

Foreign Ownership, R&D and Firm Innovation in ASEAN Countries: A Generalized Ordered Logit Model

Dung NGUYEN-VAN

*Southern Taiwan University of Science and Technology
1 Nan-Tai Street, Yongkang Dist., Tainan City 710, TW
da71g206@stust.edu.tw*

Chia-Hua CHANG

*Southern Taiwan University of Science and Technology
1 Nan-Tai Street, Yongkang Dist., Tainan City 710, TW
chiahua@stust.edu.tw*

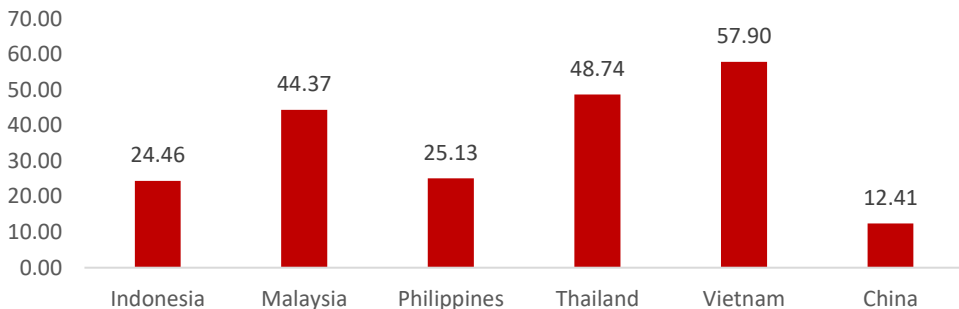
Abstract. *The study investigates the direct effects of foreign ownership and R&D on firm innovation and the moderating effects of R&D on the foreign ownership–innovation relationship in ASEAN countries. This research focus is important as ASEAN countries have received a large amount of inward FDI as part of their export-led growth strategy, and FDI can bring both benefits and negative impacts for the host country. To the authors' knowledge, this study contributes as the first attempt to examine this topic in ASEAN. The study employs a novel approach (i.e., generalized ordered logit model (GOLM)) to deal with the restrictive “parallel regression/proportional odds” assumption of the standard ordered logit model (OLM), which has not been adequately addressed in previous studies on the foreign ownership–innovation relationship. The findings show that foreign ownership relates negatively to the possibility of radical innovation, while R&D relates positively to the possibility of radical innovation. In addition, R&D positively moderates the effect of foreign ownership on the possibility of radical innovation. The findings verify the important role of R&D as a mechanism for absorptive capacity building in the foreign ownership–innovation relationship, which has been under-researched in prior studies on the role of foreign ownership in firm innovation. The policy implications emphasize that ASEAN governments should have more technological regulations and incentives to encourage foreign investors to bring advanced technologies and invest more in R&D.*

Keywords: *ASEAN; foreign ownership; generalized ordered logit model; innovation; R&D.*

Introduction

FDI (Foreign Direct Investment) plays an important role in ASEAN (Association of Southeast Asian Nations) as part of the export-led growth strategy. In fact, ASEAN is considered one of the most successful regions regarding export-led growth by FDI (OECD, 2019). As a result, the share of inward FDI stock relative to the size of the domestic market is high. For example, Figure 1 shows the large share of inward FDI (% of GDP) of five ASEAN countries in our analysis, even larger than China. In particular, the figure of Vietnam is nearly five times greater than China. Indonesia, the country with the

lowest share among our five ASEAN countries, still has the share of inward FDI (% of GDP) being double that of China.



**Figure 1. Inward FDI stock 2017 (% of GDP)
(UNCTAD, 2019)**

FDI can bring many advantages for the host country, and one of them is innovation enhancement, especially in developing countries. There is growing literature positing that increasing foreign ownership is positively related to more innovation performance because foreign investors can bring necessary resources, especially financial resources and advanced technologies for innovation activities (Chen, Lin, Lin, & Hsiao, 2016; Choi, Park, & Hong, 2012; Olabisi, 2017). However, FDI can be negatively associated with innovation outcomes due to inferior technologies transfer and exploitative purposes to take advantage of cheap, unskilled or semi-skilled labor in developing countries (Almeida & Fernandes, 2008; Fu, Pietrobelli, & Soete, 2011). Given the large FDI share in ASEAN economies, a few questions may arise. Does foreign ownership play any role in firm innovation in the ASEAN context? Are there any factors moderating the impact of foreign ownership on innovation? To answer these questions, we, therefore, aim to examine the direct effects of foreign ownership and R&D on firm innovation and the moderating effects of R&D on the foreign ownership–innovation relationship in ASEAN countries (i.e., Indonesia, Malaysia, the Philippines, Thailand, and Vietnam).

