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Trade Openness, Foreign Direct Investment and Industrial Growth: Panel Data Evidence from the ASEAN Region

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Abstract

This paper re-examines the role of trade and FDI inflows in accelerating the process of industrial growth involving countries belonging to the "Association of Southeast Asian Nations (ASEAN)" region. Trade openness and foreign direct investment (FDI) have improved the growth performance of numerous economies and regions over the years. However, the specific role of both trade openness and FDI inflows in advancing the industrial growth process of economies has yet to be investigated in the case of economies belonging to ASEAN. This study analyzes data from 2000 to 2023 and employs several relevant econometric tools, including the "Pooled Ordinary Least Squares (POLS)", "Fixed Effects Filter (FEF)", "Feasible Generalized Least Squares (FGLS)" and "Two Stages Least Squares (TSLS)", to assess the specific impact of both trade openness and FDI inflows on industrial growth. Our findings show that both trade openness and FDI have advanced the industrial growth of ASEAN member economies. In terms of relative importance, the impact of trade openness is higher as compared to FDI inflows on the industrial sector. Similarly, the results demonstrate that the industrial growth of ASEAN economies could be explained positively by increased domestic investment and government expenditures. Moreover, our results indicate that the inflation rate and the natural resource sector have adversely impacted industrial growth. Finally, the labor force has not had the desirable positive impact on the industrial progress of ASEAN economies. The obtained results are robust across alternative specifications and estimation techniques. Therefore, our results have important policy implications for ASEAN economies.

Keywords: trade openness; FDI; industrial growth; ASEAN; panel data

JEL Classification: F1; F2; F6; L6

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1. Introduction

A number of previous studies have been conducted to assess the true and explicit impact of trade openness on economic growth. The dominant lessons from mainstream studies are that trade openness indeed contributes to economic growth positively and significantly (Dollar, 1992; Sachs & Warner, 1995; Edwards, 1998; Frankel & Romer, 1999).

On the other hand, some studies have questioned the positive trade-growth nexus reported by mainstream studies by identifying flaws related to the estimaton methodology and the measurement of trade openness (Rodriguez & Rodrik, 2000). Recent studies believe that trade openness is an essential part of growth-promoting strategies (Tahir & Azid, 2015; Keho, 2017; Duernecker et al., 2022; Seti et al., 2025). Trade openness brings significant benefits for host economies, including access to important raw materials, advanced technologies, and access to extended global markets, which ultimately advances the process of economic growth.

A stream of literature has focused on exploring the specific role of "Foreign Direct Investment (FDI, hereafter)" from the perspective of improved economic performance. FDI inflows help economies through multiple channels, including the spillover of knowledge and through increased investment. For instance, Borensztein et al. (1998) pointed out that FDI is one of the main channels of technology transfer and is more important for economic growth as compared to domestic investment. Similarly, Pegkas (2015) highlighted the role of FDI in advancing the economic performance of host economies by enhancing productivity through the channels of increased investment, advanced technologies and managerial skills. However, empirical studies have shown conflicting evidence about the role of FDI inflows from the perspective of improved economic performance. For instance, Almfraji and Almsafir (2014) reviewed the published literature and endorsed that some studies have reported a positive, negative and even no significant relationship between the inflows of FDI and economic growth. The FDI-growth relationship is not straightforward, and it depends on the size of the natural resource sector (Hayat, 2018), the stock of human capital (Borensztein et al., 1998) and an advanced financial system (Alfaro et al., 2004).

This study is distinct from conventional literature by exploring the impact of trade and FDI inflows on industrial growth instead of economic growth. The common misperception is that both trade and FDI harm the domestic industrial sector of developing countries. This misperception is based on the traditional infant industry philosophy, which assumes that the industrial sector of developing countries requires protection amid global economic integration in the form of increased trade openness and FDI flows. The infant industry philosophy believes that some strategic industries should be given temporary protection against international competitors with the expectation that they will mature eventually and will compete successfully in the market (Irwin, 2008). Moreover, Saure (2007) documented that the infant industry argument assumes that free trade harms developing countries as they specialize according to their comparative advantage in sectors having poor dynamic externalities. Similarly, the same infant industry argument could also be put forward to explain the relationship between FDI inflows and industrial performance, specifically in the case of developing countries. It is possible that FDI may impact the progress of industries adversely, specifically in developing countries, as their industries are unable to compete with multinational corporations. Therefore, this study investigates the relevance of the infant industry argument from the perspective of increased trade openness and FDI for ASEAN economies.

