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The Nexus of Foreign Direct Investment and Economic Growth from the Open Economy Perspective

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ABSTRACT

The purpose of this research is to study the impact of Foreign Direct Investment (FDI) on Malaysian GDP growth under the analysis based on a time series model for the period 1974-2023. The purpose of this research is to study how FDI, exports, and inflation will respond to each other in creating Malaysian economic growth based on ARDL and ARIMA models. The study uses secondary data from sources like the World Bank. It tests the variables for stationarity and models short-run and long-run dynamics using ARDL. The ARIMA model is applied to forecast GDP trends. The background includes Malaysia's economic transformation from a rural-based to an export-oriented industrial base. The literature review confirms prior empirical evidence supporting FDI's contribution to capital accumulation, technology transfer, and productivity, moderated by institutional quality and inflation. The ARDL results reveal a statistically significant long-run relationship between FDI and GDP growth, while exports and inflation exert opposite impacts. Based on the ARIMA model, there is an expected positive and consistent pattern of GDP growth through 2030, in support of the long-term FDI benefit to economic performance. This report stresses the importance of judicious macroeconomic policies, human capital formation, trade openness, regulatory reform, and infrastructure building in sustaining FDI inflows as well as the future growth of Malaysia.

Keywords: Macroeconometrics, Time Series Analysis, Forecasting, ARDL and ARIMA Models, Macroeconomic Factors
JEL Classifications: E0, E2, E6

1. INTRODUCTION

The gross domestic product was the best measure of economic expansion. Gross domestic product (GDP) is an estimate of the final amount of production. Foreign direct investment (FDI), which has brought in the money, technological advances, and managerial know how required for the nation's economy to thrive, has substantially helped Malaysia. Malaysia is an Asian appearing nation that is succeeding and making its own efforts towards becoming a developed state. The nation has changed from an agricultural economy to one that is diversified.

It has long been believed that foreign direct investment (FDI) is a key factor in economic growth, particularly in emerging nations like Malaysia. Foreign Direct Investment is an international strategy whereby firms establish a physical presence abroad through acquisition of productive assets. In other words, foreign direct investment is one of the international investments that were made by an investor in foreign countries with interest to gain more return, expanding their products market, and enjoy the economies of scale (Shaari et al., 2012). Significant foreign investment has frequently chosen the country due to its favourable geographical position, diverse economy, and welcoming setting for business.

Foreign Direct Investment (FDI) has remained the chief driving force during Malaysia's change from the 1970s to a high-technology manufacturing and export-led economy from the once agriculture-based economy. The government incentivized the FDI by offering tax holidays and free trade zones (Nguyen et al., 2021). Being a part of ASEAN-6, Malaysia has enjoyed regional financial integration, and FDI has been a major contributor to capital formation, technology transfer, and productivity improvement. As compared to other capital flows, FDI is considered a more stable option, although there is also the possibility of opening up the economy to foreign shocks (Le et al., 2023).

The GDP growth of Malaysia with respect to FDI, on the other hand, is mixed in environmental and technological dynamics of the ASEAN region. The EKC hypothesis, based on this background, relates to a nonlinear relationship such that economic growth first raises environmental degradation but, at a threshold development, results in improved environmental quality. FDI has been fundamental to the economic development of Malaysia, often related to the levels of technological and infrastructural development. However, a strategic management will be needed at the environmental level in order to achieve sustainability concerning ASEAN regional development (Othman et al., 2024). In the next section, the effects of Foreign Direct Investment on Malaysia's GDP growth will be discussed.

Foreign direct investment (FDI) has boosted sales development by obtaining innovation, state of the art equipment, and executive knowledge. This is a key element of Malaysia's development goal. With the manufacturing and services sectors leading the way in attracting foreign direct investment (FDI), the country's economy has grown increasingly diversified across time. Although the beneficial effects of foreign direct investment (FDI), uncertainties persist over the scope and durability of this influence on Malaysia's long term economic expansion. This is especially true given the unpredictable nature of international investment patterns and domestic obstacles including a lack of trained labour and technology capabilities. In the next paragraph, Impact of openness, FDI and inflation on GDP will be discussed.

Gross Domestic Product (GDP) is one of the most important indicators of a country's economic performance, and knowledge of its determinants is important for sound policymaking. From the numerous factors that affect GDP, openness to trade, foreign direct investment (FDI), and inflation stand out, particularly in developing nations. Trade openness gives access to wider markets, encourages competition, and improves the transfer of technology, which could lead to increased economic growth. FDI contributes to GDP through increased domestic capital, new technology injection, and job creation. Inflation, particularly high or uncertain inflation, can offset economic stability by lowering purchasing power, distorting investment choices, and eroding consumer and investor confidence. More specifically, micro and macroeconomic variables are very responsive to components in finance such as inflation rate, GDP growth rate and capital (Amin et al., 2014). This study investigates the contribution of openness, FDI, and inflation to GDP to better understand their roles in the dynamics of economic growth, with Malaysia as a case study.

1.1. Problem Statement

The study discusses the role of Foreign Direct Investment (FDI) in Malaysian economic growth and GDP creation in an open economy. FDI is a key factor in domestic capital growth, creating job opportunities, and technology transfer. FDI has been beneficial to Malaysian industrialization, yet its performance is subject to domestic policy dynamics, sectoral realities, and global economic changes. While FDI has the potential to boost productivity, it is also faulted by determinants such as environment and reliance on foreign capital (Serikkyzy et al., 2024).

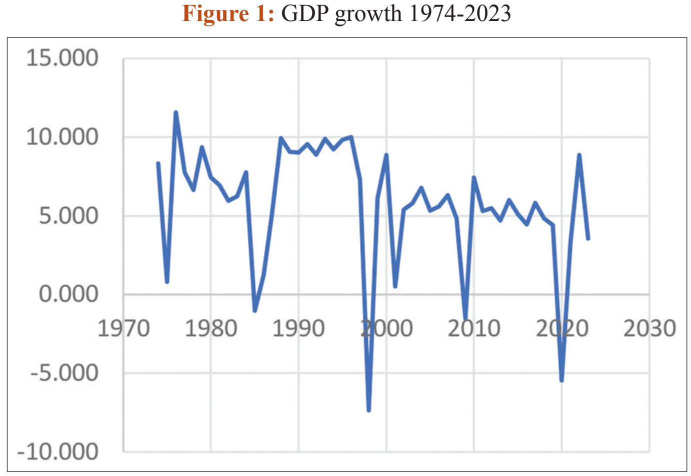
FDI performance also depends on the quality of institutions and openness to the economy. Trade liberalization, regulatory transparency, and protection of property rights are favorable conditions to attract quality investment. FDI would be expected to raise diversification, productivity, and innovation in the high-quality institutional environment. Macro instability, like policy uncertainty or inflation, and weak institutions decrease the long-run growth contribution from FDI (Uzar, 2024).

