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MALAYSIAN FOREIGN DIRECT INVESTMENT AND GROWTH: DOES STABILITY MATTER?

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The objective of the paper is twofold. First, is to examine causal relationship between foreign direct investment (FDI) and economic growth in Malaysia and second, to look at the impact of FDI on the stability of economic growth and the impact of growth on stability of FDI. Using time series data, the paper implements the recent Toda and Yamamoto's (1995) non-causality test to establish the direction of causation between the two variables. In addition, the impact of FDI on stability/volatility of economic growth and impact of growth on stability of FDI are tested using Generalised Autoregressive Conditional Heteroskedasticity (GARCH) model. The study found no strong evidence of causal relationship between FDI and economic growth. However, the analysis found evidence that the flow of FDI contributes to less volatility of economic growth and the growth also contributes to less volatility of FDI flow. This indicates that, in the case of Malaysia, FDI does not cause economic growth, vice versa, but FDI does contribute to stability of growth as growth contributes to stability of FDI. Thus policies ensuring the stability of both FDI and growth are important for long-run sustainability of Malaysian economy.

1. Introduction

The relationship between foreign direct investment (FDI) and economic growth has motivated many empirical literatures focusing on both industrial and developing countries. Neoclassical models of growth as well as endogenous growth models provide the basis for most of the

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empirical work on the FDI-growth relationship. The relationship has been studied from four main channels: (i) the determinants of growth, (ii) the determinants of FDI, (iii) role of multinational firms in host countries, and (iv) direction of causality between the two variables.
Fry (1996), for example, examines the effects of FDI inflows on a group of six Asian economies (Indonesian, Korea, Malaysia, Philippines, Singapore, and Thailand). He examines five channels through which FDI activity may affect the balance of payments (savings, investments, exports, imports and economic growth) and found a positive effect of FDI on the first four variables, with a lagged response for exports. But the said findings could not simply be generalized. The balance of payment effect of FDI activity varies across countries and depends on the purpose on investments, the nature of the activity, and the age of the project. There is no solid ground to make one believe that foreign firms contribute more or less to the balance of payment of the host country than domestic firms. Case studies comparing the export performance of local and foreign firms show a mixed pattern. For instance, Willmore (1986) found foreign firms to be more export oriented than their matched Brazilian firms. Chen (1983) found no difference in the export performance of Malaysia and foreign firm. Cohen (1975) found foreign firms to be more export oriented in Korea; domestic firms are more export oriented in Singapore, and no difference in the export performance of foreign and domestic firms in Thailand.

Besides, FDI can affect growth by the generation of productivity spillovers. Blomstrom (1986) found evidence that FDI has led a significant positive spillover effects on the labour productivity of domestic firms and the rate of growth of domestic productivity in Mexico. Similar evidence also found in most of other Latin countries. In case of Malaysia, it is generally assumed that the flood of FDI into the country over the last 20 years has resulted in moderate to strong growth performance for the country. The belief is that, the FDI generated the growth. However, the causality could take place at the opposite direction. FDI possibly is determined by the growth as higher income would motivate foreign firms to invest more into the country. Chowdhury and Mavrotas (2005), for example, find a bi-directional causality between GDP and FDI for both countries Malaysia and Thailand over the period of 1969-2000. But for Chile, there exist only uni-directional of causality, that is, GDP causes FDI.

This study attempts to devote attention again on this direction of causality between GDP and FDI however with different sample period. In addition, it is also expected that flow of one variable (either FDI or GDP) could determine some degree of stability/volatility of another variable. For example, the FDI flows to the country could probably the best explanation for the stability of the country's economic growth or probably the performance of the country through economic growth will best explain the stability/volatility of FDI into the country.

For these purposes, we use an innovative econometric methodology to study the direction of causality between the two variables, FDI and economic growth, namely the Toda-Yamamoto test for causality (Toda and Yamamoto, 1995) and we also use GARCH method of estimation to observe the impact of FDI on stability of economic growth and the impact of economic growth on stability of FDI. It is hope that this methodology will allow us to derive much more robust conclusions compared to the existing empirical work on the causality between FDI and growth which uses standard Granger-causality-type tests to detect the direction of causality. Moreover, the analysis of stability will enhance the understanding of non-linear relationship between these two variables in the context of variability/fluctuation of the series rather than assuming that the relationship of the series is linear.

