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A Study of Long-Run Equilibrium Relationship Between Foreign Direct Investment and Its Key Determinants in Malaysia

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Abstract: This study investigates the long-run equilibrium relationship between foreign direct investment (FDI) and its key determinants in Malaysia. Employing the Autoregressive Distributed Lag (ARDL) model on annual data between 1971 and 2021, it aims to identify the factors influencing FDI inflows and assess its impact on the Malaysian economy. The key findings confirm a long-run equilibrium relationship between FDI and the selected macroeconomic variables as a group. However, the individual impact of gross domestic product, inflation, exchange rate, and trade openness on FDI is not statistically significant when analyzed separately. Specifically, the long-run results suggest that the determinants do not have significant effects on FDI. Meanwhile, the short-run relationship between FDI and its determinants in Malaysia reveals a complex interplay of factors. Inflation and exchange rates play significant roles, with inflation generally encouraging FDI and exchange rate volatility creating mixed effects. Trade openness on the other hand shows some short-run significance but it is not consistently impactful. The error correction (ECM) model also confirms the existence of a long-run relationship. It highlights that while short-term fluctuations can occur, FDI tends to move towards a long-term equilibrium influenced by a relatively moderate speed of adjustment. The key conclusion implies that FDI is influenced by the combined effect of these variables in the longer term, but the individual contribution of each variable is not strong enough to stand out statistically. This research contributes to the understanding of FDI dynamics in Malaysia by providing insights, thereby informing policymakers and investors about effective strategies to attract and leverage FDI for sustainable development. It also indicates that the relationship between FDI and macroeconomic variables is more complex, involving other underlying factors or non-linear dynamics.

Keywords: *Foreign Direct Investment, Gross Domestic Product, Inflation, Exchange Rate, Trade Openness, ARDL Model, Malaysia.*

1. Introduction and Background

Foreign Direct Investment (FDI) is a significant investment made by a firm or individual in one country into business interests located in another country. It can be classified into Greenfield and Brownfield Investment categories (Rani, 2023). FDI is crucial for economic growth and development, providing benefits such as capital inflow, technology transfer, employment prospects, and globalization. As stated by Bakar et al. (2022) factors influencing a country's appeal include market size, growth potential, political and legal factors, financial factors, labor market factors, trade and investment policies, and social and cultural impact. Technological advancements can introduce novel managerial practices and skills development technologies, while multinational corporations can enhance local personnel through training and development initiatives. Environmental impact is another factor that influences FDI, with the implementation of advanced and environmentally friendly technology being beneficial but potentially damaging to the environment if corporations capitalize on inadequate ecological regulations (Saqib & Dinca, 2024).

According to Boltayev (2024), social and cultural impact also influences FDI, with cultural exchange promoting ideas and cross-cultural interactions, while foreign cultural values can facilitate the erosion of local cultures. FDI faces various risks and challenges, including political and economic risks, regulatory and compliance risks, operational risks, and integration challenges. In recent decades, there has been a transition in FDI migration from developed to developing countries, particularly in Asia and Africa. Services and high-tech industries have become the primary focus, with Asia, particularly India and China, being the first recipients due to their substantial markets and development potential. Economic reforms have made FDI more appealing to numerous countries, with Western Europe being a traditional hub due to its skilled populace and stable

economic environment. Global FDI volumes decreased by 12.4% in 2022, reaching a total of USD1.3 trillion. The majority of this decrease occurred in developed economies, where FDI decreased by 36.7% to USD 378 billion. In contrast, FDI flows into developing economies increased by 4.0%, reaching a historic high of USD 916 billion. However, this increase was only uniform across some regions (UNCTAD, 2022). In 2022, developing Asia and Oceania were the largest recipients of FDI, representing half of the global inflows.

Foreign direct investment (FDI) has emerged as a crucial catalyst for economic growth and development in many countries, including Malaysia. Of late, however, it has become a concern for Malaysia to maintain its appeal as an FDI destination. Malaysia is faced with confronting rising challenges related to environmental sustainability, regulatory transparency, and global economic volatility (Subramaniam, 2021). There are various factors influencing FDI in Malaysia including market size and growth, natural resources, infrastructure, political stability, financial factors, labor market factors, trade and investment policies, and investment incentives (Hatim et al., 2024). The major components of FDI include an increase in GDP, development of the industrial sector, competitiveness in the export market, technological advancements, employment and skill development, and social and environmental impact (Zaharum et al., 2024).

Despite the many factors that have been identified in the past literature, Malaysia is still finding it a challenge to maintain its appeal as a popular FDI destination of choice. Therefore, this study aims to delve into both the long-run equilibrium and short-run relationship between FDI and its key determinants within the Malaysian context. The selected macroeconomic variables include gross domestic product, inflation, exchange rate, and trade openness in Malaysia. By understanding these dynamics, policymakers and investors can make informed decisions to identify the factors influencing FDI inflows and assess their impact on the Malaysian economy.

