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A Time Series Analysis on Foreign Direct Investment Determinants in Malaysia

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ABSTRACT

Using time series analysis from 1971 to 2022, this paper investigates the important economic factors influencing foreign direct investment in Malaysia. Malaysia's economic growth depends heavily on foreign direct investment, which is impacted by factors including GDP per capita, inflation rate, and population growth. This study determines the relationship between said variables and foreign direct investment using multiple linear regression model. The results suggested that both population growth and inflation rate have statistically significant effects on foreign direct investment, with population growth and inflation rate having a negative link and a positive correlation, respectively. However, in this study, GDP per capita has little bearing on foreign direct investment. These revelations help to clarify how macroeconomic variables influence investment choices.

1. Introduction

1.1 Research Background

The term "Foreign Direct Investment (FDI)" refers to an investment arrangement in which the host nation offers the investor nations investment opportunities. The investment could be in terms of joint ventures, acquisitions, or the founding of a new business in the host nation initiated by foreign investors. Due to the potential advantages for the host nations' economies and higher returns for investors, there is constantly growing competition on a global scale to draw foreign direct investment, as stated by Srinivasan *et al.*, [1] and Albulescu [2].

To make large investments and get respectable returns, investors are looking for places that are conducive to making investments. Asbullah *et al.,* [3] states that Asian nations have gained a lot of prominence in this area due to their bountiful investment options, low labour costs, strategic location, and higher returns at lower risk.

According to the economic theory, FDI reduces risk through asset diversification, increases intertemporal expenditure smoothing, and allocates global savings more efficiently. International

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technological transfers have also been connected to international investment. The expansion of the financial industry is a critical component that occurs along with economic growth. In reality, it is reasonable to believe that stability and growth in the economy and financial system are two sides of the same coin, in agreement with Borio [4] and Nasir *et al*., [5]. As such, even though financial development is acknowledged as a significant contributor to global expansion, it is equally important to take this relationship into account on a broader scale considering its social and ecological effects. This is the main topic of this subject study, with a particular emphasis on Malaysia as a developing country.

Referring to the World Investment Report [6], the global FDI flows dropped from its 2019 value of $1.54 trillion to as low as 40% in 2020. This would be the first since 2005 that FDI values dropped below $1 trillion. FDI flows to emerging Asia fell by 5% in 2019 to $479 billion, amidst the increase in China, India, and Southeast Asia. A lot of countries in Africa, Asia, and the Middle East are experiencing growth, as stated by Akadiri *et al.*, [7]. However, necessary resources are lacking for sustained development. As a result, these countries are in competition with one another to improve the investment climate in order to position themselves as the most favourable destination for FDI.

FDI is critical to a company's profitability and competitiveness since foreign facilities may have better or more affordable access than domestic facilities to labour, money, land, and natural resources. Although Asian nations can serve as a gateway for trade with other nations, one of the main obstacles to some of these nations' broader development is the scarcity of available resources. Malaysia is a rising Asian nation that has done a great job of diversifying its economy in the last several years, in consonance with Awad [8].

It is observed that there is a significant lack of studies regarding the effect of population growth, that this study includes as one of the independent variables which affect the trends for FDI. This study also aims to further improve existing studies by using a more recent interval of time, which is from 1971 to 2022. The research objectives are as follows; first is to examine the socioeconomic determinants that significantly affect Foreign Direct Investment in Malaysia. The second objective is to examine the relationship between Foreign Direct Investment with inflation rate, population growth and GDP per capita. For the completion of the said objectives, this study will respond to the following questions, the first one is “What are the variables that significantly affect Foreign Direct Investment in Malaysia?”. The second research question is “What is the relationship between Foreign Direct Investment and with inflation rate, population growth, and GDP per capita?” The components that follow that are methodology, results and conclusion and this study will elaborate further in those aspects to achieve the research objectives and answer the research questions.

1.2 Literature Review

1.2.1 Foreign direct investment

According to Hamood *et al.*, [9], the Malaysian economy is expanding quickly every day, and FDI is a major contributing factor to this robust expansion. A number of factors, including its well-developed infrastructure, steady economic growth, solid microeconomic management, and robust financial system, have made Malaysia an appealing destination for FDI. His research was a time series analysis through 30 years, from 1985 to 2014 which involved FDI and five other independent variables, namely market size, infrastructure, exchange rate, inflation rate, and education. No multicollinearity was detected from the relationship of the independent variables, making results of the study meaningful.

