November-December 2019
ISSN: 0193-4120 Page No. 5847 - 5853

The Effect of Foreign Direct Investment on Renewable Energy Consumption in Malaysia

Mohamed Khudari
College of Graduate Studies, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, 43000 Kajang, Selangor, Malaysia
khudari@uniten.edu.my

Article Info
Volume 81
Page Number: 5847 - 5853
Publication Issue:
November-December 2019

Article History
Article Received: *5March 2019*
Revised: *18 May 2019*
Accepted: *24 September2019*
Publication: *27 December 2019*

Abstract
The flow of foreign direct investment (FDI) of multinational enterprises from the home countries to their host countries is normally accompanying with transferring of knowledge, and technology, beside to the management practices. In this concern, the better management practices that related to environmental performance, these multinational enterprises try to transfer cleaner technology, which leads to drive down the usage of energy consumption to a larger extent. Therefore, many developing countries (including Malaysia) are seeking to attract more FDI in renewable energy. This paper investigates the relationship between the macroeconomic factors (including FDI), CO2, energy intensity and renewable energy in Malaysia, covering the period of 1999-2016. The Partial Least Square (PLS) analysis results show that the relationship between macroeconomic factors and renewable energy consumption is negative, this could be related to the high cost of renewable energy in Malaysia.

Keywords: *Energy consumption, FDI, Renewable Energy*

1. Introduction

Many developing economies are forced to increase the capacities of energy generation to meet energy access challenges and growing demand, and to enhance economic growth. There is a global awareness to the significant of using renewable energy and increasing its deployment to highlight the most critical issues in the world starting from the climate change, air pollution, creating new economic opportunities, and ending by providing energy access to many people all over the world.

In the context of renewable energy development, FDI forms the main source of capital and an important means of transferring more productive technology and techniques to developing economies. Going beyond other kinds of financing, the contribution of FDI in economic development is an essential (Sun, 2002). FDI is considered as the quick and efficient means of cross-border transfer and adoption of best practice that ranging from technological to environmental and socio-economic standards. Many researchers indicated that multinationals firms can get a competitive advantage only from the knowledge and better practices, and that explains the FDI spillovers of productivity and environment. As a consequence, FDI has become a dynamic element in the most of the economic strategies put forward by countries.

From this prospective, many developing economies are seeking to attract more FDI, particularly, FDI in renewable energy; which is increasing steadily globally. As shown in figure 1. the capital investment (capex) in renewable energy reaching around USD 122 Million, representing for more than 7% of all FDI in 2017. (FDI Markets, 2019).

During the last few decades, FDI had the enormous growth in the global economy (Villaverde and Maza, 2012). As a result the role of FDI has been increased since 1970 when the total value of FDI net-inflows in the global economy was only $10 billion, comparing to $2.45 trillion (both in current USD) in 2016. As a share of GDP, FDI increased from 0.34% in 1970 to 3.23% in 2016, which refers that FDI raised at a much faster pace than economic growth generally (The World Bank, 2019).

November-December 2019
ISSN: 0193-4120 Page No. 5847 - 5853

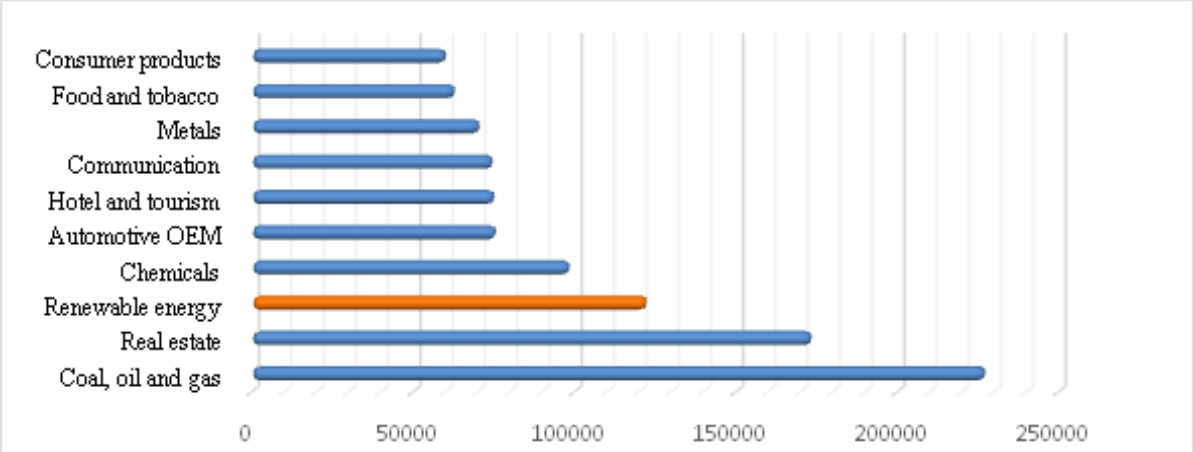

Figure 1: Top 10 Sectors of the World FDI (cpital investments capex Million USD) in 2017