2. Review of the Literature

This section provides a thorough review of the literature relating to the factors that attract foreign direct investment (FDI) into an economy. Several theoretical aspects are also highlighted which include the Production Cycle Theory, Dunning Eclectic Paradigm Theory, and Foreign Direct Investment Internalization Theory (Faruq, 2023). Past studies are critically reviewed ranging from academic papers, journals, and other relevant sources to seek an understanding of FDI-related topics and hence the correct direction for this paper. According to Paul & Feliciano-Cestero (2021), a literature review acknowledges, summarizes, objectively evaluates, and clarifies the antecedent study, henceforth incorporating fundamental theories to clarify the investigation's objective. The methodology and choice of variables applied in prior research on FDI in Malaysia are assessed, with the definition of each explanatory variable and previous findings of relevant studies identified (Miraz & Soo, 2024).

Relationship between Gross Domestic Product and Foreign Direct Investment

Macroeconomic factors, such as GDP, have been widely used as determinants of Foreign Direct Investment (FDI) in various studies. A significant positive correlation has been found between GDP and FDI, with long-term relationships being statistically significant and positive in Malaysia (Al-Matari et al., 2021). This relationship is beneficial for inbound FDI and enhances the gross domestic product, making it an attractive market for foreign investors (Mudiyanselage & Epuran, 2022). FDI can enhance productivity and efficiency by generating positive economic spillover effects.

Policymakers should prioritize continuous improvement and preservation of GDP's upward trajectory to make affected nations more attractive targets for FDI (Ashurov et al., 2020). Increased FDI inflows can stimulate economic activity, employment, and consumer demand, while complementary variables like a strong and expanding GDP can attract higher levels of FDI (Immurana et al., 2023). A well-structured analysis of FDI and GDP dynamics in Malaysia is crucial for fostering economic growth and competitiveness. The causality between GDP and FDI has been the subject of numerous investigations, with Carkovic and Levine (2005) suggesting that GDP may attract FDI and FDI may also influence GDP growth. Market size, which is often approximated by GDP, is a significant factor in determining the positive relationship between FDI and GDP growth. Li and Liu (2005) the relationship between GDP and FDI may be contingent upon other variables, such as human capital, infrastructure, and institutional quality.

According to Nunnenkamp (2002), the correlation between GDP and FDI may differ depending on the industry and country, with variations in the relationship based on sector characteristics, level of economic development, and governance. Financial crises have also been studied, with Bevan and Estrin (2004) stating that economic stability and the prevention of severe recessionary periods are critical factors in the attraction of FDI. Negative GDP growth may serve as a deterrent to FDI inflows, and the relationship may differ based on long-term effects.

Relationship between Inflation and Foreign Direct Investment

Inflation in Malaysia has a significant positive relationship with FDI in both the long and short term, as suggested by Dadu and Payu (2022). However, it also has a substantial and beneficial effect on FDI in Vietnam, Thailand, Indonesia, and Singapore. In other related studies, however, researchers have found that governments must decrease inflation to attract more FDI. The relationship between inflation and FDI in Malaysia is complex, with high inflation rates affecting investment costs, stability, predictability, exchange rate impact, policy responses, and macroeconomic stability (Mudiyanselage & Epuran, 2022). Foreign investors may find it less appealing to invest in companies with high inflation rates due to potential decreases in profit margins and return on investment. Low and consistent inflation rates foster a business environment conducive to growth, increasing investor confidence and attracting FDI.

As stated by Morshed and Hossain (2022), regressors for inflation have been implemented, and policy responses, such as interest rates, can also increase financing costs and impact investment decisions. Consistent FDI is attracted by stable economic conditions, necessitating the implementation of a solid monetary policy to regulate inflation (Azam & Haseeb, 2021). It is also possible for the influence of inflation on FDI to differ between developed and developing countries, with excessive inflation potentially being highly detrimental in developing economies with inferior institutional frameworks and financial markets (Alfaro et al., 2010).

Relationship between Exchange Rate and Foreign Direct Investment

The relationship between foreign direct investment (FDI) and exchange rates has been extensively studied, with various countries showing significant impacts on their economies. In Indonesia, Malaysia, and Vietnam, FDI is adversely affected by exchange rates, while Thailand has a substantial and advantageous influence (Dadu & Payu, 2022). In Singapore, the exchange rate has a positive but insignificant impact on FDI. In Malaysia, the exchange rate has a positive long-term relationship but a negative short-term relationship, impacting investor profitability and risk (Shaari et al., 2023). The study suggests that the exchange rate needs to be increased to account for the variation in inbound FDI, indicating policy implications such as enhancing the investment climate through open trade policies and preserving a stable exchange rate (Mudiyanselage & Epuran, 2022). Exchange rate fluctuations also affect the cost of investment, competitiveness of exports, repatriation of profits, and stability and predictability (Aldalou & Sarsour, 2022).