It is widely accepted that Malaysia is a desirable destination for FDI due to its stable economic growth, efficient macroeconomic management, and robust financial system, as stated by Ang [10] and Fazidah [11]. However, since the early 1990s, the ratio of FDI inflows to GDP has been steadily declining. His research showed that, contrary to popular belief, macroeconomic uncertainty appears to promote FDI inflows. This may be the case when foreign investors believe that a larger degree of uncertainty translates into a bigger possible return on investment. Therefore, the findings suggest that the overall composition of FDI may have changed in favour of more speculative foreign investment, which is not always associated with growth.

1.2.2 Inflation rate

Low inflation is regarded as a sign of strong internal economic stability for a country, as stated by Ezeoha and Cattaneo [12]. Conversely, elevated inflation indicates a lack of effectiveness in the government's budget management measures and a mishandling of the central bank's monetary policy. Investors are drawn to a country with a long history of stable low inflation because of the government's credibility and the stability of the country. According to Lee [13], stable economies are more likely to draw foreign direct investment (FDI) than those with high rates of inflation because they demonstrate the capacity of the host government to effectively regulate the nation; as a result, low-inflation countries are more appealing to foreign capital inflows.

1.2.3 GDP per capita

The neoclassical model states that foreign direct investment (FDI) boosts GDP by improving the economy's short-term efficiency. Findings from Sijabat [14] concluded that there is a positive bilateral relationship between FDI and GDP per capita. In other words, GDP has a positive effect on FDI, and FDI has a positive effect on GDP. GDP shows actual economic growth after accounting for inflation. Regarding the business cycle, GDP serves as the main benchmark for all other measures of financial and economic stability, in agreement with Nasir *et al.*, [15].

1.2.4 Population growth

Cities all throughout the world are concerned about an excessive pace of population expansion. Therefore, controlling population growth is crucial to preserving overall sustainability of cities. Approximately half of the world's population currently resides in cities, and by 2050, that number will rise to 66%, in accord with Department of Economics and Social Affairs [16]. Cyhn and Zara [17] stated that 16% of Cambodians, 42% of Indonesians, 62% of Malaysians, 48% of Filipinos, 100% of Singaporeans, 31% of Thais, and less than 30% of persons in Myanmar, Bangladesh, and Vietnam were urban dwellers in 2000. The increase in population has increased the need for jobs and corporate workers especially in Malaysia, which indirectly attracts big companies who need a lot of manpower to run the buildings in order to invest in a capital in a certain country.

2. Methodology

2.1 Data Collection

All data stated are obtained from various trustable sources, such as Bank Negara Malaysia (BNM), Our World in Data, and Department of Statistics Malaysia (DOSM). A total data of 51 years has been successfully collected for each variable, specifically from 1971 to 2022. The datasets are

divided into two different categories, namely dependent and independent variables consisting of one and three datasets respectively. Independent variables consist of population growth, inflation rate, and GDP per capita while the dependent variable is foreign direct investment.

2.2 Data Analysis

2.2.1 Correlation analysis

A statistical technique called correlation analysis is used to determine whether two variables are related and to estimate the strength of that link. Correlation analysis is employed in this study to examine the collected data sets and see if there are any noteworthy associations, patterns, or tendencies between each independent variable which is Foreign Direct Investment, and the dependent variables which are population growth, inflation rate and GDP per capita. Correlation analysis is essentially used to identify trends in datasets. A positive correlation indicates an increase in both variables relative to one another, whereas a negative correlation indicates an increase in one variable as the other falls. The strength of the association between two variables can be measured using Pearson's correlation coefficient. The values of Pearson's correlation coefficient, r, range from -1 to +1. Perfect linear relationships between the two variables are shown by values of −1 or +1, whereas no linear relationship is indicated by values of 0. Pearson's correlation coefficient can be calculated using Eq. (1):

$$r = \frac{\sum(x_i+\bar{x})(y_i+\bar{y})}{\sqrt{\sum(x_i+\bar{x})^2 \sum(y_i+\bar{y})^2}} \quad (1)$$

