

Foreign Direct Investment Determinants in Algeria: Evidence from ARDL Model and Toda Yamamoto Causality Approach

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Abstract: This study aims to test and analyse the determinants of foreign direct investment in Algeria during the period 1980-2020, using the ARDL model and the causality test of Toda Yamamoto. The test of the cointegration shows the existence of a long-term relationship between foreign direct investment and its basic variables GDP, degree of trade openness, exchange rate, foreign exchange reserves minus gold and real interest rate. The results of the error correction model estimates indicate that the error correction coefficient is negative and statistically significant at the 1% level, the adjustment speed is about 63% per year, and an important causal relationship was found between all the variables determined for FDI according to the Toda Yamamoto causality test.

Keywords: Foreign Direct Investment, ARDL Model, Toda Yamamoto Causality Test

JEL Classification Number: C32, F21

1. Introduction

Foreign investments are one of the most important forms of international finance at the present time and a factor that leads to economic growth (Wang 2009), so attracting them is one of the most important bets for the Algerian economy due to the important and vital role it plays in raising the productive capacities of national economies on the one hand, and providing jobs; on the one hand other. The importance of foreign direct investment, especially for developing countries, has increased because many governments from developed and developing countries believe that foreign direct investment can help them overcome the recession (Brooks et al 2010), including Algeria, which seeks to create the appropriate environment to attract and receive foreign investments and know the effects of foreign direct investment regarding employment, which is still controversial, to know and

explore the relationship between them in order to improve macroeconomic indicators and reduce unemployment rate.

Theories of FDI have evolved over time, with a number of different determinants proposed to explain the flow of foreign direct investment. These determinants can be broadly classified into two categories: organizational factors, such as ownership advantages and economies of scale, and macro-level factors such as market size, political stability, and barriers to entry. These theories have been developed since the 1960s and have been refined over time to better understand the driving forces behind FDI (Faeth, 2009).

Algeria is among the countries that have sought to improve the investment climate and attract foreign capital through several macroeconomic policies such as monetary policy, fiscal policy and exchange rate policy, in this study we will try to modelling the behaviour of foreign direct in Algeria during the period (1980 – 2020). The research problem of our study can be formulated as:

What are the fundamentals macroeconomics variables that can be considered as the determinants of FDI inflows in Algeria over the period (1980 – 2020)?

Based on the research problem we will propose the following hypothesis:

The first hypothesis: the FDI inflows in Algeria is cointegrated with the fundamentals macroeconomics variables such as: GDP growth rate, degree of openness, exchange rate

The second hypothesis: Foreign direct investment attractiveness policy depends on the coordination between the various macroeconomic policies such as: monetary policy, fiscal policy and trade policy.

2. Theoretical Approaches to FDI

2.1. Definition of FDI

The World Trade Organization (WTO) defines foreign direct investment as the investment that occurs when an investor in a country (home country) owns an asset or is located in another country (host country) with the original intention to manage it. It is also known as the partial or absolute ownership of the investment project by a foreign party, whether it is a project for marketing, sale, production or any other type of production and service activity.

2.2. Location Determinants of FDI

Various theories about foreign direct investment have identified a number of determinants that can explain FDI flows, and their attraction by the host country. Despite the various

incentives offered by developing countries to attract foreign direct investment, it has been observed that the volume of these flows does not necessarily depend on these incentives. Instead, other factors such as the economic and political climate, as well as the nature of the investment project, play a larger role in determining the success of the investment. Factors such as the size and type of investment flows, the conduct of business, and economic conditions all play a part in shaping the foreign direct investment landscape.

2.3. The effects of foreign direct investment in developing countries

The process of flow of foreign direct investment through multinational companies and the desire of countries is the issue related to how to balance the costs and benefits of these investments, i.e., the appropriateness between achieving profits and reducing risks for both parties, and that the resulting effects may be positive or negative on the host country and lie in:

- The impact of foreign direct investment on domestic investment and economic growth rates.
- The impact of foreign direct investment on exchange rates and inflation rates.
- Impact of Foreign Direct Investment on Technological Progress.
- Impact of Foreign Direct Investment on Employment.

