation	33.0	50.9	45.4	51.2
Logistic innovation	25.3	37.0	39.4	48.8
Marketing innovation	27.1	48.5	45.4	37.5
Organizational innovation	17.9	36.0	37.1	32.5

## 4.3 Econometric Analysis

The results of the logit regression models and the marginal effects for innovation inputs and outputs are summarized in Tables 5 and 6, respectively. The discussion will mainly focus on the marginal effects of variables that are statistically significant. The marginal effect of an explanatory variable is evaluated when all explanatory variables are at their mean values. For a dichotomous variable, the marginal effect of the probability is calculated when there is a discrete change from 0 to 1 in the variable, *ceteris paribus*. A quick glance at the results shows that global engagement and most firm-specific variables are statistically significant in influencing the probability of engaging in innovation input (Table 5) and innovation output (Table 6), and that the significant



influence of these factors and the magnitude of marginal effects tend to differ from one innovation activity to another.

### 4.3.1 Innovation Inputs

Table 5 presents the logit regression results (2nd column – 5th column) and the marginal effect of explanatory variables (6th column – 9th column) for innovation input models. Out of six factors considered, five of them (global engagement, firm size, human capital, firm age, and quality management capability) are statistically significant in affecting the probability of engaging in innovation input.

**Table 5: Estimated Results for Logit Model and the Marginal Effects of Explanatory Variables: Innovation Input**

Variables	Coefficients of Logit Regression			
	Formal R&D	Human Capital Training	Purchase or License Inventions and Knowledge	Usage of Foreign Technology License
Export-oriented domestic firms	1.206*** (0.334)	0.637** (0.264)	1.151*** (0.326)	0.494 (0.326)
Export-oriented foreign firms	0.310 (0.407)	-0.063 (0.341)	0.570 (0.395)	1.022*** (0.379)
Nonexport-oriented foreign firms	0.886 (0.561)	0.931* (0.539)	0.985* (0.561)	2.483*** (0.593)
Size (large firm)	1.395*** (0.290)	0.940*** (0.257)	1.176*** (0.278)	0.439 (0.293)
Human capital	0.040** (0.019)	-0.010 (0.012)	0.014 (0.017)	-0.018 (0.013)
Age	0.034*** (0.013)	0.0176 (0.011)	0.029** (0.013)	-0.003 (0.013)
Belonging to group	0.488 (0.298)	-0.0919 (0.281)	0.328 (0.295)	-0.385 (0.326)
Quality management capability	1.118*** (0.270)	0.921*** (0.231)	1.159*** (0.259)	0.367 (0.266)
<i>Industry</i>	YES	YES	YES	YES
<i>No. of observations</i>	487	494	498	466
Variables	Marginal Effects of Explanatory Variables			
	R&D	Human Capital Training	Purchase or License Inventions and Knowledge	Usage of Foreign Technology License
Export-oriented domestic firms	0.177***	0.135**	0.179***	0.078
Export-oriented foreign firms	0.046	-0.013	0.088	0.161***
Nonexport-oriented foreign firms	0.130	0.197*	0.153*	0.392***
Size (large firm)	0.205***	0.199***	0.183***	0.069
Human capital	0.006**	-0.002	0.002	-0.003
Age	0.005***	0.004	0.004**	-0.001
Belonging to group	0.072	-0.019	0.049	-0.061
Quality management capability	0.164***	0.195***	0.180***	0.058
<i>Industry</i>				
<i>No. of observations</i>				

Note: Standard errors in parentheses. \*\*\*, \*\*, and \* represent significance at the 1%, 5%, and 10% levels, respectively.

Global engagement variables are statistically significant and positively associated with the probability of participating in all innovation input activities (Table 5). The results of statistically significant coefficients (2nd column – 5th column) suggest that exported-oriented domestic firms have a higher probability of investing in formal R&D, undertaking human capital training for innovation, and purchasing or licensing inventions and knowledge than nonexport-oriented domestic firms, while nonexport-oriented foreign firms have a relatively higher probability of undertaking human capital training for innovation, purchasing or licensing inventions and knowledge, and using foreign technology licenses, and export-oriented foreign firms have a relatively higher probability of using foreign technology licenses than nonexport-oriented domestic firms.