Figure 1 illustrates the trend of GDP growth in Malaysia from 1974 through 2023, characterized by fluctuations due to high-profile events both at the international and domestic fronts. It experienced severe downturns during the Asian Financial Crisis (1997–1998), the Global Financial Crisis (2008–2009), and the 2020 COVID-19 pandemic. Aside from the crisis shock, the Malaysian economy has been solid with good growth periods during the late 1980s and early 2000s. The trends show the need for prudent macroeconomic policies to drive growth (World Bank, 2024).

Figure 2 shows FDI inflows into Malaysia for the same years with modest starts during the 1970s, robust growth during the 1990s, but sharp declines in the face of profound financial crises and once more in 2020 because of the pandemic. This volatility is consistent with the manner in which FDI reacts to exogenous factors and says a lot about the necessity of establishing a stable and favourable investment environment (World Bank, 2024).

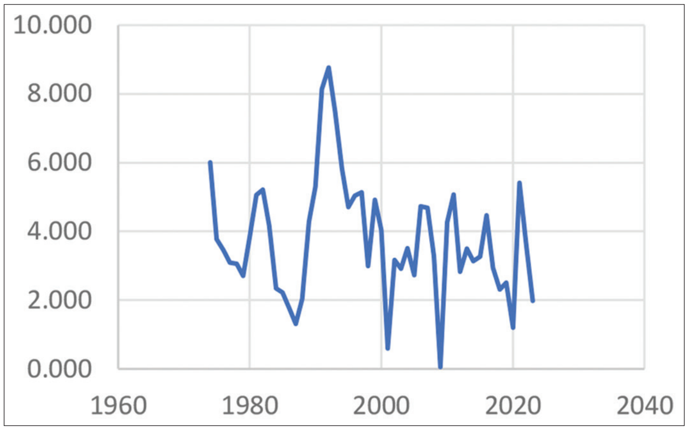
Figure 3 depicts Malaysia's export trend, which in the long-term exhibit's growth but in the short term is unstable. Industrialization and internationalization of the nation led to the rise in exports. While its exports suffered adversely from the crises of 1997, 2008, and 2020, the exports form a most significant contributor to GDP growth, showing Malaysia's favourable position in foreign trade and should be positioned in rivalry in the international market (World Bank, 2024).

Figure 1: GDP growth 1974-2023



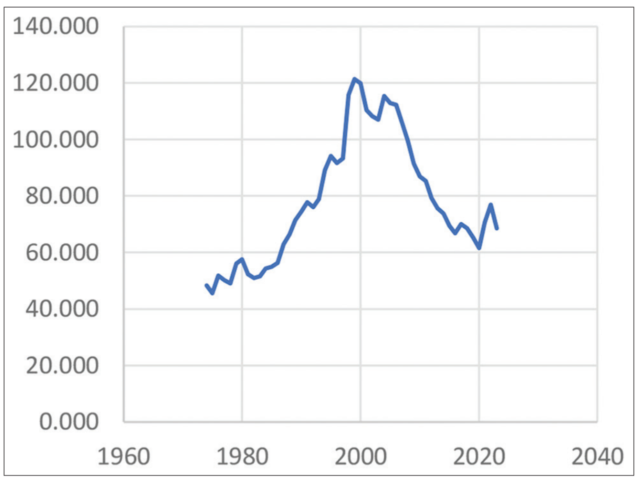
Source(s): World Development Indicators

Figure 2: Foreign Direct Investment 1974-2023



Source(s): World Development Indicators

Figure 3: Export 1974-2023



Source(s): World Development Indicators

1.2. Research Gap

While numerous studies have been conducted relating foreign direct investment (FDI) to economic growth, virtually all but a handful have employed historical or short-run data analyses with the emphasis usually being on the nexus between FDI and GDP in isolation from other macroeconomic determinants or on the basis of forward-looking projections. These analyses tend to overlook the way that FDI operates in the larger context of an open economy, with effects coming from trade liberalization, inflation, and foreign market forces on the determination of growth experiences. In addition, there are limited analyses that have employed forecasting techniques to make an estimation of the probable direction of GDP growth from previous FDI trends. This study fills this important lacuna not only by describing the historical link between GDP growth and FDI in Malaysia but also by forecasting GDP growth through 2030, thus making it forward-looking. Projection up to 2030 is also relevant and opportune since it falls in line with Malaysia's long-term strategic development plan such as the Shared Prosperity Vision 2030 and provides a forward-looking orientation to ascertain whether current FDI trends are sufficiently strong to underpin future economic growth amidst global uncertainty and structural reforms. The blending of past trends and future projections better enables us to appreciate the long-term implications of FDI in an open economy. This is particularly relevant to Malaysia, which aims to become a high-income, investor-driven economy in its national development plans. Therefore, this research makes an unprecedented contribution by bridging the gap between empirical analysis and economic projections, offering results that are not only of academic merit but also policy-relevant.

The research questions of this study are:
- What are the trends of Gross Domestic Product (GDP), Foreign Direct Investment, and Export in Malaysia?
- What are the key determinants of GDP growth in the context of foreign direct investment within an open economy?
- What are the forecasted GDP growth rates for Malaysia up to the year 2030?

The objectives of this study are:
- To analyse the trends of Gross Domestic Product, Foreign Direct Investment, and Export in Malaysia.
- To identify the key determinant of GDP growth in the context of foreign direct investment within an open economy.
- To forecast the GDP growth rates for Malaysia up to the year 2030.

1.3. Significant of the Study

This study aims at the association between Foreign Direct Investment (FDI) and Gross Domestic Product (GDP) growth, in the expectation that FDI will be a propelling determinant of economic growth in Malaysia. FDI is crucial to countries like Malaysia as it enhances employment creation, technology transfer, and overall advancement.

According to Cahyadin and Sarmidi (2019), the problem is based on the necessity to align Foreign Direct Investment (FDI) relations with Malaysia's economic goals. In contrast to more broader texts that overview more than one region, this text focuses on Malaysia and its local economic status. Strategically located and with its rapidly developing economy, the text under focus is how FDI catalyses growth, particularly in specialty sectors such as technology and manufacturing. The outcomes of this study can be used by policymakers to develop policies for optimizing the gains of FDI. Dependence on a small group of industries can be diversified in Malaysia by foreign investment into emerging areas such as food, medical sciences, and construction.

Finally, this study is consistent with SDG 8 and 10. FDI can assist in achieving decent work, economic growth, and inequality reduction through the realization of sustainable regional balanced development and opportunities. Attaining how FDI achieves GDP growth secures that the journey of Malaysia towards sustainable and inclusive economic development is guaranteed.

2. METHODOLOGY

2.1. Data Sources

The research material for this study is the secondary dataset from 1974 to 2023 to explore the relationship between FDI and exports, inflation, and GDP growth in Malaysia. The data for GDP growth, FDI, exports and inflation data have been sourced from the World Development Indicator Database from the World Bank. The statistical techniques followed in the research were descriptive statistics, Auto-Regressive Distributed Lag (ARDL) and Auto-Regressive Integrated Moving Average (ARIMA) to achieve the research objectives. This would also lead to understanding the comprehensive economic factors for GDP growth in Malaysia through historical data trends in a systematic manner.