The structure of this paper is as follows. Section 2 discusses details of the Toda-Yamamoto approach to test for causality as well as GARCH method of estimation for the analysis of the stability of FDI and GDP. Data related to our empirical work is also discussed in this section. Section 3 presents the empirical findings and section 4 concludes.

2. Methodology

Quarterly data from Malaysia are used in estimation. Both, the foreign direct investment (FDI) and gross domestic product (GDP), as a measure of growth, are in million Ringgit Malaysia (RM). The sample period runs from the first quarter of 1990 to the fourth quarter of 2002, which comprises of 52 observations. The variables are expressed in their logarithmic transformation and all data are in real term. Sources of data are *International Financial Statistic* (IFS) CD-ROM, the *Asian Development Bank*'s website, (www.adb.org) and Bank Negara Malaysia (BNM) Bulletin.

For ***causality test,*** the paper implements the more recent *Toda and Yamamoto's* (1995) *non-causality test* to establish the direction of causation between the two variables. In most previous studies, the first-differenced VAR model of Granger's causality test was extensively used. However, the unit root and cointegration tests are usually required before testing for causality. This might contribute to possible pretest biases due to the sensitivity of stationary or cointegration tests. The pretest biases might be severe as the power of unit root tests is known to be very low and tests for cointegrating rank in Johansen (1991) are not very reliable for finite samples (see Reimers(1992) and Toda and Yamamoto(1995)). Taken these limitations cautiously, therefore, we use alternative approach to test for noncausality developed by Toda and Yamamoto(1995). In this test, we ignore any possible non-stationarity or cointegration between series.

The Toda and Yamamoto(1995) procedure essentially suggests the determination of the *d-max*, namely, the maximal order of integration of the series in the model, and to intentionally over-fit the causality test underlying model with additional *d-max* lags – so that the VAR order is now $p = k + d$, where k is the optimal lag order. This modified version of the Granger causality test is employed to establish a causal relationship between GDP and FDI in this study. The test is done by estimating a two-equation system:

$$GDP_t = \alpha_1 + \sum_{i=1}^{k+d\max} \beta_i \, GDP_{t-i} + \sum_{i=1}^{k+d\max} \delta_i \, FDI_{t-i} + \mu_t \quad (1)$$

$$FDI_t = \alpha_2 + \sum_{i=1}^{k+d\max} \phi_i \, GDP_{t-i} + \sum_{i=1}^{k+d\max} \theta_i \, FDI_{t-i} + \nu_t \quad (2)$$

where d-max is the maximal order of integration of the series in the system and μ_t and ν_t are error correction terms that are assumed to be white noise. The Wald tests were then applied to the first k coefficient matrices using the standard χ^2-statistics. The null hypothesis set for equation (1) is $\delta_i = 0 \forall_i \leq k$ and for equation (2) is $\phi_i = 0 \forall_i \leq k$. From equation (1), FDI "Granger-causes" GDP if its null hypothesis is rejected and from equation (2), GDP "Granger-causes" FDI if its null hypothesis is rejected. Unidirectional causality will occur between two variables if either null hypothesis of equation (1) or (2) is rejected.

Bidirectional causality existed if both null hypotheses are rejected and no causality existed if neither null hypothesis of equation (1) nor equation (2) is rejected.
The lag selection is a crucial step in this non-causality test especially when theory and statistical results indicate a small number of lags in the VAR component (Yamada and Toda, 1998). To choose the optimum lag length (*k*), the Akaike Information criterion (AIC) and Final Prediction Error (FPE) are implemented.

For ***stability analysis***, the *GARCH model* is used which consists of estimating two equations jointly. In the first equation, the dependent variable is the change or the log change of the series (either GDP or FDI) and the independent variable includes, in principle, a range of variables that effect changes in dependent variables and they may include lagged values of dependent variables as well. The error term in this equation will be expected to have a mean *zero* and a *time-varying* variance. The first equation is known as the *mean equation*. In general, say for *growth* equation, it could be an ARMA(Autoregressive Moving Average Model) model such as the following ARMA(1,1):

$$\Delta LGDP_t = \theta + \beta_1 \Delta LGDP_{t-1} + \beta_2 u_t + \beta_3 u_{t-1} + \eta_t \quad (3)$$

where $\Delta LGDP$ is the growth of GDP, u_t is uncorrelated random error of AR (Autoregressive) model and η is the error term and t is time period. The second equation to be estimated is the *variance equation* itself. It is assumed that the variance (h_t^2) depends on lagged squared values of the first equation's error term on its own lagged values and possibly on other variables (X_t). This second equation is known as the *conditional variance equation*, that is