In addition, the statistical significance and the magnitude of marginal effects (6th – 9th column) also differ across export-oriented domestic firms, export-oriented foreign firms, and nonexport-oriented foreign firms. This suggests that the tendency to engage in innovation input differs across these globalized firms. Only exported-oriented domestic firms have a higher probability of investing in formal R&D. The magnitude of marginal effects suggests that engaging in exporting increases domestic firms' probability of spending on formal R&D by 17.7 percentage points compared to their nonglobalized counterparts. Being nonexport-oriented foreign firms increases the probability of engaging in human capital training for innovation by 19.7 percentage points compared to nonexport-oriented domestic firms. In comparison, the corresponding marginal effect observed for export-oriented domestic firms is much smaller (13.5 percentage points). The reverse is observed for the purchasing or licensing of inventions and knowledge, for which the magnitude of marginal effects is larger among export-oriented domestic firms (17.9 percentage points) than nonexport-oriented foreign firms (15.3 percentage points). The statistically significant and positive sign of the coefficients for both export- and nonexport-oriented foreign firms suggests that foreign firms have a higher probability of using foreign technology licenses than nonglobalized firms. Nevertheless, being nonexport-oriented foreign firms increases the probability of using foreign technology licenses more (39.2 percentage points) than the corresponding increases observed for being export-oriented foreign firms (16.1 percentage points).

Firm size is statistically significant and positively associated with participation in innovation input. Being a large firm increases the probability of spending on formal R&D, undertaking human capital training, and purchasing or licensing inventions and knowledge by 20.5, 19.9, and 18.3 percentage points, respectively, compared to their small and medium-sized counterparts. Human capital is statistically significant and positively associated with spending on formal R&D activity. The value of marginal effect suggests that each additional 1% increase in the number of skilled workers in the labor force increases the probability of investing in formal R&D activity by only a small magnitude, i.e., 0.6 of a percentage point. As for firm age, each additional year a firm is established increases the probability of spending on formal R&D and the probability of purchasing or licensing inventions and knowledge by 0.5 and 0.4 percentage points, respectively. For belonging to a group, the coefficient is not statistically significant in all innovation input statistical models. However, there is weak evidence that firms belonging to a group are likely to have a higher probability of spending on formal R&D activities than those who do not.<sup>5</sup>

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<sup>5</sup> Statistically significant at 10.5% level.

### 4.3.2 Innovation Outputs

Table 6 presents the results of the logit regression (2nd column – 7th column) and the marginal effect of explanatory variables (8th column – 13th column). Out of six factors considered, five of them (global engagement, firm size, firm age, belonging to a group, and quality management capability) are statistically significant in affecting the probability of engaging in all innovation output models.

