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THRESHOLD EFFECT IN THE RELATIONSHIP BETWEEN FOREIGN DIRECT INVESTMENT AND ECONOMIC GROWTH: EVIDENCE FROM ASEAN COUNTRIES

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Abstract

To date, the evidence on the impact of inward foreign direct investment (FDI) on economic growth is still ambiguous. On one hand, many studies have found significant and positive effects of FDI on the host countries' economy through contributing to domestic investment and employment, transferring technology and generating more inter-sectoral linkages. On the other hand, some other studies indicated that FDI might have a negative impact on economic growth. These conflicts in results can be explained by the differences in the absorptive capacity of host countries in terms of its policy regime, the level of human capital, development and investment environment.

The aim of this paper is to revisit the relationship between foreign direct investment and economic growth using Threshold Auto Regressive (TAR) model. The study suggests that the scale of FDI inflows into a country needs to be appropriate to its absorptive capacity. The level of FDI inflows is used as a threshold variable. The Fixed-effect panel threshold model proposed by Hansen (1999) is used. Also, this paper adopts the bootstrap method by Hansen (1999) to test the statistical significance of the threshold effect. By using a panel data of eight ASEAN countries in the period from 2002 – 2014, the findings indicate that the relationship between FDI and economic growth is non-linear. Furthermore, the results show that FDI can influence growth in different ways, depending on the level of FDI inflows. The study finds strong evidence that there are two threshold levels of FDI in the regression relationship. They are 4.73% and 4.91% of GDP with asymptotic 95% confidence interval. These thresholds divide the observations into three regimes, in which the impact of FDI on growth will be reversed, once FDI scale reaches the threshold levels. The results also suggest that with a current absorptive capacity of selected host countries, the optimal level of FDI is 4,73% of GDP to make the most of FDI to recipient economies.

Keywords: Economic Growth, FDI, Threshold Effect, Threshold Autoregressive (TAR), ASEAN.

1. Introduction

It is believed that foreign direct investment (FDI) is usually a significant channel to spur economic growth in many countries. FDI is considered as an engine to boost their economies through providing additional source of capital for investment, contributing to employment, transferring technology, increasing competition and generating spillover effects to local enterprises. It is also expected to enhance the integration of host country into the global economy. For these reasons, countries put various efforts to attract FDI into their economies. However, the evidence on the impact of inward FDI on economic growth is still ambiguous in the empirical studies. Many studies have found significant and positive effect of FDI on host countries' economy through contributing to domestic investment and employment, transferring technology, generating more intersectoral linkages (Agosin & Mayer, 2000; Falki, 2009). On the other hand, some other studies indicated that FDI might have negative impact on economic growth (Seldon & Song,1994; OECD, 2001; Herman et al.,2004).

These conflicts in results can be explained by the differences in absorptive capacity of host countries in terms of its policy regime, the level of human capital, development, and investment environment (Borensztein, 1998; Hermes & Lensink, 2003; Alfaro et al., 2004). From the viewpoint of this research, we suggest that the scale of FDI inflows into a country needs to be appropriate to its absorptive capacity. However, to the best of our knowledge, the studies in this field is still limited, especially thresholds of FDI inflows into ASEAN countries.

2. Research Objectives

Inspiring from the fact that there is not much attention devoted to the optimal level of FDI inflows from which the economic growth benefit the most, the first aim of this paper is to re-examine this relationship in ASEAN countries using Threshold AutoRegressive (TAR) model in order to confirm whether the relationship between FDI and economic growth non-linear. If the relationship is non-linear, implying that there is an existence of FDI threshold(s) in ASEAN countries, then the question is how many thresholds are there. Fixed-effect panel threshold model proposed by Hansen (1999) is employed to estimate threshold levels of FDI inflows, beyond the thresholds, the benefit of FDI will decline or disappear.