$$h_t^2 = \alpha + \delta_1 \eta_{t-1}^2 + \delta_2 h_{t-j}^2 + \delta_3 X_t \quad (4)$$

where h_t^2 is variance of equation (1), t is time period, j is time lag and X could be log-differenced of FDI ($\Delta LFDI$). If this is the case, equation (4) could be rewritten as:

$$h_t^2 = \alpha + \delta_1 \eta_{t-1}^2 + \delta_2 h_{t-j}^2 + \delta_3 \Delta LFDI_t \quad (5)$$

at which, in this equation (5), we could observe the impact of FDI flows on stability/volatility of GDP through coefficient δ_3. If the coefficient is *negative* and significant, it implies that the flow of FDI contributes to *less volatility* or more stability of GDP. On the other hand, the significant *positive* value of the coefficient would imply that FDI flow contributes to *higher volatility* of GDP.

We could also test the *impact of GDP on volatility of FDI* by just changing the dependent and independent variables in equation (3) and (5). In this case, $\Delta LFDI$ would replace the dependent variable in equation (3) and $\Delta LGDP$ would replace the independent variable in equation (5). Specifically, this test will regress the following *mean* (any ARMA model suited, for example, ARMA(1,1)) and *variance* equations:

$$\Delta LFDI_t = \theta^* + \beta_1^* \Delta LFDI_{t-1} + \beta_2^* u_t + \beta_3^* u_{t-1} + \eta_t^* \quad (6)$$

$$h_t^2 = \alpha^* + \delta_1^* \eta_{t-1}^{*2} + \delta_2^* h_{t-j}^2 + \delta_3^* \Delta LGDP_t \quad (7)$$

in which the *positive* value of δ_3* implies that GDP contributes to higher volatility of FDI and *negative* value of δ_3* implies GDP contributes to *less volatility* of FDI.

Before estimating equations (3) and (5) or equations (6) and (7), data series are to be inspected for their stationary. This is done by using Augmented Dickey Fuller (ADF) and Phillip-Perron (P-P) unit root tests. The stationary series are then tested for non-linearity in order to assess the present of possibly some non-linear structure within the data which allow us to use the GARCH model. In this process, the BDS test is used as it is thought of as portmanteau test of non-linearity[2]. The BDS test is a powerful tool for detecting serial dependence in time series. It tests the null hypothesis of independent and identically distributed (i.i.d.) against an unspecified alternative. This test can test nonlinearity provided that any linear dependence has been removed from the data, for example, using traditional ARIMA-type models or taking the first difference of natural logarithms.

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[2] BDS test was first devised by W.A. Brock, W.Dechert and J. Scheinkman in 1987 (Brock, Dechert and Scheinkman, 1987).

For this study, we will use the ARMA model of the time series which developed by using general-to-specific approach. The BDS test is used to choose the good fit of ARMA model. If the null hypothesis is rejected, it implies some hidden non-linear structure in the series. Then, we can proceed by developing the GARCH model. A specific GARCH model is selected base on, again, the test of i.i.d. on residuals of the model using the BDS test. If the null hypothesis of i.i.d. in residuals is failed to be rejected for the specified GARCH model, the model is considered as suitable for the series.

3. Results

3.1. Causality test

The results of causality test are reported in three steps. First, we test for the order of integration for both GDP and FDI in Malaysia. Second, we find out the optimum lag structure using the Akaike Information criterion (AIC) and Final Prediction Error (FPE). Lastly, we conduct *Wald* test to analyze non-causality between variables FDI and GDP.

Prior to Toda-Yamamoto non-causality test, the order of integration of the variables is initially determined using the ADF and P-P unit root tests. The results are given in Table 1. LGDP and LFDI are the logarithm of gross domestic product and foreign direct investment, respectively. The results show that the GDP and the FDI series for Malaysia are I (1) as the null hypothesis of a unit root is not rejected for the level series but rejected at the first differenced series. Therefore, it is concluded that all variables included in this study are integrated of order one.