**Table 6: Estimated Results for Logit Model and the Marginal Effects of Explanatory Variables: Innovation Output**

Variables	Coefficient of Logit Regression					
	Product Innovation	Process Method Innovation	Process Supporting Innovation	Logistic Innovation	Marketing Innovation	Organizational Innovation
Export-oriented domestic firms	1.558*** (0.446)	0.947*** (0.266)	0.469* (0.240)	0.192 (0.258)	1.256*** (0.259)	0.620** (0.282)
Export-oriented foreign firms	1.128** (0.519)	0.431 (0.338)	-0.577* (0.319)	-0.336 (0.339)	0.485 (0.332)	-0.118 (0.358)
Nonexport-oriented foreign firms	0.452 (0.892)	1.488*** (0.546)	0.629 (0.557)	0.406 (0.531)	0.871* (0.521)	0.414 (0.569)
Belonging to group	0.779** (0.348)	-0.096 (0.277)	0.634** (0.268)	0.170 (0.273)	0.169 (0.276)	0.986*** (0.282)
Size (large firm)	0.141 (0.352)	1.059*** (0.259)	1.096*** (0.248)	1.302*** (0.257)	0.782*** (0.253)	0.697*** (0.266)
Human capital	0.004 (0.021)	0.005 (0.013)	0.006 (0.012)	0.005 (0.013)	-0.002 (0.012)	0.003 (0.014)
Age	0.049*** (0.014)	0.017 (0.011)	-0.008 (0.011)	0.008 (0.011)	0.014 (0.011)	-0.023* (0.014)
Quality management capability	0.550* (0.330)	0.489** (0.236)	0.689*** (0.223)	0.693*** (0.234)	0.644*** (0.228)	0.809*** (0.244)
<i>Industry</i>	YES	YES	YES	YES	YES	YES
<i>No. of observations</i>	501	505	507	505	497	499
Variables	Marginal Effects of Explanatory Variables					
	Product Innovation	Process Method Innovation	Process Supporting Innovation	Logistic Innovation	Marketing Innovation	Organizational Innovation
Export-oriented domestic firms	0.117***	0.192***	0.113**	0.040	0.280***	0.112**
Export-oriented foreign firms	0.085**	0.088	-0.140*	-0.069	0.108	-0.021
Nonexport-oriented foreign firms	0.034	0.302***	0.152	0.084	0.195*	0.075
Belonging to group	0.058**	-0.020	0.154**	0.035	0.038	0.178***
Size (large firm)	0.011	0.215***	0.265***	0.269***	0.175***	0.126***
Human capital	0.000	0.001	0.001	0.001	0.000	0.001
Age	0.004***	0.003	-0.002	0.002	0.003	-0.004*
Quality management capability	0.041*	0.099**	0.167***	0.143***	0.144***	0.146***
<i>Industry</i>						
<i>No. of observations</i>						

Note: Standard errors in parentheses. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively.

Global engagement variables are statistically significant and positively associated with the probability of participating in all innovation outputs except for logistic innovations (Table 6). It is surprising to note that the negative value of the marginal effects suggests that being export-oriented foreign firms decreases the probability of undertaking process supporting innovation by 14 percentage points compared to their nonglobalized counterparts. A quick glance at the number of statistically significant coefficients (2nd column – 7th column) appears to suggest that exported-oriented domestic firms are more likely to undertake more innovation outputs than others. Exported-oriented domestic firms have a higher probability of undertaking all innovation outputs except for logistic innovation, while export-oriented foreign firms have a higher probability of undertaking product innovation and process supporting innovation, and nonexport-oriented foreign firms have a higher probability of undertaking process method and marketing innovations. The results also highlight that the tendency of firms to engage in different types of innovation activities differs across global engagement groups of firms.

In addition, it is also observed that the magnitude of marginal effects (and statistical significance) (8th column – 13th column) differs across firms of differing global engagement. For product innovation, being export-oriented domestic firms and export-oriented foreign firms significantly increases the probability of undertaking product innovation compared to nonglobalized firms, but this similar finding is not significantly observed for nonexport-oriented foreign firms. The magnitude of marginal effect indicates that being export-oriented domestic firms increases the probability of engaging in product innovation by 11.7 percentage points compared to the corresponding magnitude increase of 8.5 percentage points for export-oriented foreign firms.

For process method innovation and marketing innovation, being export-oriented domestic firms and nonexport-oriented foreign firms increases the probability of undertaking both innovation outputs. Nonetheless, a higher percentage in the probability of engaging in process method innovation is observed among nonexport-oriented foreign firms (30.2 percentage points) than in export-oriented domestic firms (19.1 percentage points), while the reverse is observed for marketing innovation, i.e., a relatively higher percentage in the probability of undertaking marketing innovation is observed among export-oriented domestic firms (28.0 percentage points) than in nonexport-oriented foreign firms (19.5 percentage points). None of the global engagement variables has a statistically significant influence on the probability of undertaking logistic innovation. While being export-oriented domestic firms increases the probability of engaging in organizational innovation by 11.2 percentage points more than nonglobalized firms, no similar statistically significant influence is observed among nonexport-oriented foreign firms and export-oriented foreign firms.