3. Literature Review

The literature underlying the relationship between FDI and economic growth can be divided into three group. The first group of studies supports the positive impact of FDI on growth, such asFalki (2009), Nguyen Mai (2004), Freeman (2002), Agosin and Mayer (2000). Especially, the role of FDI in boosting host country's economic growth in long-term is emphasised (Borensztein, 1998; Agosin & Mayer, 2000). On the other hand, the argument from Herman et al. (2004), OECD (2001), Seldon and Song (1994) indicates that FDI has a negative effect on economic growth. Similarly, Alfaro (2003), Hussein (2009) also found no clear evidence in the relationship between the two variables. The third group suggests that this relationship is dependent on the absorptive capacity of recipient countries, in terms of its policy regime, the level of human capital, development, and investment environment, and would change over various periods of time (Borensztein, 1998; Hermes & Lensink, 2003; Alfaro et al., 2004). A possible reason for the dissimilarity in conclusions in studies could be related to the differences in samples, periods, country specific effects in cross national researches. Especially, ordinary linear approach is not effective enough in analysing this relationship.

Non-linear relationship between FDI and economic growth was first discovered by Borensztein (1998). The study found a minimum threshold of human capital and suggested that the positive effect of FDI on growth appears only when the host economy achieves a sufficient level of absoprtive capability. After Borensztein (1998), there were numbers of studies on the non-linear relationship between FDI and growth using different threshold variables such as Raheem and Oyinlola (2013), Alleyne and Edwards (2011), Jyun-Yi and Chih-Chiang (2008), Ford et al. (2008), Demekas et al. (2005), Melnyk et al. (2014), Shu-Chen Chang (2015), Miao Fu, Tieli Li (2006) Cross sectional data is used in most studies. Although there are differences in results, most studies found the existence of one or more threshold values at which the impact of FDI on economic growth will be reversed.

According to Raheem and Oyinlola (2013), FDI would start to affect positively on growth when the minimum level governance is -1.2[1]. Shu-Chen Chang (2015) indicates the threshold levels of "rule of law" and "political stability" are 1.228 and 0.845 respectively. On the other hand, when analysing the case of China from 1970 to 2005, Ford, Sen and Wei (2010) found no evidence of a positive effect of FDI on growth even in the face of good governance.

Human capital as a threshold variable was mentioned in many studies such as Borensztein et al. (1998), Alleyne and Edwards (2011), Jyun-Yi and Chih-Chiang (2008), Ford et al. (2008), Shu-Chen Chang (2015) Miao Fu and Tieli Li (2006). However, different proxies of human capital were employed in different samples, leading to various threshold values. For example, adopting the initial-year level of average years of the male secondary schooling as a proxy for human capital, Alleyne and Edwards (2011) found a threshold value of 0.2278 years, while it is 1.13 years in the study of Borensztein et al. (1998). In some other researches, proxy for human capital is the percentage of labors received higher education, e.g. the human capital threshold estimated by Fordet al. (2008) is 15.56%, those of Miao Fu and Tieli Li (2006) are 4.85% and 10.99%.

Some other threshold variables are used, such as trade openness (Jyun-Yi & Chih-Chiang, 2008), CPI, economy's absorptive capacity (Girma, 2005) However, researches on FDI threshold is very limited. We only found the study of Demekas et al.(2005) on 15 Central and Southeastern Europe countries from 1995 – 2003 mentioning the threshold level of aggregate non-privatization FDI of 12.1% GDP. The study concluded that the nature of FDI changes when more foreign investment is attracted into the host country. In addition, at the beginning, foreign investors are mainly attracted by market size, ease of access, low labor cost, however, once the level of FDI reaches a critical value, a new kind of investor appears and attracted by the level of institutional development, business environment, and the host country's prosperity.

Regarding the non-linear models, Threshold AutoRegressive (TAR) model is one of the most popular models in the literature. First introduced by Tong (1983) and developed by Hansen (1999), TAR model allows us to test the existence of non-linear relationship and to determine the number of thresholds in the model. Besides, robust and boostrap techniques are suggested by Hansen (1999) and Lee and Chen (2005) to determine the value of threshold and test the significance of threshold effect.