Table 1: Unit Root Tests
Augmented Dickey Fuller and Phillip-Perron tests

Variable	ADF test statistic (with trend and intercept)		P-P test statistic (with trend and intercept)	
	Level	***First Difference***	***Level***	***First Difference***
Gross Domestic Product[LGDP]	-2.208	-3.762**	-2.831	-10.426***
Foreign Direct Investment [LFDI]	-2.723	-5.792***	-2.328	-5.792***

Note: *** significant at 1% level
** significant at 5% level
* significant at 10% level

Given that both series were found to be integrated of order one, we specify the model by determining the optimal lag length of all level variables in the model. The optimum lag length (k), chosen by AIC and FPE is found to be 5 (i.e. 1.25 year). Before examining the causality test, a series of diagnostic test are implemented to assure that the underlying assumption hold. The results from Breaush-Godrey Serial Correlation LM test indicate that both equation (1) and (2) have no problem of serial correlation.

The Toda-Yamamoto test involves the addition of one extra lag of each of the variables to each equation and the use of Wald test is to see if the coefficients of the lagged ‘other' variables (excluding the additional one) are jointly zero in the equation. The results of the Wald test are given in Table 2. The results show that there is no evidence of causality between GDP and FDI as the null hypotheses of no causality for both equations are not rejected at any conventional level of significance.

Table 2: Toda-Yamamoto test results

Equation	Wald test (χ^2)
FDI (in GDP equation)	2.358 (0.798)
GDP (in FDI equation)	1.358 (0.929)

Note: The figures in parentheses are the p-values.

b. Volatility/stability test

Since the non-causality test implies no causality between FDI and GDP within the period of study, we expect that the series would better be modeled using non-linear rather than linear model. The reason for considering non-linear model is the observation that probably the series display typical nonlinear characteristics especially when there are outliers such as during the 1997 financial crisis and the implementation of capital outflow controls a year after the crisis broke out.
In light of this view, the nonlinear model of GARCH is established for the series, in which, the impact of one variable on the volatility of another variable could be observed. As mentioned in the previous section, prior to the estimation of model, unit root test has to be done for both series to ensure their stationarity. The results as displayed in Table 1 have shown that the original/level series are non-stationary. However, when the series are transformed into log and differenced once they are stationary as the null hypotheses are rejected at 5% level of significance.

Using the transformed series (log and difference once), the ARMA model is developed for each series to attempt possible fit model for the data. This is done by using general-to-specific approach. The ARMA model for each FDI and GDP series is displayed on Table 3.

Table: 3 ARMA models for FDI and GDP series

Series	ARMA model	Diagnostic test	BDS test on residuals of ARMA model
GDP	$\Delta LGDP_t = \alpha_0 + \alpha_1 GARCH + \alpha_2 \Delta LGDP_{t-4} + \alpha_3 u_t + \alpha_3 u_{t-4}$	Adj. R^2 = 0.736 JBnormal = 28.655*** Far = 1.836 Farch = 0.045 Fhet = 0.069	BDS Z-statistics in all dimension 2 until 5 are significant
FDI	$\Delta LFDI_t = \beta_0 + \beta_1 \Delta LFDI_{t-1} + \beta_2 u_t + \beta_3 u_{t-1} + \beta_4 u_{t-3}$	Adj. R^2 = 0.185 JBnormal = 125.12*** Far = 3.054 Farch = 18.859*** Fhet = 31.801***	BDS Z-statistics in all dimension 2 until 6 are significant

Note: 1. Far is the F-statistic of Breusch-Godfrey Serial Correlation LM Test
Farch is the F-statistic of ARCH Test
JBnormal is the Jarque-Bera Statistic of Normality Test
Fhet is the F-statistic of White Heteroskedasticity Test
2. Null hypothesis of BDS test is the residuals are i.i.d.
3. *** significant at 1% level
** significant at 5% level.
* significant at 10% level.

The results of ARMA model for both series, GDP and FDI, clearly show that the models suffer normality failure in their residuals. In particular, ARMA model of FDI has low ‘goodness of fit’ (adjusted R^2) and its residuals also face problems of ARCH effect and heteroskedasticity. Most importantly, the BDS test statistics on both ARMA residuals fail to accept the null hypothesis of independent and identically distributed (i.i.d.). The departures from i.i.d. series identified in the ARMA models may well be attributable to the present of autoregressive conditional heteroskedasticity in series innovations which probably due to the volatility of series within the period of study (e.g. during the Asian financial crisis and the controls of capital outflows)

For this reason, GARCH model is developed to capture the volatility of the series. The selected GARCH model is displayed on Table 4. The results of BDS test on residuals of GARCH model indicate that the residuals are now i.i.d. which suggested that the selected GARCH model is fit to the data series.

