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The Impact of Infrastructure on Foreign Direct Investment: The Case of Malaysia

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Abstract

The purpose of this study is to examine the role of infrastructure in influencing FDI inflows to Malaysia for the period of 1970-2010 using time series analysis techniques that address the problem of non-stationarity. Specifically, infrastructure together with other determinants of FDI such as market size, trade openness, and human capital are used to analyze their effects on FDI inflows. The ADF test is used to see whether all variables are stationary. Results obtained show that all variables are non-stationary and integrated of order one or I(1). After confirming that all variables are stationary, the ordinary least square (OLS) with the standard White Heteroskedasticity-Consistent Standard Errors and Covariance is employed to estimate the model. Findings indicate that infrastructure has a significant and positive effect on FDI inflows to Malaysia. As expected other FDI's determinants; market size, trade openness and human capital still play significant roles in determining FDI inflows to Malaysia. Results from this study can be used as guidance for policy makers on FDI where government can give more attention on the development of both; hard and soft infrastructure. The availability of infrastructure in a country definitely can attract FDI and further can accelerate the rate of economic development.

Keywords: FDI; Trade; Unit root Test; Cointegration; Malaysia

1. Introduction

The main contribution of foreign direct investment (FDI) to the economic growth of a country has been well recognized in the literature. FDI plays an important role in the economy as it generates economic growth by increasing the domestic capital formation as well as facilitates the transfer of new technology. Among huge literature on FDI, few researchers have acknowledged the importance of infrastructure along

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with other determinants to stimulate FDI. They include Wheeler and Mody (1992), Asiedu (2002, 2006), Loree and Guisinger (1995), Richard et.al. (1999). They argued that investors search for markets where they can maximize the benefits and lower the cost of production, and this can be achieved if the infrastructure are in good conditions and supportive to investors.

Generally, a country with good physical infrastructures such as highways, ports, bridges, communications, are likely to attract more FDI. Coughlin et.al. (1991) in their study, analyzed factors that affect the inflows of FDI into the U.S for the period of 1981-1983. They found that more extensive transportation infrastructures were associated with a high level of FDI. Wheeler and Mody (1992) in their study also found that infrastructure quality is an important variable for developing countries trying to attract FDI from the United States, conversely it is less crucial for developed countries that already have high quality infrastructures. Khadaroo and Seetanah (2010) focused on transport infrastructure together with other variables and found the positive impact of infrastructure in attracting FDI.

Malaysia has been one of the most successful Southeast Asian countries in attracting FDI. Malaysia has always trying to maintain the competitiveness of FDI determinants where many policy instruments have been set up by the Malaysian government to attract FDI. After being an independent state, Malaysia has taken advantage of both tangible assets like natural resources, abundant labour and intangible assets like trade status under Generalised System of Preferences (GSP), macroeconomic stability, to bring in FDI. The needs of logistic and communication within the country's boundry also have been carried out, for instance the PLUS-highways and KTM railways are both linking the major towns. A cheaper ports services in Southern Johor and Klang, and budget airline services are also available. In term of communication, there are 95% area coverage in Peninsular and 77% area coverage in East Malaysia World Investment Report (2008). With all the physical infrastructure provided, they can attract more FDI inflows to Malaysia.

The purpose of this study is to analyze the significant determinants of FDI in Malaysia using a time series data from 1970 to 2010 focusing on infrastructure along with other variables such as trade openness, human capital, and market size, which will be represented by their respective proxies. The results of this study will reveal whether infrastructure have an impact in influencing FDI inflows to Malaysia and therefore appropriate policies can be implemented by the government.

The rest of the paper is outlined as follows. Section 2 provides the literature review. Section 3 discusses empirical data used and methodology, followed by empirical results in section 4. Section 5 concludes.

2. Literature Review

Many articles in the literature have highlighted the importance of physical infrastructure as one of the determinants of FDI inflows to a country. With a good quality of physical infrastructure the investment climate for FDI would improve as the cost of total investment by foreign investor can be subsidized, therefore increase the rate of return. Pioneering works are provided by Wheeler and Mody (1992) and Root and Ahmed (1979) who portrayed the crucial role of infrastructure for inward FDI. Among more recent works confirming this aspect are those of Loree and Gusinger (1995), Mody and Srinivisan (1996), where they showed that the pattern of FDI inflows are influenced by the favourable role of physical infrastructure. As stated by many researchers the quality of infrastructure available affects the decision made by MNEs in relocating the export-platform production.