Belonging to a corporate group increases the probability of engaging in product innovation, process supporting innovation, and organizational innovation by 5.8, 15.4, and 17.8 percentage points, respectively. Firms with international quality certification tend to have a higher probability of engaging in innovation output than those without. The value of marginal effect suggests that a higher magnitude of increases (in terms of percentage points) is observed among nontechnological innovations such as process supporting innovation (16.7 percentage points), logistic innovation (14.3 percentage points), marketing innovation (14.4 percentage points), and organizational innovation (14.6 percentage points). For the human capital factor, its coefficient is not found to be statistically significant in any of the innovation output statistical models. Being a large firm significantly enhances the probability of participating in all innovation output, ranging between 12.6 and 26.9 percentage points, except for product innovation.

Nevertheless, the results do not support the notion that greater intensity of knowledge labor increases the probability of engaging in various innovation outputs. Firm age appears to matter for engaging in both product and organizational innovations. As the age of a firm increases by an additional year, the probability of engaging in product innovation will increase by 0.4 of a percentage point, while the probability of engaging in organizational innovation will decrease by 0.4 of a percentage point.

#### **4.4 Integrating Results for Innovation Inputs and Outputs**

The results of the analysis of innovation input and output highlight some interesting findings regarding factors that affect Malaysian manufacturing firms' participation in different types of innovations. Below, the key findings of the current study are summarized.

The overall result of the incidence of innovation for all firms reveals that Malaysian manufacturing firms are less likely to undertake product innovation than other types of innovation activity. Globalized firms are more actively engaged in innovation activity than nonglobalized firms. This is reflected by a higher incidence of innovation among globalized firms (export-oriented domestic firms, export-oriented foreign firms, and nonexport-oriented foreign firms) than among nonglobalized firms (nonexport-oriented domestic firms) for all innovation input and output activities. Furthermore, the likelihood of engaging in innovation activities is statistically significantly higher among export-oriented domestic firms than in nonglobalized firms and this finding is consistently observed in all innovation activities except for using foreign technology licenses and engaging in logistic innovation.

Both export-oriented foreign and domestic firms have a higher incidence of, and higher probability of engaging in, product innovation, and the magnitude of marginal effects suggests that export participation tends to have a greater impact on the probability of engaging in product innovation among domestic firms than foreign firms. Similarly, both export-oriented domestic and foreign firms have a higher incidence of product innovation than nonexport-oriented foreign firms. While export-oriented domestic firms have a higher probability of undertaking R&D activity, export-oriented foreign firms are not found to have a statistically significantly higher probability of undertaking R&D activities than nonglobalized firms. The statistically insignificant coefficient for export-oriented foreign firms could be due to the majority of export-oriented foreign firms being large-sized firms and the influence of firm size has been accounted for in the statistical model.

In addition, the results of innovation output show that export-oriented domestic firms and nonexport-oriented foreign firms have a higher incidence and higher probability of undertaking marketing innovation. Nevertheless, the magnitude of the marginal effect appears to be larger among export-oriented domestic firms. Domestic firms exploring foreign markets stress more marketing innovation than their foreign counterparts. Domestic firms may encounter greater pressure to venture into the global market than their foreign counterparts as they are no longer protected from competition (Un 2016). Therefore, their tendency to introduce marketing innovations (such as introducing new product packaging design, promotion or pricing) in order to increase their sales revenue and market shares will be higher than their foreign competitors who may have a stronger marketing advantage in the global marketplace.

