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The economic impact of China's Foreign Direct investment on ASEAN-4

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Abstract— This study examines the economic impact and determinants of China's foreign direct investment (FDI) in four ASEAN countries - Indonesia, Malaysia, Thailand and Singapore - focusing on its impact on economic growth and key macroeconomic indicators. This study analyzes the short-run dynamic and long-run equilibrium relationships between China's FDI and the variables of trade openness, government expenditure, inflation, unemployment rate, and population using panel data from 2003 to 2023, using a cross-section augmented autoregressive distributed lag (CS-ARDL) model. The CS-ARDL model effectively considers the cross-sectional dependence among the variables, heterogeneity and mixed-order integration among the variables, thus ensuring that the results are robust and unbiased, and therefore particularly suitable for this analysis. The findings suggest that Chinese FDI plays an important role in influencing GDP growth in the ASEAN-4 countries, highlighting the importance of institutional frameworks and macroeconomic conditions in moderating FDI outcomes. This study provides valuable insights for ASEAN policymakers, foreign investors in China, and recommendations on how to optimize the development benefits of FDI and strengthen regional economic cooperation. In addition, the findings contribute to the academic debate on FDI and its impact on sustainable economic development.

Keywords: Foreign Direct Investment,Economic Growth,Sustainable Economic Development,Chinese economy, Fiscal Policy

I. INTRODUCTION

The Belt and Road Initiative (BRI), launched by China in 2013, has become a significant international platform for promoting global development and cooperation. ASEAN countries, strategically positioned at the crossroads of land and sea, are key partners in this initiative. Over the past decade, the BRI has facilitated substantial cooperation between China and ASEAN in areas such as trade, investment, connectivity, green transformation, and digital economy, fostering a model of high-quality development within Southeast Asia. Through initiatives like the China-ASEAN Free Trade Area (CAFTA) and the Regional Comprehensive Economic Partnership (RCEP), China has strengthened ties with ASEAN-4 countries—Thailand, Singapore, Indonesia, and Malaysia—creating new opportunities for regional growth and integration.

Foreign Direct Investment (FDI) has played a central role in ASEAN's economic rise, particularly following its adoption of export-led growth strategies. FDI from China has been a key driver of this transformation, fueling industrialization, supporting the digital transition, and enhancing regional cohesion. ASEAN nations, from the early stages of Singapore's proactive FDI policies to the evolving strategies of newer member states, have benefited from inward investments, which have spurred growth across various sectors, including technology, infrastructure, and green industries. China's FDI has thus contributed not only to the economic development of ASEAN but also to the region's competitive positioning within global value chains.

The economic impact of China's FDI in ASEAN is multifaceted, with each country benefiting in different ways based on their unique economic structures. Investments in infrastructure, technology transfer, and green technologies have enhanced domestic growth, job creation, and regional connectivity. This mutual partnership has not only advanced China's strategic objectives but also supported ASEAN's long-term development goals, fostering greater regional cooperation and positioning the ASEAN-4 as a key economic bloc in the global landscape. As China's FDI strategy continues to evolve, its tailored approach reflects the changing dynamics of the global economy and its role in shaping the future of ASEAN.

As China's Foreign Direct Investment (FDI) in ASEAN-4 countries continues to evolve, it reflects both a strategic response to global economic shifts and a tailored approach to each country's unique development needs. This dynamic relationship has seen a shift from initial caution to a more aggressive investment strategy, particularly after the global financial crisis of 2008 and the intensification of trade tensions with the U.S. Chinese investments have increasingly focused on sectors such as digital infrastructure, green technology, and the electric vehicle industry, aligning with both regional development priorities and global sustainability goals. The diversification of FDI across ASEAN-4 countries, with Singapore leading in finance and technology, and Indonesia in resources and infrastructure, highlights the multifaceted nature of this cooperation, fostering long-term growth and integration within the region.

II. LITERATURE REVIEW

Azman-Saini and Kadir (2020) examine FDI in ASEAN and emphasize the role of governance and macroeconomic stability in enhancing growth outcomes, particularly in economies with institutional strength. Shahbaz et al. (2021) underscores the significance of infrastructure and human capital in maximizing the GDP growth effects of FDI, demonstrating its transformative potential in Asian economies.