The paper contributes to the literature in three aspects. First, our study complements existing literature by incorporating the moderating role of R&D in the foreign ownership–innovation relationship, which is rarely investigated in the line of studies on the influence of foreign ownership on firm innovation. Second, we introduce a novel approach (i.e., GOLM) to deal with the restrictive “parallel regression/proportional odds” assumption of the standard OLM. Third, unlike most prior studies that concentrate on developed (e.g., Chen et al., 2016; Choi et al., 2012) or large countries (i.e., China) (e.g., Choi, Lee, & Williams, 2011; Girma, Gong, & Görg, 2008; Jiang, Waller, & Cai, 2013), our study focuses specially on developing countries in ASEAN. To the best of our knowledge, this is probably the first research to investigate this research topic in ASEAN, a region that follows the FDI-led growth strategy significantly.

The rest of the paper is organized as follows. The next section examines the role of FDI in firm innovation and the moderating effects of R&D on the foreign ownership–innovation link; we also develop appropriate hypotheses. In section 3, we discuss the

data source and estimation techniques. In-depth discussions of the results are presented in section 4. Finally, in section 5 we conclude and offer some practical implications.

Literature review and hypothesis development

Foreign ownership and firm innovation

The role of foreign ownership in firm innovation is widely discussed in the literature (Chen et al., 2016; Choi et al., 2012; Olabisi, 2017). However, there are still contrasting arguments on whether FDI brings positive or negative effects on innovation. The arguments supporting the positive impact of FDI on innovation are based generally on four reasons. First, foreign owners can provide financial and technological resources for innovation activities. According to the resource dependence perspective, foreign investors are considered important outside resources that can bring firms with necessary resources, especially financial and technological resources for innovative activities, particularly in developing countries (Chen et al., 2016; Choi et al., 2012; Olabisi, 2017). In fact, firms in developing countries often do not have adequate resources for innovation. Thus, they have to depend on external ones for financial and technological resources. From this viewpoint, resource-rich foreign investors can bring necessary resources for conducting innovation (Choi et al., 2012).

Second, foreign investors (e.g., multinational corporations (MNCs)) can contribute positively to the innovation activities of local subsidiaries or partners by transferring advanced technologies and boost their R&D efforts. MNCs are typically a valuable model and provide firm-specific knowledge for enhancing the innovation capabilities of invested local firms when they are majority owners (Choi et al., 2011; Olabisi, 2017). They can also utilize their ownership power to motivate domestic partners to channel more resources into technology development (Chang, Chung, & Mahmood, 2006). Therefore, majority of foreign-owned firms are likely to have more opportunities to access advanced foreign innovation resources. This is also the reason why some developing countries such as China have provided much financial and tax incentives to support the entry of foreign MNCs (Choi et al., 2011; Douma, George, & Kabir, 2006).

Third, foreign investors provide focal firms with managerial knowledge and relational resources, which is particularly important for innovation activities in developing countries (Chen et al., 2016; Falk, 2008). Invested firms can employ the advanced managerial knowledge and relational resources to cooperate with other partners (e.g., other firms, research institutes, universities) to come up with new products, thereby boosting innovation performance (Chen et al., 2016).

Fourth, firms with the majority of foreign ownership tend to focus on new and international markets (Douma et al., 2006). To gain competitive advantages in the international markets, where the quality regulations and requirements are much higher than the domestic market, foreign-invested firms have to possess advanced technologies and good R&D capacities. From this perspective, foreign shareholders in the local firms are forced to transfer advanced technological and managerial resources and intensify R&D efforts, ultimately leading to better innovation outcomes to be more competitive (Chen et al., 2016; Choi et al., 2011).

Some recent empirical evidence lends support to the positive role of FDI (e.g., Chen et al., 2016; Choi et al., 2011, 2012; Girma et al., 2008; Jiang et al., 2013). Girma et al. (2008), using data from the “Annual Reports of Industrial Enterprise Statistics” with a sample of 239,085 domestic firms in China from 1999–2005, found that firms with more MNCs’ capital have more possibility to undertake product innovation. Choi et al. (2011), employing data from 548 firms in China, found that foreign corporations and foreign institutional investors are crucial in encouraging corporate innovation performance. Using data from 301 publicly listed firms in Korea, Choi et al. (2012) found that firms with larger foreign ownership are related to higher innovation performance. Using data of 303 firms from the “China Enterprise Innovation Survey” (CEIS), Jiang et al. (2013) found that foreign-invested enterprises are positively related to more product innovation. Recently, Chen et al. (2016), using panel data from 138 Taiwanese firms from 2002–2005, found that firms with more foreign ownership are associated with better innovation.