The exchange rate regime (fixed versus floating) can also influence FDI, with countries with fixed exchange rate regulations attracting a higher volume of FDI due to increased certainty regarding future exchange rates (Klein & Rosengren, 1994). The long-term relationship between FDI and exchange rates may differ by sector, with other variables such as inflation, interest rates, and political stability influencing the relationship (Froot & Stein, 1991). The impact of exchange rates on FDI may differ by country and region, with market size, distance, and cultural connections influencing the relationship (Chakrabarti & Scholnick, 2022). Dunning's Eclectic Paradigm is the most suitable theory for understanding the relationship between FDI and exchange rates, as it explicitly accounts for the impact of macroeconomic factors on FDI decisions (Dunning, 1998).

Relationship between Trade Openness and Foreign Direct Investment

The relationship between trade openness and FDI in Malaysia is crucial for understanding the impact of international trade policies on FDI inflows. Studies have shown that trade openness has a positive long-term relationship with FDI, while the relationship is positive and insignificant in the short term (Mudiyanselage & Epuran, 2022). Trade openness in Malaysia can improve market access, facilitate supply chain integration, align with export-oriented FDI strategies, promote policy coherence, and facilitate technological transfer and knowledge spillovers.

According to Bakdi (2022), trade liberalization is the primary factor influencing FDI in India, with trade openness being the most critical factor for FDI inflow in middle-income economies. However, the relationship

is multifaceted, with factors such as market size, political stability, infrastructure, human capital, and sector-specific considerations also influencing FDI decisions (Rathnayaka Mudiyanselage et al., 2021). Macroeconomic indicators and investor perceptions are essential components of a thorough examination of Malaysia's trade openness and FDI dynamics (Dewi & Hutomo, 2021).

Open trade policies are correlated with more substantial FDI inflows, particularly in developing nations. Trade agreements and common markets can attract FDI through the use of trade agreements and common markets (Globerman & Shapiro, 2002). Export-platform FDI is facilitated by increased trade openness, with economic growth, market size, and other variables mediating the relationship between trade liberalization and FDI in Mexico (Jordaan, 2005). As stated by Asiedu (200) the relationship between trade openness and FDI may differ between developed and developing nations, with financial and trade openness having a more robust impact on FDI. Dunning's Eclectic Paradigm is the most suitable theory for explaining the relationship between trade openness and FDI, as it explicitly evaluates the impact of macroeconomic factors on FDI decisions (Dunning, 1998).

3. Research Methodology

Data for all variables in this study were sourced mainly from the Central Bank of Malaysia and World Bank databases to ascertain how the factors influence FDI in Malaysia. Annual time series data span from 1971 to 2021 and the E-Views 12 software was utilised to analyse the data. Time series data is a sequence of routinely recorded data pieces throughout time. It is widely used in finance, economics, weather forecasting, stock market analysis, and sales forecasting (Sharma & Bandhu, 2023). Time series analysis of temporal dependency also helps in finding the underlying structures, trends, seasonal fluctuations, and patterns (Runge et al., 2023). In this study, the ARDL model is employed to evaluate the data and identify the main elements influencing FDI in Malaysia. It is particularly advantageous because it can be applied regardless of whether the fundamental variables are I(0) (stationary) or I(1) (non-stationary) as seen in Table 4. This model combines GDP, inflation, exchange rate, and trade openness. The functional form model specification is expressed as FDI = f (GDP, INF, EXR, TOP).

Figure 1: The Conceptual Framework

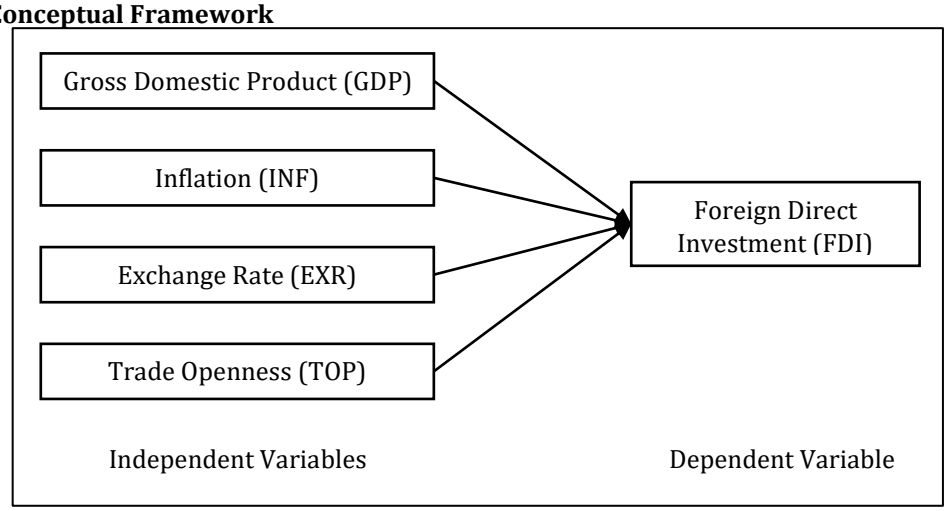


Figure 1 shows the conceptual framework undertaken in this study which highlights the links among variables. In a conceptual framework, the dependent and independent variables are the two most important aspects corresponding with each other. The dependent variable is also known as the criteria variable that mostly interests the study (Bansal et al., 2023). Either favorably or negatively, independent predictor variables will directly affect the dependent variable. Figure 1 shows FDI as the dependent variable, while the other macroeconomic variables (gross domestic product, inflation, exchange rate, and trade openness) are the independent variables that are investigated for its long-run equilibrium relationship in Malaysia for the years spanning between 1971 and 2021.