2.2. Descriptive Statistics

The terms descriptive statistics in the given appendix mean the techniques which are used for reducing and structuring data to bring to the surface the essential features and trends that exist in the series depicting the phenomena under study. These methods are very important in establishing the correlation between the variables such as foreign direct investments and GDP. Thus, descriptive statistics as a technique prepare the ground for any complex manipulation like regression or causality analysis where one will analyse the relationship of the data set with other underlying factors (Trung & Gál, 2024).

2.3. Auto-Regressive Distributed Lag (ARDL) Model

The ARDL is a flexible econometric tool in modelling the relationship of time series variables. It focuses on both short-run fluctuations and long-run equilibrium. Unlike many models, ARDL does not require all data series to be similarly ordered; it can handle a mix of data that is stationary at level, I(0), and at first difference, I(1). The above adaptability, combined with the ARDL's applicability to small sample sizes, makes it an extremely useful avenue for cointegration analysis (Sanusi et al., 2018). To identify the key determinant of Gross Domestic Product (GDP) in the context of Foreign Direct Investment (FDI)., we estimate the regression model as follows:

$$LGDP_t = \alpha_0 + \alpha_1 LFDI_t + \alpha_2 LEXP_t + \alpha_3 LINF_t + \varepsilon_t \quad (1)$$

Equation 1 is the control long-run relationship between economic growth (proxied for by log of GDP) and its determinants: foreign direct investment (LFDI), openness (measured as LEXP), and inflation (LINF). The variables are natural logarithm transformations in order to linearize exponential growth trends and to have coefficients interpreted as elasticities α_1, α_2, α_3 are the long-run effects of each independent variable on GDP. The error term εt captures other unseen factors.

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \sum_{i=1}^{p} \gamma i \Delta Y_{t-i} + \mu t \quad (2)$$

Equation 2 is the Augmented Dickey-Fuller (ADF) test utilized to check whether each variable is stationary or not. Stationarity means statistical properties of the series remain time-invariant. It is required since ARDL models require variables to be either I(0) or I(1), but not I(2). If β_1 is strongly negative, then the null hypothesis of a unit root is rejected, and the variable is stationary. The lagged difference terms ΔY_{t-i} is employed to account for autocorrelation in the error term μt.

$$\begin{aligned}\Delta LGDPt &= \alpha_0 + \sum_{i=1}^{p} a_1^i \Delta LGDP_{t-i} + \sum_{j=0}^{q} a_2^j \Delta LFDI_{t-j} \\ &+ \sum_{k=0}^{r} a_3^k \Delta LEXP_{t-k} + \sum_{l=0}^{s} a_4^l \Delta LINF_{t-1} \\ &+ \lambda_1 LGDP_{t-1} + \lambda_2 LFDI_{t-1} + \lambda_2 LEXPt_{-1} \\ &+ \lambda_4 LINF_{t-1} + \varepsilon_t \end{aligned} \quad (3)$$

Equation 3 is the Autoregressive Distributed Lag (ARDL) that captures short-run and long-run relationships between GDP growth and explanatory variables. The differenced terms (Δ) capture the short-run effects, while the lagged level terms capture the long-run relationship. Both ensuring the model can handle mixed orders of integration (I(0) and I(1)). The order of the lag structure (p, q, r, s) is determined by criteria like AIC or SBC.

$$\begin{aligned}\Delta LGDPt &= \sum_{j=1}^{p} \beta_1^i \Delta LGDP_{t-i} + \sum_{j=0}^{q} \beta_2^i \Delta LFDI_{t-j} \\ &+ \sum_{k=0}^{r} \beta_3^k \Delta LEXP_{t-k} + \sum_{l=0}^{s} \beta_4^l \Delta LINF_{t-1} + \phi ECM_{t-1} + \varepsilon_t \end{aligned} \quad (4)$$

Equation 4 reparametrized ARDL model in ECM form used when cointegration between variables has been determined. The ECM term (ECM_{t-1}) is long-run equilibrium error correction, computed based on Equation (1) residuals. The ϕ coefficient (should be significant and negative) reflects the rate of adjustment to equilibrium after a short-run shock. A value between (-1,0) implies stable adjustment.

The ARDL approach embodies the short-term and long-term dynamics in this model. As such, it allows for lagged values of dependent variables-in this case, GDP-and the explanatory variables of FDI, exports, and inflation that make it versatile for identification of temporal effects. This becomes particularly helpful in cases where time series are non-stationary but have a long-run equilibrium relationship.

The ARDL model estimates the immediate impacts of the explanatory variables and their lagged effects that reflect delays in responses by economic systems. This makes it all the more appropriate for policy-driven studies since it underlines the extent and timing of changes in one variable affecting others. It also identifies the long-run equilibrium relationship through the cointegration test within the ARDL framework while simultaneously capturing the short-run deviations to analyze the determinants of GDP comprehensively.

2.4. Auto- Regressive Integrated Moving Average (ARIMA) Model

The ARIMA-the Autoregressive Integrated Moving Average-is a statistical tool into which time series data analysis and predictions are fed. It combines three key elements of the process of time-series analysis: the integrated, or raw, state; differencing in order to create stationarization; and a moving average. ARIMA will be represented as ARIMA (p, d, q), with "p" describing the order of the autoregressive term, "d", the degree of differencing, and "q", the order of the moving average term. It is highly effective in modelling temporal dynamics besides the data that includes a trend and missed values, and thus it finds a wide field of applications in different areas such as air quality prediction or PM2.5 concentration by using the models leveraging the pattern from history (Sharma et al., 2024). We estimate the ARIMA model as follows:

$$\Delta GDP_t = \beta_0 + \sum_{i=1}^{q} \beta_i \, \mathrm{GDP}_{t-i} + \varepsilon_t + \sum_{t=1}^{q} \theta_i \varepsilon_{t-i} \tag{5}$$

ARIMA, or the Auto-Regressive Integrated Moving Average, is a tool for statistical analysis utilized for prediction and further understanding of time series data. It encompasses three integral parts the Auto-Regressive part addresses how past values bring about the current value; the Integrated part, where one has to difference the data in order to turn it stationary; and lastly, the Moving Average models dependenn eors from former forecasts. It then goes on to incorporate in one equation these comnts Δ differenced GDP that achieves stationarity; AR, the autoregressive term in which lagged values of GDP are incorporated, while the MA will incorporate past error terms. These kinds of models are often used in analyses to predict a future trend, such as GDP growth of Malaysia, based on their past behavior while making adjustments for non-stationarity.