Figure 2 shows that FDI grew at the rate of 12% during the period of 1970-2017. While the highest growth rate of global FDI net-inflows was 51% in 2000. This large increase due to the effects of globalisation as explained by the International Monetary Fund (IMF). One effect of Globalisation of FDI that has facilitated mergers and acquisitions of the large cross-border and allowed for global integration of capital markets, spiking up net FDI net-inflows (IMF, 2003).

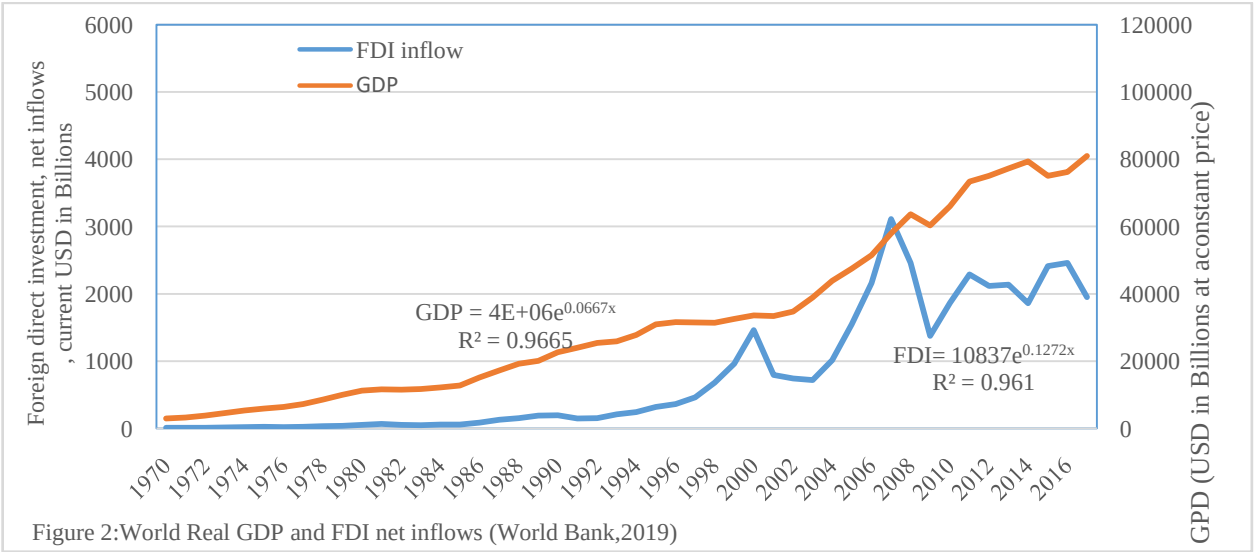

Figure 2:World Real GDP and FDI net inflows (World Bank,2019)

Due to strict environmental regulations, the FDI multinational enterprises are affected by using the efficient energy in production process. Whereas the host countries tend to uphold high environmental standards. Foreign companies can lead to an appropriate progress in energy-efficiency in the host countries, while the local firms can apply the energy-saving production that foreign firms brought it from their countries. In this concern, FDI plays a vital role in improving the performance and standards of regional environment through transferring the cleaner technology and enhancing the best practices, which leads to drive down the usage of energy consumption to a larger extent (Mabey et al., 2003).

The challenges that are facing the Malaysian economy in harmonizing between increasing both FDI flows and the use of renewable energy technologies are clearly highlighted in Figure 3. As shown in Figure 3, FDI grew at negative rate of 4.5%, as well as, the negative growth rate of 4.2% for using renewable energy during the period of 1991-2017. While the growth rate of CO_2 emissions is growing at 5.1% during the same period. In this context, the role of renewable energy in Malaysia increased according to its ability in reducing CO2 emissions and decreasing the negative effects on the environment that accompanying all energy processes (i.e. energy generation, transmission, conversion, and consumption) (Bekhet and Harun, 2017).