The ASEAN region includes diverse economies, including "Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam". The ASEAN member states are much more open to global economic integration. Over the years, the ASEAN region has adopted relatively liberalized trade policies by reducing certain restrictions on international trade. For this purpose, ASEAN members established the "ASEAN Free Trade Area (AFTA)" in 1992 to abolish a number of restrictions on international trade (ADBI, 2024). In subsequent years, the average tariff rate, which is a main hurdle for trade flows, has decreased from 7.99 percent in 2000 to just 3.97 percent in 2020, showing a significant movement towards trade liberalization (Nam & Ryu, 2024). In

2024, the exports of the ASEAN region reached USD 2.05 trillion, which is 4 percent higher compared to the previous year. In the first quarter of 2025, the ASEAN region exported goods and services worth approximately USD 367.23 billion (Market Analysis, 2025).

The ASEAN region has historically also performed well in attracting significant FDI inflows from advanced economies. According to the ASEAN Investment Report (2024), the ASEAN region has achieved a top position in attracting FDI inflows for three consecutive years among the developing countries. The total amount of FDI inflows reached USD 230 billion in 2023 in ASEAN, despite the global decline in FDI inflows worldwide. In 2009, ASEAN members signed the "ASEAN Comprehensive Investment Agreement (ACIA, hereafter)", which is based on liberalization, protection, promotion and facilitation (ADBI, 2024). The main purpose behind ACIA is to encourage the inflows of FDI into the ASEAN region by helping potential investors and businesses. The ASEAN region has remained a popular destination for international investors, mainly due to its business-friendly environment, stable environment and better law and order conditions.

This study advances the current body of knowledge in two ways. Firstly, we focus on the role of both trade openness and FDI from the perspective of industrial growth instead of economic growth, which is indeed an unexplored area. Secondly, our study adds to the body of knowledge contextually by focusing on the members of the ASEAN region, as they are much more open to global economic integration in the form of both FDI inflows and trade openness. In summary, our study provides detailed evidence regarding the influence of trade and FDI on industrial growth. Our results are expected to draw the attention of authorities, policymakers and future researchers and assist them in formulating appropriate policies regarding the development of industrial sectors.

This study is organized with Section 2 elaborating on relevant literature. Section 3 presents the methodology. In Section 4, we present our findings and discussion, with Section 5 providing some concluding remarks and policy implications. A final section provides relevant appendices.

2. Literature Review

Over the last several decades, numerous research studies have been carried out to assess the true impact of trade openness and FDI inflows on the growth of economies. To provide clarity, we have divided the literature review section into two sub-sections. The first section is devoted to studies on trade-growth linkages, while the second section includes discussion of studies dealing with the FDI-growth relationship.

2.1. Literature on Trade and Growth

The relationships of international trade openness have received significant attention worldwide from government authorities, policymakers and researchers during the last few decades, specifically after the failure of import substitution policies in the early 1970s. Economies worldwide have adopted the policies of outward orientation after the failure of import substitution policies. In subsequent years, restrictions on international trade have declined significantly worldwide. After the implementation of liberalized trade policies, some researchers have conducted comprehensive research studies to assess their usefulness from a growth perspective. In this regard, Dollar (1992) focused on 95 developing countries and applied several relevant econometric tools, and concluded that economies with relatively liberalized trade policies have performed exceptionally well as compared to economies with protected trade policies. Sachs and Warner (1995) utilized data for 118 economies and demonstrated that economies with liberalized trade policies have outperformed economies with restrictions on international trade. Similarly, the seminal study of Edwards (1998) also endorsed that liberalized trade policies promote productivity.

Finally, Frankel and Romer (1999) also demonstrated that trade openness indeed increases the level of income by utilizing the gravity model of international trade.

Rodriguez and Rodrik (2000) critically reviewed the earlier literature on the trade-growth relationship and questioned the positive trade-growth relationship reported in the literature. They argued that the earlier evidence of the positive trade-growth relationship is either based on poor econometric techniques or due to the flaws related to the measurement of trade openness. The research by Rodriguez and Rodrik (2000) opened the trade-growth relationship to further investigation. In subsequent years, some researchers have carried out comprehensive studies to see the responsiveness of economic performance to increased trade openness. For example, Yanikkaya (2003) empirically demonstrated that trade barriers are positively linked with economic performance in most of the specifications estimated. These studies have opened the debate, and the positive trade-growth relationship has turned doubtful.

After the setback to initial evidence, several studies have been conducted in the literature to explore the exact relationship using more advanced methodologies and diverse measures of trade openness. Dar and Amirkhalkhali (2003) have focused on 19 OECD economies adopting the common growth-accounting framework and concluded that the relative importance of trade is indeed diverse across countries. Similarly, Sarkar (2008) demonstrated that the trade-growth relationship is only valid for the middle-income economies. Moreover, some recent studies provided evidence regarding the positive impact that trade has on growth (Tahir & Khan, 2014; Tahir et al., 2019).