Nonexport-oriented foreign firms are more likely to engage in process method innovation than product innovation, as reflected by a higher incidence of process method innovation compared to the incidence of product innovation. The magnitude of the marginal effect also suggests that the tendency to engage in process method innovation is relatively greater among nonexport-oriented foreign firms. It is worth highlighting that a relatively large difference between the incidences of product innovation and formal R&D is observed for nonexport-oriented foreign firms compared to other globalized firms. Note that firms may undertake R&D activities for product and process development (UNCTAD 2005). It is plausible that nonexport-oriented foreign firms place greater focus on the development of production method in their R&D activities. These firms are likely to be final product assemblers and hence less focused on the creation of new or improved products.

Foreign firms, whether export-oriented or nonexport-oriented, are more likely to engage in extramural innovation activities. Export-oriented foreign firms have a higher likelihood of using foreign technology licenses than nonglobalized firms. They also exhibit higher incidences of using foreign technology licenses, and purchasing or licensing inventions and knowledge, than domestic firms. Similarly, nonexport-oriented foreign firms have a higher likelihood of purchasing or licensing inventions and knowledge, and using foreign technology licenses, than nonglobalized firms. They also exhibit a higher incidence of using foreign technology licenses than other globalized firms.

In terms of firm-specific characteristics, firm size and quality management capability (proxied by the possession of internationally recognized quality certification) are statistically significant in explaining the probability of engaging in all innovation inputs and outputs. Firm age is statistically significant for determining the probability of undertaking product innovation, investing in formal R&D activity, and purchasing or licensing inventions and knowledge. Belonging to a group is statistically significant in explaining the probability of undertaking product innovation and process supporting innovation, while human capital, proxied by knowledge labor intensity, matters for investing in formal R&D activity. To summarize, the results of the analyses of both innovation inputs and outputs show that factors affecting the likelihood of participating in innovation differ from one innovation activity to another and substantial heterogeneity can be observed in innovation behavior across firms with different types of global engagement.

## **5. DISCUSSION AND POLICY IMPLICATION**

This section discusses the findings and their policy implications. It is worth noting that policy implications suggested in this section are based on an evaluation of the situation in 2015, as the present analysis is carried out using firm-level data from the World Bank's Enterprise Survey 2015. Generally, the results of this study show that factors affecting the likelihood of participating in innovation differ from one innovation activity to another. The results of the analysis can be segregated into two main groups. First, the influences of firm-specific characteristics on firms' participation in innovation vary from one activity to another, and the magnitudes of the influence for a particular firm-specific variable also differ from one to another. Second, globalized firms, i.e., firms that engage in global activities such as foreign trade and foreign direct investment, engage in various innovation activities more actively than nonglobalized firms. Third, the impact of global engagement variables and their magnitude tend to vary from one activity to another. This implies that the likelihood of participating in innovation activity differs across multiglobal engagement groups of firms. Export-oriented domestic firms are

more likely to participate in almost all innovation activities, highlighting a diverse portfolio in their innovation strategies. Similarly, nonexport-oriented foreign firms are more likely to engage in a number of innovation activities, but appear to put more emphasis on process development than on product development. They have a higher tendency to provide human capital training for innovation, engaging in extramural innovation activities, namely using foreign technology licenses, and purchasing or licensing inventions and knowledge. In contrast, export-oriented foreign firms adopt a more strategic innovation strategy, i.e., using foreign technology licenses and engaging in product innovation. The subsequent discussions will mainly focus on the objective of the current paper regarding the influence of globalization on firms' participation in innovation activity. Several interesting results on the relationship between global engagement variables and innovation participation are observed.