3. RESULTS AND DISCUSSION

This study employs the Autoregressive Distributed Lag (ARDL) approach coupled with ARIMA forecasting models with the objective of investigating the short-run and long-run dynamics of Malaysian economic growth and the impact of Foreign Direct Investment (FDI), exports, and inflation on GDP growth (LGDPG) using annual time series data for the period 1974-2023. Because of the presence of squared orders of integration in the variables, the ARDL method of Pesaran et al. (2001) is selected because of its ability to allow for both I(0) and I(1) series and being suitable for small samples.

3.1. Descriptive Statistics

The analysis of descriptive statistics is an initial step in deriving insight into the relationship between Foreign Direct Investment (FDI) and the growth of Gross Domestic Product (GDP) in Malaysia. Descriptive statistics provide essential information regarding the central tendency, dispersion, and distribution of key variables that are crucial in determining patterns and underlying trends before conducting sophisticated econometric tests. FDI, which is foreign capital invested with the aim of attaining lasting interest and control of host country firms, is a key driver in a country's enhanced economic performance in terms of the role it plays in GDP growth (Shkodra et al., 2024). Therefore, with the descriptive statistics of FDI inflows and GDP growth in Malaysia, this study provides an initial impression of the variables and sets the stage for determining the potential relationship between foreign investment and economic performance.

Table 2 shows the descriptive statistics of GDP Growth (GDPG), Foreign Direct Investment (FDI), Exports (EXP), and Inflation (INF) give us a general impression of their distribution and trends for 50 observations. The mean values show the average performance of all the variables, where GDPG is at 5.75%, FDI is at 3.78% of GDP, exports are at 77.87% of GDP, and inflation is at 8.23%. These figures are indicative of a modestly expanding economy with high exports, consistent FDI inflows, and relatively higher inflation.

Standard deviation and variance provide details on the volatility of the data. Exports (EXP) had the highest standard deviation (22.21) with high fluctuations, followed by GDPG (3.80) and INF (2.75). FDI was fairly stable with a standard deviation of 1.74. In other words, while exports and GDP growth were very unstable, FDI was stable in the long term.

Skewness and kurtosis define the shape of each distribution. GDPG is negatively skewed (−1.511) and more bunched up on the higher side with some very low ones (e.g., −7.36). FDI and EXP are very lightly positively skewed (0.5951 and 0.4553), while INF is very positively skewed (2.9850) and leptokurtic with very high kurtosis (13.8036), suggesting a lot of small values and occasional extreme highs.

The spread reflects the value spreading: GDPG and INF spreads are big at 18.92 and 18.47, respectively, indicating highest economic volatility. FDI and EXP spreads are 8.70 and 75.76, respectively. The min and max values affirm the same trends e.g., GDPG fell as low as −7.36% and rose to 11.56%, whereas inflation ranged from 3.86% to 22.33.

Lastly, the 95% confidence level tells us the margin of error in our estimation of the mean: ±1.08 for GDPG, ±0.49 for FDI, ±6.31 for EXP, and ±0.78 for INF. These ranges indicate how precisely the sample mean is approximating the population mean smaller ranges (like FDI) suggest greater reliability. Briefly, Malaysia's economic indicators portray moderate growth and FDI stability but with high volatility in exports and inflation, particularly high variability and extremities in inflationary tendencies.

3.2. Autoregressive Distributed Lag (ARDL)

The Pesaran et al. (2001) Autoregressive Distributed Lag (ARDL) approach is an approach that is most frequently applied in determining short- and long-run relationships among variables even when the data are composed of a mixture of I(0) and I(1) but not I(2). It performs well in handling small sample sizes and utilizes the bounds test procedure to check for cointegration (Chia & Lim, 2015). This study utilizes an ARDL (3,1,2,0) model to estimate the short- and long-run effects of FDI, exports, and inflation on Malaysia's GDP growth in log form. D(LGDPG) is the endogenous variable that measures the variation in GDP growth. As in economic theory and prior literature (Fama, 1981; Pesaran et al., 2001), the results indicate that GDP growth is determined by its past and FDI flows, and the absence of contribution from inflation and exports may be a sign of structural shocks or missing variables. On the whole, the ARDL model offers a viable platform to examine macroeconomic interlinkages that casts valuable light on policymakers' agendas towards fostering economic growth and stability.

Table 3 presents the stationarity test results of 4 variables LGDPG, LFDI, LEXP and LINF using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests at 3 levels, i.e., level, level 1 differencing and level 2 differencing are shown in Table 1. Those in the parentheses are the lags selected by Newey-West procedure with the Bartlett Kernel. The significance of test statistics is denoted by *, **, and * at 1%, 5%, and 10% levels of significance respectively. All variables (LGDPG, LFDI, LEXP, and LINF) are non-stationary at level according the ADF and PP tests in all specifications (none, intercept, trend & intercept). The test statistics are non-significant, that indicates a unit root exists. Initially, after the first differencing, all variables become stationary. Both the ADF and PP tests show very major results (***), which means we can confidently reject the idea that there's a unit root at the 1% significance level. In other words, these variables are integrated of order one, or I(1). When testing second differences, all variables still show major results across different setups with both tests. But since they already become stationary after the first difference, doing a second differencing isn't necessary and could actually cause over-differencing. Based on these results from both tests, we see that LGDPG, LFDI, LEXP, and LINF are not stationary when at their original level, but they become stationary after the first difference. That makes them suitable for cointegration analysis and exploring their long-term relationships, using models like ARDL or Johansen Cointegration.

Table 4 presents the ARDL Bounds Test to check whether there is no long-run relationship (cointegration) or not between the dependent variable (GDP growth) and certain independent variables (FDI, exports, and inflation). It performs a test for no levels relationship (no cointegration in the long run) under the null hypothesis. The calculated upper bound F-statistic is 8.8106, and this is above the upper bound critical value (I(1)) at all levels of normal significance, including the 1% level whose upper bound is 5.61. Since the F-statistic is considerably above even the most stringent critical value, the null hypothesis has to be rejected. This constitutes extremely strong evidence of long-run cointegrating relationship among the variables in the model. That is, other than short-run volatility, Malaysia's GDP growth is driven by FDI, trade openness, and inflation in the long run, supporting suitability in proceeding with the estimation of a long-run ARDL model and ECM for further analysis.