However, there are some arguments to support the negative impacts of foreign ownership on firm innovation. First, in developing countries, the legal framework, especially the intellectual property rights protection is rather weak, which disincentive innovation efforts of foreign investors (Almeida & Fernandes, 2008; Fu et al., 2011). As a result, foreign owners often reduce innovation activities to avoid the threat of duplication or move R&D abroad to protect intellectual capital (Branstetter, Fisman, & Foley, 2006; Olabisi, 2017). Available studies generally indicate that MNCs tend to transfer inferior technologies to subsidiaries located in developing countries since they encounter the higher risk of expropriation in developing countries (Almeida & Fernandes, 2008; Branstetter et al., 2006; Javorcik, 2006).

Second, developing countries commonly follow the export-led growth strategy. Foreign-owned firms located in these countries focus mostly on manufacturing products using cheap, unskilled or semi-skilled labor. Due to this nature of manufacturing for exploitative purposes, there are limited innovation efforts (Fu et al., 2011).

There are several empirical studies supporting the negative impact of FDI on innovation (e.g., Almeida & Fernandes, 2008; Olabisi, 2017; Yi, Hong, Chung Hsu, & Wang, 2017). Employing firm-level data of 43 developing countries during 2002–2005 that gives the final sample of 17,667 firms, Almeida and Fernandes (2008) suggested that majority foreign-owned firms (i.e., firm’s foreign capital is more than 50%) are less likely to perform innovation. Olabisi (2017), using an unbalanced panel of over 329,000 unique firms from 2005–2007 from the “Annual surveys of Chinese industrial firms”, found that foreign ownership (measured as the foreign share of a firm’s total capital) leads to less innovation in some model specifications. Yi et al. (2017), based on the balanced dataset of 193,506 Chinese manufacturing firms during the period 2005–2007, found that foreign ownership (measured by a foreign capital share in foreign-invested firms) is negatively associated with innovation performance (proxied by the ratio of new product sales to total sales).

We argue that in the ASEAN context foreign investors focus mainly on producing labor-intensive and low value-added products for exporting. Thus, foreign-owned firms tend to be associated with less innovation. Hence, we develop the following hypothesis:

Hypothesis 1: Foreign ownership relates negatively to the possibility of innovation.

R&D and its moderating effects on the foreign ownership–innovation relationship

R&D is commonly regarded as an important input for innovation (Ganotakis & Love, 2010; Karamanos, 2015; Love & Roper, 1999; Wang, 2017). It often plays two important roles: (i) boosting innovation, (ii) and enhancing firms' ability to assimilate and exploit existing knowledge or "absorptive capacity" (Cohen & Levinthal, 1990; Griffith, Redding, & Reenen, 2004). R&D directly contributes to innovation by creating new technological or specialized knowledge that can be used for conducting innovation in different ways (Ganotakis & Love, 2010; Kafourous, 2008). Therefore, we hypothesize as follows:

Hypothesis 2: R&D relates positively to the possibility of innovation.

R&D is also crucial in building absorptive capacity (Cohen & Levinthal, 1990; Griffith et al., 2004). Cohen and Levinthal (1990) defined absorptive capacity as "a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends". Accordingly, R&D investments are important for firm innovation by leveraging the absorptive capacity (Cohen & Levinthal, 1990). Firms with a high level of absorptive capacity can absorb knowledge easier so that they can create new ideas and products (Cohen & Levinthal, 1990; Zahra & George, 2002). Thus, they can utilize knowledge from foreign counterparts to support their innovation efforts (Tsai, 2001). In particular, foreign investors can transfer advanced technologies to investment firms. The more absorptive capacity firms possess, the more knowledge and resources they can acquire from foreign partners, thereby facilitating their innovation activities (Chen et al., 2016; Tsai, 2001). On the contrary, if firms have limited absorptive capacity, they tend to have inadequate abilities to acquire or create knowledge by interacting with their foreign counterparts, suggesting that they cannot transfer the foreign knowledge into developing new products (Chen et al., 2016).

The empirical evidence on the moderating role of absorptive capacity (proxied by R&D) in the foreign ownership–innovation relationship is rather limited. To the best of authors' knowledge, to date, there have been only two studies examining this problem (i.e., Chen et al., 2016; Jiang et al., 2013). In particular, using data of 303 firms from the "China Enterprise Innovation Survey" (CEIS), Jiang et al. (2013) found that internal R&D activities have positive leverage effects on foreign ownership–product innovation performance relationship. However, based on data of 138 Taiwanese firms in the electronics industry during the period 2002–2005, Chen et al. (2016) could not find evidence of the moderating effects of R&D. The possible explanation is that firms may lack effective interaction mechanisms to absorb foreign resources and knowledge adequately (Chen et al., 2016).