November-December 2019
ISSN: 0193-4120 Page No. 5847 - 5853

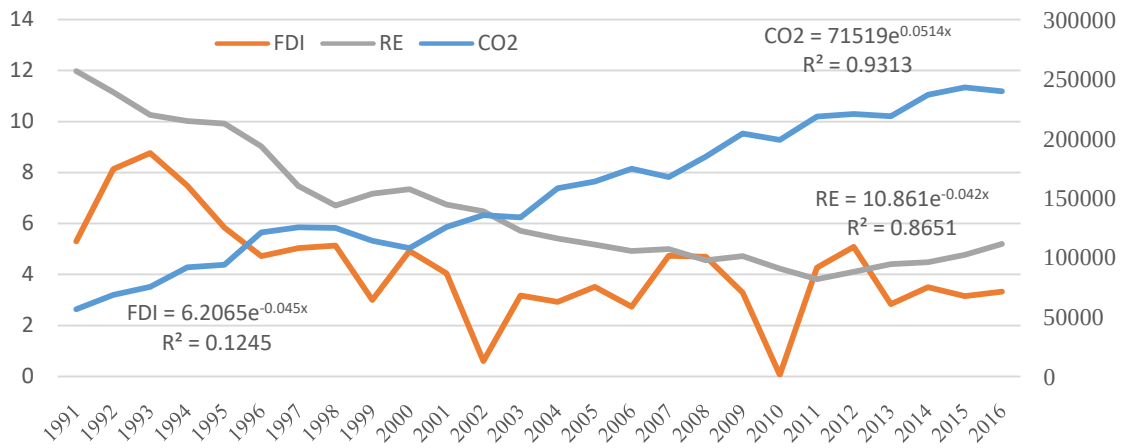

Figure 3: Renewable energy consumption (% of total final energy consumption), CO_2 emissions (kt) and FDI net inflows % of GDP) in Malaysia

2. Literature Review

A large body of literature concentrated on the FDI spillover effects on the environment through energy consumption, CO_2 emissions, and clean energy usage. These studies (Friedman. et.al, 1992), (Chung, 2014), (Aliyu, 2015) and (Hoffman. et.al, 2005) show that FDI have two aspects, the first is could be a threat to environment and have negative effects, while the second is could be a source of reducing energy consumption. Other studies (Djulius, 2017) highlighted the knowledge spillover as a form of technology transfer from FDI and aimed to investigate the spillovers that might occur horizontally and vertically, also to discover whether specialization and the rivalry in industry play a role in eases knowledge spillover in industry sector.

Generally, according to these studies FDI could have positive and negative externalities. Based on production function in the host economy of FDI, such a result related to the constant return to scale, FDI have a direct effect on production and therefor the economic development depending on the economy absorptive capacity. This could affect energy consumption and it is known as "scale effect". "The scale effect tries to keep energy intensity constant which is considered as indirect positive impact of FDI on energy consumption, therefore, in such stage of economic development, economic growth has a positive effect on environmental decay (Bekht and Othman, 2018)".

Many researchers have used CO2 emissions and energy intensity as proxies for the effective use of energy source in the country, as the correlation between FDI and renewable energy consumption has been hard to confirm. It has then been shown that FDI has a positive impact on CO2 emissions, i.e. as FDI net-inflows increase, the host economy is responsible for a larger share of CO2 pollution, but that FDI has a negative effect on energy intensity. This indicates that even though FDI net-inflows have been shown to increase a country's CO2 emission, the efficiency of the economy has improved: more output per primary unit of energy (Mielnik and Goldemberg, 2002). However, Antweiler et al. (2001) came out with contradictory conclusions indicating that FDI affects domestic production of host economy but does not affect the energy intensity. Lately, Lee (2013) found a compound relationship between FDI, energy consumption, CO2 emissions, clean energy and economic growth. The empirical analysis suggested that FDI increasing the economic growth and reducing CO_2 emissions while decreasing energy intensity by the mean of energy-efficient equipment. Further, the adoption of clean energy increases economic growth similarly.

Hubler (2009) used the general equilibrium framework to inspect the impact of FDI and trading of energy-saving technologies on energy consumption. He confirmed that FDI could be considered as incentives to implement energy-efficient technology that decrease energy consumption.