Tang and Zhang (2020) find that Chinese FDI enhances economic growth by improving infrastructure and reducing logistical barriers in ASEAN-4 countries. Similarly, Nguyen et al. (2020) demonstrate that FDI in infrastructure projects lowers trade costs and promotes regional economic integration, driving higher economic growth in Vietnam and Thailand. In a related study, Rahman and Wong (2023) highlight that Belt and Road Initiative-related FDI fosters economic expansion through large-scale infrastructure development and increased trade connectivity in South and Southeast Asia.

Yao et al. (2021) argue that FDI significantly boosts economic growth by enhancing productivity and fostering innovation in host countries with strong institutional frameworks. Furthermore, Wang and Lin (2023) identify digital FDI as a vital growth driver in Asia, where investments in ICT sectors accelerate technology adoption and improve long-term productivity. Expanding on this, Li and Xie (2022) report that FDI in smart city development contributes to economic growth by enhancing urban infrastructure, economic efficiency, and overall quality of life.

Hossain et al. (2022) emphasize that greenfield FDI in renewable energy projects not only advances sustainability goals but also stimulates economic growth through new investment opportunities. In addition, Alam and Chowdhury (2021) demonstrate that environmentally friendly policies attract FDI with higher growth-enhancing externalities, particularly in the green technology sector.

III. METHODOLOGY

3.1 Pannal Data Analysis

For panel data analysis, the objective is to examine the impact of Chinese Foreign Direct Investment (FDI) on the economic growth of ASEAN-4 countries (Indonesia, Malaysia, Thailand, and Singapore) using both cross-sectional and time-series data. Panel data allows us to control for individual heterogeneity and analyze the impact of variables over time.

Panel data involves both cross-sectional (individual countries) and time-series (years) components. This allows you to capture both the variation between countries and the variation over time.

The general form of the panel data model can be specified as follows:

$$GDPG_{it} = \alpha + \beta_1 OFDI_{it} + \beta_2 TOP_{it} + \beta_3 GOV_{it} + \beta_4 UR_{it} + \beta_5 INF_{it} + \beta_6 POP_{it} \quad (1)$$

Where $GDPG_{it}$:is the dependent variable (GDP growth) for country *i* at time *t;* $OFDI_{it}, TOP_{it}, GOV_{it}, UR_{it}, INF_{it}, POP_{it}$:is the independent variable; ϵit*:*is the error term.

3.2 Types of Pannal Data Models

(1)Pooled Ordinary Least Squares(POLS)

Larch et al. (2017) pointed out that the OLS estimator has been the most used estimator in terms of FDI analysis. For OLS regression equation, cross-sectional data have the same intercept term. After combining the data, the best regression equation is estimated by the OLS method. In the equation, it represents that there is no significant difference in the individual effects among observations when $\alpha_{it} = \alpha_i$. The problem of heteroskedasticity bias occurs in a panel or longitudinal data analysis with the assumption of constant parameters. With the assistance of the Fixed Effects Model and Random Effects Model, researchers use additional assumptions to deal with the problem of heteroskedasticity bias and estimate the difference in cross-sectional data by various intercept terms. The pooled regression model is set as follows:

$$y_{it} = \alpha + \beta x_{it} + \varepsilon_{it} \quad (2)$$

Where:*Yit:* is the dependent variable GDPG for country i*i* at time *t*. α :is the common intercept across all observations; β1:is the coefficient for the independent variable (*Xit*), which could be China's FDI in the ASEAN-4 countries, trade openness, etc. ϵit*:*is the error term, assumed to be homoscedastic constant variance.