Cheng and Kwan (2000) in their study for the period of 1985 to 1995, used a self-reinforcing model of FDI, find support for good infrastructure i.e. density of road as a determinant of FDI into 29 Chinese regions. However, the quality of the roads, did not matter much, high grade paved roads did not perform any better than all roads in determining which regions hosted the most FDI.

Fung et. al. (2005) examine whether hard infrastructure, in the form of more highways and railroads, or soft infrastructure, in the form of more transparent institutions and deeper reforms leads to more FDI. They used other determinants of FDI such as regional market sizes, human capital, and tax policies;

covering countries such United States, Japan, Korea, Hong Kong and Taiwan to regions of China. They discover that soft infrastructure is more important determinant of FDI than hard infrastructure. Asiedu (2002), used panel data estimates, found that countries with good infrastructure can attract more investments.

3. Data And Methodology

3.1 Description of variables and data

This study uses annual time series data from 1970 to 2010 and all variables are converted into natural log form. Data are collected from various sources such as Malaysian Department of Statistics, the various issues of International Financial Statistics published by the International Monetary Fund and various issues of the Monthly Bulletin published by Bank Negara Malaysia (Malaysian Central Bank).

The dependent variable for this study is the net FDI flows into Malaysia measured in millions of U.S. dollars (**FDI**). The real government expenditure per real GDP (**INFR**) is used as a proxy for infrastructure. A high expenditure rate may indicate stability in expenditure patterns since part of government expenditure is invested in infrastructure, thus a positive and significant relationship is expected. Real Gross Domestic Product Per Capita (**GDPCAP**) is used as a proxy for market demand and market size in Malaysia. It is calculated by dividing GDP per capita with the GDP deflator for 1995, then times one hundred ((GDP per capita / 1995 deflator) x100)). The use of Real GDP per capita of host countries for measuring market size and demand has been proven by Loree and Guisinger (1995) to be a significant determinant of FDI from the United States. Schneider and Frey (1985) and Tsai (1994) also found that there is a positive relationship between real GDP per capita and FDI. The next variable is trade openness, which is measured using the trade share (Import plus Export) of GDP (**OPEN**) as a proxy. Previous studies [Edwards (1990), Hausmann and Fernandez-Arias (2000), Chakrabarti (2001), Asiedu (2002)] showed a positively correlated and significant relationship between trade openness and FDI using this proxy. The most important element in human resources development is the high levels of education (see UNCTAD, 1994; World Bank, 1999). With high level of education a country will be full with a labor force that is literate, numerate and skilled in the use of modern production facilities and techniques. In this study we use the proxy of real total education expenditure in Malaysia measured in real terms to measure human capital (**EDUEXP**). In many developing countries, the cost of labor is still an important consideration for labor intensive; efficiency seeking FDI since, for a given level of productivity, labor typically costs less in developing countries. This is echoed by Lucas (1993) and Wheeler and Moody (1992), which found that the wage cost variable, is a significant determinant of FDI flows. Taking this result into consideration and the fact that much of the FDI in Malaysia is labor intensive and efficiency or cost seeking, a significant and negative relationship is expected since higher level of human capital would imply better skills- and higher labor costs.

3.2 Model Specification

We specify the following equation to analyze the effects of infrastructure on FDI along with market size, openness and human capital.

$$LnFDI = \beta_0 + \beta_1 LnINFR_t + \beta_2 LnGDPCAP_t + \beta_1 LnOPEN_t + \beta_1 LnEDUEX_t + \mu_t \quad .....(1)$$

Where:

FDI	=	Total foreign direct investment in Malaysia
β_0	=	Constant
$INFR_t$	=	Infrastructure (Real Government expenditure per real GDP)
$GDPCAP_t$	=	Market Size (Real GDP Per Capita)
$OPEN_t$	=	Openness (Real trade share (import + export) per real GDP)
$EDUEX_t$	=	Human Capital (Total real education expenditure)
μ_t	=	Error term

3.3 Estimation Method

The unit root test using a standard Augmented Dicky Fuller (ADF) is performed to determine whether all variables are stationary and identify the orders of integration of the variables. According to Nelson and Plosser (1982), most economic time series appear to be difference-stationary processes. Thus, in this study, the augmented Dickey and Fuller (1981) unit root tests is employed to determine the order of integration of the individual series.