Table 1: Summary of the determinants of foreign direct investment related to the location dimension of the OLI model

Author(s) (year)	Effect	Indicator (index)	Determinants of FDI
Cleeve (2008), Mohamed and Sidiropoulos (2010)	0	Telephone lines per 1000 inhabitants.	Infrastructure
Asiedu (2006), Biswas (2002), Mhlanga <i>et al.</i> (2010) Mhlanga <i>et al.</i> (2010), Vijayakumar <i>et al.</i> (2010), Biswas (2002)	+	The number of internet lines	
Botrićand Škuflić(2006)	-	Fixed and mobile phone number Subscribers per 1000 inhabitants	
Schneider and Frey (1985), Cleeve (2008)	0	Secondary education index.	Human capital
Asiedu (2006)	+	Adult illiteracy rate.	
Vijayakumar <i>et al.</i> (2010), Mhlanga <i>et al.</i> (2010), Mohamed and Sidiropoulos (2010), Mohamed and Sidiropoulos (2010)	0	Inflation rate foreign exchange reserves Unemployment rate.	Macroeconomic stability
Schneider and Frey (1985), Mohamed and Sidiropoulos (2010), Mhlanga <i>et al.</i> (2010), Schneider and Frey (1985), Vijayakumar <i>et al.</i> (2010).	-	Budget deficit. Financial Development Index. Public expenditure as a percentage	
Mohamed and Sidiropoulos (2010), Botrićand Škuflić(2006), Cleeve (2008), Schneider and Frey (1985)	+	of production. nominal exchange rate.	
Biswas (2002)	0	Workers' wages.	
Botrićand Škuflić(2006)	-	Remittances of workers and wages.	Production costs
Schneider and Frey(1985), Vijayakumar <i>et al.</i> (2010)	+		

Source: Assunção et al (2011).

Table 2: FDI determinants (previous studies)

Author	The year	The sample	Standard method	results
Campos and Kinoshita	2003	25 economies in transition using data for 1990-1998		It was concluded that the economies and institutions of the bloc outweigh the economic variables as they are the main determinants of foreign direct investment. While economic variables such as abundant natural resources, large markets, lower labor cost, more openness to trade, and external liberalization, managed to attract more foreign direct investment, while the weak bureaucracy was found to have a significant impact on foreign direct investment.
Imad A. Moosa, Buly A. Cardak	2006	138 countries	Extreme bounds analysis	The results reveal that developed countries with large economies, a high degree of openness and low country risks, are more successful than others in attracting foreign direct investment.
Ismail Çevis and Burak Çamurdan	2007	Dataset from 17 developing countries and economies in transition for the period 1989-2006		The study found that the inflation rate, interest rate, growth rate and trade rate (openness) are the main determinants of foreign direct investment inflows, which have a major role in giving strength to the economies of the host countries.
Thu Thi Hoang		vietnam's economy from 1988 to 2005	The ordinary least squares	The results showed that higher market size, GDP growth, openness to trade and infrastructure development are the most important factors that attract FDI inflows to Vietnam.
Marial A. Yol and Ngie Teng teng	2009	Using annual data for Malaysia for the period 1975-2006	Cointegration and Error Correction Model	The results concluded that Malaysia is positively affected by exports. While in the short term FDI flows are negatively affected by GDP growth, infrastructure and exports, and are positively affected by the openness of the economy and real exchange rate variables.

Table 2 continued

Micah B. Masuku and Thula S. Dlamini	2009	Swaziland over the period of 1980 to 2001	The cointegration and error correction model technique	The study concluded that incoming foreign direct investment flows are positively affected by economic stability and infrastructure, as well as internal economic stability and the openness of the domestic market economy.
Khondoker Abdul Mottaleb and Kaliappa Kalirajanb	2010	68 low-income and lower-middle income developing countries		The study shows that countries with a larger GDP, a higher growth rate, a higher proportion of international trade and a more business-friendly environment, are more successful in attracting foreign direct investment.
Bruce A Blonigen and Jeremy Piger	2011		The bayesian statistical technique	They found that trade openness, host country business costs, host infrastructure (including the credit market), and host country institutions are the primary determinants of FDI inflows.
Ab Quyoom Khachoo and Mohd Imran Khan	2012	Using a sample of 32 developing countries for the period 1982-2008	The panel cointegration technique	The study found that the FMOLS panel cointegrating equation estimator suggests that the market size, total reserves, infrastructure and labour costs are the main determinants of FDI inflows to developing countries.
Priscila Gomes de Castro, et al	2013	Brazil and Mexico during the period 1990 to 2010	The Vector Error Correction Model	The results found that the strategy of the main multinational companies in Brazil is to search for the market associated with the size of the domestic market, while the dominant strategy in Mexico is to seek efficiency, with regard to the importance of trade liberalization and historical flows to attract foreign direct investment.