First, firms that engage in global activities such as foreign trade and foreign direct investment have a higher likelihood and incidence of innovation than those that do not engage in such activities. Hence, trade policies targeting export promotion and attracting foreign direct investment can be formulated to increase firms' participation in innovation activity. These policies include intensifying the promotion of participation in international trade exhibitions, providing information about foreign markets (e.g., by the Malaysia External Trade Development Corporation, MATRADE, and the Japan External Trade Organization, JETRO), providing marketing development assistance and training programs for exports. In addition, policymakers should liberalize investment policy to attract selective foreign direct investment, especially those from high-tech sectors. In addition, tax incentive policies (such as the introduction of special tax allowance packages) can be introduced to encourage foreign companies to set up in-house research and development for the first time in Malaysia. Another policy is the provision of higher corporate tax rebates for skilled labor training expenses abroad incurred by firms.

Second, firms with an export orientation tend to put more emphasis on product development strategy. The analysis of innovation output shows that export-oriented domestic firms and foreign firms have a relatively higher likelihood of undertaking product innovation, and the magnitude of marginal effects indicates that being export-oriented domestic firms increases the likelihood of engaging in product innovation more than being export-oriented foreign firms. Meanwhile, the result of innovation input shows that export-oriented domestic firms have a significantly higher likelihood of investing in formal R&D activity. These results indicate that export-oriented domestic firms exhibit a higher likelihood of investing in R&D activity and undertaking product innovation, while a similar finding is observed only for product innovation among export-oriented foreign firms.

Furthermore, the results show that nonexport-oriented foreign firms are more likely to undertake a number of innovation activities, and the likelihood of engaging in process method innovation and using foreign technology licenses appears to be relatively higher. These results indirectly imply that nonexport-oriented foreign firms put more emphasis on process development than on product development strategy. A likely explanation for this is that firms that venture into foreign markets via an import substitution strategy are likely to emphasize production for the domestic market, and therefore they will be more likely to focus more on a process development strategy as their source of competitive advantage. It is also plausible that foreign-owned firms have adapted advanced process technology and product designs, transferring from affiliates in other countries (Goldberg et al. 2008). Given that foreign firms, especially nonexport-oriented foreign firms, are less likely to engage in formal R&D activities, suggested measures to increase firms' participation in R&D include establishing in-house R&D

and recruiting more in-house R&D labor force. All these measures may induce firms to participate in R&D activity, which will lead to more firms engaging in product innovation.

Finally, the results show that firms venturing into foreign markets such as export-oriented domestic firms and nonexport-oriented foreign firms (foreign firms that venture into Malaysian markets) are more likely to undertake marketing innovation. Undertaking innovative market practices assists firms in effectively introducing their products in the dynamic and competitive foreign market. Following information technology and globalization characterizing today's economy, there exists increasing market competition and much of the competition occurs in virtual space (Ren, Xie and Krabbendam 2010). The magnitude of marginal effects reveals that the probability of export-oriented domestic firms undertaking market innovation is much higher than that of undertaking product innovations. Export-oriented domestic firms appear to place greater importance on marketing innovation over product innovation. These firms might perceive marketing innovation as an important source of competitive advantage to gain or sustain their competitive advantage in the dynamic foreign market. It is undeniable that the adoption of new marketing strategies (marketing innovation) is vital for successful innovations, but on the other hand, it is equally important to have continuous engagement in product innovation as a successful marketing strategy needs to be accompanied by new or improved products (product innovation). The results also indicate that the probability of participating in formal R&D activity is relatively lower among small and medium-sized firms (SMEs) and tends to decline with decreasing knowledge labor intensity. Therefore, to increase or ensure domestic firms' continued interest in engaging in product innovation, there is a need to formulate innovation policies that consider the differential needs between SMEs and large firms. Given that innovation is no longer restricted to in-house R&D (OECD 2018) and SMEs' limited human capital, measures such as R&D collaboration (OECD 2018) may be considered to assist SMEs in their innovation process, rather than following the traditional innovation pathway, i.e., via in-house R&D activities.