The result of the Bound Test is strong evidence in favor of a long-run relationship between GDP growth and its macroeconomic determinants foreign direct investment (FDI), exports, and inflation. The F-statistic of 8.8106 is above the upper bound

Table 1: Variable measurement

Variable	Brief description	Source
Dependent variables		
Gross Domestic Product	GDP Growth	World Development Indicator (WDI)
Independent Variables		
Foreign Direct Investment	FDI Inflows	World Development Indicator (WDI)
Inflation	Consumer Price Index (CPI)	World Development Indicator (WDI)
Export	Export of Good and Services	World Development Indicator (WDI)

Source (s): This table is created by the author

Table 2: Descriptive statistics

Summary Statistics	GDPG	FDI	EXP	INF
Mean	5.7463	3.7784	77.8663	8.2270
Standard error	0.5372	0.2463	3.1416	0.3893
Median	6.0722	3.5011	74.1298	7.7789
Standard deviation	3.7983	1.7413	22.2147	2.7526
Sample variance	14.4271	3.0321	493.4924	7.5767
Kurtosis	2.9535	1.0081	−0.9381	13.8036
Skewness	−1.5110	0.5951	0.4553	2.9850
Range	18.9229	8.7038	75.7624	18.4677
Minimum	−7.3594	0.0567	45.5490	3.8613
Maximum	11.5635	8.7605	121.3114	22.3290
Sum	287.3161	188.9215	3893.3171	411.3479
Count	50	50	50	50
Confidence Level (95%)	1.0795	0.4949	6.3133	0.7823

Source (s): This table is created by the author

Table 3: Stationarity test results using ADF and PP methods

Variables	ADF			PP		
	Level (none)	Level (intercept)	Level (trend & intercept)	Level (none)	Level (intercept)	Level (trend & intercept)
Level						
LGDPG	−0.348 (2)	−6.601***(0)	−6.818***(0)	−0.474 (11)	−6.601***(0)	−6.827***(3)
LFDI	−1.333 (2)	−6.069***(0)	−6.129***(0)	−2.539** (2)	−6.069***(0)	−6.133***(1)
LEXP	0.525 (1)	−1.892 (4)	−0.660 (0)	0.555 (2)	−1.558 (2)	−0.742 (1)
LINF	−0.605 (1)	−5.618***(0)	−5.948***(0)	−1.264 (3)	−5.604***(1)	−5.947***(1)
First difference						
LGDPG	−9.056***(1)	−8.954***(1)	−8.854***(1)	−29.507***(22)	−28.565***(22)	−28.350***(22)
LFDI	−8.052***(1)	−7.963***(1)	−7.865***(1)	−28.227***(27)	−29.088***(27)	−28.610***(27)
LEXP	−5.375***(0)	−5.380***(0)	−5.557***(1)	−5.436***(1)	−5.443***(1)	−5.834***(6)
LINF	−9.534***(0)	−9.433***(0)	−9.306***(0)	−10.462***(3)	−10.340***(3)	−10.152***(3)
Second difference						
LGDPG	−7.155***(3)	−7.065***(1)	−6.998***(3)	−57.166***(36)	−58.493***(36)	−62.165***(37)
LFDI	−8.335***(2)	−8.234***(1)	−8.133***(2)	−63.009***(46)	−62.977***(37)	−70.317***(46)
LEXP	−7.718***(2)	−7.620***(2)	−7.513***(2)	−15.020***(15)	−15.361***(15)	−15.102***(15)
LINF	−10.043***(1)	−9.912***(1)	−9.793***(1)	−17.628***(4)	−17.448***(4)	−16.689***(3)

Standard errors are in parentheses. ***P<0.01, **P<0.05, *P<0.1.
Source (s): This table is created by the author

Table 4: Bound test results

F-Bounds test			
Null hypothesis: No levels relationship			
F-Statistic	Signif (%)	Model D (LGDPG)	
		Lower Bound I (0)	Upper Bound I (1)
		Asymptotic: n=1000	
	10	2.72	3.77
	5	3.23	4.35
	1	4.29	5.61
F- statistic		F=8.8106***	

Standard errors are in parentheses. ***P<0.01, **P<0.05, *P<0.1.
Source (s): This table is created by the author

critical value at the 1% significance level (5.61), and the null hypothesis of no levels relationship is rejected. This suggests that the GDP growth of Malaysia is cointegrated with FDI, trade openness, and inflation, confirming the existence of a long-run equilibrium relationship among the variables (Pesaran et al., 2001). As such, economic policy that affects these indicators will have lasting impacts on GDP growth. For example, chronic increases in FDI and exports can bring about long-run economic growth via higher capital inflows, technological advancement, and export-led revenues. However, the long-run impact of inflation is contingent on its level and stability, under which circumstance moderate inflation will maintain growth but high inflation will cause distortion in growth (Khan & Senhadji, 2001). The findings form the grounds for estimation of a long-run ARDL model and Error Correction Model (ECM) in order to investigate further both short- and long-run dynamics.

Table 5 shows the ARDL (3,1,2,0) order specification both reveals short-run and long-run relationships between GDP growth and macroeconomic determinants such as FDI, exports, and inflation. The error correction term is significant at 1% and is negative (−2.3574, P < 0.01), reflecting a rapid and strong adjustment towards long-run equilibrium after a shock. However, the FDI, export, and inflation long-run coefficients are all positive but statistically insignificant, which means that these variables have no lasting impact on GDP growth in the long term in this model.

During the short run, the model captures strong dynamics. Negative and significant lagged growth variables for GDP capture possible cyclical adjustment. FDI captures a heterogeneous short-run effect having a positive contribution to GDP growth during the measurement period, and its lagged value being negative, perhaps capturing adjustment costs or effects of repatriation. Exports contribute positively with a lag, as seen from the significance of LEXP01(-1). Inflation is positive but statistically insignificant on both horizons.

Collectively, the results emphasize the contribution of FDI and exports to determining short-run economic growth in Malaysia. FDI impacts the economy immediately but may be accompanied by short-run adjustments, while exports contribute positively with a lag effect. The results confirm the broader open economy growth literature, and they indicate that investment and trade are short-term growth drivers, although their longer-term effects are less significant without structural support (Tang & Tan, 2016; Chong & Tan, 2008).

Table 6 presents the Error Correction Model (ECM) estimate shows the lagged error-correction term, ECM (-1), to be highly significant and negative (−2.3574, P < 0.01), with high and rapid adjustment towards long-run equilibrium. The Error Correction Term (ECM) coefficient of −2.3574 in the ARDL model is the rate at which the growth of the Gross Domestic Product (LGDPG) moves back to long-run equilibrium after having been struck with short-run shocks. The sign is positive and it indicates that indeed there is a stable relation among the variables in the long run. Specifically, the coefficient is taking into account that around 236% of the gap from the last period is corrected in the current period. This is a sign of a rapid adjustment process since the system not only corrects the imbalance in the short run but maybe overcorrects the balance in the initial stages before reaching a stable position in later periods. Statistical significance of ECM at 1% level also supports the appropriateness of such an adjustment rate, which shows that the Malaysian economy tends to return to its long-run growth path after short-run shocks due to factors such as Foreign Direct Investment (FDI) and exports. FDI (D(LFDI)) in the short run is positively contributing to GDP growth with a significant coefficient of 0.1742 (P < 0.01), which suggests that FDI contributes to short-run economic growth. The impacts of export are heterogeneous negative and marginally significant D(LEXP01), but positive and marginally significant D(LEXP01(-1)) implying that export growth may have a positive lagged effect. The very first lag in GDP growth (D (LGDPG (-1),2)) is also significant, complementing the significance of past growth in explaining current performance. Overall, the model confirms a valid long-run relationship and significant short-run effects of FDI and exports.