(2)Fixed Effect Model (FEM)

The fixed effect model also known as the dummy variable model is based on the fundamental assumption that there are differences between variables and that different observations do not have the same individual effect. The fixed-effect model is characterized by its ability to accommodate both cross-sectional and time-series data, rendering it an appropriate choice in situations where the slope coefficient is fixed, and the intercept term is determined by the specific unit of observation. It is possible to enhance the precision of the estimated outputs by increasing the covariance of the model. Adopting dummy variables is a way to measure the relationship between the unobserved variables and the model. α_i is set to be a certain constant and persist through time. Each individual has a fixed and unique intercept term to reflect the characteristics of the individual. The fixed-effect model is set as follows:

$$y_{it} = \beta_k X_{kt} + \alpha_i + v_{it} \tag{3}$$

Where(While $i = 1,2, \cdots, n$; $t = 1,2, \cdots, T$; $k = 1,2, \cdots, K$),X_{kt}: The explanatory variable of the k-th individual during period t; α_i shows individual effects with $E(\alpha_i x_{it}) \neq 0$; β_k indicates the parameter of $k-th$ explanatory variable.

(3) Random Effect Model (REM)

The Random Effect Model is also referred to as the Error Component Model. In instances where data exhibits a high degree of similarity, the REM prioritizes an understanding of the relationship between the entire population, rather than focusing on the discrepancies between individuals. Consequently, the intercept term of the random variable is employed to represent the diverse structural configurations of the cross-sections. The random variable examines the effect and relation between the observation unit and time: $\varepsilon_{it} = \alpha_i + v_{it}$ the random effect model is set as follows:

$$y_{it} = u + \beta X_{kt} + \varepsilon_{it} \tag{4}$$

$$y_{it} = u + \beta X_{kt} + \alpha_i + v_{it} \tag{5}$$

Where(While $i = 1,2, \cdots, n$; $t = 1,2, \cdots, T$; $k = 1,2, \cdots, K$) X_{kt}: The explanatory variable of the k-th individual during period t; u: Overall intercept;α_i: shows random effects.$E(\alpha_i x_{it}) \neq 0$;ε_{it} :$is\ error\ term,\ \varepsilon_{it} = \alpha_i + v_{it}$

3.3 Cross-Sectional Autoregressive Distributed Lag(CS-ARDL)

The Cross-Sectional Autoregressive Distributed Lag(CS-ARDL) model is an advanced econometric technique that combines both time-series and cross-sectional data to examine dynamic relationships between variables. This model is particularly useful when analyzing panel data, which involves multiple entities observed over time. It allows for dynamic interactions between the dependent variable and explanatory variables, while accounting for heterogeneity across different entities. The CS-ARDL model is an extension of the traditional ARDL model, designed to address cross-sectional variations by incorporating entity-specific intercepts and slopes.The CS-ARDL model can be expressed as follows:

$$Y_{it} = \alpha_i + \sum_{j=1}^{p} \beta_j Y_{it-j} + \sum_{k=0}^{q} \gamma_k X_{it-k} + \epsilon_{it} \tag{6}$$

Where, *Yit:* is the dependent variable (GDP growth of a country i*i* at time *t*), and *Xit* :is the explanatory variable (FDI inflows, trade openness) for country i*i* at time *t*. The model allows for different intercepts (αi) across entities, capturing cross-country heterogeneity. The lagged terms (*Yit−j*and *Xit−k*) account for both short-term and long-term effects. The error term ϵit:captures unobserved factors.

IV. EMPIRICAL ANALYSIS

The Table 1 empirically analyzes the impact of China's outward foreign direct investment on the economies of ASEAN-4 based on a fixed effects model. The results show that the coefficient of OFDI is -0.0154 with a p-value of 0.538, indicating that its impact on the economic growth of ASEAN-4 is statistically insignificant, which may reflect the fact that FDI does not effectively drive economic development in the short term or that its impact is constrained by other structural factors. the coefficient of top

is negative, with a p-value close to the 10% significant level, suggesting that the impact of trade openness on the economy is more complicated. The impact of trade openness on the economy is complex and its structural characteristics need to be further explored. unemployment rate is negative and significant at the 1% level, suggesting that the higher the unemployment rate, the worse the economy performs, which is in line with the expectations of economic theory.