## **6. CONCLUDING REMARKS**

The findings of this study provide important insights into the innovation landscape in terms of the type of innovation that firms undertake during the innovation process in the context of a developing country, namely Malaysia. The results indicated some variations in innovation behavior across globalized firms. The incidence and the likelihood of undertaking innovation input and output activities vary across firms of differing global engagement. Generally, export-oriented domestic firms are more active in engaging in various types of innovation input and output activities. Foreign firms tend to engage in extramural innovation activities such as purchase or license inventions and knowledge, and utilize foreign technology licences. Nonexport-oriented foreign firms emphasize process method innovation more, while export-oriented foreign firms have a higher likelihood of undertaking product innovation. Despite these variations, the results clearly indicate that globalized firms, i.e., firms that participate in global activities such as foreign trade and foreign direct investment, engage in innovation activity more actively than nonglobalized firms. Consequently, policymakers may consider formulating policies that promote participation in exporting and attracting selective foreign direct investment. Policies such as providing information about foreign markets, marketing development assistance, and training programs for export can assist domestic firms in integrating into the global value chain. In addition, investment liberalization can be used to attract selective foreign direct investments. Tax incentives can be formulated to facilitate innovation activities such as in-house R&D.



## REFERENCES

- Alvarez, R., C. Bravo-Ortega, and L. Navarro. 2010. Innovation, R&D Investment and Productivity in Chile. IDB Working Paper Series No. IDB-WP-190. <https://publications.iadb.org/publications/english/document/Innovation-RD-Investment-and-Productivity-in-Chile.pdf> (accessed on 24 July 2021).
- Branstetter, L., I. Goldberg, and S. Kuriakose. 2008. The Links Between Among Knowledge Absorption, Trade and FDI. In I. Goldberg, L. Branstetter, Gabriel J. Goddard, and S. Kuriakose, 2008. *Globalization and Technology Absorption in Europe and Central Asia*. World Bank Working Paper No. 150, 23–54.
- Bratti, M., and G. Felice. 2010. Are Exporters More Likely to Introduce Product Innovations? EFIGE Working Paper 25. March 2010. <https://www.dagliano.unimi.it/media/EFIGEWP25.pdf> (accessed on 29 Jun 2021).
- . 2018. Product Innovation by Supplying in Domestic and Foreign Markets, JRC Working Papers in Economics and Finance, 2018/3, Publications Office of the European Union, Luxembourg. ISBN 978-92-79-81723-6, doi:10.2760/99096, JRC111338.
- Chudnovsky, D., A. López, and G. Pupato. 2006. Innovation and Productivity in Developing Countries: A Study of Argentine Manufacturing Firms' Behavior (1992–2001). *Research Policy* 35(2): 266–288.
- Cirera, X., and W. F. Maloney. 2017. *The Innovation Paradox. Developing-Countries Capabilities and the Unrealised Promise of Technological Catch-up*. World Bank: Washington, DC.
- Criscuolo, C., J. E., Haskel, and M. J. Slaughter. 2010. Global Engagement and the Innovation Activities of Firms. *International Journal of Industrial Organization* 28(2): 191–202. <https://doi.org/10.1016/j.ijindorg.2009.07.012>.
- Goldberg, I., L. Branstetter, G. J. Goddard, and S. Kuriakose. 2008. Globalization and Technology Absorption in Europe and Central Asia. World Bank Working Paper No.150. The World Bank: Washington, US.
- Griliches, Z. 1979. Issues in Assessing the Contribution of R&D to Productivity Growth. *Bell Journal of Economics* 10, 92–116.
- Griffith R., Huergo E., Mairesse J., and Peters, B. 2006. Innovation and Productivity across Four European Countries. NBER Working Papers 12722, National Bureau of Economic Research, Inc.
- Gustavo, C., and Z. Pluvia. 2010. Innovation and Productivity : Evidence from Six Latin American Countries. Inter-American Development Bank (IDB). IDB Working Paper Series No. IDB-WP-218. <https://publications.iadb.org/publications/english/document/Innovation-and-Productivity-Evidence-from-Six-Latin-American-Countries.pdf> (accessed on 24 July 2021).
- International Monetary Fund. 2009. Balance of Payments and International Investment Position Manual. 6th Edition. Washington, DC: International Monetary Fund.
- KOF Globalisation Index (KOFGI). 2021. 2021 KOF Globalisation Index. KOF Swiss Economic Institute. <https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html> (accessed 3 Mar 22).