2.2.2 Multicollinearity test

Multicollinearity is a quantitative concept that shows how collinearity causes an increase in a regression coefficient's variance. When multiple predictor variables in a model of regression have a strong correlation, this is known as multicollinearity. There is a significant linear link between variables when they have a high correlation. Regression analysis's Variance Inflation Factor (VIF) gauges how severe multicollinearity is. The formula for VIF is as Eq. (2):

$$VIF = \frac{1}{1-R^2} \quad (2)$$

2.2.3 Stationarity test

Checking for the existence or lack of a unit root is the conventional technique for determining whether a time series is stationary or otherwise. Typically, testing is expanded to include both stochastic trends represented by unit roots and deterministic trends. The primary purpose of the Augmented Dickey Fuller (ADF) test is to analyse a large, complex time series data and provide it in a statistical manner. The formula for the ADF test is as shown in Eq. (3-5):

$$No\ constant, no\ trend: \Delta Y_t = \gamma Y_{t-1} + \delta_1 \Delta Y_{t-1} + \delta_2 \Delta Y_{t-2} + \cdots + \delta_p \Delta Y_{t-p} + \mu_t \quad (3)$$

$$Constant, no\ trend: \Delta Y_t = \beta_0 + \gamma Y_{t-1} + \delta_1 \Delta Y_{t-1} + \delta_2 \Delta Y_{t-2} + \cdots + \delta_p \Delta Y_{t-p} + \mu_t \quad (4)$$

$$Constant\ and\ trend: \Delta Y_t = \beta_0 + \beta_1 t + \gamma Y_{t-1} + \delta_1 \Delta Y_{t-1} + \delta_2 \Delta Y_{t-2} + \cdots + \delta_p \Delta Y_{t-p} + \mu_t \quad (5)$$

2.2.4 Multiple Linear Regression (MLR) model

A single dependent variable and a minimum of two independent variables make up a multiple line regression model. Furthermore, explanatory factors, which are used to forecast the result of the dependent variable, are referred to as independent variable variables. Several linear regressions are the model of choice primarily because it allows the researcher to incorporate several independent variables. Its adoption is also attributed to the assurance it offers that the estimated outcomes would not deviate from the actual outcome. It is important that the independent variables are assessed at the same time as to reduce bias and assist in highlighting unique explanatory power of individual variables. This makes MLR a perfect model to accommodate specific restrictions that are present in this study. With the real-world complexity that comes with multiple factors interacting with one another in one instance, MLR better captures and reflects the individual effects of each variable.

To enable more accurate projections, three independent variables have been chosen for this investigation. For this multiple linear regression, the following model Eq. (6) will be used:

$$FDI = \beta_0 + \beta_1 Pop_t + \beta_2 InfR_t + \beta_3 GDP_t + \varepsilon_t \quad (6)$$

where,
$FDI =$ Foreign Direct Investment in Malaysia
$Pop =$ Population growth
$InfR =$ Inflation rate
$GDP =$ GDP per capita
$\beta_i =$ Estimated coefficients where $i = 0, 1, 2$ and 3.
$\varepsilon_t =$ Error term

2.2.5 R^2

In a regression model, R^2 represents a statistical metric that establishes how much of the variance in the dependent variable can be accounted for by the independent variable. The goodness of fit, or R^2, indicates whether the data fits the regression model or not. It has a range of 0 to 1, with 1 denoting a perfect match between the model and the data. In this case, we can use R^2 to know how well population growth, GDP per capita and inflation rate can explain Foreign Direct Investment. The formula used to find R^2 value is as shown in Eq. (7):

$$R^2 = 1 - \frac{RSS}{TSS} \quad (7)$$

where,
$TSS =$ Total sum of squares
$RSS =$ Sum of squares of residuals

2.2.6 F-test

The F-test can be used to determine whether the regression model is statistically significant or not. It can determine if at least one of the independent variables namely inflation rate, GDP per capita, and population growth can significantly predict Foreign Direct Investment. The formula of F-Test is as shown in Eq. (8):

$$F = \frac{\left(\frac{RSS}{k}\right)}{\left(\frac{SSE}{n-k-1}\right)} \quad (8)$$

where,
RSS = Residuals sum of square
SSE = sum of the squared errors
n = the sample size
k = total parameters estimated in the unrestricted model (including the intercept)

3.2.7 t-test

A statistical method known as *t*-test can be used to measure the difference in a variable's mean (average value) between two or more datasets. The significance of each regression coefficient can be assessed using the *t*-test. This makes it easier to assess whether particular factors have a significant impact on FDI. The formula for the *t*-test is as shown in Eq. (9):

$$t = \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}} \quad (9)$$

where,
$\bar{x}$ = observed mean of the data
μ = assumed mean
s = standard deviation
n = data size

3. Results

3.1 Stationarity Test

We performed the stationarity test on all variables. Stationarity of data is crucial for regression analysis as it ensures that the statistical properties of the data such as mean, autocorrelation and variance remain constant over time. Regression analysis becomes more reliable when non-stationarity is addressed, which makes it easier to model variable connections correctly. A significance level of 0.05 is used to determine stationarity, which means that if the p-value is less than 0.05, the H_0 is rejected and the variable is stationary, and vice versa. The results show that all variables are not stationary at level. We then proceed with the first difference data where the results are shown in Table 1.