The main objective of this study is to investigate the long-run equilibrium relationship between FDI and the selected macroeconomic variables including GDP, inflation, exchange rate, and trade openness. The following Table 1 presents a summary of the research objectives (RO), research questions (RQ), and hypotheses statements (HS) that are undertaken in this study.

Table 1: **Summary of RO, RQ, and Hypotheses Statements**

Research Objectives (RO)	Research Questions (RQ)	Hypotheses Statements (HS)
RO1: To examine the impact of GDP on FDI in Malaysia.	RQ1: Does GDP significantly influence FDI in Malaysia?	H_1: There is no significant relationship between GDP and FDI. H_1: There is a significant relationship between GDP and FDI.
RO2: To analyze the effect of inflation on FDI in Malaysia.	RQ2: Does inflation significantly influence FDI in Malaysia?	H_2: There is no significant relationship between inflation and FDI. H_2: There is a significant relationship between inflation and FDI.
RO3: To investigate the influence of exchange rates on FDI in Malaysia.	RQ3: Do exchange rates significantly influence FDI in Malaysia?	H_3: There is no significant relationship between exchange rate and FDI. H_3: There is a significant relationship between exchange rate and FDI.
RO4: To explore the role of trade openness in affecting FDI in Malaysia.	RQ4: Does trade openness significantly influence FDI in Malaysia?	H_4: There is no significant relationship between trade openness and FDI. H_4: There is a significant relationship between trade openness and FDI.

4. Results and Discussion

Section 4 of this research work highlights the empirical results and their analyses. It focuses on the interpretation of descriptive statistics, regression and estimation results which clarify the relationships between variables and address the research problems. The dependent and independent variables involved in this study include foreign direct investment, gross domestic product, inflation, exchange rate, and trade openness. The analysis uses descriptive statistics, correlation matrix, unit root test, optimal lag length selection, ARDL model, Bounds test, and long-run estimation, as well as diagnostic and stability tests. The E-Views 12 software is employed for analysis purposes, with the final goal of investigating the relationship between the independent and dependent variables.

Descriptive Statistics

This section analyses the results that have been obtained for the central tendency and dispersion distribution measurements. Other than investigating the normalcy of the data, unprocessed data have been transformed into logs before estimation. Table 2 presents the central tendency and dispersion results for this study.

Table 2: **Descriptive Statistics**

	Mean	Median	Maximum	Minimum	Std. Dev	Skewness	Kurtosis	ırque-Bera	Probability
FDI	3.7277	3.4502	8.7605	0.0567	1.7429	0.6361	3.7811	4.7362	0.0937
GDP	5.9946	6.2522	11.7011	-7.3594	3.8969	-1.4256	5.4348	29.8716	0.0000
INF	3.3507	2.8132	17.3289	-1.1387	2.9199	2.5645	12.2339	237.0919	0.0000
EXR	3.0824	2.8196	4.3004	2.1769	0.6692	0.3553	1.6283	5.0710	0.0792
TOP	143.3523	136.6891	220.4068	73.3755	41.9883	0.2481	1.8853	3.1637	0.2056

Source: Authors' computation.

Table 2 shows the data on foreign direct investment (FDI) as a percentage of GDP, with an average value of 3.7277%. The data spans from 8.7605% to 0.0567%, with a standard deviation of 1.7429%. The data shows positive skewness and kurtosis of 3.7811, suggesting a flattened curve distribution. The average GDP is 5.9946%, with a middle value of 6.2522%. The lowest recorded GDP is -7.3594%, while the highest is 11.7011%. The data is platykurtic, meaning a positive kurtosis and a flattened curve. Meanwhile, the exchange rate (EXR) and trade openness (TOP) have mean values of 3.0824 and 2.8196, respectively.

Correlation Matrix

The correlation test assesses the linear relationship between variables, evaluating their direction and strength (Baak et al., 2020). It uses a correlation matrix containing FDI, GDP, inflation, exchange rate, and trade openness, and analyses the correlation coefficients thoroughly as depicted in Table 3.