Nguyen and Bui (2021) used data from ASEAN economies and concluded that trade improves economic growth before the first threshold. However, they further demonstrated that the impact of trade openness weakens after the second threshold. Pradhan et al. (2017) used historical data from 1961 to 2012 and applied panel data techniques to link trade openness and banking performance to economic performance. Their results demonstrate that the economic performance of ASEAN economies has responded positively to increased trade openness and improved banking sector performance. Finally, Sriyana and Afandi (2020) endorsed that openness has helped the economies of Singapore and the Philippines in terms of better economic performance.

This brief review shows that numerous studies have established a relationship between trade and economic performance. However, the specific role of trade openness in impacting the industrial sector's performance is yet to be convincingly established, mostly due to the lack of research evidence. Therefore, to enrich the literature, the present study examines how increased openness to trade impacts the performance of the industrial sector. We believe that the outcome of this study will shape policies regarding the improvement of the industrial sector.

2.2. FDI and Economic Growth

FDI inflows are an integral part of global economic integration, and they bring multiple benefits for the host economies. Global economic integration and market internalization have encouraged companies worldwide to expand their businesses, which has led to an increase in the volume of FDI (Almfraji & Almsafir, 2014). FDI adds to the growth and development of host economies mainly due to technological diffusion and skill development of the labor force. According to Berthélemy and Demurger (2000), FDI openness contributes to the growth of the recipient economy through two main channels, namely, the extension effect and the external effect. The extension effects imply that FDI adds to the extension of the intermediate-goods sector. Similarly, the external effects indicate that FDI contributes to research activity, which could be used by firms in the host countries.

Furthermore, some studies endorsed that FDI inflows help the recipient economies through the channel of domestic investment (Mehic et al., 2013).

Recently, some studies have attempted to assess the true impact of FDI inflows on economic growth using quantitative approaches. For instance, Pegkas (2015) focused on the Eurozone economies and adopted data for the period 2002–2012 to analyze the impact of increased FDI inflows on economic growth. The study quantitatively demonstrated that FDI inflows positively contribute to economic growth. Similarly, the study of Chakraborty and Nunnenkamp (2008) found that FDI in the services sector is positively linked with the improvement in the manufacturing sector through the channel of cross-sector spillovers. Nunnenkamp (2002) focused on the beneficial impacts of FDI and rightly advised the developing countries to attract FDI as it complements domestic savings and ultimately enhances economic growth.

Some researchers have focused on individual countries to study the linkages that may exist between FDI and economic performance. For example, using the data from Tanzania, Utouh and Kitole (2024) demonstrated a positive and significant influence of FDI inflows on economic growth, both in the long and short run. Similarly, Mose and Kipchirchir (2024) focused on the economy of Kenya and applied the ARDL technique to data spanning from 1990 to 2021. Their results show that FDI openness has added positively to the growth performance of Kenya. Moreover, in the case of Romania, Nistor (2014) endorsed the positive impact that FDI has on economic performance. On the other hand, Saqib et al. (2013) reported that the economic performance of Pakistan is adversely impacted by increased inflows of FDI. A possible reason could be the absorptive capacity in the Pakistani economy. However, the study of Rehman (2016) showed that FDI has improved the economic performance of Pakistan.

In the case of ASEAN economies, some studies have tested the influence of FDI inflows on economic performance. For instance, Lee and Tan (2006) focused on members of ASEAN and demonstrated a positive impact that FDI has on economic performance. Similarly, Moudatsou and Kyrkilis (2011) utilized data from ASEAN economies from 1970 to 2003 to assess the impact of FDI inflows on economic performance. Their results confirmed the causal relationship running from GDP to FDI. Moreover, Mariska et al. (2021) applied the random effects model and used data from 2015 to 2019. Their results also proved the worth of FDI for ASEAN economies. Finally, Phyoe (2015) demonstrated an insignificant impact that FDI has on the economic performance of ASEAN economies.

However, the sole impact of FDI inflows on the industrial growth of ASEAN economies is yet to be explored. This study is an attempt to figure out the responsiveness of the industrial sector to increased FDI inflows. The outcome of this study will help the government authorities of ASEAN economies develop policy responses to increased FDI inflows.