The test is the *t*-statistic on the parameter α from the following equation

$$\Delta Y_t = \delta_0 + \alpha Y_{t-1} + \sum_{i=1}^{L} \delta_i \Delta Y_{t-i} + \nu_t$$

where ν_t is the disturbance term. The role of the lagged dependent variable in the ADF regression equation (2) is to ensure that ν_t is white noise. The null hypothesis, H_0: Y_t is I(1), is rejected (in favour of I(0)) if α is found to be negative and statistically significantly different from zero. The computed *t*-statistic on parameter α, is compared to the critical value tabulated in MacKinnon (1991). The unit root tests were also carried out for first-difference of the variables, that is, the following regression equation is estimated

$$\Delta^2 Y_t = \delta_0 + \alpha Y_{t-1} + \sum_{i=1}^{L} \delta_i \Delta^2 Y_{t-i} + \omega_t$$

where the null hypothesis is H_0: Y_t is I(2), which is rejected (in favour of I(1)) if α is found to be negative and statistically significantly different from zero. The optimal lag length in the above equation is identified by ensuring the error term is white noise.

Once all variables are stationary, then the regression using the ordinary least squares method (OLS) with the standard White (1980) Heteroskedasticity-Consistent Variances and Standard Errors can be proceeded to correct for biasedness due to non-constant variance. To ensure that the regression is not spurious, the cointegration test in which the residual of the regression using the Engle-Granger approach is also employed to prove the existence of a meaningful long-run relationship.

4. Empirical Results

4.1 Unit Root Test

Prior to the testing of cointegration, we conducted a test of order of integration of each variable using Augmented Dickey-Fuller (ADF) test. These are both t tests and rely on rejecting the hypothesis that the series is a random walk in favour of stationarity. The ADF test for the unit roots for all variables is shown in Table 1. The null hypothesis of a unit root in the first difference with and without trend can be rejected for all variables. Thus, all variables are non-stationary and are integrated in the order of one I[1].

After confirming that all variables are integrated of order one, I(1), the long run relationship among variables is estimated. The results of the OLS regression using the Heteroskedastic and Standard Error Consistent White test are shown in Table 2.

Table 1: The ADF Test for Unit Roots

Series	Levels		1st Differences	
	Without Trend	With Trend	Without Trend	With Trend
FDI	-1.7722	-2.1079	-4.0684	-4.0622
INFRA	-1.8298	-3.0335	-4.5645	-4.5154
GDPCAP	-2.4535	-2.9360	-4.2978	-4.4408
OPEN	-0.8356	-2.2280	-4.8864	-4.8270
EDUEX	-1.6991	-3.4235	-4.8427	-4.7724

Notes: The critical values for this table are based on Mc Kinnon (1991)

Table 2: OLS - White Heteroskedasticity-Consistent Standard Errors and Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.5028	1.8448	8.9455	0.000
INFRA	0.44942	0.25011	1.7969	0.081
GDPCAP	1.1065	0.44336	2.4957	0.017
OPEN	2.2322	0.50594	4.4121	0.000
EDUEXP	-0.65837	0.21222	-3.1023	0.004

R-squared	0.88671	Mean dependent var	14.0952
Adjusted R-squared	0.87376	S.D. dependent var	1.2600
S.E. of regression	0.44766	Akaike info criterion	-26.9385
Sum squared resid	7.0141	Schwarz criterion	-31.1607
Log likelihood	-21.9385	F-statistic	68.4846
Durbin-Watson stat	1.7858	Prob(F-statistic)	0.000

Based on the result we can apply it into equation (1) as follows.