Table 3: Correlation Matrix

	FDI	GDP	INF	EXR	TOP
FDI	1	0.4339	0.3715	-0.2399	0.2030
GDP	0.4339	1	0.3047	-0.4630	-0.1378
INF	0.3715	0.3047	1	-0.4395	-0.2639
EXR	-0.2399	-0.4630	-0.4395	1	0.4973
TOP	0.2030	-0.1378	-0.2639	0.4973	1

Source: Authors' computation.

Stationarity Unit Root Test

The test assesses the sequence of integration in each data set using comprehensive dataset analysis to determine stationarity and determine if the data sets are stationary (Ching et al., 2024). It improves the ability to determine if the data sets are stationary. A unit root test is necessary before using the Autoregressive Distributed Lag Model (ARDL). Statistical validation of the unit root test was achieved using the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) criteria (Efendi et al., 2024). Each trait was considered independently, and their significance was significantly proportional. Two levels are constructed at the level and first difference, using automated lag adjustments to achieve stationary behavior as seen in Table 4.

Table 4: Unit Root Test

Variable	ADF Test Statistics (with Intercept)			PP Test Statistics (with Intercept)		
	Level	First Difference		Level	First Difference	
FDI of GDP	0.0051*	0.0000*	I(0) I(1)	0.0048*	0.0000*	I(0) I(1)
GDP	0.0000*	0.0000*	I(0) I(1)	0.0000*	0.0001*	I(0) I(1)
INF	0.0025*	0.0000*	I(0) I(1)	0.0025*	0.0000*	I(0) I(1)
EXR	0.8481	0.0000*	I(1)	0.8481	0.0000*	I(1)
TOP	0.3566	0.0001*	I(1)	0.5062	0.0001*	I(1)

* Stationary and significant at 5% level respectively.
ADF: Augmented Dickey-Fuller. PP: Philips-Perron.
Source: Authors' calculation.

The dataset is a mix of connectivity, with some variables remaining constant and others becoming fractionally integrated after the initial difference. Unit root testing determines the dataset's fit for the ARDL model (Efendi et al., 2024). The Phillips-Perron test shows that only FDI, GDP, and inflation variables show stationarity at the level. Both trade openness and exchange rate are non-stationary at level but show stationarity at the first difference. As stated by Efendi et al., (2024) the ARDL model can fit stationary and first-order integrated variables, making it suitable for studying a combination of I(0) and I(1) variables. However, exchange rates and

trade openness become stationary after initial differencing, indicating they must be more differentiated before inclusion in the model (Pesaran & Shin, 1995).

Optimal Lag Length Selection

The optimal ARDL order specification for this study was determined through the automatic ARDL model selection. It is summarized in Table 5. Employing the Akaike Information Criterion (AIC), the ARDL (1,0,3,4,4) configuration was the most successful, with the lowest AIC values of 3.147081 compared to other ARDL order specifications. The criteria graph shows the model selection value for the twenty best models with the lowest AIC value.

Table 5: Optimal Lag Length Selection

Model	FDI	GDP	Inflation	Exchange Rate	Trade Openness	AIC
2401	1	0	3	4	4	3.147081
1776	2	0	3	4	4	3.159708
2276	1	1	3	4	4	3.178428
2376	1	0	4	4	4	3.188037
1151	3	0	3	4	4	3.191609
1651	2	1	3	4	4	3.194737
1777	2	0	3	4	3	3.201104
1751	2	0	4	4	4	3.201709
1152	3	0	3	4	3	3.205975
2402	1	0	3	4	3	3.211172
2151	1	2	3	4	4	3.219270
2251	1	1	4	4	4	3.220062
1827	2	0	1	4	3	3.227389
1652	2	1	3	4	3	3.228887
1026	3	1	3	4	4	3.229453
2277	1	1	3	4	3	3.230653
1126	3	0	4	4	4	3.233728
526	4	0	3	4	4	3.234012
527	4	0	3	4	3	3.234369
1526	2	2	3	4	4	3.236414

Source: Authors' computation.

Autoregressive Distributed Lag (ARDL) Model and Short-Run Estimation

The Autoregressive Distributed Lag (ARDL) model is an econometric technique used to estimate the relationship between a dependent variable and one or more independent variables (Lucky & Elfreda, 2024). It was developed by Pesaran and Shin in 1998 and is useful for analyzing time series data with varying integration orders. The model estimates the relationship between a dependent variable and its own lagged values and other independent variables. In this study, it is employed for estimating the relationship between FDI and macroeconomic variables including gross domestic product (GDP), inflation (INF), exchange rate (EXR), and trade openness (TOP).