3. Models and Methods

3.1. Model Derivation

Model derivation is indeed an important step in studies using secondary data. For this purpose, we attempt to specify proper econometric models in this section for the purpose of achieving the objectives of the study. Industrial sector growth is the dependent variable, and the prime independent variables are trade openness and FDI inflows. There is significant literature evidence that supports the relationship between trade openness, FDI inflows and industrial growth (Hao, 2023; Umer & Alam, 2013). Besides trade openness and FDI inflows, the industrial sector also responds to the increased labor force, macroeconomic stability and domestic investment. Therefore, we have included them among the regressors. Therefore, we have specified the following functional form.

$$\mathrm{ING}_{i,t} = \left(\mathrm{OPN}^{a}_{it}, \mathrm{FDI}^{b}_{it}, \mathrm{INV}^{c}_{it}, \mathrm{LAB}^{d}_{it}, \mathrm{INF}^{e}_{it}\right) \quad (1)$$

Equation (1) shows that the industrial sector performance of ASEAN member states is dependent on trade openness, FDI inflows, domestic investment, labor force and inflation rate. We transform Equation (1) to the estimable form as provided below.

$$\mathrm{LNING}_{i,t} = \beta_0 + \beta_1 LN\mathrm{OPN}_{i,t} + \beta_2 \mathrm{FDI}_{i,t} + \beta_3 \mathrm{LNINV}_{i,t} + \beta_4 \mathrm{LNLAB}_{i,t} + \beta_5 \mathrm{INF}_{i,t} + u_{i,t} \quad (2)$$

The dependent variable, industrial growth, is approximated by taking the growth rate of "Industry (including construction), value added (% of GDP)". For calculating the growth rate, we have taken the log differences ($\mathrm{GING}_{i,t} = LN\mathrm{ING}_{i,t} - LN\mathrm{ING}_{i,t}(-1)$). Similarly, openness to international trade of ASEAN economies is measured as "trade (% of GDP)", while domestic investment is measured as "gross fixed capital formation (% of GDP)". FDI inflows are measured by taking "FDI inflows as a % of GDP". For labor force, this study adopted "Labor force participation rate, total (% of total population ages 15–64) (modeled ILO estimate)", while inflation is measured by utilizing the "growth of consumer price index (CPI)". Natural logarithm transformation (LN) is applied to all variables except FDI and inflation rate due to the presence of negative values.

3.2. Data and Sample

In the first step, the study focused on all members of ASEAN. However, due to the unavailability of data, Laos PDR and Myanmar are omitted from the final sample. Therefore, the final sample includes eight member states of ASEAN. Data on all selected variables for the analysis in the current study are sourced from "World Development Indicators (WDI, hereafter)". The study period covers the years 2000 to 2023. The list of countries and variable construction information, along with sources of data, is included in Appendix A (Tables A1 and A2).

3.3. Estimating Methods

This section of the article is devoted to methods required for estimation. In the first step, we have sourced relevant panel data from credible sources. Panel data, by its design, requires some specific estimating tools due to its cross-sectional and time dimensions. There are two primary tools for the estimation of models involving panel data, which are known as the "Fixed Effects (FEF, hereafter)" and "Random Effects (REF, hereafter)", as endorsed by Dewan and Hussein (2001). Over the years, these tools have been repeatedly used in numerous studies, mainly due to their effectiveness in handling panel data. The FEF modeling is usually applied for estimation in situations where the error term and regressors are correlated. Accordingly, the FEF addresses the issue of likely serial correlation and provides valid estimates of the unknown parameters. The use of the REF is valid when the disturbance term is uncorrelated with independent variables. However, the decision regarding the selection of the relevant estimating tools is usually made in the literature with the application of the Hausman specification (Hausman, 1978) testing procedure. Following prior literature, we have also adopted the Hausman (1978) framework for the selection of appropriate estimators.

Moreover, we also used "Feasible Generalized Least Squares (FGLS)" for conducting robustness analysis (Tahir & Alam, 2022). Lastly, for addressing the endogeneity problem, we used "Two Stages Least Squares (TSLS)" for estimation purposes. The commonly used "Generalized Method of Moments (GMM)" is therefore skipped, because the number of countries is less than the number of years. Previous research studies have also highlighted the same issue and recommended using TSLS instead of GMM in scenarios where the

cross-sectional dimension is less than the time dimension (Tahir & Alam, 2022; Albahouth & Tahir, 2025).

3.4. Preliminary Testing

Before moving to the main results, we conducted several important tests, and the results are displayed in Appendix A. We ran the Hausman test (Hausman, 1978), and the findings depicted in Table A3 (Appendix A) indicated the superiority of FE modeling. Similarly, the "Pesaran (2004) CD test" confirmed the cross-sectional independence, which is important for the validity of FE modeling (Table A4, Appendix A). Finally, the absence of multicollinearity in our models is validated by the "Variance Inflation Factor test (VIF)", whose results are shown in Table A5 (Appendix A).