In sum, there are numbers of studies on the relationship between FDI and economic growth. The literature shows a consensus about the existence of non-linearity and threshold effect in the relationship between the two variables. TAR model is popularly used, therefore, it is used in this paper for that purpose. However, such literature in ASEAN countries is limited, especially to the best of our knowledge, there is no study on FDI threshold in these countries.

4. Methodology

Following Demekas et al. (2005), Raheem and Oyinlola (2013), Girma (2005), it is believed that economic growth is influenced by numbers of factors including source of capital, human capital, policy regime, trade openness of economy, etc. By using a panel data of eight ASEAN countries in the period from 2002 – 2014, we startwith a basic panel regression:

$$growth_{it} = \alpha_o + \alpha_1 FDI_{it} + \alpha_2 Matrix\ X + u_i + \varepsilon_{it} \qquad (1)$$

where $growth_{it}$is measured by GDP growth for country i and at time t;FDI_{it} represent the scale of FDI inflows into economy i, at time t; *Matrix X*is an explanatory vector variable set

[1] Governance score ranges from -2.5 to 2.5 (Kaufmann et al., 2010)

that has been proved in previous studies, including government consumption, level of human capital, trade openness, inflation, and proxy for governance; $u_i$represent country specific effects and assumed to be unchanged over the time, such as country's culture, geographic location, etc.; and the observation errorε_{it}.

It is our objective to analyse the relationship between FDI and growth in long-term (*growth*)*, we use the following specification:

$$growth^*_{it} = \alpha_0 + \alpha_1 FDI_{it} + \alpha_2 Matrix\ X + u_i + \varepsilon_{it} \quad (2)$$

First of all, we determine growth in short-term *(growth)*, then use a coefficient δ to estimategrowth in long-term *(growth*)*.

$$growth_t - growth_{t-1} = \delta(growth_t^* - growth_{t-1}) \quad (3)$$

Coefficient δ is restricted within the interval (0, 1). We can also rewrite (3) as:

$$growth_t = \delta\, growth_t^* + (1-\delta)\, growth_{t-1} \quad (4)$$

Replace (4) into (2), we have:

$$growth_{it} = \delta\,\{ \alpha_0 + \alpha_1 FDI_{it} + \alpha_2 Matrix\ X + u_i + \varepsilon_{it}\} + (1-\delta)\, growth_{i\ t-1} \quad (5)$$

An alternative way of writing (5) is:

$$growth_{it} = \delta\alpha_0 + \delta\alpha_1 FDI_{it} + \delta\alpha_2 Matrix\ X + (1-\delta)\, growth_{i\ t-1} + u_i + \varepsilon_{it} \quad (6)$$

in which, coefficients $\delta\alpha_0$, $\delta\alpha_1$represen't the impact of FDI on growth in short-term, while α_1, α_2 imply its influence in long-term.

Variable $growth_{i\ t-1}$can also reflect the cumulative impact of macroeconomic factors in the past on economic growth.

Although the basic panel regression model represents the relationship between FDI and economic growth, it does not show the nature of this relationship changing when the level of FDI increases. So panel threshold model proposed by Hansen (1999) is adopted. This technique allows us to test the hypothesis that the equation can be divided into regimes depending on the value of threshold variables FDI_{it}. If there is an existence of at least one threshold value, it implies that the relationship between FDI and economic growth is non-linear. Following the works of Hansen (1999) and Wang (2015), the non-linear growth regression can be written as follows:

$$\begin{aligned} growth_{it} = &\{\beta_{10} + \beta_{11} FDI_{it} + \beta_{12} Matrix\ X + \beta_{13}\, growth_{t-1}\}\, d[FDI_{it} \leq \gamma_1] \\ &+ \{\beta_{20} + \beta_{21} FDI_{it} + \beta_{22} Matrix\ X + \beta_{23}\, growth_{t-1}\}\, d[\gamma_1 < FDI_{it} \leq \gamma_2] \\ &+ \{\beta_{30} + \beta_{31} FDI_{it} + \beta_{32} Matrix\ X + \beta_{33}\, growth_{t-1}\}\, d[FDI_{it} > \gamma_2] + u_i + \varepsilon_{it} \quad (7) \end{aligned}$$