In the ASEAN context, we argue that foreign-invested firms, which invest in R&D activities, can build up their absorptive capacity. As a result, they can have better innovation performance. Thus, we hypothesize:

Hypothesis 3: R&D positively moderates the effect of foreign ownership on the possibility of innovation.

Data and research method

Data

The econometric analysis is based on firm-level data from the “Enterprise Survey” (ES), a large-scale survey conducted by the World Bank. The ES covers more than 130,000 firms in approximately 140 nations. The questionnaire in each country follows the standardized methodology, so it is convenient for country comparison. The ES is considered the most comprehensive database on private firms operating in developing economies (Pérez, Kunc, Durst, Flores, & Geldes, 2018; World Bank, 2018).

Regarding ASEAN countries, we use the most recent ES data for five countries (i.e., ES 2015 for Indonesia, Malaysia, the Philippines, Vietnam, and ES 2016 for Thailand). Furthermore, our study only focuses on manufacturing firms. Following the “United Nations’ International Standard Industrial Classification (ISIC Revision 3.1)”, the manufacturing sectors have two-digit codes between 15 and 37 (United Nations Statistical Division, 2002).

Research method

To formally test the above hypotheses, we develop the following specification:

$$Innovation_i = \beta_0 + \beta_1 Foreign_i + \beta_2 R\&D_i + \beta_3 Foreign \times R\&D_i + \beta_4 Control_i + \varepsilon_i$$

The dependent variable (*Innovation*) refers to the degree of innovation performance. It is an ordinal variable with three values. *Innovation* = 0 if the firm had no innovation; *Innovation* = 1 if the firm had innovation performance that is new only to the firm; *Innovation* = 2 if the firm conducted innovation that is new to the market. Thus, the innovation that is new to the market is the most radical type of innovation in our analysis.

The independent variable of interest is *Foreign*. *Foreign* is constructed as a dummy variable that takes the value of 1 if more than 50% of the firm’s capital is owned by foreign individuals, companies or organizations, and it is equal to 0 otherwise. We follow the conventional definition of foreign-owned firms (i.e., majority foreign-owned firms) that emphasizes that the majority ownership (more than 50%) comes from foreign capital (Almeida & Fernandes, 2008; Girma et al., 2008; Olabisi, 2017). Moreover, according to Olabisi (2017), majority or wholly-owned foreign affiliates tend to receive more technology transfer from parent firms than minority-owned affiliates. It is also important to note that “ownership of 10 percent or more of the ordinary shares of voting stock is the criterion for determining the existence of a direct investment relationship”, or we can consider that it is FDI (World Bank, 2019). Hence, according to the above classification by World Bank (2019), the majority of foreign-owned firms in our sample are in fact FDI firms.

R&D is the dummy variable that takes the value of 1 if the firm conducted formal R&D, and it is equal to 0 otherwise. The interaction term *Foreign x R&D* refers to the moderating effects of R&D on the foreign ownership–innovation relationship.

Following previous studies (e.g., Almodóvar, Saiz-Briones, & Silverman, 2014; Girma et al., 2008; Pérez et al., 2018), we employ several standard control variables. First, *Age* is measured as the log of the firm's total years in operation. Second, *Size* is operationalized by the log of total employees. Third, *Country* is the dummy variable representing each ASEAN country. Fourth, *Industry* is the dummy variable for the two-digit ISIC manufacturing sector that the firm registered.

The dependent variable (*Innovation*) is an ordinal variable. Therefore, an ordered logit model (OLM) is usually employed in the estimation. However, standard OLM has some limitations. One of these limitations is the restrictive "parallel regression/proportional odds" assumption (Long & Freese, 2006). In particular, the "parallel regression/proportional odds" assumption imposes the unchanged slope coefficients in all response categories. If this assumption is violated, it can result in "incorrect, incomplete, or misleading results" (Williams, 2006). The widely used method to test this assumption is the "Brant test" (Brant, 1990; Long & Freese, 2006). However, the "Brant test" often gives evidence of the assumption violation as this assumption is overly restrictive in empirical studies (Williams, 2006). To solve this problem, a generalized ordered logit model (GOLM) developed by Williams (2006) is considered a good alternative. The advantage of GOLM is that it only imposes a "partial proportional odds" model, which makes the ordinal regression estimation more effective. The user-written command "gologit2" is used to estimate GOLM in Stata (Williams, 2006). This method is also "more parsimonious and interpretable than those fitted by a nonordinal method, such as multinomial logistic regression" (Williams, 2006).

