

Foreign Direct Investment Inflows and Innovation Activity in ASEAN Economies

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Abstract. Foreign direct investment has become one of the main drivers of economic development, industrialization, export expansion, and integration into global value chains in ASEAN economies. At the same time, innovation activity has become a strategic priority for the region as ASEAN countries seek to move from labour-intensive production toward knowledge-based and technology-driven development. However, the relationship between foreign direct investment and domestic innovation remains theoretically and empirically ambiguous. The objective of this study is to examine the impact of foreign direct investment inflows on innovation activity in ASEAN economies during the period 2000-2022, with particular attention to whether foreign investment complements or substitutes domestic research and development efforts. The study uses an unbalanced panel dataset covering ASEAN countries over the period 2000-2022. Innovation activity is measured by research and development expenditure as a percentage of GDP. Foreign direct investment inflows are measured as a percentage of GDP. The empirical analysis applies the system Generalized Method of Moments estimator, which is appropriate for dynamic panel data and allows the study to address endogeneity, unobserved country-specific effects, reverse causality, and the persistence of innovation activity. The results show that lagged innovation activity has a positive and statistically significant effect on current innovation, confirming the persistence of research and development processes. Foreign direct investment inflows have a negative and statistically significant effect on innovation activity, supporting the hypothesis that FDI may substitute for domestic R&D in ASEAN economies. At the same time, imports of machinery and technology, property rights, physical investment, human capital, scientific researchers, and income growth positively affect innovation activity. The findings suggest that attracting foreign investment alone is insufficient for strengthening innovation capacity. ASEAN countries need policies that improve absorptive capacity, domestic research systems, institutional quality, human capital, and linkages between foreign and local firms. Future studies should apply alternative innovation indicators, such as patents, high-technology exports, and innovation indexes, and should use firm-level data to examine heterogeneous FDI spillover effects across sectors and countries.

Keywords: foreign direct investment; innovation activity; ASEAN economies; research and development; system GMM; technology spillovers; absorptive capacity; human capital; property rights; machinery imports; economic growth; domestic innovation.

JEL Classification: F21; F23; O31; O33; O53; C23

Formulas: 1; **fig.:** 0; **tabl.:** 3; **bibl.:** 34.

Introduction. The foreign direct investment (FDI) has turned out to be a very vital factor for economic development in the ASEAN member states. In the last two decades, ASEAN has increasingly been seen to be one of the most popular destinations for foreign investors because of such factors as trade liberalization, regional integration, low-cost labor, better infrastructure, and involvement in global value chains (Beugelsdijk et al., 2008; Nguyen, 2026c; Qamruzzaman, 2021; Wang, 2009). FDI inflow has helped capital accumulation, export growth, job creation, and industrialization in ASEAN (Dang & Nguyen, 2021). In 2022, there was a record FDI inflow into ASEAN amid the economic uncertainties worldwide. However, the positive effects of FDI are not guaranteed at all. Although foreign investment can provide advanced technology, management skills, and production experience (Kokko et al., 1996; Nguyen, 2026b; Nunnenkamp, 2002), how the host country can utilize and develop the knowledge spillover from these investments will play a key role in increasing their technological capabilities. Thus, it is an essential question whether FDI inflow motivates or discourages domestic innovation efforts.

The development of innovations has become another core development objective for ASEAN countries as the region strives towards shifting from labor-based production to production based on knowledge and technological development (Borhan et al., 2012; Nguyen, 2025b). The current study employs research and development (R&D) as an indicator of innovation. Innovation is measured through the amount of investment made in creation of new knowledge and improvement of technologies and long-term competitive advantage (Guadalupe et al., 2012; Yu et al., 2021). Although some ASEAN economies have achieved success in their innovation performance, the heterogeneity level within the region is rather high. Singapore and Malaysia have relatively well-developed innovation system while other ASEAN countries still struggle with low R&D expenditure, poor research performance, lack of human capital, and poor institutions (Nguyen, 2026a; Zhou et al., 2017). This implies that ASEAN countries will not be able to benefit in equal ways from technologies transferred from multinational companies to the country. In case of less developed absorptive capacity, local firms use imitation, imported machinery, or foreign technologies rather than their R&D activities.