Table 1
ADF test at 1st difference

Variables		Abbreviation	p-value at 1st difference	Stationary
Independent	Foreign Direct Investment	FDI	0.0000	Yes
Dependent	GDP per capita	GDP	0.0005	Yes
	Inflation rate	InfR	0.0000	Yes
	Population growth	Pop	0.0111	Yes

As shown in Table 1, all variables show a p-value of less than 0.05, which indicates that the data are all stationary at the first difference. In other words, the null hypothesis which states that the data is not stationary can be rejected.

3.2 Variance Inflation Factor (VIF) Value

Multicollinearity is present when there is a notable correlation between two or more independent variables. Regression coefficients may be affected if multicollinearity occurs, hence it is important to ensure there is no or low multicollinearity present. The Variance Inflation Factor (VIF) is used to identify multicollinearity in the multiple linear regression model. VIF measures the extent to which multicollinearity among the independent variables inflates the variance of the regression coefficient.

All the independent variables in Table 2 namely population growth, inflation rate, and GDP per capita—have extremely low VIF values, with a maximum of 1.11. As VIF values below 10 (and preferably below 5) are typically seen as acceptable, this suggests that these variables do not significantly exhibit multicollinearity. As a result, it is highly unlikely that multicollinearity will skew the results of the regression model, and the impact of each independent variable on FDI may be accurately and reliably interpreted.

Table 2
The VIF values for each independent variable

Variable	VIF
Population growth	1.00
Inflation rate	1.11
GDP per capita	1.11

3.3 Descriptive Analysis

In Table 3, we demonstrate the descriptive analysis. Apparently, all variables are negatively skewed except for the FDI, whereas all variables seem to be leptokurtic since their values are above 0. The negative mean value for population growth indicates there may have been a period between 1970 and 2022 where Malaysia experienced a slow growth in population. GDP per capita having a small standard error value (0.005) indicates that a more precise estimate and inflation rate having the highest standard error value indicates a less accurate estimate, most likely due to increased variation. It can be seen that inflation rate has a high value of standard deviation with a glaring 2.9089, which exhibits a high spread around the mean of said data. Consequently, standard variance which is the square root of standard deviation shows the dispersion of data, and inflation seems to have the highest variance of 8.4615, which indicates more spread.

Table 3
Descriptive analysis of all variables

	Foreign Direct Investment	GDP per capita	Inflation rate	Population growth
Mean	0.0228	0.0370	0.0295	-0.0255
Standard error	0.2328	0.0050	0.4034	0.0088
Standard deviation	1.6788	0.0359	2.9089	0.0634
Standard variance	2.8182	0.0013	8.4615	0.0040
Kurtosis	0.5868	4.0654	7.3168	0.9307
Skewness	0.5570	-1.7787	-1.2770	-0.0830

3.4 Correlation Analysis

The correlation among the variables is tested to demonstrate the relationship between the independent variables and dependent variable. An inverse relationship between variables is indicated by a negative value, and a positive value represents positive correlation between variables. This analysis highlights the independent variables that have a strong association with the dependent variable.

Based on Table 4, it is observed that the FDI and population growth have an inverse relationship, as seen from the negative value displayed which is -0.3087. This means that an increase in the population growth in Malaysia will slightly decrease the Foreign Direct Investment, and vice versa. Additionally, both inflation rate and GDP per capita exhibit a positive relationship with Foreign Direct Investment, exhibiting results of 0.3977 and 0.3307 respectively.