The review of estimation methods in previous studies on this topic reveals that there are various methods. For the continuous dependent variable, some popular methods are instrumental variable Tobit model (Girma et al., 2008), hierarchical Tobit model (Yi et al., 2017), OLS (Olabisi, 2017). For a count of dependent variable, Choi et al. (2012), and Chen et al. (2016) used a negative binomial model. For the dummy dependent variable, Almeida and Fernandes (2008) employed the probit model. For a 5-point Likert dependent variable, Jiang et al. (2013) used hierarchical moderated regression analysis. We find that no studies on the role of foreign ownership on innovation, to date, have taken into account the degree of innovation radicalness using ordinal regression models. Therefore, this study contributes as the first attempt to estimate the degree of the radicalness of innovation.

Findings and discussions

Descriptive statistics

Table 1 presents the descriptive statistics and Table 2 presents the distribution of innovation by radicalness. About 21% of firms conducted innovation, and more firms introduced "new-to-the-market" innovation than "new-to-the-firm" innovation. In our sample, there is 8% of the sample are foreign firms with ownership greater than 50%. Approximately 15% of firms performed formal R&D activities. Lastly, the number of foreign-owned firms carrying out formal R&D activities accounts for about 1% of the sample.

Table 1. Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min.	Max.
Innovation	3,928	0.35	0.71	0	2
Foreign	3,928	0.08	0.28	0	1
R&D	3,867	0.15	0.36	0	1
Foreign x R&D	3,867	0.01	0.11	0	1
Age	3,928	2.79	0.62	0	4.38
Size	3,928	3.98	1.45	0.69	9.90

Table 2. Innovation by radicalness

Variable	Observations	Percentage
Innovation = 0	3,102	78.97%
Innovation = 1	278	7.08%
Innovation = 2	548	13.95%
Total	3,928	100%

Notes: Innovation = 0 if the firm had no innovation; Innovation = 1 if the firm had innovation performance that is new only to the firm; Innovation = 2 if the firm conducted innovation that is new to the market.

Table 3 reports the pairwise correlation coefficients. All the coefficients are smaller than 0.5, suggesting no evidence of the possible multicollinearity problem.

Table 3. Pairwise correlation

	FDI	R&D	FDI*R&D	Age	Size
Foreign	1				
R&D	0.0824***	1			
Foreign x R&D	0.3663***	0.2552***	1		
Age	-0.0620***	0.0473***	-0.0240	1	
Size	0.2270***	0.2670***	0.1267***	0.2063***	1

Notes: * $p < .10$; ** $p < .05$; *** $p < .01$

Results

Table 4 reports the estimation results using both the GOLM and OLM. The “Brant test” of the “parallel regression/proportional odds” assumption (not reported here for brevity) indicates the violation of the assumption. Therefore, we have evidence to support the use of the GOLM. Furthermore, both the GOLM and OLM give similar and consistent estimation results, which lends support to the robustness of our results.

The estimation results show that foreign ownership exerts a negative and significant influence on the possibility of innovation in both the GOLM and OLM. Thus, Hypothesis 1 is strongly supported. The results are in line with several prior studies in the developing country context (e.g., Almeida & Fernandes, 2008; Olabisi, 2017). We suggest two main reasons for this negative impact. First, foreign-owned firms in ASEAN tend to over-rely on low value-added and labor-intensive manufacturing for export (OECD, 2019). This results in limited innovation efforts due to the exploitative nature of this type of manufacturing. Second, foreign investors may be still concerned with the risk of duplication and expropriation due to weak intellectual property protection. In fact, according to “The global competitiveness report 2018” by World Economic Forum, intellectual property protection rankings of ASEAN countries (over 140 economies) are from medium to low: Malaysia (24), Indonesia (44), the Philippines (52), Thailand (99), Vietnam (105) (Schwab, 2018). Therefore, this may discourage incentives to transfer advanced technologies to subsidiaries located in ASEAN.

Our finding on the negative effect of majority foreign ownership on innovation is contrary to the positive impact of foreign ownership found by Girma et al. (2008), Choi et al. (2011), and Jiang et al. (2013) in China, Choi et al. (2012) in Korea, Chen et al. (2016) in Taiwan. It is possible that these economies, especially China have strict regulations on foreign technology transfer to help boost domestic innovation capacities. Specifically, the “forced technology transfer” policies in China may help foreign-invested domestic firms overcome core technological capacity shortage and acquire valuable foreign technology, simultaneously leading to better innovation outcomes (Prud'Homme & von Zedtwitz, 2019; Prud'homme, von Zedtwitz, Thraen, & Bader, 2018).