4. Results and Interpretations

4.1. Discussion on Descriptive Analysis

Table 1 presents the descriptive statistics of the study. The mean value of industrial growth is −0.105 percent, with a standard deviation of 1.857. The highest value of industrial growth is recorded for the Indonesian economy (5.924) in 2001, while the lowest value of industrial growth was observed for the economy of Brunei (−9.136) in 2009. The statistics of industrial growth show that the region has given importance to the process of industrialization, as it is the way forward for sustainable growth and development.

Table 1. Descriptive analysis.

Description	$GING_{i,t}$	$OPN_{i,t}$	$FDI_{i,t}$	$INF_{i,t}$	$INV_{i,t}$	$LAB_{i,t}$
Mean	−0.105	141.690	5.608	3.225	25.774	72.543
Maximum	5.924	437.326	33.304	24.096	40.891	87.661
Minimum	−9.136	32.972	−2.757	−2.314	15.197	56.681
Std. Dev.	1.857	91.646	6.838	3.574	5.034	6.955
Observations	192	192	192	192	192	192

Note: Authors own calculations using data from the World Bank.

The mean of trade openness is 141.690. The maximum value for openness is witnessed for Singapore (437.326) in 2008, while the lowest trade openness is observed in Indonesia (32.972) in 2020. Generally, the ASEAN economies have implemented liberalized trade policies over the years. In essence, it could be said that better economic performance of ASEAN economies could be dependent largely on the liberalized trade policies. Moreover, the statistics of FDI show that its mean value is 5.608 percent during the study period. The highest FDI among the ASEAN economies is received by Singapore (33.304) in 2021, while the economy of Indonesia experienced the lowest FDI inflows in 2000.

Furthermore, the ASEAN economies have performed well in managing the inflation rate. Inflation remained at 3.225 percent in the ASEAN region. The highest inflation among the ASEAN members is experienced by Cambodia (24.096) in 2008, while the lowest inflation occurred in Brunei in 2002. The inflation figures overall suggest that macroeconomic policies remained stable in the ASEAN region. Moreover, the investment statistics show that the capital formation in the ASEAN region is about 25.774 percent, with a standard deviation of 5.034. The highest investment (40.891) and lowest investment (15.197) occurred both in Brunei Darussalam in 2018 and 2006, respectively. Finally, the statistics show that the average labor force participation rate is 72.543 percent. The highest labor force participation rate was observed in Cambodia (87.661) in 2011, while the lowest labor force participation was seen in the Philippines (56.681) in 2020.

4.2. Analysis of Correlation

In Table 2, the correlation between the variables is demonstrated. According to our correlation analysis, the highest correlation is observed between FDI and trade, while the lowest correlation is recorded between domestic investment and trade openness. Similarly, we noticed a positive correlation between trade openness, FDI inflows and industrial growth of ASEAN economies. A moderate correlation is witnessed among the rest of the variables.

Table 2. Correlation analysis.

Variables	$GNING_{i,t}$	$LNOPN_{i,t}$	$FDI_{i,t}$	$INF_{i,t}$	$LNLAB_{i,t}$	$LNINV_{i,t}$
$GING_{i,t}$	1.000					
$LNOPN_{i,t}$	0.351 (0.000)	1.000				
$FDI_{i,t}$	0.517 (0.000)	0.716 (0.000)	1.000			
$INF_{i,t}$	−0.111 (0.114)	−0.171 (0.015)	−0.075 (0.289)	1.000		
$LNLAB_{i,t}$	−0.236 (0.000)	0.301 (0.000)	0.272 (0.000)	0.077 (0.276)	1.000	
$LNINV_{i,t}$	0.189 (0.007)	0.0003 (0.996)	0.054 (0.444)	0.040 (0.572)	0.299 (0.000)	1.000

Note: "Values in parentheses stand for probability values."

4.3. Discussion on Regression Results

Table 3 includes the results of the regression analysis. Column 2 includes POLS, while the findings of the fixed effects model are demonstrated in column 3. The POLS analysis shows that trade has not improved industrial growth, while FDI has negatively and significantly impacted the industrial growth of ASEAN economies. Similarly, the inflation rate and labor force participation rate appeared to be detrimental from the perspective of industrial growth. Lastly, domestic investment has positively and significantly impacted the industrial growth of ASEAN economies. However, as the Hausman test (1978) provided evidence about the appropriateness of the FEF estimator, we do not emphasize the results of the POLS further.