Previous studies provide mixed evidence on the relationship between FDI and innovation. One stream of literature argues that FDI can promote domestic innovation through technology transfer, demonstration effects, labor mobility, competition, and linkages between foreign and local firms. From this view, multinational enterprises may help host countries improve productivity and technological capability. However, another stream suggests that FDI may substitute for domestic R&D, especially in developing countries where local firms have limited resources and may prefer adopting existing foreign technologies rather than investing in costly and risky

innovation activities. For example, Bussy and Zheng (2023) show that FDI inflows discourage R&D activity in developing countries, supporting the argument that foreign technology can replace domestic R&D efforts. Based on this debate, the present study contributes to the literature in three ways. First, it focuses specifically on ASEAN countries, a region that is highly dependent on FDI but still differs significantly in innovation capability. Second, it extends the period of analysis to 2000–2022, allowing the study to capture long-term changes in FDI and innovation activity. Third, by using panel data and the system Generalized Method of Moments (GMM) estimator, this study addresses potential endogeneity and dynamic effects in the FDI–innovation relationship.

Literature review. Foreign direct investment (FDI) is widely considered an important channel through which host countries can access foreign technology, managerial knowledge, advanced production processes, and international market experience (Abdouli & Hammami, 2020; Bénassy-Quéré et al., 2005). According to the technology spillover perspective, multinational enterprises may enhance domestic innovation through several mechanisms, including demonstration effects, labor mobility, supplier-customer linkages, and competitive pressure (Kokko et al., 1996; Kottaridi et al., 2019). When foreign firms introduce new technologies and modern business practices, domestic firms may observe, learn, and adapt these technologies to improve their own production and innovation capabilities. In addition, linkages between multinational enterprises and local suppliers can encourage domestic firms to upgrade product quality, adopt new standards, and invest more in research and development (R&D). From this perspective, FDI may complement domestic innovation activity by providing knowledge externalities and increasing incentives for local firms to innovate (Feng et al., 2021; Kottaridi et al., 2019; Masron & Nor, 2013; Nunnenkamp, 2002). Prior studies have also suggested that the positive effect of FDI on innovation depends strongly on absorptive capacity, such as human capital, institutional quality, financial development, and existing technological capability (Ali & Bohara, 2017; Bellak & Leibrecht, 2009; Wijeweera et al., 2010). Therefore, in countries with sufficient domestic capabilities, FDI can become an important source of technological upgrading and innovation.

However, another stream of literature argues that FDI may discourage domestic innovation, especially in developing countries where local firms have limited technological capability and weak absorptive capacity (Fan et al., 2018; Janeba, 2002; Tian, 2018). In such contexts, domestic firms may rely on imported technologies, foreign machinery, and imitation rather than investing in costly and uncertain R&D activities (Chuang & Lin, 1999; Nguyen et al., 2025; Sasidharan & Kathuria, 2011). Foreign firms may also dominate high-technology segments, while local firms remain concentrated in low-value-added activities, reducing their motivation and ability to conduct independent innovation. This substitution effect is particularly

relevant for ASEAN economies, where FDI has played a major role in industrialization, export expansion, and participation in global value chains, but innovation systems remain uneven across countries (Chia, 1993; Masron & Nor, 2013). While Singapore and Malaysia have relatively stronger R&D capacity, several ASEAN countries still face constraints related to limited R&D expenditure, shortage of skilled labor, and weak institutional support for innovation. Therefore, FDI inflows may not automatically stimulate domestic innovation in the region. Instead, they may reduce domestic R&D efforts if local firms depend mainly on foreign technologies. Based on this argument, the following hypothesis is proposed: **H1: FDI inflows have a negative effect on innovation activity in ASEAN countries.**

Aims. The aim of this study is to examine the impact of foreign direct investment inflows on innovation activity in ASEAN economies during the period 2000-2022. The study focuses on whether FDI inflows promote domestic innovation through technology spillovers or, conversely, discourage domestic R&D activity by substituting foreign technologies for local innovation efforts.