Table 1: Fixed Effects Results

Variables	Coefficient	Std. Err.	t-Statistic	P-value	95% Confidence Interval
ofdi	-0.0154	0.0248	-0.62	0.538	[-0.0648, 0.0341]
top	-1.10E-11	6.44E-12	-1.7	0.093	[-2.38e-11, 1.88e-12]
ur	-1.511	0.5482	-2.76	0.007	[-2.6032, -0.4188]
inf	0.5117	0.179	2.86	0.006	[0.1549, 0.8684]
pop	-0.0521	0.1093	-0.48	0.635	[-0.2698, 0.1656]
er	-7.99E-06	0.00006	-0.13	0.894	[-0.0001267, 0.0001107]
_cons	16.2699	9.118	1.78	0.078	[-1.8981, 34.4380]

Inflation rate has a positive and significant coefficient, which may imply that moderate inflation is associated with vibrant economic activity. population and exchange rate variables are insignificant, suggesting that they are not effective in driving economic growth in this model, or that their impact is constrained by other structural factors. have limited explanatory power for economic growth in this model. Overall, the model emphasizes the importance of macroeconomic variables such as unemployment and inflation in influencing the ASEAN economy, while the role of China's OFDI needs to be combined with more structural analyses to be fully assessed.

Table 2: Random Effects Results

Variables	Coefficient	Std. Err.	z-Statistic	P-value	95% Confidence Interval
ofdi	-0.0404	0.0242	-1.67	0.094	[-0.0878, 0.0069]
top	-9.02E-14	4.80E-12	-0.02	0.985	[-9.50e-12, 9.32e-12]
ur	-0.1857	0.2625	-0.71	0.479	[-0.7001, 0.3287]
inf	0.4849	0.172	2.82	0.005	[0.1477, 0.8220]
pop	-0.0414	0.0158	-2.62	0.009	[-0.0723, -0.0104]
er	0.000061	0.000025	2.45	0.014	[0.000012, 0.000110]
_cons	5.8164	1.7535	3.32	0.001	[2.3797, 9.2531]

In analyzing the impact of China's outward foreign direct investment on the economy of ASEAN-4 using the Random Effects model, the coefficient of ofdi is -0.0404 with a p-value of 0.094, which is on the edge of the 10% level of significance, indicating that China's investment in ASEAN-4 may have a certain negative impact on the growth of the economy, which needs to be further explored to find out the industrial structure or capital flow behind. It is necessary to further explore the industrial structure or capital flow behind it. Trade openness has a very small and insignificant coefficient in the model p=0.985, suggesting that it does not play a prominent role in explaining economic changes. unemployment is insignificant, indicating that the unemployment rate does not have a significant impact on the economy after controlling for the other variables. inflation is significant at the 1% level with a positive coefficient, suggesting that moderate inflation may be accompanied by positive growth, indicating that moderate inflation may be accompanied by positive inflation, and that it may have a negative effect on economic growth. , indicating that moderate inflation may be accompanied by a rise in economic activity, consistent with general economic phenomena. Notably, population is negative and significant at the 1% level, suggesting that population growth may put pressure on the economy, such as resource constraints or underemployment. In addition, exchange rate is positive and significant, reflecting that exchange rate

changes have a positive impact on the economy, possibly through promoting exports or attracting foreign investment. In summary, the random effects model shows that OFDI tends to have a significant impact on the economy and that macroeconomic factors such as inflation, population and exchange rate have a significant impact on the economic performance of ASEAN countries

Table 3: Panel Unit Root Test(CIPS) Summary

Variables	CIPS at Level	Stationary at Level	CIPS at 1st Diff.	Stationary at 1st Diff.
gdpg	-4.098**	Yes (1%)	-5.606***	Yes
ofdi	-0.015	No	-3.953***	Yes
top	-2.101	No	-4.198***	Yes
ur	-2.251*	Weak (10%)	-4.026***	Yes
inf	-2.77***	Yes (1%)	-5.489***	Yes
pop	-1.069	No	-2.892***	Yes
gov	-2.18	No	-3.845***	Yes

According to the results of the CIPS panel unit root test, most of the variables are not smooth in the level state, but all of them exhibit smoothness after first-order differencing, indicating that most of these variables are first-order single-integration I(1) processes, which are consistent with the prerequisites for conducting cointegration analyses and the use of models such as CS-ARDL.