Next, we discuss the results of FEF shown in column 3 of Table 3, which is the more appropriate estimating technique for the specified model 1. Our results indicate that trade openness has improved the industrial performance of ASEAN economies, which is indeed consistent with the perception hypothesized. The recent research by Hao (2023) also demonstrated similar results regarding trade openness and industrial performance in the case of the Chinese economy. On the other hand, our results do not support the results demonstrated by Umer and Alam (2013). The ASEAN states are advised to liberalize their trade regime by following the aggressive policy of trade liberalization to improve the performance of industrial sectors and consequently enhance the speed of economic growth significantly.

Further, our results demonstrate that FDI inflows, which are an integral part of the growth-promoting strategy, have also accelerated the performance of the industrial sector significantly in the case of ASEAN member states. Previous research studies such as Umer and Alam (2013) and Hao (2023) also reported a positive relationship between FDI inflows and the growth of the industrial sector. FDI inflows generally complement domestic investment and hence improve the performance of the industrial sector. Several important policy actions need to be taken, including tax rebates, one-window operations for foreign

investors and a feasible business environment. These policy changes are expected to help the ASEAN members achieve improved industrial performance, which is essential for better economic performance.

Table 3. Regression results.

Variables	POLS	FEF
$LNOPN_{i,t}$	0.045 (0.038)	0.114 *** (0.042)
$FDI_{i,t}$	−0.022 *** (0.002)	0.006 *** (0.002)
$INL_{i,t}$	−0.008 ** (0.003)	−0.007 *** (0.002)
$LNLAB_{i,t}$	−0.984 *** (0.101)	−1.967 *** (0.352)
$LNINV_{i,t}$	0.476 *** (0.098)	0.187 *** (0.048)
Constant	5.703 (0.492)	9.813 (1.38)
"Country Fixed Effects"		Yes
"Year Fixed Effects"		Yes
Diagnostics	Adj: R^2: 0.474 S.E.R: 0.461 F. Test: 35.081	Adj: R^2: 0.936 S.E.R: 0.922 F. Test: 66.983

Note: "The dependent variable is industrial growth. Values in parentheses represent standard errors. The asterisk (***, **) shows significance levels at 1 percent and 5 percent, respectively."

Furthermore, our results show that the performance of the industrial sector is also dependent on domestic investment. The performance of the industrial sector is the key channel by which domestic investment impacts economic growth. Domestic investment ensures the increased production of goods and services, which are essential for the advancement of the industrial sector. Therefore, the ASEAN member states are advised to ensure increased investment in their domestic economies.

Moreover, the results further indicate the adverse effects of the inflation rate on the performance of the industrial sector. A heightened inflation rate is generally considered undesirable as it harms both producers and consumers (Tahir & Azid, 2015). Producers are unable to play their due role in the development of their industries amid heightened inflation, as it creates uncertainty.

Lastly, our results confirm that the labor force has not had the desirable positive impact on industrial growth. The coefficient of the labor force in the estimated models is not statistically different from zero, and further, it carries a negative coefficient. It means that the modern-day industrial sector relies more on advanced technologies and machines instead of the ordinary labor force. This could be one of the reasons behind the negative role of the labor force in the process of industrialization. Furthermore, it is a common observation that the ordinary labor force is unable to contribute to the growth of the industrial sector due to poor skills. It is also possible that there is a significant mismatch between the existing skills of the labor force and technological intensity in the case of ASEAN economies. In other words, the current mismatch of skills could be the main factor behind the unexpected role of the labor force participation rate in advancing industrial growth. Therefore, the ASEAN member states must invest in the skill development of the labor force to make their contribution meaningful from the perspective of industrial growth.

Finally, it is appropriate to mention that the estimated model also includes year FEF, as these control for the common shocks that affect all economies. Hence, the estimated coefficients indicate the within-country variation when accounting for the year FEF. In other words, by the utilization of the year FEF, we have effectively measured the true policy impact of variables.

4.4. Sensitivity Analysis

This study attempts to address the sensitivity analysis of the results reported earlier. For this purpose, in the first step, we include some additional control variables, such as government expenditures and natural resources, in the model to see the responsiveness of industrial growth to trade openness and FDI inflows. In the next step, we adopt alternative estimating tools, such as FGLS and TSLS, for the purpose of estimation to assess whether our results remain robust or change, as presented in Table 4.

Table 4. Regression results (robustness).