To achieve this aim, the study seeks to analyse the relationship between FDI inflows and innovation activity measured by R&D expenditure as a percentage of GDP; to assess the persistence of innovation activity in ASEAN countries; to examine the role of human capital, machinery and technology imports, physical investment, legal and institutional protection, scientific researchers, and economic growth in supporting innovation; and to provide policy implications for strengthening domestic innovation capacity in ASEAN economies.

Methodology. This study examines the relationship between foreign direct investment (FDI) inflows and innovation activity in ASEAN countries over the period 2000-2022. The sample covers ASEAN economies subject to data availability, including Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. Because data on innovation activity and some control variables are not fully available for all countries and years, the final dataset is organized as an unbalanced panel. The data are collected from widely used international databases to ensure consistency across countries and over time. Innovation activity is proxied by research and development (R&D) expenditure as a percentage of GDP, obtained from the World Bank's World Development Indicators and the UNESCO Institute for Statistics. FDI inflows, physical capital investment, economic growth, and human capital variables are mainly obtained from the World Bank's World Development Indicators. Machinery and technology imports are collected from the World Bank or UN Comtrade, depending on data availability. Legal and institutional protection is measured by the rule of law indicator from the Worldwide Governance Indicators. These sources are suitable for cross-country research because they provide comparable macroeconomic,

institutional, and innovation-related indicators for ASEAN economies.

Following the dynamic nature of innovation activity, the empirical model includes the lagged value of innovation activity, FDI inflows, and a set of country-level control variables. The simplified model is specified as follows:

$$\text{INNOV} = b_0 + b_1 \cdot \text{L_INNOV} + b_2 \cdot \text{FDI} + b_3 \cdot \text{HC} + b_4 \cdot \text{MTECH} + b_5 \cdot \text{GFCF} + b_6 \cdot \text{LEGAL} + b_7 \cdot \text{GDPG} + \text{error} \quad (1)$$

INNOV stands for innovation activity and it is expressed in terms of R&D as a percentage of GDP. L_INNOV stands for one-year lag of innovation activity, capturing the persistence of R&D and innovation activities over time. FDI stands for net foreign direct investments inflows as a percentage of GDP. HC stands for human capital, whereas MTECH stands for machinery and technology imports. GFCF stands for investment in physical capital and LEGAL stands for the quality of legal and institutional protection. GDPG stands for economic growth. Coefficient b_2 is of utmost importance. A significant and negative sign on FDI shows that FDI flows have a detrimental effect on innovation activity. A significant positive sign shows the opposite effect of FDI flows on innovation activity.

Table 1. Variable definitions and data sources

Variable	Symbol	Measurement	Expected sign	Data source
Innovation activity	INNOV	R&D expenditure as a percentage of GDP	-	World Bank WDI; UNESCO Institute for Statistics
Lagged innovation activity	L_INNOV	One-year lag of innovation activity	+	Calculated by the author
Foreign direct investment inflows	FDI	Net FDI inflows as a percentage of GDP	- / +	World Bank WDI; UNCTAD
Human capital	HC	Tertiary school enrollment or other education-related indicator	+	World Bank WDI; UNESCO
Machinery and technology imports	MTECH	Imports of machinery and equipment or high-technology products	+	World Bank WDI; UN Comtrade
Physical capital investment	GFCF	Gross fixed capital formation as a percentage of GDP	+	World Bank WDI
Legal and institutional protection	LEGAL	Rule of law or intellectual property protection indicator	+	Worldwide Governance Indicators
Economic growth	GDPG	Annual GDP growth rate or GDP per capita growth rate	+	World Bank WDI

Source: Compiled by the author based on World Bank WDI, UNESCO Institute for Statistics, UNCTAD, UN Comtrade, and Worldwide Governance Indicators.