Error Correction Model (ECM) determines that GDP growth adjusts rapidly to its long-run level, as determined by the coefficient and negative ECM term (−2.3574, P < 0.01), determining model stability (Pesaran et al., 2001). FDI has a positive effect on GDP growth in the short run (0.1742, P < 0.01), determining its role in accelerating economic activity through the transfer of capital and technology (Borensztein et al., 1998). Exports have a bimodal effect negative in the initial phase but positive in the second phase suggesting trade gains lagged. Overall, the ECM estimates focus on the role of FDI and exports in short-run growth and long-run stability.

Table 7 shows the diagnostic statistics of the ARDL model indicate that the assumptions of regression are well satisfied. The 0.827 R^2 indicates that approxitely 82.7% of the variability in GDP growth is explained by the independent variables and that there is a good fit in the model. The normality test (x^2_{NOR} . = 0.3069, P = 0.3069) fails to reject the null hypothesis that residuals are normally distributed, and hence the error terms are normally distributed. The serial correlation test (X^2_{SC} = 2.362, P = 0.3069) fails to reject the null hypothesis, and hence no autocorrelation among the residuals. Also, the heteroscedasticity test (X^2_{HET} = 0.669, P = 0.6489) is not able to reject the null hypothesis that the residual variance is homoscedastic, i.e., equal to a constant. The p-value is greater than 0.05, hence the model fulfills the assumption of homoscedasticity. Lastly, the Ramsey RESET test (R_m = 1.4207, P = 0.2413) fails to reject the null hypothesis that the model is well-specified and does not offer any evidence for omitted variables or functional form misspecification. Altogether, these findings confirm that the model is statistically reliable and ready to be safely interpreted and forecasted.

Together, these diagnostics render the model statistically sound and useful in policy analysis. The estimates could be confidently employed to identify the short- and long-term effects of FDI, exports, and inflation on GDP growth. Since the model does not violate any basic assumptions, the significant coefficients such as the short-run positive impact of FDI and lagged exports can be regarded as genuine economic relationships and not statistical anomalies. This enhances the value of the model in guiding development policy in sustaining GDP growth in the case of Malaysia's open and investment-driven economy (Haruna et al., 2022).

Figure 4 depicts the CUSUM test for stability diagnostics of the ARDL model. Recursive residuals remain in the 5% significance interval for the whole sample period, which attests to the structural stability of the model as well as estimated. This implies that there is no break in the model structure or parameter instability over time, which attests further to the validity of the ARDL estimates.

The Figure 5 shows the CUSUM of Squares test plot, which can be used to test the constancy of the coefficients over time for a

Figure 4: Recursive cumulative error sum (CUSUM) test results

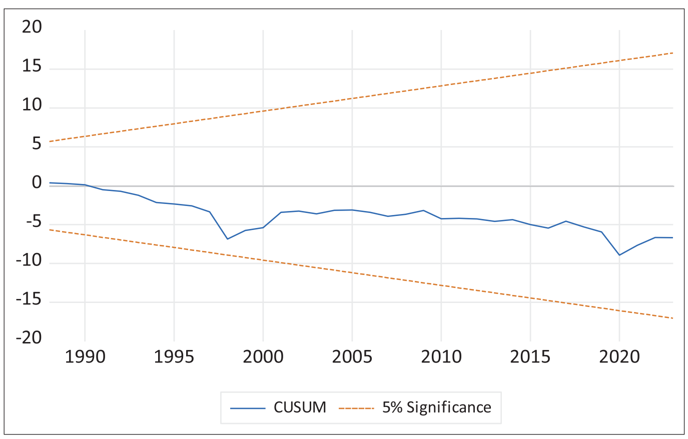
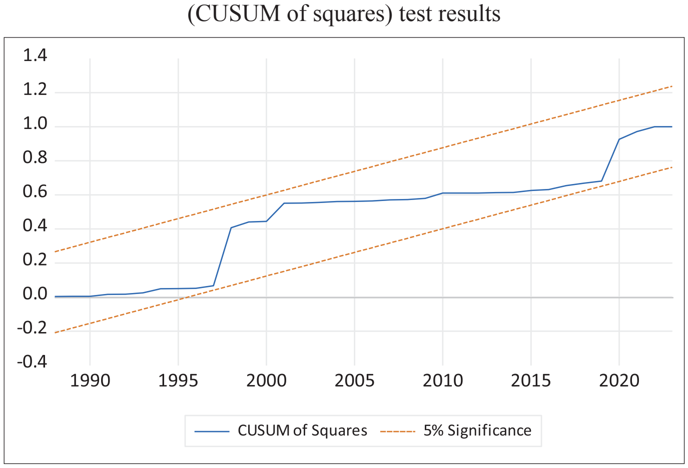


Figure 5: Recursive cumulative error sum of squares (CUSUM of squares) test results



regression model. The cumulative sum of squares is plotted by the blue line and the two red dashed lines are the 5% significance boundaries. Since the CUSUM of Squares line remains within the 5% significance bounds for the entire sample period (1990 to approximately 2022), conclude that the regression model has no temporal instability at the 5% level of significance.

There is no structural break or extreme instability in the estimated coefficients.

This means that the model parameters do not change much over time and the model can be used safely for prediction or inference in the observed time. Parameter stability is a significant requirement for validity of long-run relationship and policy-making advice.

3.3. Auto-Regressive Integrated Moving Average

ARIMA is a general statistical approach that is involved with

Table 5: ARDL estimation dependent variable

Variables	D (LGDPG) ARDL (3,1,2,0)		
	Coefficient	Standard error	t-statistic
Long Run			
D (LGDPG (−1)) *	−2.3574	0.3992	−5.9061***
LFDI (−1)	0.0044	0.1279	0.0343
LEXP01(−1)	0.0198	0.2275	0.0872
LINF**	0.0703	0.3105	0.2264
D (LGDPG (−1),2)	0.7610	0.2927	2.5999**
D (LGDPG (−2),2)	0.2287	0.1613	1.4180
D (LFDI)	0.1742	0.0923	1.8878*
D (LEXP01)	−1.5520	0.9980	−1.5551
D (LEXP01(−1))	1.6527	0.9971	1.6575
LFDI	0.0019	0.0542	0.0343***
LEXP01	0.0084	0.0966	0.0872***
LINF	0.0298	0.1314	0.2270***
C	−0.2485	1.2117	−0.2050
Short Run			
D (LGDPG (−1))	−0.5965	0.1538	−3.8779***
D (LGDPG (−2))	−0.5322	0.1695	−3.1405***
D (LGDPG (−3))	−0.2287	0.1613	−1.4180
LFDI	0.1742	0.0923	1.8878*
LFDI (−1)	−0.1698	0.0873	−1.9461*
LEXP01	−1.5520	0.9980	−1.5551
LEXP01(−1)	3.2246	1.5460	2.0857**
LEXP01(−2)	−1.6527	0.9971	−1.6575
LINF	0.0703	0.3106	0.2264
C	−0.2485	1.2117	−0.2050