3. The model specification, estimation and results interpretation

There are many variables that are essential in explaining *FDI* inflows; however, it is not possible to include all of them. The variables in this study were chosen because of their importance especially in Algeria and availability of data, the econometric model is specified as:

$$FDI = f(RMG, GDP, OPEN, EXC, RIR)$$

$$FDI = \alpha_0 + \alpha_1 * RMG + \alpha_2 * GDP + \alpha_3 * OPEN + \alpha_4 * EXC + \alpha_5 * RIR + U_t \dots (1)$$

Table 3: Variables explanation

Variable	Explanation
FDI	Foreign direct investment flows (% of GDP)
GDP	Gross domestic product (growth rate)
EXC	Real exchange rate
OPEN	Degree of openness ($\frac{export + import}{Gdp}$)
RIR	Real interest rate %
RMG	Foreign exchange reserves minus gold (MLR of dollars)

3.1. Unit root test

The Augmented Dickey–Fuller (ADF) (1979, 1981) is used to determine the presence of unit roots in the data sets. The ADF test is based on the estimate of the following regression:

$$\Delta X_t = \delta_0 + \delta_1 t + \delta_2 X_{t-1} + \sum_{i=1}^k \alpha_i \Delta X_{t-i} + u_i \tag{2}$$

where, Δ is the first-difference operator, X_t is the observations of the series, $\delta_0, \delta_1, \delta_2$, and α_i are being estimated and u_t is the error term. The null and the alternative hypothesis for the existence of unit root in variable X_t is: $H_0: \delta_2=0$ against $H_e: \delta_2<0$.

Table 4: ADF Unit Root Test

Variables	ADF unit root test		Order of Integration I(d)
	Level	First difference	
FDI	-3,302 (0,0804)	-6.7765*** (0.0000)	I(1)
GDP	-2.905 (0.1718)	-5.8169*** (0.0001)	I(1)
EXC	-0,9879 (0.9332)	-6.9587*** (0.0000)	I(1)
RIR	-4.565 (0.0039)		I(0)
OPEN	-1.535 (0.8001)	-4,7461*** (0,0025)	I(1)
RMG	0.1264 (0.9962)	-5.3307*** (0.0008)	I(1)

Note: *** The null hypothesis is rejected at 1 % and 5 % level of significance. (.) Value between parentheses rate probabilities.

The ADF test results showing in table 1 indicates that the null hypothesis of non-stationary at level cannot be rejected for the following variables: FDI, GDP, , OPEN and RMG, applying the same test for their first differences shows that the null hypothesis of a unit root is rejected in all cases at a 5 percent significance level, meaning that FDI, GDP EXC, OPEN and RMG are integrated for order one I (1), only RIR is integrated for order I(0)

3.2. The ARDL Model

The Bound tests in the ARDL approach can be applied regardless of the properties of the time series, if they are stationary at the level, integrated of degree zero (0) I or integrated of first degree (1), or a combination of the two, and the only condition for applying this test is that the time series are not integrated of the second order I(2). Therefore, the ARDL Model can be specified as:

$$\Delta Y = \beta_0 + \delta_1 * Y_{t-1} + \delta_2 * X1_{t-1} + \delta_3 * X2_{t-1} + \delta_4 * X3_{t-1} + \dots + \delta_k * Xk_{t-1} + \sum_{i=1}^P \theta_i * \Delta Y_{t-i} + \sum_{i=1}^P \alpha_i * \Delta X1_{t-i} + \sum_{i=1}^P \psi_i * \Delta X2_{t-i} + \sum_{i=1}^P \lambda_i * \Delta X3_{t-i} + \dots + \sum_{i=1}^P \omega_i * \Delta Xk_{t-i} + \varepsilon_t \tag{3}$$