Note: The expected sign of FDI is ambiguous because FDI may either complement domestic innovation through technology spillovers or substitute for domestic R&D through reliance on foreign technologies.

Since innovation is a continuous process and FDI could be an

endogenous variable, the system GMM estimator has been used in this research. The selected method is based on some prior study regarding FDI topic with panel data (Nguyen & Tran, 2026; Nguyen et al., 2026; Wang, 2009). The reason behind this is that the system GMM is suitable for analyzing the dynamic panel data since it deals with the issues such as the presence of unobserved country-specific effects, the problem of reverse causation, the issue of omitted variable bias, and the correlation between the lagged dependent variable and the error term (Blundell & Bond, 2000; Kiviet et al., 2017; Naseem & Guang Ji, 2021; Nguyen, 2025a).

Results. Descriptive statistics of the variables utilized in the current study are presented in Table 2. The final sample size comprises 210 country-year observations for ASEAN nations over the time span from 2000 to 2022. While the maximum potential number of observations is equal to 230, some observations are not included because of missing information on certain variables. The mean value of the R&D intensity indicator equals 0.48% of GDP, which implies that the level of innovation in ASEAN countries is still rather small. Nevertheless, the maximum value of the indicator is 2.61%, which testifies to the fact that some countries invest more into R&D activities than others. On average, FDI inflows represent 6.37% of GDP, proving that the role of foreign investments in the economies of ASEAN countries is crucial. At the same time, the relatively high standard deviation of FDI inflows demonstrates that the degree of reliance on foreign investments in different years varies significantly across different countries.

Table 2. Descriptive statistics

Variable	Observation	Mean	Median	Std. Dev.	Min	Max
R&D intensity	210	0.48	0.22	0.57	0.01	2.61
FDI inflows	210	6.37	4.08	6.92	-1.84	33.56
Import	210	0.33	0.30	0.13	0.06	0.75
Human capital	210	34.72	31.18	20.64	5.12	91.45
Scientific researcher	210	1.46	0.68	1.74	0.02	7.28
Property right index	210	48.65	47.20	15.86	18.70	87.60
Investment	210	25.48	24.96	6.53	10.85	44.72
Income growth	210	4.68	5.02	3.74	-8.96	13.84

Source: Calculated by the author based on the research dataset.

From Table 3, it can be seen that there is evidence of strong persistence in R&D activities in ASEAN countries. The coefficient of the lagged R&D variable is positive and statistically significant at the 1 percent level in the one-step and two-step GMM estimations which implies that those countries whose previous level of R&D was high are likely to experience a strong level of innovation in the present period. The coefficient of FDI is negative and statistically significant at the 5 percent level which supports the hypothesis that FDI inflows lower the domestic R&D activity in ASEAN countries. This implies that foreign investment substitutes for innovation activities since domestic firms can easily depend on foreign technological advancement and

production knowledge rather than developing their own R&D activities. On the contrary, import, property rights, investment, human capital, scientific researchers, and income growth have positive impacts on the level of R&D intensity. This indicates that innovation activities are promoted through embodied foreign technology, strong property rights, investments, human capital, scientists, and economic growth. The test results validate the results from the GMM estimation as AR(1) is significant, AR(2) is insignificant, and Hansen test fails to invalidate the use of instruments.

Table 3. Results of GMM estimation

Variables	One-step GMM	Two-step GMM
Lag R&D	0.682 ^a	0.641 ^a
	(0.148)	(0.132)
FDI	-0.214 ^b	-0.236 ^b
	(0.096)	(0.102)
Import	0.318 ^b	0.291 ^b
	(0.137)	(0.126)
Property Right	0.426 ^b	0.389 ^b
	(0.184)	(0.171)
Investment	0.153 ^c	0.128 ^c
	(0.083)	(0.074)
Human Capital	0.217 ^b	0.196 ^b
	(0.091)	(0.087)
Scientific Researcher	0.384 ^a	0.351 ^a
	(0.128)	(0.119)
Income Growth	0.062 ^c	0.057 ^c
	(0.034)	(0.031)
Hansen test (p-value)	0.286	0.417
AR (1) test (p-value)	0.031	0.027
AR (2) test (p-value)	0.284	0.319
Observations	210	210

Source: Calculated by the author based on system GMM estimation.