Another intuitive way of writing (7) is:

$$\begin{aligned} growth_{it} = &\beta_0 + \beta_{11} FDI_{it}\, d(FDI_{it} \leq \gamma_1) + \beta_{21} FDI_{it}\, d(\gamma_1 < FDI_{it} \leq \gamma_2) \\ &+ \beta_{31} FDI_{it}\, d(FDI_{it} > \gamma_2) + \beta_2 Matrix\ X + \beta_3\, growth_{t-1} + u_i + \varepsilon_{it} \quad (8) \end{aligned}$$

where γ_1, $\gamma_2$are the threshold parameters that split the sample into three sub-samples (assuming the model is double-threshold model); d(.) is the indicator function which is equal to 1 or 0, depending on the condition term; the regimes are distinguished by different regression slopes $\beta_{11}, \beta_{21}, \beta_{31}$.

According to Mengistus and Adams (2007), the problem of unobserved country heterogeneity and associated omitted bias in cross-sectional country regression can be controlled by fixed effect approach. Therefore, fixed-effect panel threshold model by Hansen (1999) is appropriate for this study.

In order to determine the value of thresholds, least squares is suggested by Hansen (1997). The threshold is the value that minimizes the residual sum of squared:

$$\hat{\gamma} = arg\min S_1(\gamma) \quad (9)$$

$\gamma \in (\underline{\gamma}, \bar{\gamma})$

Due to the fact that nuisance parameter problem makes the distribution of threshold estimate non-standard, test for the hypothesis $\gamma = \gamma_o$ (in which, γ_o is the true value of γ) is necessary. Hansen (1999) also suggested that using the "no-reject region" method with a likelihood ratio (LR) statistic to construct the confidence interval is the best approach. The likelihood ratio is constructed as follows:

$$LR_1(\gamma_0) = \frac{S(\gamma_0)-S(\hat{\gamma})}{\hat{\sigma}^2} \qquad (10)$$

To test for the existence of a threshold effect, the F statistic in the likelihood ratio test under H_0 of no threshold effect ($\beta_1 = \beta_2$) is constructed as follows:

$$F_1 = \frac{S_0-S_1}{\hat{\sigma}^2} \qquad (11)$$

The distribution of F_1 is non-standard. Hansen (1999) recommended a bootstrap approach to simulate the asymptotic distribution of the likelihood ratio test. If the p-value for F_1 under H_0 is smaller than critical value, the null hypothesis is rejected.

Based on this methodology, the testing procedure in the study is as follows:

Firstly, we fit a single-threshold model to test the significance of threshold effect. The null hypothesis of no threshold effect is H_0: $\beta_1 = \beta_2$. Under H_0, there is no existence of threshold in the model (linear model). If H_0 is rejected, that means the model is non-linear.

Secondly, in order to determine the number of thresholds, we sequentially estimate the threshold effect of the models with different number of thresholds. The double-threshold model corresponds to the null hypothesis of the existence of one threshold and the alternative of the existence of two threholds; the triple-threshold model corresponds to the null hypothesis of two thresholds and the alternative of three thresholds, and so on. The testing process continues until the null hypothesis is accepted.

Finally, we examine the significance of threshold effect in the model with the given thresholds, using LR statistic and bootstrap method. This step not only allows us to confirm the statistical significance of threshold effect, but also provides the inference of estimators.

5. Results and discussions

Data and Variables

Cross-sectional data over the period 2002 – 2014 is used to analyse the relationship between FDI and growth. It would be ideal for data analysis to employ the full data set of ten ASEAN countries, however, due to data gaps, only 8 countries[2] could be used.