Specifically, gdpg (economic growth rate) and inf (inflation rate) have reached the 1% significance criterion in the level state, indicating that they are smooth and can be used directly in modeling analysis. On the other hand, ofdi (OFDI rate), top (trade openness), pop (population), and gov (government expenditure) fail the unit root test in the horizontal state and are significantly smooth after first-order differencing, suggesting that there is a trend in these variables and that their non-stationarity needs to be dealt with either by differencing or by cointegration. ur (unemployment) is close to the marginal significance of 10 percent in the horizontal state weakly stationary but is clearly smooth after first order differencing.

In summary, most of the macro variables in ASEAN-4 countries have the unitary properties required for modeling. For the empirical analysis with China's OFDI as the core research variable, this result provides a solid foundation for the subsequent application of cointegration methods such as the CS-ARDL model, and also suggests that researchers need to be alert to the importance of the long-run relationship between variables to avoid the emergence of pseudo-regression problems.

Table 4: Pesaran's CADF Test Summary

Variables	t-bar	CV10	CV5	CV1	Z[t-bar]	P-value
gdpg	-1.591	-2.21	-2.33	-2.57	0.349	0.637
ofdi	-1.287	-2.21	-2.33	-2.57	0.975	0.835
top	-1.604	-2.21	-2.33	-2.57	0.321	0.626
gov	-0.806	-2.21	-2.33	-2.57	1.966	0.975
ur	-0.89	-2.21	-2.33	-2.57	1.795	0.964
inf	-2.252	-2.21	-2.33	-2.57	-1.014	0.155
pop	-0.729	-2.21	-2.33	-2.57	2.126	0.983
d.gdpg	-2.883	-2.21	-2.34	-2.6	-2.24	0.013
d.ofdi	-2.92	-2.21	-2.34	-2.6	-2.311	0.01

d.top	-2.485	-2.21	-2.34	-2.6	-1.466	0.071
d.gov	-2.144	-2.21	-2.34	-2.6	-0.804	0.211
d.ur	-2.936	-2.21	-2.34	-2.6	-2.341	0.01

Table 4(Continued): Pesaran's CADF Test Summary

Variables	t-bar	CV10	CV5	CV1	Z[t-bar]	P-value
d.inf	-2.336	-2.21	-2.34	-2.6	-1.177	0.12
d.pop	-1.97	-2.21	-2.34	-2.6	-0.465	0.321

At Table 4, Pesaran's CADF test shows that most of the variables are not smooth in the horizontal state, only inflation rate is barely close to the critical value of 5% in -2.252 vs. CV5 -2.33, but the p-value of 0.155 is still not significant. The t-bar of other variables such as OFDI rate, trade openness, unemployment rate, population and government expenditure are all much higher than the critical value, with p-values generally greater than 0.6, clearly indicating that they are not smooth in the horizontal direction. The smoothness of the variables improves significantly after first-order differencing. d.gdpg, d.ofdi, and d.ur all have t-bar values significantly lower than CV5 or CV1, and p-values lower than 0.05, suggesting that these variables are smooth sequences after first-order differencing. d.top is also close to being significant p = 0.071, showing a stronger tendency to be smooth. Other variables such as d.gov, d.inf and d.pop do not reach the level of significance but also have a trend of t-bar approaching the critical value.

In summary, it shows that most of the variables in this study are first-order single-integration I(1) processes, and further cointegration analysis is needed to avoid pseudo-regression phenomena. This provides a theoretical basis for the subsequent use of methods such as CS-ARDL or panel cointegration and supports the modeling of the dynamic and long-term relationship between the impact mechanisms of China's OFDI in this paper.