Doytch and Narayan (2016) analysed the outputs of FDI net-inflows on environment and suggested that there is empirical support for the FDI "halo effect", i.e. the claim that foreign investments bring developed domestic environmental performance, according to "green spillovers". "The halo effect brings down the cost of production, making the local firms more internationally competitive". Hence, the domestic industries have gained from reproducing the foreign technology. They argued that FDI is a crucial means of increasing the renewable energy consumption in upper middle-income countries, whereas the effect in lower middle-income countries is not as large, when studying the effects of sectoral FDI.

Tang (2009) found unidirectional causality running from FDI to electricity consumption in Malaysia in the long run and feedback effect in the short run by applying the VECM Granger causality approach. Finally, Zaman et al. (2012) stated that foreign capital inflow Granger causes electricity consumption.

November-December 2019
ISSN: 0193-4120 Page No. 5847 - 5853

3. Research Method

The study employs aggregate data in Malaysia for the period 1999-2016. Table 1. explains the data

Table 1. Variables' Definition and source

Variable's name in SmartPLS	Full name	Definition	Sources
Renewable energy	Renewable energy consumption	"Renewable energy consumption is the share of renewable energy in total final energy consumption".	World Bank, Sustainable Energy for All. 2019
FDI-in	Foreign direct investment, net inflows	"Foreign direct investments are the net inflows of investments in the reporting economy from foreign investors, and are divided by GDP".	World Bank, International Debt Statistics, 2019
FDI-out	Foreign direct investment, net outflows	"FDI out-flows shows the net outflows of investment from the reporting economy to the rest of the world, and are divided by GDP".	World Bank, International Debt Statistics, 2019
GDP	Real GDP	"Gross Domestic Product is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products". (in constant price 2010 USD)	World Bank national accounts data, 2019
enprice	Energy price index	"An index price of all energy which measured using the consumer price index (2010 base year)"	Malaysia energy information hub.
netien	Energy imports	"Net energy imports are estimated as energy use less production, both measured in oil equivalents".	IEA Statistics
energyint	Energy intensity level of primary energy	"Energy intensity level of primary energy is the ratio between energy supply and GDP measured at purchasing power parity". (MJ/$2011 PPP GDP)	World Bank, Sustainable Energy for All. 2019
CO_2	CO_2 emissions (kt)	"Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement".	World bank, 2019

Source: Author's compilations from the world bank and MEIH.

This study examines the effect of macroeconomic factors and CO_2 emissions on the consumption of renewable energy at the aggregate level as shown in figure 4.

SmartPLS 3.0 software was used to evaluate the relationship among the constructs of the research model as shown in figure 4 by conducting partial least square (PLS) analysis.

PLS is a predictive technique that is an alternative to ordinary least squares (OLS) regression, canonical correlation or structural equation modelling. PLS can relate the set of independent variables to multiple dependent (response) variables. On the predictor side, PLS is particularly useful when predictor variables are highly correlated, or when the number of predictors exceeds the number of cases. PLS may be implemented as a regression model, predicting one or more dependents from a set of one or more independents; or it can be implemented as a path model, handling causal paths relating predictors as well as paths relating the predictors to the response variable(s) (Garson, 2016) .

Past research concerning the effects of FDI on renewable energy consumption or CO_2 emissions with other macroeconomic factors, while in this study the analysis will concern on the effects of both macroeconomic (including FDI) and CO_2 emissions on renewable energy consumption in Malaysia hence, the following hypotheses have been developed:

Hypothesis 1 (H1): Macroeconomic factors affect the consumption of renewable energy.

Hypothesis 2 (H2): Macroeconomic factors affect the CO_2 emissions.

Hypothesis 3 (H3): Energy intensity affect the consumption of renewable energy.

Hypothesis 4 (H4): Energy intensity affect the CO_2 emissions.

Hypothesis 5 (H5): CO2 emissions affect the consumption of renewable energy.

4. Results

The loadings of construct variables are illustrated in Table 2 it shows that variables with loadings less than

November-December 2019
ISSN: 0193-4120 Page No. 5847 - 5853

0.40 are excluded from the model. While the loadings represent the correlation, the expected positive relationships between macroeconomic factors (FDI net-inflow, FDI net-outflow, GDP, energy price index and energy net imports) and renewable energy consumption. Although this study conducts with secondary data, it could be acceptable to show the average variance extracted (AVE) value as a measurement model. The AVE value of the each construct is generated using SmartPLS algorithm function where all AVE values are greater than 0.5. Based on the results the tests on the measurement model are satisfactory.