Standard errors are in parentheses. ***P<0.01, **P<0.05, *P<0.1.
Source (s): This table is created by the author

Table 6: Error Correction Model (ECM) Estimation

	Model 1: D (LGDPG) ARDL (3,1,2,0)		
Variables	Coefficient	Standard error	t-statistic
D (LGDPG (-1),2)	0.7610	0.2800	2.7178**
D (LGDPG (-2),2)	0.2287	0.1549	1.4772
D (LFDI)	0.1742	0.0598	2.9152***
D (LEXP01)	−1.5520	0.9175	−1.6915*
D (LEXP01(-1))	1.6527	0.9324	1.7726*
C	−0.2485	0.0687	−3.6169***
ECM (-1)	−2.3574	0.3816	−6.1786***

Standard errors are in parentheses. ***P<0.01, **P<0.05, *P<0.1.
Source (s): This table is created by the author

Table 7: Statistics and diagnostics

Test	ARDL
R^2	0.827
X^2_{NOR} (Normality)	0.3069 (P=0.3069)
X^2_{SC} (Serial Corr.)	2.362 (P=0.3069)
X^2_{HET} (Heterosced.)	0.669 (P=0.6489)
R_m	1.4207 (P=0.2413)

X^2_{NOR}, X^2_{SC}, X^2_{HET} represents normality, rial correlation and hetero-scedasticity, spectively. R_m stands for Ramsey reset test.
Source (s): This table is created by the author

time series data modeling and forecasting, particularly used in data sets which are trended, cycled, or autocorrelated over time. ARIMA works by the integration of three components: autoregression (AR), which uses lagged values to predict current values; integration (I), which uses differencing of the data in order to preserve stationarity; and moving average (MA), which utilizes previous error forecast in the model. These components are referred to with the parameters p, d, and q respectively (Al-lami & Török, 2024).

The Table 8 shows the result of an automated ARIMA (Auto Regressive Integrated Moving Average) forecasting procedure for the response variable GDPG (likely to be GDP growth). The analysis has been carried out using yearly data from 1974 to 2023, i.e., 50 observations. The forecast horizon has been set to 7 future time points. With the experimentation of 25 ARMA models, the selected model is ARIMA (1,1,0) where one autoregressive term (AR=1), one difference in order to achieve stationarity (I=1), and no moving average term (MA=0). It suggests that the majority of models of current GDPG are influenced by the directly previous value (lag 1) and that the first difference needed to be taken out to remove trends or non-stationarity. The AIC for this model is 5.5746, and this suggests a good model fit, with the smaller values of AIC preferred when models are compared and contrasted.

Table 9 presents the forecasted growth rates of GDP from 2024 to 2030 under the ARIMA (1,1,0) model. According to the forecast, GDP growth will be 15.178% in 2024, increase to a peak of 16.001% in 2025. This is a positive economic growth during the nearby post-estimation period. However, from 2026 onwards, growth increases at a diminishing rate, predicting 15.420% in 2026 and 15.830% in 2027. The trend is quite stable with minor oscillations for the rest of the years, recording 15.541% in 2028, 15.745% in 2029, and 15.601% in 2030. These recurring and high anticipated rates of growth point towards the economy still being on a robust and consistent trajectory for the seven-year outlook period.

Figure 6 displays the historical and forecasted GDP growth rates (%) from 2014 to 2030, with the past values between 1974 and 2023 and the forecast between 2024 and 2030. The real GDP growth is indicated by the orange line, which makes small rising and declining movements between 2014 and 2019 and a steep falling movement in 2020, likely due to economic impacts of the COVID-19 pandemic.

Table 8: ARIMA forecasting

Automatic ARIMA Forecasting
Selected dependent variable: GDPG
Sample: 1974 2023
Included observations: 50
Forecast length: 7
Number of estimated ARMA models: 25
Number of non-converged estimations: 0
Selected ARMA model: (1,1) (0,0)
AIC value: 5.57462006532

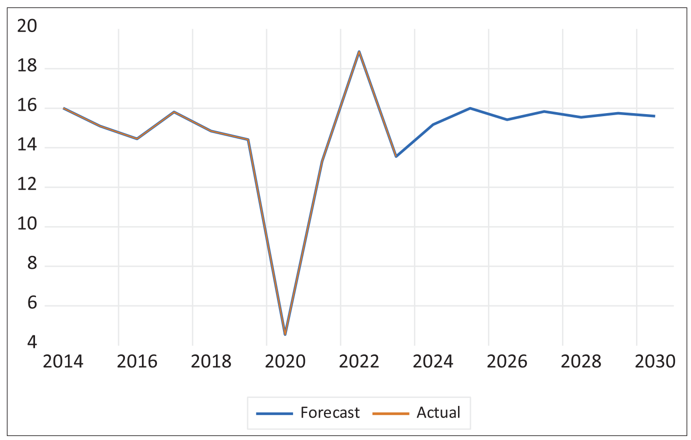
Source (s): This table is created by the author

Table 9: Forecasting of GDP growth (%)

Year	GDP growth (%)
2024	15.178
2025	16.001
2026	15.420
2027	15.830
2028	15.541
2029	15.745
2030	15.601

This table is created by the author

Figure 6: Actual and forecast of GDP growth (%)



There is a strong rebound in 2021, with rapid recovery efforts followed by stabilization in 2022 and 2023. Starting from 2024 and onwards, the blue line indicates the values forecast by the ARIMA (1,1,0) model. The forecast shows a smooth increasing trend from 2024 to 2025, reaching its peak in 2025.After that, the projection continues with a high and consistent rate of growth with minor fluctuations until 2030. The trend shows a strong and consistent economic performance in the near future, which is a sign that the economy will continue to enjoy growth momentum in the medium term.

Figure 7 is a graph of comparison of projections with various ARMA (Auto Regressive Moving Average) models between 2024 and 2030. Each of the gray lines represents a unique ARMA(p,q) model combination that has been used to forecast the target variable over time. Among these, the ARMA (1,1) (0,0) model is marked red to indicate its comparative performance. Overall, most models' forecasts fall together in the 15 to 17 value range and suggest the same pattern of predictions. Some models are also more unstable and differ, especially for 2026 and 2028. The ARMA (1,1) (0,0) model (in red) takes a relatively stable