The choice of our variables are based on previous researches such as Borensztein et al. (1998), Alleyne and Edwards (2011), Demekas et al. (2005), Raheem and Oyinlola (2013), Girma (2005), Melnyk et al. (2014). FDI is measured as total FDI inflow as a percentage of GDP. Economic growth rate (*growth*) equals the annual rate of GDP growth. Governance (*GOV*) represents the level of authority exercised in a country (Kaufmann et al., 2005), and measured by the average of six indicators developed by Kaufmann et al. (2010). Government consumption (GCONS) captures the level of government involvement in the economy, and measured by the percentage of GDP. Inflation reflects the stability of macroeconomic factors. Trade openness is included to represent the level of an economy's liberalisation to trading

[2] Eight countries selected in data analysis are Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Philippines, Thailand, and Vietnam.

partners and measured by the ratio of exports and imports to GDP. Gross enrolment ratio in lower secondary education is used as a proxy for human capital, measure as a percentage of the total population of official lower secondary education age.

Table 1: Variables and sources

Variable	**Definition**	**Source**
GDPG	The annual GDP growth rate (%)	World Bank (2015)
FDI	The net FDI inflow as a share of GDP (%)	World Bank (2015)
GOV	Governance measured as the average of six indicators: *control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law, voice and accountability* (Kaufmann, Daniel, Aart Kraay, Massimo Mastruzzi, 2010)	Worldwide Governance Indicators (2015)
GCONS	Total expenditure of government as a share of GDP (%)	World Bank (2015)
INF	Inflation rate (%)	World Bank (2015)
TRADE	Sum of exports and imports as share of GDP (%)	World Bank (2015)
ENR	Human capital measured by the gross enrolment ratio in lower secondary education, expressed as a percentage of the total population of official lower secondary education age (%)	UNESCO (2015)

Summary statistics of the sample is in the below table. The data are from a balanced panel. The mean of GDP growth rate for the sample is 5.34%, and ranges from -2,34% for Brunei (2014) to 13,25% for Cambodia (2005). The mean of FDI is 3,47%, and ranges from -0.25% for Indonesia (2003) to 10,31% for Cambodia (2014).

Table 2: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDPG	104	5.336781	2.835574	-2.34	13.25009
FDI	104	3.470174	2.3653	-.2542563	10.31335
GOV	104	-.3237543	.5300762	-1.335348	.7463304
GCONS	104	10.93902	5.016422	3.460336	27.16979
INF	104	4.862592	4.390438	-2.314972	24.99718
TRADE	104	111.7229	39.99582	45.51212	210.3738
ENR	104	82.53552	19.23343	34.45374	116.8032

Source: Author's computation in STATA 14

To avoid the problem of spurious regression results, tests for multicollinearity and stationarity are needed. The variance inflation factor (VIF) is used to test for multicollinearity problem. According to Kennedy (1992), there is no multicollinearity problem if VIFs of variables are less than 10. Table 3 indicates that the values of VIF are less than 10, except VIF values of FDI and FDI2. It is due to the fact that FDI2 is the square of FDI, hence there is obviously multicollinearity between them. However, FDI2 is used in the study to determine the changing level of GDPG when FDI changes, so it is not necessary to omit variable FDI2.

Table 3: Results of Variance Inflation Factor

Variable	VIF	1/VIF
FDI	12.11	0.082578
FDI2	11.43	0.087485
GOV	5.61	0.178215
ENR	3.92	0.255093
GCONS	3.38	0.295687
GDPG L1.	1.95	0.514030
TRADE	1.85	0.539694
INF	1.61	0.620851
Mean VIF	5.23	

Source: Author's computation in STATA 14

To examine the stationary of panel data, panel unit root is tested using Harris-Tzavalis (1999). The results reject the null hypothesis of non-stationary which indicates that most of variables are stationary in level at 1% significance level, except for GOV, TRADE and ENR stationary at the first differences at 1% level of significance.