Table 2: Measurement Model

Construct	Items	Loading	AVE
Macroeconomic factors			0.782
FDI-in	Foreign direct investment, net inflows (% of GDP)	---*	
FDI-out	Foreign direct investment, net outflows (% of GDP)	0.901	
GDP	GDP (current US$)	0.818	
enprice	Energy price index	0.898	
netien	Energy net imports	0.936	
Energy intensity			1.000
CO_2 emissions			1.000

*--- loading less than 0.40 were excluded from the model. AVE = average variance extracted

The validity of the model is evaluated by using the coefficient of determination (R^2) and path coefficients. Whereas, the beta β value refers to the amount of variance in the dependent variables that is explained by the independent variables, and the larger value of R^2 the more predictive ability of the model. Since this study is using secondary data so f^2values become more efficient than R^2. The variance inflation factors (VIF) uses to describe how much multicollinearity (correlation between predictors) exists in a regression analysis. The results show that there are no multicollinearity whereas the value of VIF of all constructs are less than 4. The SmartPLS algorithm function is used to obtain the R^2 and f^2values, while the SmartPLS bootstrapping function is used to generate the t-statistics values. For this study, the bootstrapping function generated 500 samples from 18 cases. The results of the structural model are presented in Figure 4

Based on the results are shown in Table 3, the relationship between the macroeconomic factors → renewable energy (β= -0.860, p<0.05) is negative related to renewable energy with a $f^2$of 4.503 indicating the highest percentage of the variance in renewable energy can be explained by macroeconomic factors. Hence, H1 is supported. The relationship between energy intensity → CO_2 emissions (β=0.644, p<0.05) is positive related to CO_2 emissions with a $f^2$of 0.476 indicating that 47.6% of the variance in CO_2 emissions can be explained by energy intensity. Hence, H4 is supported. The relationship between CO2 emissions → Renewable energy (β= -0.414, p<0.05) is negative related to renewable energy with a $f^2$of 1.007 indicating the highest percentage of the variance in renewable energy can be explained by CO2 emissions. Hence, H5 is supported. According to the relationship Macroeconomic factors → CO2 emissions and Energy intensity → Renewable energy the results show that there are insignificant relationship between them whereas H2 and H3 are not supported.

Table 3: Path Coefficient

Hypothesis	Relationship	Standardized β	f^2	*SE*	*VIF*	*T* value	Decision
Hypothesis 1	Macroeconomic factors -> Renewable energy	-0.860	4.503	0.143	1.422	6.003*	supported
Hypothesis 2	Macroeconomic factors -> CO_2 emissions	0.303	0.105	0.267	1.287	1.135	Not supported
Hypothesis 3	Energy intensity -> Renewable energy	-0.083	0.031	0.104	1.889	0.979	Not supported
Hypothesis 4	Energy intensity -> CO_2 emissions	0.644	0.476	0.171	1.287	3.772*	Supported
Hypothesis 5	CO_2 emissions -> Renewable energy	-0.414	1.007	0.117	1.476	3.555*	Supported

*p<0.05.

November-December 2019
ISSN: 0193-4120 Page No. 5847 - 5853

5. Conclusion

Energy, generally, is a crucial element in economic growth. Hence the consumption of renewable Energy is considered as a vital role in enhancing the economic growth in many economies. In this context, the role of renewable energy in Malaysia has increased due to its capability to reduce the level of CO_2 emissions and to decrease the negative impacts of all energy processes. The potential impacts of FDI on renewable energy consumption could be through competition or direct knowledge transfer. Thus, the existence of foreign companies in any economy may conduct as an incentive of enhancing the energy efficiency of the local firms. Such foreign firms may be have more propensity to use cleaner energy from renewable sources.

The results suggest that the stage of economic development of a country must be considered while devising policies to promote renewable energy production. The results of PLS analysis revealed that significant relationships are exist among the variables of macroeconomic, CO_2 emissions and renewable energy. Furthermore, the challenges for Malaysia in attaining sustainable economic development, are represented by the high cost of renewable energy, which is required enormous capital investment (Bekhet & Othman, 2018). Therefore FDI saves renewable energy. These encouraging results could induce Malaysia to increase FDI flows without affecting renewable energy consumption. In this context, as one implication of mitigate the negative relationship between the macroeconomic variable and renewable energy, it could be impose fiscal incentives such as tax relief and exceptions for clean energy technology imports, subsidies, and loans for the purchase of renewable energy.