We find that the coefficients of *R&D* are positive and significant. The results are consistent in both models, which strongly support Hypothesis 2. Our findings indicate that R&D activities contribute positively to firm innovation, which agrees with the majority of previous studies (e.g., Barbosa, Faria, & Eiriz, 2013; Ganotakis & Love, 2010; Kafourous, 2008). Our findings once again confirm the argument that firms that invest in R&D can have better innovation performance directly as R&D can help create new technological or specialized knowledge that is contributive to innovation purposes.

The moderating effects coefficients of *Foreign x R&D* are positive and significant in both models, which strongly supports Hypothesis 3. Our findings are in line with those by Jiang et al. (2013). The results indicate that when coupled with R&D investments, foreign ownership has a positive influence on innovation, while foreign ownership alone does not. The results lend support to our argument that in the ASEAN context foreign-owned firms with R&D investments can build up their absorptive capacity. This helps them acquire foreign technologies better. Thus, they can have better innovation performance.

Table 4. GOLM and OLM estimation

	GOLM		OLM
	(1)	(2)	
Foreign	-0.578***	-0.578***	-0.562***
	(0.177)	(0.177)	(0.176)
R&D	1.552***	1.552***	1.535***
	(0.105)	(0.105)	(0.105)
Foreign x R&D	0.719**	0.719**	0.672*
	(0.347)	(0.347)	(0.345)
Age	0.271***	0.271***	0.270***
	(0.075)	(0.075)	(0.075)
Size	0.160***	0.160***	0.162***
	(0.033)	(0.033)	(0.033)
Country (dummies)	Yes	Yes	Yes
Industry (dummies)	Yes	Yes	Yes
Constant	-2.460***	-3.173***	
	(0.583)	(0.584)	
/cut1			2.516
			(0.582)
/cut2			3.113
			(0.583)
LR χ^2	730.7		663.47
Prob > χ^2	0.0000		0.0000
Observations	3,867		3,867

Notes: Standard errors are in parentheses. * p < .10; ** p < .05; *** p < .01

(1): no innovation vs. “new-only-to-the-firm” or “new-to-the-market” innovation

(2): no or “new-only-to-the-firm” innovation vs. “new-to-the-market” innovation

Regarding control variables, we find strong evidence that older and larger firms are more likely to introduce radical product innovation. It is possible that as firms operate longer in their business, they may accumulate more knowledge and understandings of the market and have more opportunity to realize past investment in innovation efforts. Furthermore, firms with a bigger scale tend to have more resources for innovation efforts. As a result, innovation outcomes are better for older and bigger firms.

Sensitivity analysis

We test the robustness of our findings by introducing the new variable (*Foreign_100*), which is constructed as a dummy variable that takes the value of 1 if 100% of the firm’s capital is owned by foreign individuals, companies or organizations, and it is equal to 0 otherwise. In other words, we test the case of 100% FDI firms. The rationale for choosing the 100% FDI firms is that these firms are fully under foreign investors’ management in terms of operation and strategy. Tables 5 reports the results from our sensitivity analysis. The estimated coefficients for *Foreign_100*, *R&D*, and *Foreign_100 x R&D* are consistent with those reported in Table 4, which gives strong support for our hypotheses.

Table 5. GOLM and OLM estimation–sensitivity analysis

	GOLM		OLM
	(1)	(2)	
Foreign_100	-0.744*** (0.247)	-0.457* (0.276)	-0.695*** (0.247)
R&D	1.610*** (0.111)	1.420*** (0.117)	1.513*** (0.106)
Foreign_100 x R&D	0.777** (0.395)	0.777** (0.395)	0.860** (0.390)
Age	0.291*** (0.075)	0.291*** (0.075)	0.284*** (0.074)
Size	0.151*** (0.032)	0.151*** (0.032)	0.153*** (0.032)
Country (dummies)	Yes	Yes	Yes
Industry (dummies)	Yes	Yes	Yes
Constant	-2.459*** (0.583)	-3.264*** (0.585)	
/cut1			2.527 (0.581)
/cut2			3.124 (0.582)
LR χ^2	737.07		661.57
Prob > χ^2	0.0000		0.0000
Observations	3,867		3,867