$$FDI = 16.5028 + 0.44942INFRA + 1.1065GDPCAP + 2.2322OPEN - 0.65837EDUEXP$$
$$(8.94) \quad (1.7969) \quad (2.4957) \quad (4.4121) \quad (-3.1023)$$

$R^2 = 0.88671$

Adjusted $R^2 = 0.87376$

Durbin Watson Stat = 1.7858

Although it was proved that all variables are non-stationary, the ADF residual-based test for cointegration is also conducted to confirm that the regression is not spurious. Table 3 reports the ADF residual based test results for cointegration of the FDI equation. Based on the test statistics, the null hypothesis of no cointegration for the corresponding residual obtained from the long-run FDI equation can be rejected at 5% level of significance.

Table 3: ADF Residual-based Test for Cointegration: The Long run FDI equation.

	TEST STATISTICS		CRITICAL VALUES			
	DF	**ADF(1)**	**5%**		**10%**	
			U	**L**	**U**	**L**
FDI	-5.5059	-3.8843	-3.50	-3.71	-3.16	-3.33

Notes: The critical values are obtained from Charemza and Deadman (1992)

For infrastructure, the value of 0.44942 is significant at 1 percent level. This finding is consistent with the results of similar studies done by Wheeler and Moody (1992) and Loree and Guisinger (1995), which showed a strong positive correlation between FDI and infrastructure quality despite each using a different proxy. This means that countries with higher levels of agglomeration are more likely to attract FDI since better quality infrastructure would allows MNC's to operate at their optimal level of efficiency.

Meanwhile for market size, it is also significant at 1 percent level of significance with the coefficient of 1.1065. The result obtained from this variable is also similar to studies done by Tsai (1994) and Schneider and Frey (1985). Both studies indicate that real GDP per capita as a proxy of market size has a strong positive relationship with FDI.

The ratio of real trade share per real GDP (OPEN) with the coefficient value of 2.2322 is also significant at 1 percent. It has a positive relationship with FDI as expected. This finding is very much similar to the findings of many studies, (see Chakrabarti (2001), Asiedu (2002)) as they also use a similar proxy. This is a very strong signal that trade openness is still a very important determinant of FDI inflows to Malaysia.

Human capital is also significant with the value of 0.65837 and negatively correlated with FDI. This phenomenon can be explained by looking at the predominant types of FDI in Malaysia. At present while Malaysia is striving to enhance its technological capability through R&D, better training and other types of created assets designed to enhance its competitiveness, much of the existing FDI in Malaysia consists of labor intensive and cost seeking FDI which is especially prevalent in the manufacturing sector. While higher levels of human capital may enhance the flow of FDI into more knowledge seeking and skills intensive industries, they also increase the wage cost which in itself is a significant determinant according to Lucas (1993), and Wheeler and Mody (1992), hence the negative relationship. However, this relationship is expected to be short term in nature since Malaysia is now moving rapidly along its development path into a more knowledge intensive and value added economy as more Malaysians are better trained and educated. As more inflows of knowledge and capital seeking FDI enter Malaysia, this variable (EDUEXP) is expected to be significant and positively correlated with FDI.

5. Conclusion

This paper examines the role of infrastructure in stimulating FDI inflows to Malaysia. Other important determinants; market size, openness and human capital are also included in this study. By using time series data from 1970 to 2010 and applying the OLS - White Heteroskedasticity-Consistent Standard Errors and Covariance, we found that infrastructure has a significant and positive impact on FDI inflows into Malaysia. In line with several other empirical studies, results of this study indicate that market size still play an important role in influencing FDI inflows to Malaysia. At the same time trade openness and human capital are also greatly increasing in importance, especially during this era of globalization. In order to continue and increase competition for FDI, it is crucial for Malaysia to formulate policies in improving local infrastructure. A good physical infrastructure can serve to attract FDI into the country, especially in particular sector such as the electrical and electronic (E&E) sector. With the development of highways, they will shorten the time to reach the Penang airport and KLIA as the E&E goods are exported mainly through these two airports. The problem of airport excess capacity can be solved by expanding the facilities to continue attracting FDI inflows to Malaysia.

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