Variables	FEF	FEF	FEF	FGLS	TSLS
	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
$LNOPN_{i,t}$	0.104 ** (0.045)	0.116 ** (0.045)	0.105 *** (0.036)	0.179 *** (0.061)	0.102 ** (0.045)
$FDI_{i,t}$	0.005 ** (0.002)	0.004 *** (0.001)	0.006 ** (0.002)	0.001 ** (0.0006)	0.014 * (0.008)
$INF_{i,t}$	−0.007 *** (0.002)	−0.006 ** (0.002)	−0.002 (0.001)	−0.001 (0.001)	−0.023 ** (0.010)
$LNLAB_{i,t}$	−2.324 *** (0.884)	−1.970 *** (0.259)	−2.412 *** (0.231)	−1.880 *** (0.382)	−0.420 *** (0.129)
$LNINV_{i,t}$	0.187 * (0.101)	0.193 *** (0.045)	0.195 *** (0.043)	0.126 * (0.071)	0.579 *** (0.100)
$LNGEX_{i,t}$	0.224 * (0.115)	---	0.276 *** (0.047)	0.233 *** (0.026)	0.257 *** (0.056)
$LNNRS_{i,t}$	---	−0.022 *** (0.003)	−0.030 *** (0.004)	−0.015 (0.009)	0.073 *** (0.014)
Constant	11.737 (3.310)	9.818 (1.086)	12.195 (0.946)	9.952 (1.526)	3.149 (0.490)
"Country Fixed Effects"	Yes	Yes	Yes	Yes	Yes
"Year Fixed Effects"	Yes	Yes	Yes	No	Yes
Diagnostics	Adj R^2: 0:931 S.E.R: 0.074 F. Test: 74.343	Adj R^2: 0.926 S.E.R: 0.076 F. Test: 69.053	Adj R^2: 0.939 S.E.R: 0.069 F. Test: 83.019	Adj: R^2: 0.932 S.E.R: 0.067 F. Test: 194.308	Adj: R^2: 0.767 S.E.R: 0.148 F. Test: 18.291 No. Instruments: 31 First-Stage F (minimum): >10 *p*-value (Wald): 0.000 *p*-value (J-Statistic): 0.919

Note: "The dependent variable is industrial growth. Values in parentheses represent standard errors. The asterisk (***, **, *) shows significance levels at 1 percent, 5 percent and 10 percent, respectively."

The findings demonstrate that the established positive relationship between trade openness, FDI inflows and industrial growth does not alter in the presence of additional control variables. It means that trade openness and FDI inflows are the robust determinants

of industrial growth in ASEAN member states. The results show that the government sector's involvement in the economy is important, as it flourishes the industrial sector due to an increase in aggregate demand. Wu et al. (2010) hence support our results. Moreover, the results show that natural resource richness has adversely impacted industrial progress, which supports the resource-curse hypothesis. Sachs and Warner (1995) correctly pointed out that resource-abundant economies could not perform well economically.

Moreover, in the TSLS estimation, we use the lagged values of independent variables as instruments. The first-stage F-statistic is greater than 10 for all variables, as shown in Table A6 (Appendix A), which confirms the relevance of the instruments. Secondly, the probability of Hansen (J-test), shown in the bottom part of Table 4, is 0.919, which indicates the validity of the instruments utilized in the analysis. Finally, the significance of the Wald test confirms that the independent variables jointly explain variation in the dependent variable significantly.

Finally, it is important to mention that instrumenting regressors with their own lagged values does not provide a convincing exclusion restriction in this macro-panel context, and the very high Hansen J-test *p*-value is consistent with instrument proliferation rather than strong evidence of validity. Therefore, our TSLS results are basically a descriptive robustness check rather than evidence of causal relationships.

5. Summary Remarks and Implications

5.1. Summary Remarks

This study analyzed the influence of both trade openness and FDI inflows on the industrial growth of ASEAN region economies. Our study examines data for the period 2000–2023 for selected ASEAN economies and applies appropriate econometric techniques suitable for panel data.

The main findings of our study established our prior perception about the relationship between trade openness, FDI inflows and industrial growth in ASEAN economies. In terms of relative importance, the impact of trade openness is higher as compared to FDI inflows on industrial growth. Therefore, an insightful approach that would promote industrial growth would be to wholeheartedly embrace the policies of outward orientation. Similarly, our findings established that domestic investment and the government sector have also contributed positively to the industrial progress of ASEAN economies. On the other hand, the rate of inflation and the natural resource sector have contributed negatively to the performance of the industrial sector. Moreover, the labor force has not had the expected positive impact on the industrial sector. Our results are valid in different modeling specifications and econometric estimators and therefore can be used for policy formulation.

5.2. Policy Implications

Based on the research findings, we suggest the following points for the consideration of government authorities and policymakers of the ASEAN region.