Notes: Standard errors are in parentheses. * p < .10; ** p < .05; *** p < .01

(1): no innovation vs. “new-only-to-the-firm” or “new-to-the-market” innovation

(2): no or “new-only-to-the-firm” innovation vs. “new-to-the-market” innovation

Conclusions and implications

We utilize a new approach (i.e., GOLM) to investigate the role of foreign investment in innovation in ASEAN and find robust evidence that firms with the majority of foreign ownership are less likely to conduct radical innovation. However, majority of foreign ownership is positively associated with more innovative activities when these firms engage in internal R&D activities. Furthermore, R&D also shows strong positive impacts on the possibility of radical innovation. In addition, the results are strongly consistent when we conduct sensitivity analysis. The findings lend support to our arguments about the low value-added and labor-intensive nature of the majority of foreign-owned manufacturing firms in ASEAN as well as weak intellectual property protection in ASEAN, which hinders innovation efforts.

The findings presented in this paper suggest some important implications. First, due to the fact that FDI still plays an important role in the industrial development of ASEAN countries, ASEAN policymakers should apply more technological regulations and incentives to encourage foreign investors to bring more advanced technologies, not outdated ones. In this way, invested firms can have better conditions for innovation activities. In fact, easy-going policies to attract FDI at all costs can bring negative impacts

on innovation. Second, given the low intellectual property protection environment in ASEAN, the policymakers should improve intellectual property protection laws to motivate foreign investors to transfer advanced technologies, which is the key driver of technological innovations. Third, ASEAN governments should encourage foreign-owned firms to invest more in R&D as our findings suggest that the firm's absorptive capacity is important for incorporating and transforming foreign knowledge into technological innovations.

References

- Almeida, R., & Fernandes, A.M. (2008). Openness and technological innovations in developing countries: evidence from firm-level surveys. *Journal of Development Studies*, 44(5), 701-727. doi: 10.1080/00220380802009217.
- Almodóvar, P., Saiz-Briones, J., & Silverman, B.S. (2014). Learning through foreign market participation: the relative benefits of exporting, importing, and foreign direct investment. *Journal of Technology Transfer*, 39(6), 915-944. doi: 10.1007/s10961-013-9324-9.
- Barbosa, N., Faria, A.P., & Eiriz, V. (2013). Industry-and firm-specific factors of innovation novelty. *Industrial and Corporate Change*, 23(3), 865-902. doi: 10.1093/icc/dtt029.
- Branstetter, L.G., Fisman, R., & Foley, C.F. (2006). Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from US Firm-Level Panel Data. *The Quarterly Journal of Economics*, 121(1), 321-349. doi: 10.3386/w11516.
- Brant, R. (1990). Assessing proportionality in the proportional odds model for ordinal logistic regression. *Biometrics*, 46(4), 1171-1178. doi: 10.2307/2532457.
- Chang, S.-J., Chung, C.-N., & Mahmood, I.P. (2006). When and how does business group affiliation promote firm innovation? A tale of two emerging economies. *Organization Science*, 17(5), 637-656. doi: 10.1287/orsc.1060.0202.
- Chen, C.-J., Lin, B.-W., Lin, Y.-H., & Hsiao, Y.-C. (2016). Ownership structure, independent board members and innovation performance: A contingency perspective. *Journal of Business Research*, 69(9), 3371-3379. doi: 10.1016/j.jbusres.2016.02.007.
- Choi, S.B., Lee, S.H., & Williams, C. (2011). Ownership and firm innovation in a transition economy: Evidence from China. *Research Policy*, 40(3), 441-452. doi: 10.1016/j.respol.2011.01.004.
- Choi, S.B., Park, B.I., & Hong, P. (2012). Does ownership structure matter for firm technological innovation performance? The case of Korean firms. *Corporate Governance: An International Review*, 20(3), 267-288. doi: 10.1111/j.1467-8683.2012.00911.x.
- Cohen, W.M., & Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), 128-152. doi: 10.2307/2393553.
- Douma, S., George, R., & Kabir, R. (2006). Foreign and domestic ownership, business groups, and firm performance: Evidence from a large emerging market. *Strategic Management Journal*, 27(7), 637-657. doi: 10.1002/smj.535.