Where: Δ : denotes the first difference; P:denotes optimal lag length determined by the Akaike information criterion (AIC), X: dependent variable in the model specification; ε_t : white noise; $\delta_1, \delta_2, \delta_3, \delta_4, \delta_k$ are long run parameters (long run association) and $\theta_i, \alpha_i, \psi_i, \lambda_i, \omega_i$ short run parameters (short run dynamics of the model):

$$\Delta FDI_{it} = \sum_{i=1}^p \alpha_{1i} \Delta FDI_{it-i} + \sum_{i=1}^n \beta_{1i} \Delta GDP_{it-i} + \sum_{i=1}^j \theta_{1i} RMG_{it-i} + \sum_{i=1}^k \gamma_{1i} \Delta OPEN_{it-i} + \sum_{i=1}^l \varphi_{1i} \Delta EXC_{it-i} + \sum_{i=1}^f \varphi_{1i} \Delta RIR_{it-i} + \sum_{i=1}^m \delta_i * FDI_{t-i} + U_t \tag{4}$$

Table 5: Cointegration - Bounds Test results

Test Statistic	Value	k
F-statistic	6.126420	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.08	3
5%	2.39	3.38
2.5%	2.7	3.73
1%	3.06	4.15

Table 4 presents the Cointegration bounds test. The result shows that F statistic is statistically significant at 5% and 1% level. Therefore, there is long run co-integration relationship between Foreign Direct Investment and its determinants.

Table 5: The long run regression model

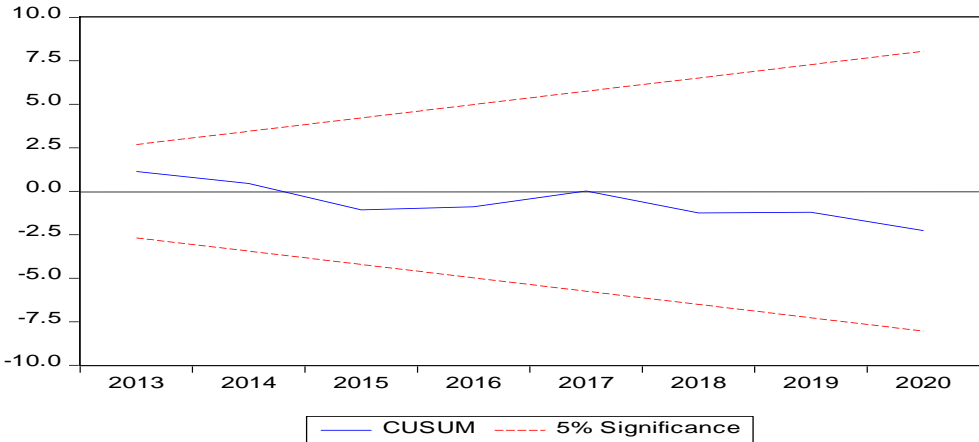
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RMG	0.008997**	0.002759	3.260541	0.0115
GDP	0.227846**	0.088496	2.574653	0.0329
OPEN	0.049936**	0.018295	2.729481	0.0259
EXC	0.013332**	0.004374	3.048365	0.0159
RIR	0.058690**	0.021901	2.679775	0.0279
C	-1.435248	0.581730	-2.467207	0.0389

Note: ** indicate 5 % level of significance.

An increase in the GDP growth rate of 1 % is associated with an increase in the *FDI* inflows of about 0.227 %, meaning that the *FDI* inflows is positively influenced GDP in Algeria this effect is statistically significant at 5 % level of significance. An increase of the Foreign exchange reserves minus gold at 1 billion will result in an increase of *FDI* at 0.0089 % this effect is statistically significant at 5 % level, this results are consistent with theoretical background.

According to the long run regression model we can see that The Degree of openness, exchange rate and Real interest rate are positively correlated with the foreign direct investment in all cases the effect is statistically significant at 5 % level.