- Lee, C. 2004. The Determinants of Innovation in the Malaysian Manufacturing Sector: An Econometric Analysis at the Firm Level. *ASEAN Economic Bulletin* 21(3): 319–329. <http://www.jstor.org/stable/25773829>.
- Lim, E. S., C. Lee, and S. Nagaraj. 2012. The Relationship between Innovation and Firm Performance: Evidence from Malaysian Manufacturing Firms. Conference Proceedings 2012. The Asian Business and Management Conference 2012. Osaka, Japan.
- Nilsson, D., and B. Johansson. 2007. Globalization and Distribution of Exports, Working Paper Series in Economics and Institutions of Innovation 93, Royal Institute of Technology, CESIS – Centre of Excellence for Science and Innovation Studies. <https://static.sys.kth.se/itm/wp/cesis/cesiswp93.pdf>.
- Organisation for Economic Co-operation and Development (OECD). 2009. *Innovation in Firms: A Microeconomic Perspective*. OECD: Paris.
- . 2018. Promoting Innovation in Established SMEs: Policy Note. 2018 SME Ministerial Conference. 22–23 February 2018, Mexico City. <https://www.oecd.org/cfe/smes/ministerial/documents/2018-SME-Ministerial-Conference-Parallel-Session-4.pdf>.
- OECD/Eurostat. 2005. Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, The Measurement of Scientific and Technological Activities, OECD Publishing, Paris, <https://doi.org/10.1787/9789264013100-en>.
- . 2018. Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg, <https://doi.org/10.1787/9789264304604-en>.
- Osano, H. M., and P. W. Koine. 2016. Role of Foreign Direct Investment on Technology Transfer and Economic Growth in Kenya: A Case of the Energy Sector. *Journal of Innovation and Entrepreneurship* 5: 31. <https://doi.org/10.1186/s13731-016-0059-3>.
- Palangkaraya, A. 2013. On the Relationship between Innovation and Export: The Case of Australian SMEs. Melbourne Institute Working Paper No. 04/13, SSRN: <https://ssrn.com/abstract=2226720> or <http://dx.doi.org/10.2139/ssrn.2226720>. (accessed on 9 Jun 2021).
- Raffo, J., S. Lhuillery, and L. Miotti. 2008. Northern and Southern Innovativity: A Comparison Across European and Latin American Countries. *The European Journal of Development Research* 20(2): 219–239.
- Ren, L., G. Xie, and K. Krabbendam. 2010. Sustainable Competitive Advantage and Marketing Innovation Within Firms: A Pragmatic Approach for Chinese Firms. *Management Research Review* 33(1): 79–89. <https://doi.org/10.1108/01409171011011580>.
- Un, C. A. 2016. Innovation in Foreign and Domestic Firms: The Advantage of Foreignness in Innovation and the Advantage of Localness in Innovation. The Advantage of Foreignness and Localness in Innovation. In *Handbook of Strategic Renewal: Core Concepts, Antecedents, and Micro-Foundations*, edited by A. Tuncdogan, A. Lindgreen, F. Van Den Bosch, and H. Volberda. Gower Publishing, Forthcoming, Northeastern U. D'Amore-McKim School of Business Research Paper No. 2942848, Available at SSRN: <https://ssrn.com/abstract=2942848> (accessed on 15 Jun 2021).

United Nations Conference on Trade and Development (UNCTAD). 2005. Globalization of R&D and Developing Countries. *Proceedings of the Expert Meeting Geneva 24–26 January 2005*. Switzerland: United Nation Publication.

World Bank. 2015. Enterprise Survey 2015 – Malaysia 2015-2016. <https://doi.org/10.48529/b122-ej84>.