The negative relationship between renewable energy and CO2 emissions in Malaysia is consistent with many studies that investigated the validation of the environmental Kuznets curve (EKC) (Bekhet & Othman, 2018), where the results showed that the inverted N-shaped relationship appears, and the renewable energy minimizes the CO2 emissions in Malaysia. The natural of this relationship proposes that GDP will be the solution for environmental pollution problems, with renewable energy as one of influential factors for remedy environmental issues.

This study recommends to increase public awareness and raise the public interest on the benefit of renewable energy, clean technology, and clean environments. Government should attract more FDI to invest in renewable energy sectors.

REFERENCES

[1] Aliyu, M.A., 2015. Foreign Direct Investment and the Environment: Pollution Haven Hypothesis Revised. In Proceedings of the Eight Annual Conference on Global Economic Analysis, Lübeck, Germany, 9–11 June 2005.

[2] Antweiler, W., Copeland, B.R., Taylor, M.S., 2001. Is free trade good for the environment? Am. Econ. Rev. 91, 877–908.

[3] Bekhet, H.A., Harun, N.H., 2017. Elasticity and causality among electricity generation from renewable energy and its determinants in Malaysia. Int. J. Energy Econ. Policy 7 (2), 202–216.

[4] Bekhet, H.A., Othman, N.S., 2018. The role of renewable energy to validate dynamic interaction between CO_2 emissions and GDP toward sustainable development in Malaysia. Energy Economics, vol. 72, p.47–61.

[5] Chung, S., 2014. Environmental Regulation and Foreign Direct Investment: Evidence from South Korea. J. Dev. Econ. 2014, 108, 222–236.

[6] Djulius, H., 2017. Foreign Direct Investment an Technology Transfer: Knowledge Spillover in the Manufacturing Sector in Indonesia. Global Business Review, 18(1) (57-70).

[7] Doytch, N. and S. Narayan, 2016. "Does FDI influence renewable energy consumption? An analysis of sectorial FDI impact on renewable and non-renewable industrial energy consumption", *Energy Economics*, vol. 54, p. 291-301.

[8] Friedman, J., Gerlowski, D.A., Silberman, J., 1992. What Attracts Foreign Multinational Corporations? Evidence from Branch Plant Location in the United States. J. Reg. Sci. 1992, 32, 403–418.

[9] Garson, D.G, 2016. Partial Least Squares: Regression, and structural Equation Models, Statistical Associates Publishing.

[10] Hoffman, R., Ging, L.C., Ramasamy, B., Yeung, M., 2005. FDI and Pollution: A General Causality Test Using Panel Data. J. Int. Dev. 2005, 17, 311–317.

[11] Hubler, M., 2009. Energy saving technology diffusion via FDI and trade using CGE model of China. Working Paper No.1491. Kiel Institute of World Economy.

[12] IMF - International Monetary Fund, 2003. *Foreign Direct Investment Trends and Statistics: A Summary*. Available at: http://www.imf.org/external/np/sta/fdi/eng/2003/102803s1.pdf Accessed: [20-04-2019]

[13] Lee, J.W., 2013. "The contribution of foreign direct investment to clean energy use, carbon emissions and economic growth", *Energy Policy*, vol. 55, p. 483-489.

[14] Mabey, N. and R. McNally - Lyuba Zarsky, 2003. "Foreign Direct Investment and the environment: from pollution havens to sustainable development". *WWF-UK*, 2003-07.

[15] Mielnik, O. and J. Goldemberg, 2002. "Foreign direct investment and decoupling between energy and gross domestic product in developing

countries", *Energy Policy*, vol. 30, no. 2, p. 87–89.

[16] Sun, X. 2002, "How to promote FDI? The regulatory and institutional environment for attracting FDI", *Foreign Investment Advisory Service*, United Nations, Marrakesh, Morocco.

[17] Tang, C.F., 2009. Electricity consumption, income, foreign direct investment, and population in Malaysia: new evidence from multivariate framework analysis. J. Econ. Stud. 36 (4), 371–382.

[18] Villaverde, J. & Maza, A. "Inward Foreign Direct Investment in the European Union", Swedish Institute for European Policy Studies, Stockholm, Sweden.

[19] Yang, B., Yang, J., Zhao, Q., 2014. Environmental Impact of Foreign Direct Investment toward Host Countries, in Maoliang Bu , Boqiong Yang (ed.) Globalization and the Environment of China (Frontiers of Economics and Globalization, Volume 14) Emerald Group Publishing Limited, pp.21 – 43.