Table 6: Estimated Short-Run Coefficient Results

ECM Regression Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(INF)	0.240865	0.070105	3.435775	0.0018
D(INF(-1))	0.216115	0.063040	3.428245	0.0018
D(INF(-2))	0.165820	0.060567	2.737785	0.0103
D(EXR)	-1.884031	0.716465	-2.629620	0.0134
D(EXR(-1))	1.702545	0.733168	2.322175	0.0272
D(EXR(-2))	-0.288575	0.699193	-0.412726	0.6827

D(EXR(-3))	-2.866231	0.694275	-4.128377	0.0003
D(TOP)	0.017888	0.018266	0.979295	0.3353
D(TOP(-1))	-0.008839	0.019774	-0.446990	0.6581
D(TOP(-2))	0.038922	0.018779	2.072696	0.0469
D(TOP(-3))	0.038794	0.019271	2.013103	0.0532
CointEq(-1)*	-0.445575	0.083967	-5.306522	0.0000
R-squared	0.754102	Mean dependent var		-0.012669
Adjusted R-squared	0.676820	S.D. dependent var		1.657106
S.E. of regression	0.942047	Akaike info criterion		2.934315
Sum squared resid	31.06081	Schwarz criterion		3.406693
Log-likelihood	-56.95640	Hannan-Quinn criteria.		3.112074
Durbin-Watson stat	1.859286			

Table 6 reports the results from the error correction model (ECM) regression. It highlights the ARDL short-run model results that indicate how changes in the determinants of FDI influence it in the short term. The model's short-term dynamics are illustrated by the coefficients of the differenced variables, reflecting the immediate impact of changes in the independent variables on the dependent variable (Bati, 2024).

The immediate impact of changes in inflation (D(INF)) is significantly positive (coefficient = 0.240865, p = 0.0018). This suggests that an increase in changes in inflation initially attracts FDI. Meanwhile, the lagged effects of changes in inflation, represented by D(INF(-1)) and D(INF(-2)), remain positive and significant, with coefficients of 0.216115 (p = 0.0018) and 0.165820 (p = 0.0103), respectively. This indicates a sustained short-run positive influence of inflation on FDI in Malaysia.

On the other hand, the direct impact of exchange rate fluctuations (D(EXR)) is negative and significant (coefficient = -1.884031, p = 0.0134), suggesting that in the short run, a depreciation in the exchange rate discourages FDI. Interestingly, the lagged exchange rate effects (D(EXR(-1)) and D(EXR (-3))) show varying impacts. The first lag (D(EXR(-1))) has a positive and significant effect (coefficient = 1.702545, p = 0.0272), while the third lag (D(EXR(-3))) has a strong negative effect (coefficient = -2.866231, p = 0.0003). This volatility suggests that exchange rate movements have complex and fluctuating impacts on FDI in the short run. Overall, this volatility might reflect investor sensitivity to currency fluctuations. The short-run effects of trade openness (D(TOP)) are largely insignificant, except for D(TOP(-2)), which has a positive and significant effect (coefficient = 0.038922, p = 0.0469). In the short run, increased trade openness can positively affect FDI, but the overall impact is not consistent across different time lags.

The error correction term (CointEq(-1))* is significant with a negative coefficient (-0.445575, p = 0.0009). This indicates that there is a long-run equilibrium relationship between FDI and its determinants. The speed of adjustment to equilibrium is relatively moderate, implying that deviations from the long-run path correct at a moderate pace. As the existence of a long-run relationship is confirmed, it implies that while short-term fluctuations can occur, FDI tends to move towards a long-term equilibrium influenced by the key determinants identified in the study.

F-Bounds Test and Long-Run Estimation

The ARDL F-Bounds Test is used to test for the existence of a long-term relationship between variables in a model. The F-Bounds Test is used in the ARDL model to determine whether a long-run equilibrium relationship exists between the dependent variable (in this case, FDI as a percentage of GDP) and the selected macroeconomic variables (GDP, inflation, exchange rate, and trade openness) using the Malaysian data.

Table 7: ARDL F-Bounds Test

Test Statistic	Value	*k*
F-Statistics Value	4.022739	4
Significance Level	I(0)	I(1)
10%	2.2	3.09
5%	2.56	3.49

2.5%	2.88	3.87
1%	3.29	4.37

Source: Authors' computation.

In Table 7, the calculated F-statistic (4.0227) is greater than the upper bound at the 5% significance level (3.49) and close to the 1% significance level upper bound (4.37). This result indicates that there is a statistically significant long-run equilibrium relationship between FDI (as a percentage of GDP) and the selected macroeconomic variables (GDP, inflation, exchange rate, and trade openness). This means that these variables collectively influence FDI in the long run. Once the F-Bounds test confirms that a long-run relationship exists, it implies that the selected macroeconomic variables, when considered together, have a meaningful impact on FDI over time.

Autoregressive Distributed Lag (ARDL) and Long-Run Estimation

In this section, the following Table 8 shows the estimated results for long-run coefficients from the ARDL model. The ARDL estimation provides specific coefficients for each macroeconomic variable, showing how each one impacts FDI in the long run.