Graph 1: test – CUSUM plot



Graph 2: test – CUSUMSq plot

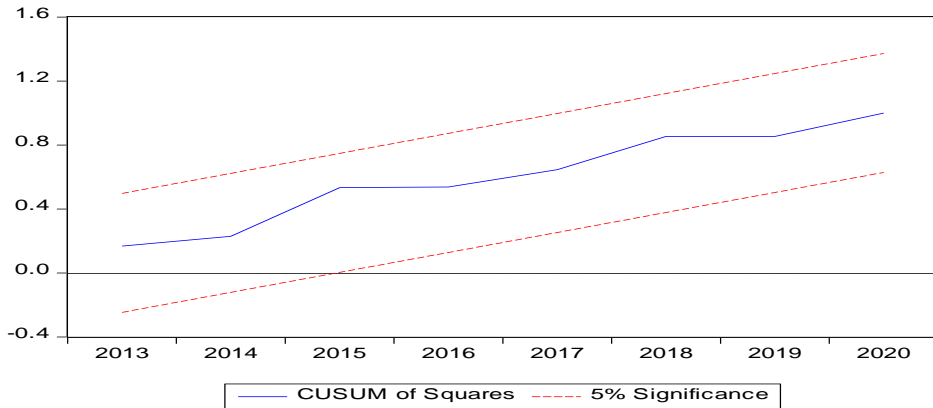


Table 6: Error correction model ECM-ARDL

<i>Cointegrating Form</i>				
<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-Statistic</i>	<i>Prob.</i>
D(FDI(-1))	0.780418	0.213743	3.651195	0.0065
D(FDI(-2))	0.540673	0.187863	2.878019	0.0206
D(FDI(-3))	0.221558	0.116887	1.895493	0.0946
D(RMG)	-0.047277	0.011066	-4.272426	0.0027
D(RMG(-1))	0.101344	0.018073	5.607393	0.0005
D(RMG(-2))	-0.077320	0.018773	-4.118601	0.0034
D(RMG(-3))	0.057176	0.014540	3.932307	0.0043
D(GDP)	0.000155	0.021072	0.007350	0.9943
D(GDP(-1))	0.383410	0.058974	6.501299	0.0002
D(GDP(-2))	0.258830	0.045083	5.741225	0.0004
D(GDP(-3))	0.131659	0.028073	4.689955	0.0016
D(OPEN)	0.002717	0.013180	0.206122	0.8418
D(OPEN(-1))	-0.102479	0.021415	-4.785303	0.0014
D(OPEN(-2))	-0.049487	0.015278	-3.239118	0.0119
D(EXC)	-0.000836	0.000352	-2.372791	0.0450
D(EXC(-1))	-0.031635	0.003561	-8.882822	0.0000
D(EXC(-2))	-0.068711	0.017258	-3.981418	0.0041
D(EXC(-3))	-0.063765	0.015926	-4.003845	0.0039
D(RIR)	0.005484	0.006764	0.810740	0.4410
D(RIR(-1))	-0.078131	0.013790	-5.665865	0.0005
D(RIR(-2))	-0.096391	0.015601	-6.178649	0.0003
D(RIR(-3))	-0.053897	0.009194	-5.861914	0.0004
Ut (-1)	-0.631650	0.087216	-7.242373	0.0000

Figure 1 and 2 plot the CUSUM and CUSUM of squares statistic for the error correction model. It can be seen that the plot of CSUSUM and CUSUM of squares stays within the critical 5 % bounds that confirms the stability of coefficients,

The error correction term ect_{t-1} is negative and statistically significant at 1 % level, meaning that a long run causality relationship exists from the independents variables to the dependent variable, according to the ECM estimation results we shows that the speed of adjustment in the error correction model is about 63 %, in other words this means that in the short run the deviations from the long run equilibrium relationship are corrected at 68 %. Also, the diagnostic tests in the short run model do not seem to have any problem.

Table 7: Toda and Yamamoto causality test

	<i>FDI</i>	<i>OPEN</i>	<i>RMG</i>	<i>EXC</i>	<i>RIR</i>
<i>Excluded</i>	<i>Chi-sq</i>	<i>Chi-sq</i>	<i>Chi-sq</i>	<i>Chi-sq</i>	<i>Chi-sq</i>
FDI		1,108	1,671	0,209	4,441
OPEN	7,5828**		1,087	0,271	0,67
RMG	10,993***	0,431		1,614	2,023
EXC	9,5623***	1,3806	0.237		6,902**
RIR	5.358*	0.414	0,719	0,138	

Note: *, ** and *** denote significance at 0.1, 0.05 and 0.01 levels respectively.

The Toda Yamamoto Causality tests results suggest that *OPEN* , *EXC* , *RMG* and *Real interest rate* Causes *FDI* at 5 %, 1 %, 1% and 10% level of significance respectively , Thus, it can be argued that past values of that *OPEN*, *EXC*, *RMG* and *Real interest rate* contribute to the prediction of the present value of *FDI* even with past value of *FDI*, we conclude that the *FDI* inflow in Algeria is influenced by degree of openness and real exchange rate , exchange rate and foreign exchange reserves minus gold the short run.