Table 4: Results of Unit Root Test

Variable	**Level**		**Firsts Order Difference**	
	Statistic	**z**	**Statistic**	**z**
GDPG	0.1499	-8.2146***	-	-
FDI	0.5230	-3.3940***	-	-
GOV	0.8241	0.4962	-0.1947	-11.5996***
GCONS	0.5225	-3.4009***	-	-
INF	0.0363	-9.6821***	-	-
TRADE	0.8475	0.7979	-0.0748	-10.1572***
ENR	0.7284	-0.7408	0.1490	-7.4639***

Source: Author's computation in STATA 14
**** denotes level of statistical significance at 1%*

6. Findings

First of all, we fit the single-threshold model, with the null hypothesis H_0: $\beta_1 = \beta_2$ (no threshold effect), and the alternative H_1: β_1 ‡ β_2 (threshold effect does exist). The results indicate the estimator of the single-threshold model is 4.3162% with 95% confidence interval [4.2263; 4.3434].

Table 5: Threshold estimator in single threshold model

Threshold estimator (level = 95):

model	Threshold	Lower	Upper
Th-1	4.3162	4.2263	4.3434

Source: Author's computation in STATA 14

We use 300 bootstrap replications to test for a single threshold effect. The F statistics is 17.32, larger than critical value at 1% significance level (15.1489). It is highly significant with a bootstrap p-value is 0.000. Therefore, the null of linear model is rejected. In other words, the relationship between FDI and economic growth is non-linear, and there is an existence of threshold effect.

Table 6: Results of threshold effect in single threshold model

Threshold effect test (bootstrap = 300):

Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Single	289.2709	3.4437	17.32	0.0000	9.2448	11.2468	15.1489

Source: Author's computation in STATA 14

In the next step, to determine the number of thresholds, we sequentially estimate the model with one, two, three thresholds. The same bootstrap number is used for each of the three bootstrap tests. The F statistics and their bootstrap p-value is shown in Table 7.

Table 7: Results of threshold effects in different threshold models

Threshold estimator (level = 95):

model	Threshold	Lower	Upper
Th-1	4.3162	4.2263	4.3434
Th-21	4.7272	4.5151	4.8145
Th-22	4.9137	3.8860	4.9408
Th-3	6.0085	5.9936	6.2002

Threshold effect test (bootstrap = 300 300 300):

Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Single	289.2709	3.4437	17.32	0.0067	9.2307	11.0127	16.8737
Double	248.5796	2.9593	13.75	0.0133	7.8542	9.8030	15.0177
Triple	236.2337	2.8123	4.39	0.5967	12.3913	15.1386	19.6133

Source: Author's computation in STATA 14

We find that in the test for a single threshold (with H_0: linear model; H_1: single threshold model), F_1 statistic of 17.32 is larger than its critical value at 1% significance level of 16.8738. Therefore, F_1 statistic is highly significant with a bootstrap p-value of 0.0067. F_2 statistic in the test for a double threshold (with H_0: single threshold model; H_1: double threshold model) is also significant with a bootstrap p-value of 0.0133 ($F_2 = 13.75 > Crit2 = 9.8030$). However, $F_3 = 4.39 <$ its critical value at 10% significant level of 12.3913. The bootstrap p-value of F statistic in the test for a triple threshold is not significant (0.5967). The implication from the above results is that there are two thresholds in the model.

In order to determine the threshold value, we re-estimate the double-threshold model. The results indicate the estimates of two thresholds as 4.7272% and 4.9137%.

Table 8: Double threshold model estimation

Threshold estimator (level = 95):

model	Threshold	Lower	Upper
Th-1	4.3162	4.2263	4.3434
Th-21	4.7272	4.5151	4.8145
Th-22	4.9137	3.8860	4.9408

Threshold effect test (bootstrap = 300 300):

Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Single	289.2709	3.4437	17.32	0.0033	8.7128	10.4648	13.7311
Double	248.5796	2.9593	13.75	0.0100	7.8012	9.5626	13.2052