Table 8: Estimated Long-Run Coefficient Results

Levels Equation Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
GDP	0.211378	0.145669	1.451090	0.1571
INF	-0.184663	0.324299	-0.569422	0.5733
EXR	1.107145	1.044444	1.060033	0.2976
TOP	-0.011429	0.013484	-0.847609	0.4034
C	1.718010	3.504923	0.490171	0.6276
EC = FDI_OF_GDP - (0.2114*GDP -0.1847*INFLATION + 1.1071*EXCHANGE_RATE -0.0114*TRADE_OPENNESS + 1.7180)				

Source: Authors' computation.

The coefficient for GDP is 0.2114, indicating a positive relationship between GDP and FDI in the long run. However, the t-statistic (1.4511) is not significant (p-value = 0.1571). It suggests that the positive relationship between GDP and FDI might not be statistically significant in the context of this study. Meanwhile, the coefficient for inflation is -0.1847, indicating a negative relationship between inflation and FDI, which aligns with past literature. This suggests that higher inflation may lead to a reduction in FDI inflows in the long run. However, similar to GDP, the relationship is not statistically significant at a 5% level (t-statistic = -0.5694, p-value = 0.5733).

The exchange rate has a positive coefficient of 1.1071, suggesting that a higher exchange rate (likely indicating a depreciation of the local currency) is associated with increased FDI inflows. This relationship, however, is not statistically significant (t-statistic = 1.0600, p-value = 0.2976). In the case of trade openness, the coefficient of -0.0114, indicates a negative relationship between trade openness and FDI in the long run. This suggests that greater trade openness might lead to a slight decrease in FDI inflows, though this relationship is again not statistically significant (t-statistic = -0.8476, p-value = 0.4034) in this model.

The ARDL model results suggest that while there are positive and negative relationships between FDI and the selected macroeconomic variables (GDP, inflation, exchange rate, and trade openness), none of these relationships are statistically significant in the long run within the context of this model. The lack of statistical significance implies that these macroeconomic variables might not have a strong or direct long-term impact on FDI inflows according to the model's estimation. However, these relationships could still be economically meaningful and warrant further investigation with different models or additional data.

Diagnostic Checks

In this study, two types of diagnostic tools are employed to test for serial correlation and heteroscedasticity in the regression model residuals. They include the Breusch-Godfrey Serial Correlation LM Test and the Breusch-Pagan-Godfrey Heteroscedasticity Test. In addition to that are the CUSUM stability tests being undertaken for this study.

Table 9: Diagnostic Test

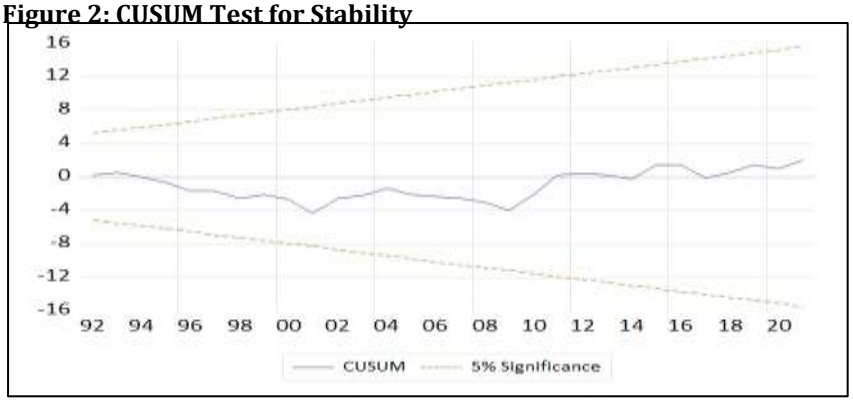
Items	Test Applied	F-Statistics	Probability
Serial correlation	Breusch-Godfrey Serial Correlation LM Test	1.853618	0.1693
Heteroscedasticity	Breusch-Pagan-Godfrey	0.190324	0.9423

Source: Authors' computation.

The Breusch-Godfrey Serial Correlation LM Test is a statistical method used to determine the presence of serial correlation in regression model residuals (Mignon, 2024). It is used when residuals from one period are correlated with those from another, violating the assumption of independence in error terms. The test results are interpreted as either a null hypothesis (H0) or an alternative hypothesis (H1). In this study, the null hypothesis is rejected due to a p-value of 0.1693 as depicted in Table 9, which exceeds the conventional significance level (0.05). This indicates that there is insufficient evidence to infer serial correlation in the residuals of the ARDL model. The summary of the test shows no evidence of serial correlation, indicating that the residuals are independent, consistent with the assumption of no serial correlation. Meanwhile, the Breusch-Pagan-Godfrey Heteroscedasticity Test is a diagnostic tool used to identify heteroscedasticity in regression model residuals (Mignon, 2024). This study failed to reject the null hypothesis (H0) due to a p-value of 0.9423, suggesting that the residuals are likely homoscedastic, meaning the variance of errors remains constant across observations. The Breusch-Pagan-Godfrey Heteroscedasticity Test did not reveal any evidence of heteroscedasticity in the residuals, confirming the reliability and robustness of the model's estimates and inferences.