Table 4
Correlation matrix between variables

	FDI	Pop	InfR	GDP
FDI	1			
Pop	-0.3087	1		
InfR	0.3977	0.0282	1	
GDP	0.3307	-0.0399	0.3102	1

3.5 Multiple Linear Regression (MLR) Model

The multiple linear regression model is estimated as shown in Eq. (10):

$$FDI = -0.558 + 10.25\ ln\ ln\ GDP\ + 0.1855InfR - 7.71Pop \quad (10)$$

Based on Table 5, it is observed that the intercept value of the model is -0.558. This value represents the expected value of Foreign Direct Investment when all independent variables are zero. The coefficient for GDP per capita which is 10.25 suggests that for every unit increase in GDP per capita, FDI will increase by 10.25 units, provided that all other variables are constant. GDP has a p-value of 0.093, which indicates that GDP is not statistically significant towards Foreign Direct Investment as it is higher than the significant level of 5%. This result aligns with the findings of Ausloos *et al*., [18] and Ahmed [19] where studies on Malaysia as one of the emerging countries revealed a negative relationship between GDP per capita and Foreign Direct Investment. Mazenda [20] mirrored this result with a study on South Africa for the period of 1960-2002.

Table 5
Results of regression analysis

	Coefficient	t-value	p-value
Intercept	-0.558	-1.81	0.077
GDP	10.25	1.71	0.093
InfR	0.1855	2.51	0.015
Pop	-7.71	-2.39	0.021

Inflation rate (InfR) has a coefficient of 0.1855, with FDI increasing by 0.1855 units per one unit of inflation rate. This indicates a positive relationship between inflation rate and FDI. It is also statistically significant as observed from the p-value of 0.015, which is smaller than the significance level 5%. On the contrary, population (Pop) has a coefficient value of -7.71, which means that a unit

increase in population decreases FDI by 7.71 units. The p-value for population is 0.021, which proves that population is statistically significant to Foreign Direct Investment as it is less that the significance level 5%. The model also has an R-squared value of 29.02% which indicates that the predictors have moderate relevance towards the target variable.

Thus, it can be deduced that inflation rate and population growth are statistically significant towards FDI, as opposed to GDP per capita. The model proposes that an increase in GDP per capita and inflation rate can increase FDI, whereas an increase in population growth can decrease FDI. Hence, the null hypothesis that states there is no significant relationship between FDI and the independent variables can be rejected.

The findings show that the quantity of FDI flowing into Malaysia is anticipated to change noticeably in response to an increase in inflation rate. Economic stability, the presence of internal economic stress, and the government's capacity to regulate the national budget are all attributed to the inflation rate. For inward investment enterprises, a high rate of inflation lowers the real worth of earnings in the local currency. According to data on inflation, Malaysia has a comparatively low rate of inflation. since a result, policymakers should work to keep the rate low since this will increase foreign direct investment inflows into the economy.

Multinational corporations are increasingly considering sustainability and environmental issues when choosing where to invest. Therefore, urban congestion, pollution, and resource stress brought on by population development do not attract environmentally responsible investors to Malaysia, hence explaining the plausibility of population growth being negatively correlated with FDI.

An empirical study by Ahmed [19], who used Ordinary Least Squares (OLS) regression to estimate the effects of FDI inflow investment in Malaysian economic growth in terms of GDP and other productivity indicators, supports the findings showing a negative correlation between FDI and GDP per capita. He observed that Malaysia's economic growth, as measured by GDP, was negatively impacted. The 1997 Asian financial crisis and the years that followed were determined to be the study's period. In comparison to the time following the country's transition to an export-oriented economy, the Malaysian economy performed terribly. This study discovered that the calibre of human capital and technological advances used in the economy's production and the 1997 financial crisis was the reason behind decreased FDI inflows and drove out Malaysia.

4. Conclusions

This study looked into factors that affect foreign direct investment (FDI) in Malaysia from 1971 to 2022, specifically investigating the relationship between FDI and three important variables: GDP per capita, population growth, and inflation rate. The results revealed that inflation rate and population growth are statistically significant predictors of FDI. On the contrary, GDP per capita appears to have no discernible impact on FDI in Malaysia. There was a positive correlation between inflation rate and FDI, suggesting that stable inflation represents economic stability. Conversely, there was a negative correlation between FDI and population growth, possibly indicating challenges in infrastructure or resource management associated with rapid population growth.

These results emphasize the importance of preserving macroeconomic stability and addressing issues relating to population to enhance the appeal of Malaysia as a destination for foreign direct investment. Policymakers should give more focus on promoting sustainable economic policies and making infrastructural investments. By addressing these issues, the perception of Malaysia as a competitive destination for foreign direct investment may be strengthened, promoting sustainability and long-term economic growth.

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