4. Conclusion

The aims of this paper are to analyses the *FDI* inflows in Algeria over the period (1980 – 2020), we used ARDL model and, Toda Yamamoto causality approach and from this study we obtained the main following results: The *FDI* inflows behaviour in Algeria is cointegrated with its fundamentals macroeconomics variables such as: exchange rate, GDP growth rate, degree of openness, meaning that there is a long run equilibrium relationship between these variables. Foreign direct investment attractiveness policy based on coordination between the various macroeconomic policies, through the study we show that *FDI* is influenced by the behaviour of macroeconomic variables of Algerian economy. Foreign direct investment flows in Algeria continue to target the hydrocarbon sector and services, which prevents the diversification of the export structure

References

- Assunção, S., Forte, R. and Teixeira, A.A.C., 2011, Location Determinants of FDI: A Literature Review, FEP Working Papers, Universidade do Porto; INESC Porto.
- Blonigen, B.A. and Jeremy, P., 2011, Determinants of Foreign Direct Investment, Working Paper 16704, National Bureau of Economic Research,
- Campos, N.F. and Kinoshita, Y., 2003, Way Does FDI Go Where it goes? New Evidence from the Transitions Economies, IMF Working Paper, WP 228.
- Çevis, I. and Çamurdan, B., 2007, The Economic Determinants of Foreign Direct Investment in Developing countries and Transitions Economies, The Pakistan Development Review, 46: 3, 285-299.
- Cushman, D.O., 1988, Exchange-rate Uncertainty and Foreign Direct Investment in the United States. *Review of World Economics*, 124, 322-334.
- Cushman, D.O., 1985, Real exchange rate risk, expectations, and the level of Direct Investment, *The Review of Economics and Statistics*, 297-308.
- Dickey, D., and Fuller, W., 1979, Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association*, 74 (366), 427-431.
- Gomes, P., Fernandes, E. and Campos, A., 2013, The determinants of foreign direct investment in Brazil and Mexico: an empirical analysis, *Procedia Economics and Finance*, 5, 231 – 240.
- Hjalmarsson, E. and Osterholm, P., 2007, Testing for cointegration Using the Johansen Methodology when variables are Near-Integrated, IMF Working Paper,
- Johansen, S. and Juselius, K., 1990, Maximum likelihood estimation and inference in cointegration – with application to the demand for money. *Oxford Bulletin of Economics and Statistics*, 52 (2), 169–210.
- Johansen, S., 1988, Statistical Analysis of Cointegration vectors, *Journal of Economic Dynamics and Control* 12, 231-254.
- Kelic, C., Bayar, Y. and Feyza, A., 2014, Effects of Currency Unions on Foreign Direct Investment Inflows: The European Economic and Monetary Union Case, *International Journal of Economics and Financial Issues*, 4, 1, 8-15.
- Khachoo, A. and Khan, M. I., 2012, Determinants of FDI inflows to developing countries: A Panel Data Analysis, Munich Personal RePEs Archive

Khondoker, A. and Kaliappa, K., 2010, Determinants of Foreign Direct Investment in Developing countries: A Comparative Analysis, ASARC Working Paper12.

Marial, A.Y. and Teng, N.T., 2009, Estimating the Domestic Determinants of Foreign Direct Investment Flows in Malaysia: Evidence from coin-integration and Error-Correction Model, *Journal Pengurusan*, 28, 3-22.

Masuku, N.B. and Dlamini, T.S., 2009, Determinants of foreign direct investment in Swaziland, *Journal of Development and Agricultural Economics*, 1(5), 177-184.

Moosa, I.A and Cardak, B.A., 2006, The Determinants of Foreign Direct Investments: An extreme bounds analysis, *Journal of Multinational Financial Management*, 16, 199-211.

Pesaran, M. H., Shin, Y. and Smith, R.J., 2001, Bounds testing approaches to the analysis of level of relationship. *Journal of Applied Econometrics*, 16 (3), 289–326.

Thuthi, H., 2006, Determinants of Foreign Direct Investments in Vietnam, Working Paper, 958-975.