Stability Test (CUSUM)

Figure 2: CUSUM Test for Stability

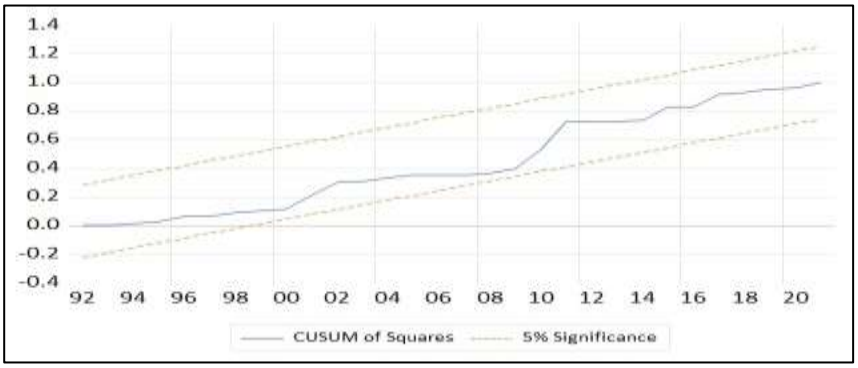


The Cumulative Sum (CUSUM) test is a stability test used in econometrics to determine the stability of regression model coefficients over time (Otto & Breitung, 2023). The test is based on the cumulative total of recursive residuals, and a stable model remains within a pair of crucial lines for analysis. The graph shows the blue line representing the cumulative sum of residuals, while red dashed lines represent the 5% significant limits. The critical values of the test are used to calculate these limits, which form a corridor for the CUSUM line to be located if the model is stable.

The graph in Figure 2 shows that the CUSUM line remains within the 5% significant boundaries during the entire sample period from 1992 to 2020. Although there are oscillations in the CUSUM line, none are significant enough to break through the significance boundaries. As a result, the model is considered stable, as the parameters remain stable over various periods.

Stability Test (CUSUM of Square)

Figure 3: CUSUM of Squares Test for Stability



The Cumulative Sum of Squares (CUSUM) test is a statistical method used to monitor a regression model's parameters over time to identify any structural changes or instability (Otto & Breitung, 2023). It uses time series analysis and econometrics to determine if the relationship between variables is consistent over the observed period. The test is displayed in a figure with significance thresholds for 5%, aiming to determine if the regression coefficients remain stable over time. The blue line in Figure 3 represents the cumulative total of squared residuals, while dashed red lines represent the bounds associated with the 5% significance level. The null hypothesis of parameter stability is accepted if the blue line remains within these boundaries throughout the experiment. From 1992 to 2020, the CUSUM of Squares line remains within the 5% significance boundaries, indicating that the regression model has remained consistent and that the model's parameters have not undergone significant structural changes.

5. Conclusion

The empirical findings from the ARDL model on the relationship between FDI and its selected macroeconomic determinants in Malaysia offer insightful conclusions about how various economic factors influence FDI as a percentage of GDP. It reveals both short-run and long-run dynamics, as analyzed through the ARDL model. In the short run, the ARDL model's results suggest that inflation, and exchange rates are important determinants of FDI in Malaysia. Trade openness, while theoretically important, does not show strong statistical significance in this empirical setup. The findings underline the importance of stable economic conditions, particularly controlled inflation and stable exchange rates, in attracting FDI into the Malaysian economy.

Meanwhile, the error correction model confirms the existence of a long-run relationship. It highlights that while short-term fluctuations can occur, FDI tends to move towards a long-term equilibrium influenced by the key determinants identified in the study. Additionally, the calculated F-statistic from the F-Bounds test results confirms that there is a stable, long-run relationship among these variables. The F-Bounds test results suggest that the selected macroeconomic variables are collectively cointegrated with FDI. This means that changes in GDP, inflation, exchange rate, and trade openness are likely to have a lasting impact collectively on FDI levels as indicated by the presence of cointegration in the model, despite its absence at the individual level. In particular, the long-run results for individual variables suggest that the determinants considered (GDP, inflation, exchange rate, and trade openness) do not have strong or significant effects on FDI.

Overall, the ARDL analysis in this study reveals a complex relationship between FDI and its determinants in Malaysia. These findings highlight the importance of managing short-term economic variables, particularly controlled inflation and stable exchange rates, to attract and maintain FDI inflows into Malaysia which is in line with Chew (2024) where preserving macroeconomic stability is crucial. This information can be used by policymakers and researchers to make informed decisions and forecasts, as it is founded on the understanding that these variables are interconnected and maintain a stable long-run relationship, albeit collectively.

Future Research

The lack of evidence for individual variables' long-run relationship could imply that there are other factors not included in the model, such as political stability, regulatory environment, or external economic conditions, that may play more critical roles in shaping long-term FDI in Malaysia. This study suggests a need for further investigation into other long-term determinants. Such efforts will assist policymakers in deducing effective strategies to increase Malaysia's appeal to foreign investors in terms of FDI.

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