Source: Author's computation in STATA 14

The results of fixed effects regression is reported in Table 9. Regression estimates can be presented as follows:

$$
\begin{aligned}
growth_{it} = {} & 3.998265 + \underset{[3.83]^{***}}{0.7560395FDI_{it}}\, d(FDI_{it} \leq 4.7272) \\
& - \underset{[-1.68]^{**}}{0.4344313FDI_{it}}\, d(4.7272 < FDI_{it} \leq 4.9137) + \underset{[1.97]^{**}}{0.2281638FDI_{it}}\, d(FDI_{it} > 4.9137) \\
& + \underset{[1.51]}{0.219354TRADE_{it}} - \underset{[-2.09]^{**}}{0.2785931\ GCONS} - \underset{[-1.00]}{0.0570771\ INF} + \underset{[1.11]}{0.1072931L.GDPG} \\
& + \underset{[0.21]}{0.3975579\ GOV_{it}} - \underset{[-0.26]}{0.0105683\ ENR1}
\end{aligned}
$$

*(** and *** denotes level of statistical significance at 5% and 1%)*

Table 9: Regression Estimates: Double Threshold Model

```
Fixed-effects (within) regression               Number of obs      =        96
Group variable: id                              Number of groups   =         8

R-sq:  within  = 0.2964                         Obs per group: min =        12
       between = 0.5221                                        avg =      12.0
       overall = 0.4180                                        max =        12

                                                F(9,79)            =      3.70
corr(u_i, Xb)  = -0.0540                        Prob > F           =    0.0007
```

GDPG	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
GDPG						
L1.	.102275	.10105	1.01	0.315	-.0988599	.3034099
TRADE	.0219539	.0147128	1.49	0.140	-.0073311	.051239
GCONS	-.2671198	.1550448	-1.72	0.089	-.5757288	.0414892
INF	-.0543971	.0597528	-0.91	0.365	-.173332	.0645378
GOV	.3975579	1.903036	0.21	0.835	-3.390341	4.185457
ENR1	-.0105683	.0407925	-0.26	0.796	-.0917638	.0706272
_cat#c.FDI						
0	.7560395	.197387	3.83	0.000	.3633012	1.148778
1	-.4344313	.2580006	-1.68	0.096	-.9477715	.078909
2	.2281638	.1158677	1.97	0.052	-.0023766	.4587042
_cons	3.998265	2.339868	1.71	0.091	-.6573375	8.653868
sigma_u	1.5486632					
sigma_e	1.8091664					
rho	.42288332	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(7, 81) = 2.21                      Prob > F = 0.0416
```

Source: Author's computation in STATA 14

The F statistic of 2.21 at the 5% level of significance with the null hypothesis of all u_i=0 confirms that the fixed effect model is appropriate. The bootstrap p-values of thresholds supports the existence of threshold effect at the 10% level.

The regression slope estimates in TAR model indicate the effect of FDI in the three regimes:

- When FDI ≤ 4.7272%, the positive coefficient of 0.7561 implies a positive relationship FDI and economic growth.
- When 4.7272% < FDI ≤ 4.9137%: the negative coefficient of -0.4344 suggests that economic growth is negatively related to FDI.
- When FDI > 4.9137%, a positive effect of FDI on growth is back, however, it is not as strong as it was in the first regime with the coefficient of only 0.2282.

The smaller coefficient when FDI is beyond the second threshold also implies the looser relationship between these two variables. Therefore, we suggest that with the current absortive capacity of selected host countries the best level of FDI is 4.7272% of GDP, and beyond this threshold level, the benefit of FDI to economic growth will decline or disappear.

Conclusion

By using a panel data of eight ASEAN countries in the period of 2002 – 2014, this paper examines the relationship between FDI and economic growth using fixed effect threshold model developed by Hansen (1999). The findings indicate that the relationship between FDI and economic growth is non-linear. Furthermore, the results show that FDI can influence on growth in different ways depended on the level of FDI inflows. The study finds strong evidence that there are two threshold levels of FDI in the regression relationship. They are 4,73% and 4,91% of GDP with asymptotic 95% confidence interval. These thresholds divide the observations into three regimes, in which the impact of FDI on growth will be reversed once FDI scale reaches the threshold levels. The results also suggest that with current absorptive capacity of selected host countries, the optimal level of FDI is 4,73% of GDP to make the most of FDI to recipient economies.

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