Table : 4 GARCH models for FDI and GDP

Series	ARMA model	Diagnostic test	BDS test on residuals of ARMA model
GDP	GARCH (1,1): $h_t^2 = 0.0004 - 0.09u_{t-1}^2 + 0.534h_{t-1}^2 - 0.001\Delta LFDI_t$ (1.37) (-1.25) (1.35) (-45.79)***	JBnormal = 11.27*** Farch = 2.76*	BDS Z-statistics in most dimensions are insignificant
FDI	GARCH(2,1): $h_t^2 = 0.023 + 1.081u_{t-1}^2 - 0.453u_{t-2}^2 + 0.309h_{t-1}^2 - 0.399\Delta LGDP_t$ (2.35)** (1.22) (-0.71) (2.00)** (-2.35)**	JBnormal = 0.26 Farch = 3.04*	BDS Z-statistics in all dimensions are insignificant

Note: 1. Farch is the F-statistic of ARCH Test
JBnormal is the Jarque-Bera Statistic of Normality Test
2. Null hypothesis of BDS test is the residuals are i.i.d.
3. Z-statistics in parentheses
4. *** significant at 1% level
** significant at 5% level.
* significant at 10% level.

In the selected GARCH model of GDP, ΔLFDI is included as additional regressor in order to observe the impact of FDI flow to volatility of GDP (see Table 4).In similar manner, in GARCH model of FDI, ΔLGDP is added to as a regressor to observe the impact of growth on volatility of FDI. In both equations, coefficients of these additional variables (i.e. ΔLFDI and ΔLGDP) are significant with negative signs. This indicates that flow of FDI does contribute to stability (less volatility) of GDP and growth through GDP also contributes to stability (less volatility) of FDI into the country. No doubt the results reflect what has happened in the country.

In fact, Malaysia’s impressive economic growth since the 1960’s and its stability especially before the Asian financial crisis was largely due to policies promoting foreign investment. It started with the introduction of the Investment Incentives Act 1968 and followed by establishment of the Free Trade Zones during the second Malaysia Plan (1971-75). Since then, Malaysia has attracted a large portion of investment which flowed into Asia. Malaysia recorded as a second largest FDI recipient among Asian economies in 1995 at about US$5.8 billion (UNCTAD, 1996). It is clear that FDI is one of the important factors contributes to stability of Malaysian economic growth as FDI is usually export-oriented and often helps transfer technology and management expertise to the host country.

However,in 1997, the figure was lower due to the lack of confidence as a result of the Asian financial crisis. Even though by 1998, in figures, the investor confidence had improved, it was found that the number of investment project at the negotiation stage in 1998 was much higher than in year 1997 (MIDA, various issues). This indicates that uncertainty of economic performance has led to delayability aspect of foreign investment or instability of the FDI. The crisis affected Malaysia badly, causing economic growth to fall to -6.8% which was the lowest ever in Malaysia’s modern economic history. Delayability of foreign investment was evident in Malaysia during 1997/98 period when the status of implementation of approved manufacturing projects is considered. If in 1994, the proportion of projects approved at the advanced stage of implementation was 41.1 per cent, in 1998 the projects approved, at similar status of implementation, was only 26.4 per cent. The proportion of projects at the negotiation stage was very high in 1998 with 68.5 per cent due to the uncertainty of the country’s economic growth. Obviously, the performance of the country reflected by its economic growth is very important to maintain stability of foreign investment into the country for long-run.

4. Conclusion

This paper has used a methodology by Toda-Yamamoto to test the direction of causality between FDI and growth for Malaysia over the period of 1990 to 2002 using quarterly data. Our empirical findings based on the Toda-Yamamoto causality test seem to suggest that there is no evidence of causality between GDP and FDI. Based on these results, the assumption that FDI causes growth, vice versa, raised some doubts. Having said this, the study, however, finds that the causality between FDI and GDP is not matter. Most importantly, the performance of one variable does contribute to stability of another variable.

The policy implication could be drawn at this point is the improvement of GDP and FDI should be emphasized by the authority to ensure stability of FDI inflow into the country and stability of the country's income. Growth should come with the quality of human capital, infrastructures, institutions, good governance, information and communication technology and also legal framework. All these are the compulsory elements needed to enable the country to be competitive in attracting FDI and to maintain the stability of FDI particularly for future development. A dynamic package internally will definitely attract FDI into the country. In return, the flood of FDI into the country may stimulate the economic growth of a country and most importantly it is able to reduce the upswing and downswing of the economic growth for long-term planning. Thus, policy on attracting FDI is equally important for stability of economic growth in the country.

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