Figure 7: Forecast comparison graph

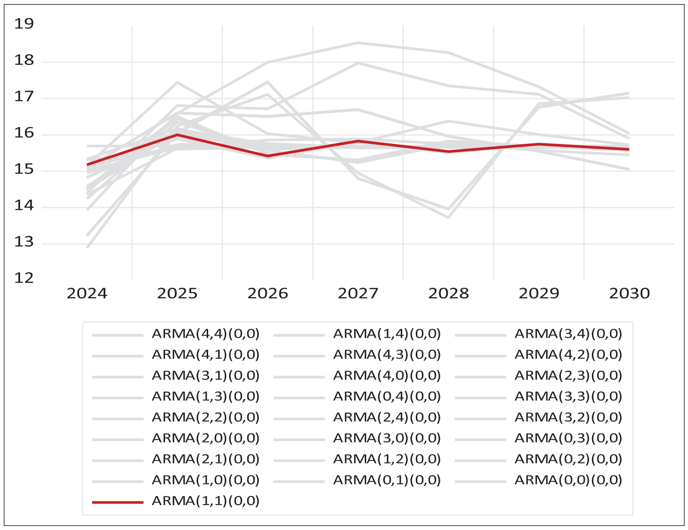
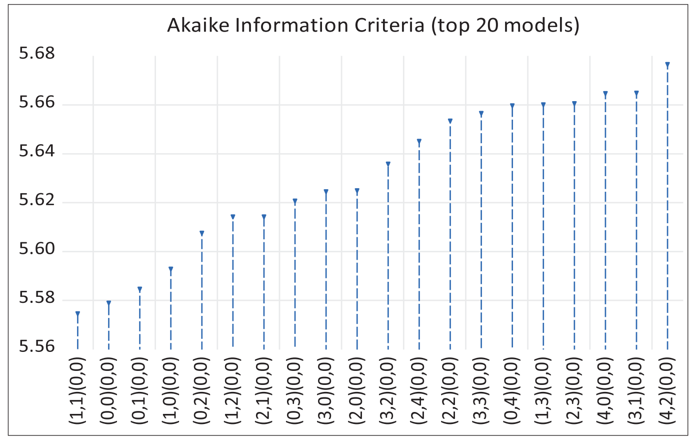


Figure 8: Akaike information criteria



and continuing path across the forecast period and suggests that it may be one of the more stable-performing or better-performing models when it comes to stability. This graph assists in ascertaining which model makes the most realistic and stable prediction, and ARMA (1,1) (0,0) is regarded as a front runner since it oscillates the least.

The model estimation result in Table 10 indicates that all the parameters are significant at the 1% level, suggesting a good-specified ARIMA model. The constant (C = 15.66026) is representative of the mean level of the dependent variable in the model. The autoregressive coefficient AR (1) = −0.7054 suggests negative correlation with the preceding period value, indicating some kind of adjustment or reversal of series. The moving average coefficient MA (1) = 0.9455 is positive and close to one, suggesting strong influence of past error terms on values. The residual variance (SIGMASQ = 12.9172) is high, in order to capture the volatility of the data by the model. In general, the model is well fit to the data and captures the underlying dynamics of the time series fairly well.

Figure 8 presents the Akaike Information Criterion (AIC) values of the top-performing 20 ARDL models. AIC is a popular model selection criterion where lower values indicate better model fit compared to others. The ARDL (1,1,0,0) model has the best AIC value and is therefore the top-performing model among the set of 20 according to this criterion. This accords with Table 8, wherein the same model boasts the lowest value of about 5.5746 AIC.

Close competitors such as ARDL (0,3,0,0) and ARDL (0,2,1,0) have low AIC values but just slightly above that of (1,1,0,0). The graph shows that even though there are models bunched within a narrow set of AICS (ranging from 5.56 to 5.68), the ARDL (1,1,0,0) model stands out in having an optimal goodness-of-fit vs. model simplicity balance. Lastly, the graphical representation in Figure 4 warrants the selection of the ARDL (1,1,0,0) model as the best suited for GDPG analysis based on it being a loss-minimizing representation and one of the most parsimonious of the models under consideration.

Table 10: Model estimayion result

Variables	Coefficient	Standard error	t-statistic
C	15.66026	0.784182	19.97018***
AR (1)	−0.705447	0.252709	−2.791539***
MA (1)	0.945480	0.143359	6.595176***
SIGMASQ	12.91723	3.182000	4.059468***

Standard errors are in parentheses. ***P<0.01, **P<0.05, *P<0.1.
Source (s): This table is created by the author

4. CONCLUSION

This research, therefore, looks into the impact of FDI on GDP growth in Malaysia. The findings affirm that FDI has indeed been an effective driver of the economic growth of Malaysia, in terms of capital injection, technology transfer, and the creation of jobs. Over these years, Malaysia has been quite successful in attracting foreign investment owing to its strategic location, business-friendly policies, and economic openness. But some other factors interact in the process: for example, inflation, trade openness, human capital, and especially, macroeconomic stability. As noted, the study shows FDI has had a positive effect on GDP; however, there are instabilities caused by varied outside economic shocks and such internal challenges as a shortage of appropriate technology or low levels of prepared labour forces. For instance, inflation has been inversely related to the GDP while openness of trade and exports have complemented the latter when it is in growth. There is, therefore, a call for policymakers to increase investment incentives, develop infrastructure, and improve regulatory frameworks so as to continue with the benefits accruing from FDI to maximum. Conclusion, FDI remains one of the strong determinants of Malaysia's economic growth, but to achieve long-term success, it is very imperative that strategic policies and human capital development in a stable economic environment are employed. Future research on the sector-specific impact of FDI will be very useful for the refinement of economic strategies for sustainable growth.

4.1. Policy Implication

For Malaysia to sustain the role of FDI in facilitating growth in GDP, it needs to improve its investment climate through improved infrastructure, transparency in regulations, and human resource development. Education and technical training will be improved in order to enable more workers to absorb foreign technology. Macroeconomic stability, low inflation levels, and reduced bureaucratic delays will attract high-quality investment even more. Selective incentives to high-value industries such as technology, green energy, and manufacturing can ensure optimal long-term gain.

Secondly, the attractiveness of sectoral FDI, particularly to highly linked industries like manufacturing and technology, is crucial to sustainable and equitable growth. Policies have also to ensure that FDI complements, rather than crowds out, local investment. A transparent and investor-friendly policy environment will ensure investor confidence and allow Malaysia not only to harness FDI to propel economic growth, but to trigger innovation and long-term development.

4.2. Future Research

Follow-up studies will need to move away from aggregative method and investigate the sectoral and geographical impacts of FDI on Malaysia, i.e., the manufacturing, service, agriculture, and technology sectors. Greater priority must be accorded to understanding how policy stability, governance, and institutional quality influence the FDI-GDP nexus because these are ignored variables whose significance has been found. Aside from this, more focus should be put on the long-term contribution of FDI, including its spillover effect on local innovation, labour market, income inequality, and environmental conservation.

The other field of focus is the application of newer econometric methods such as Structural Vector Autoregression (SVAR) or Nonlinear ARDL to identify dynamic or non-linear effects, especially in the context of economic shock. Measuring R&D, the level of education, and skill building as proxies for human capital would indicate the way local capacity interacts with FDI. Lastly, subsequent studies need to investigate Malaysia's participation in regional free trade agreements like RCEP and belonging to the global value chain as potential moderators between FDI and growth.

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