(1) The first and foremost implication based on our research on the authorities of ASEAN economies is to adopt the policy regarding outward orientation, both from the perspective of trade openness and FDI inflows. Both measures of outward orientation have proved their worth for improving industrial growth. All manner of restrictions on goods and services and capital should be immediately relaxed. The relaxation of restrictions on trade and FDI inflows in the short run would add to long-run sustainable industrial performance. Hence, the industrial-led growth hypothesis would be materialized in the long run.

(2) The ASEAN economies must initiate regional trade agreements immediately, in the short run, among themselves, following the footprints of EU or OECD economies.

Greater connectivity among the ASEAN economies would increase the volume of trade.

(3) Similarly, the ASEAN economies need to facilitate potential investors, both from the ASEAN region as well as from the outside world, by developing one-window operations to facilitate the inflows of capital among themselves. Increased integration within the ASEAN region, both in terms of trade and FDI, will protect these economies amid greater global uncertainties.

(4) Along with FDI inflows, the ASEAN economies need to encourage domestic economic investment, as it is essential for successful industrial transformation. The availability of credit facilities for potential investors and reduced interest rates would have an overall positive impact on domestic investment, and consequently, the industrial sector would benefit.

(5) The inflation rate, although it is important because it gives positive signals to potential investors for further investment, at the same time worsens the overall confidence level of all stakeholders in the economy. Therefore, strict control over inflation needs to be ensured.

(6) The government authorities of ASEAN need to continue their existing role in uplifting the performance of the industrial sector. The government sector plays a positive role in the economy through multiple channels, including the aggregate demand channel.

(7) Moreover, our results imply that diversification is the viable option for the ASEAN region, as for all other resource-abundant economies. Our results indicate that natural resource abundance has worsened the progress of the industrial sector.

(8) Finally, our results show that the labor force, which is an integral part of the production process, has not improved the performance of the industrial sector. It is possible that the skills of the labor force within ASEAN do not match the required human capital development. Therefore, focusing on the necessary skill development of the population should be given priority by the authorities of ASEAN economies in the short run. Focusing on skill development in the short run is expected to shape the relationship between labor force participation rate and the expected direction.

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Appendix A

Table A1. List of countries.

Brunei Darussalam	Malaysia	Thailand
Cambodia	The Philippines	Vietnam
Indonesia	Singapore	

Table A2. Variables and sources of data.

Variables	Definition	Source
$GING_{i,t}$	"Industry (including construction), value added (% of GDP)" Growth rate is calculated by taking $LNING_{i,t} - LNING_{i,t}(-1)$	"World Development Indicators"
$LNOPN_{i,t}$	"Trade (% of GDP)"	"World Development Indicators"
$FDI_{i,t}$	"Foreign Direct Investment (Net inflows as % of GDP)"	"World Development Indicators"
$LNLAB_{i,t}$	"Labor force participation rate, total (% of total population ages 15–64) (modeled ILO estimate)"	"World Development Indicators"
$INF_{i,t}$	"The growth rate of consumer price index"	"World Development Indicators"
$LNINV_{i,t}$	"Gross fixed capital formation (% of GDP)"	"World Development Indicators"
$LNGEX_{i,t}$	"General government final consumption expenditure (% of GDP)"	"World Development Indicators"
$LNNRS_{i,t}$	"Total natural resources rent (% of GDP)"	"World Development Indicators"

Table A3. Hausman test.

"Test Summary"	"Chi-Sq. Statistic"	"Chi-Sq. d.f."	"Prob. Value"
"Cross-section Random"	85.363	5	0.000

Table A4. Cross-sectional dependency.

Test	Statistic	d.f.	Prob.
Pesaran CD	1.268292	28	0.2047

Table A5. "Multicollinearity Testing (VIF)."

"Variables"	"Centered"
	VIF
$LNOPN_{i,t}$	2.987365
$FDI_{i,t}$	1.530491
$INFL_{i,t}$	1.276398
$LNALBR_{i,t}$	4.312533
$LNINV_{i,t}$	1.759673

Table A6. "First-stage F-Score".

"Variables"	"First-Stage F-Score"	"Prob. Value"
$LNOPN_{i,t}$	494.063	0.000
$FDI_{i,t}$	35.833	0.000
$INFL_{i,t}$	79.188	0.000

Table A6. *Cont.*

"Variables"	"First-Stage F-Score"	"Prob. Value"
$LNLABR_{i,t}$	305.840	0.000
$LNINV_{i,t}$	86.849	0.000
$LNGEX_{i,t}$	294.345	0.000
$LNNRS_{i,t}$	205.802	0.000

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