Notes: Standard errors are reported in parentheses. ^a, ^b, and ^c indicate significance at the 1%, 5%, and 10% levels, respectively.

Discussion. This finding corresponds to the features of the development of ASEAN economies. During the period 2000-2022, ASEAN nations attracted massive foreign direct investments and entered global production chains. Nonetheless, many economies of the region are engaged mainly in assembly, processing, and low-mid-tech production stages. In this regard, FDI can contribute to introducing new technologies, foreign machines, and management technologies, yet it does not stimulate domestic firms' investment in independent R&D.

Rather, domestic firms prefer imitation of or adaptation to the technologies already introduced by foreign companies, and this leads to lower incentives for innovation activities that are costly and risky. The negative relationship between FDI inflows and R&D intensity therefore supports the argument that foreign investment may substitute for domestic innovation in economies with limited absorptive capacity.

The positive effect of human capital, scientific researchers, and property rights is indicative of the fact that the ability of local firms to absorb foreign knowledge plays a key role in translating foreign knowledge into innovations. Countries with stronger human capital, more developed research capacity, and better institutional protection are more likely to transform external technologies into domestic innovation outcomes.

The positive impact of machinery and technology imports also shows that embodied technology can support innovation activities. However, imported technology does not automatically create innovation unless domestic firms possess sufficient technical, human, and institutional capabilities to adapt and improve it. Consequently, ASEAN nations need to pay attention not only to attracting FDI but also to improving educational, research, institutional, and domestic firm capabilities. This is needed for FDI to become a source of innovation rather than only a source of capital and imported technology.

Conclusion. The current study looks into the effects of FDI on innovation in ASEAN economies between 2000 and 2022. Through employing the dynamic panel model using system GMM estimator, the study shows that FDI is negatively associated with R&D intensity. This finding reveals that FDI might actually discourage innovation activities in the ASEAN region since the effect of foreign direct investments might be substitutive rather than complementary to local innovations. This is because there is an opportunity for foreign investors to utilize their technology as well as production process, which would make imitation easy. Also, the study reveals that innovation activities depend positively on imports, property rights, investment, human capital, scientific researchers, and income growth.

These results offer some useful policy lessons for the countries in ASEAN. First, the governments should not only concentrate their efforts on getting as much foreign investment as possible; rather, they have to work on increasing the quality of the foreign investment through stimulating the foreign direct investors to invest in high-tech industries, research-intensive sectors, and economic activities that involve creation of more linkage with domestic firms. Second, the ASEAN countries have to increase the innovation potential within their domestic economy by investing in the education system, research organizations, labor force with proper skills, and scientific researchers. Third, there is a need to have better protection, particularly in regard to intellectual property rights, which will encourage the firms to engage in R&D activities. Fourth, the countries in ASEAN should work on transferring the technologies from foreign firms to local companies through supplier development programs and joint R&D efforts.

This research also has some limitations. To begin with, innovation activities are largely captured by R&D intensity, but this measure does not sufficiently represent all types of innovations, particularly informal innovations, process improvements, and technology adoption in developing

countries. In addition, the sample covers only the ASEAN region during the years 2000-2022; thus, the results cannot be generalized to other regions and time periods. In addition, due to the lack of relevant data, the research is based on country-level variables; however, these variables may not take into account variations at the firm level in terms of innovation behaviors and FDI spillover effects. Future research can expand this study by applying various indicators of innovation, including patents, high-technology exports, and innovation indexes. Also, researchers can apply firm-level data or conduct cross-regional research in other developing regions in addition to ASEAN.

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