- Falk, M. (2008). Effects of foreign ownership on innovation activities: empirical evidence for twelve European countries. *National Institute Economic Review*, 204(1), 85-97. doi: 10.1177/00279501082040011001.
- Fu, X., Pietrobelli, C., & Soete, L. (2011). The role of foreign technology and indigenous innovation in the emerging economies: technological change and catching-up. *World Development*, 39(7), 1204-1212. doi: 10.1016/j.worlddev.2010.05.009.
- Ganotakis, P., & Love, J.H. (2010). R&D, product innovation, and exporting: evidence from UK new technology based firms. *Oxford Economic Papers*, 63(2), 279-306.
- Girma, S., Gong, Y., & Görg, H. (2008). Foreign direct investment, access to finance, and innovation activity in Chinese enterprises. *The World Bank Economic Review*, 22(2), 367-382.
- Griffith, R., Redding, S., & Reenen, J.V. (2004). Mapping the two faces of R&D: Productivity growth in a panel of OECD industries. *Review of Economics and Statistics*, 86(4), 883-895. doi: 10.1162/0034653043125194.
- Javorcik, B. (2006). *Technological leadership and the choice of entry mode by foreign investors*. Washington, DC: World Bank.
- Jiang, L.A., Waller, D.S., & Cai, S. (2013). Does ownership type matter for innovation? Evidence from China. *Journal of Business Research*, 66(12), 2473-2478. doi: 10.1016/j.jbusres.2013.05.037.
- Kafouros, M.I. (2008). Innovation: A competitive weapon or a defense mechanism? In M.I. Kafouros (Ed.), *Industrial innovation and firm performance: The impact of scientific knowledge on multinational corporations* (pp.25-34). Cheltenham, UK: Edward Elgar Publishing.
- Karamanos, A. (2015). The effects of knowledge from collaborations on the exploitative and exploratory innovation output of Greek SMEs. *Management Dynamics in the Knowledge Economy*, 3(3), 361-380.
- Long, J.S., & Freese, J. (2006). *Regression models for categorical dependent variables using Stata*. College Station, Texas: Stata Press.
- Love, J.H., & Roper, S. (1999). The determinants of innovation: R & D, technology transfer and networking effects. *Review of Industrial Organization*, 15(1), 43-64. doi: 10.1023/A:1007757110963.
- OECD (2019). *OECD Investment Policy Reviews Southeast Asia*. Paris, France: OECD.
- Olabisi, M. (2017). The Impact of Exporting and Foreign Direct Investment on Product Innovation: Evidence from Chinese Manufacturers. *Contemporary Economic Policy*, 35(4), 735-750. doi: 10.1111/coep.12227.
- Pérez, J.A.H., Kunc, M.H., Durst, S., Flores, A., & Geldes, C. (2018). Impact of competition from unregistered firms on R&D investment by industrial sectors in emerging economies. *Technological Forecasting and Social Change*, 133, 179-189. doi: 10.1016/j.techfore.2018.03.028.
- Prud'homme, D., & von Zedtwitz, M. (2019). Managing "forced" technology transfer in emerging markets: The case of China. *Journal of International Management*, 25(3), 100670. doi: 10.1016/j.intman.2019.04.003.
- Prud'homme, D., von Zedtwitz, M., Thraen, J.J., & Bader, M. (2018). "Forced technology transfer" policies: Workings in China and strategic implications. *Technological Forecasting and Social Change*, 134, 150-168. doi: 10.1016/j.techfore.2018.05.022.
- Schwab, K. (2018). *The global competitiveness report 2018*. Geneva: World Economic Forum.
- Tsai, W. (2001). Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and

- performance. *Academy of Management Journal*, 44(5), 996-1004. doi: 10.2307/3069443.
- UNCTAD. (2019). United Nations Conference on Trade and Development database. Retrieved from <https://unctadstat.unctad.org>.
- United Nations Statistical Division. (2002). *International standard industrial classification of all economic activities (ISIC) (Revision 3.1)*. New York, NY: United Nations.
- Wang, Y. (2017). Promoting innovation ecosystem from knowledge supplying side. *Management Dynamics in the Knowledge Economy*, 5(1), 137-147.
- Williams, R. (2006). Generalized ordered logit/partial proportional odds models for ordinal dependent variables. *Stata Journal*, 6(1), 58-82. doi: 10.1177/1536867X0600600104.
- World Bank (2018). Survey Methodology. Retrieved from <https://www.enterprisesurveys.org/methodology>.
- World Bank (2019). Foreign Direct Investment. Retrieved from <https://datacatalog.worldbank.org/foreign-direct-investment-net-inflows-bop-current-us-2>.
- Yi, J., Hong, J., Chung Hsu, W., & Wang, C. (2017). The role of state ownership and institutions in the innovation performance of emerging market enterprises: Evidence from China. *Technovation*, 62/63, 4-13. doi: 10.1016/j.technovation.2017.04.002.
- Zahra, S.A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, 27(2), 185-203. doi: 10.2307/4134351.

Received: September 11, 2019

Accepted: November 5, 2019