Table 5: Cross-Sectionally Augmented ARDL (CS-ARDL) Mel

Variables	Coefficient	Std. Error	z-value	p-value	Significance
Adjustment Term					
lr_ofdi (L.ofdi)	-1.204	0.444	-2.71	0.007	***
Short-Run Effects					
L.ofdi	-0.204	0.444	-0.46	0.646	
top	-3.17E-11	1.39E-10	-0.23	0.82	
ur	-18.342	5.513	-3.33	0.001	***
inf	4.251	2.606	1.63	0.103	*
pop	28.48	18.155	1.57	0.117	
gov	-1.723	2.469	-0.7	0.485	
Long-Run Effects					
lr_gov	-2.715	2.158	-1.26	0.208	
lr_inf	5.605	3.487	1.61	0.108	*
lr_pop	36.009	18.517	1.94	0.052	**
lr_top	-3.66E-11	1.61E-10	-0.23	0.821	
lr_ur	-17.121	3.954	-4.33	0	***

*** p < 0.01, ** p < 0.05, * p < 0.10

After estimating the impact of China's outward foreign direct investment (OFDI) on the economic growth of ASEAN-4 over the period 2003-2023 using the CS-ARDL(1,1) model, the results show a significant long-run adjustment relationship. In the adjustment term, the coefficient of the long-run lagged variable lr_ofdi of OFDI is -1.204, with a p-value of 0.007, which is significantly negative, indicating that when the system deviates from the long-run equilibrium, the economic growth will be restored to the long-run equilibrium at a faster rate. This implies that China's OFDI to ASEAN has a significant impact on economic growth in the long run.

In the short-run impact, OFDI L.ofdi is insignificant p = 0.646, indicating that it has no direct significant effect on GDP growth in the short-run. On the contrary, the short-term coefficient of ur unemployment is -18.342, p < 0.01, which is significantly negative, showing that the increase in unemployment rate significantly inhibits economic growth, a finding that is consistent with economic theory. Other variables such as inflation inf and population pop are not significant in the short-run but have positive coefficients, which may suggest a positive impact trend. At the long-run level, lr_ur long-run unemployment remains significantly negative-17.121, p < 0.01, reinforcing the negative impact of unemployment on the economy in the long-run. lr_pop population is significant at the 10% level p = 0.052, suggesting that population growth has some positive driving effect on the economy. Other long-term variables such as lr_gov and lr_inf do not reach the level of significance, but show a certain trend of impact.

In summary, China's OFDI has a significant long-run adjustment effect on economic growth in ASEAN-4, but the short-run effect is not significant, while unemployment rate significantly inhibits economic growth in both the short- and long-run. The results of the model emphasize the importance of focusing on the long-term equilibrium relationship from a structural perspective, providing empirical evidence for relevant policy formulation.

V. CONCLUSION

By constructing the CS-ARDL model, this study provides an in-depth examination of the dynamic and long-run impacts of China's foreign direct investment (OFDI) in the four ASEAN countries (Indonesia, Malaysia, Thailand, and Singapore) on economic growth and related macroeconomic variables over the period from 2003 to 2023. The empirical results show that China's OFDI does not have a significant impact on GDP growth in the short run, but exhibits a significant adjustment mechanism in the long run, and its lagged variables have a significant negative relationship, suggesting that when the economic system deviates from the long-term equilibrium, FDI helps to push the economy back to equilibrium, showing its potential in promoting sustainable development.

In addition, the unemployment rate, which shows a significant negative relationship in both the short and long run, is one of the most stable factors affecting the performance of the ASEAN-4 economy, verifying the importance of full employment to the health of the regional economy. Inflation does not show a significant effect in the short run, but its positive coefficient in the long run suggests that moderate inflation may be associated with economic dynamism. Population has some degree of positive contribution to economic growth in the long run, while government expenditure and trade openness, although not statistically significant, need to be further analyzed for their indirect effects in conjunction with structural reform factors in subsequent studies.

Overall, this study not only provides ASEAN policymakers with empirical evidence on the structural role of China's OFDI, but also reminds investors of the need to emphasize macroeconomic fundamentals and institutional quality when considering the regional investment environment. The study emphasizes the need to strengthen inter-regional coordination and cooperation to enhance investment efficiency, and to accelerate the construction of a higher-quality, more inclusive and sustainable regional economic landscape by incorporating emerging areas such as green development and the digital economy.

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