

Inward Foreign Direct Investment, Energy Consumption, and Economic Growth: “A Tale of Malaysia and Thailand”

Abstract

This study investigates the relationship among foreign direct investment, energy use, human capital, and economic growth for Malaysia and Thailand over a period 1975 to 2021. The ARDL bounds test for Malaysia and Thailand confirmed the co-integration between variables in the long-run. The long-run ARDL results corroborate that energy consumption, human capital, and financial development promote economic growth. Accordingly, the study supported the FDI-led growth hypothesis. The study observed a long-run bidirectional causality between energy consumption and economic growth and concludes that an energy policy that is oriented toward improvements in energy consumption efficiency may not adversely affect the real GDP. In the case of Thailand, the study detected four bidirectional causality relationships among the variables. Empirical findings verify that appropriate public policy must be formulated to stimulate inward FDI, human capital, trade, financial development, and energy to foster economic growth and development both in Malaysia and Thailand.

Keywords: FDI; energy use; human capital; financial development; economic growth.

JEL codes: F2; Q4; E24; E5; O4

Introduction

The linkages among foreign direct investment (FDI), energy use, and economic growth have been the issue of substantial academic research over the past several years. Numerous studies have empirically tested different sets of variables along with FDI, energy, and economic growth. However, empirical studies that include human capital and energy in the growth theory framework remain rare and need further empirical research. Therefore, energy consumption and economic growth nexus have been quantitatively evaluated by Kraft and Kraft (1978). Certain prior studies claim that energy is an important input similar to other factors of production, such as capital, labor, and land. Energy use plays an imperative role in the economic growth of any country. In addition, energy use increases the effectiveness and output of the country as well as plays a vital role for individuals and households. The importance of energy in economic growth and development is well documented in the existing works of energy economics (Akinlo, 2008; Apergis & Payne, 2009; Omri, 2013; Azam et al., 2015; Saidi & Hammami, 2015; Alaali et al. 2015; Ahmed & Azam, 2016; Achour & Belloumi, 2016).

Siddique et al. (2015) corroborate that energy consumption contributes to the national output; thus, energy use is imperative to the economy and vital for economic growth as well as development. Alaali et al. (2015) elucidate that “Energy has long been argued as an essential factor for the development of the economy and therefore it should be brought in line with the other production factors of neoclassical economics, capital and labour” (p.1).

Foreign direct investment inflow has crucial positive influences on a recipient country’s development efforts. The theoretical link between FDI and economic growth can be traced back to modernization as well as dependency theories (Adams, 2009). Modernization theories suggest that FDI could promote economic growth under the principle that growth requires capital investment (Adams, 2009). Moreover, FDI inflow can be a source of beneficial technology, export development, know-how, job creation, labor skill creation, management improvement, and enhanced productivity while promoting connections with domestic firms, which can drive an economy (De Mello, 1997; Borensztein et al., 1998; Alfaro, 2003; Omri & Kahouli, 2013; World Bank 2013; Aziz & Mishra, 2016). Many empirical studies prove that inward FDI induces energy use through the enlargement of manufacturing sector development, industrialization, and transportation and that energy use is needed for sustaining the manufacturing process (Mielnik & Goldemberg, 2000; Omri & Kahouli, 2014; Azam et al., 2015; Doytch & Narayan, 2016; Abdouli & Hammami, 2017). Nelsen and Phelps (1966) prove that production and the diffusion of technology are not viable without human capital development. Woodhull (2001) confirms that investment in human capital is more prolific than that in physical capital. Mayer et al. (2001) verify that investment in health can enhance economic growth and development. Slaus and Jacobs (2011) expound that financial capital and development have a positive effect on people’s education, develop as well as utilize technology to natural processes, and, thus, improve social welfare. Several studies validate that promoting the development of a country’s financial sector accelerates economic growth (Calderon & Liu, 2003; Hassan et al., 2011; Bojanic, 2012; Durusu-Ciftci *et al.*, 2017).

ASEAN (2017) reported that ASEAN’s economy is currently ranked the seventh biggest in the world, with a combined GDP of USD 2.4 trillion, and is expected to rank as the fourth biggest economy by 2050 in the world. The region requires billions of dollars in physical infrastructure development, which is not only for conventional ports, bridges, and roads but also for building financial systems, digital networks, ICT, education, agriculture, and health-care frameworks. ASEAN’s rapidly growing economies and expanding populations lead to the increasing

consumption of energy resources, particularly oil and gas. Investing in the ASEAN report maintains that incoming FDI to ASEAN countries dropped by 8%, which is estimated at USD 120 billion, between 2014 and 2015. Investment from Australia, China, India, Japan, South Korea, and New Zealand is enhanced by 11% to USD 40 billion. Handley (2017) also validate that Malaysia is the third largest economy (after Indonesia and Thailand) in the ASEAN and is well on track to attain its target of becoming a high-income economy by 2020. The data statistics affirm that, in spite of a moderate GDP growth rate of 4.1% in 2016, which is below the ASEAN average of 4.5%, Malaysia is one of the top-performing economies in the region in terms of effectiveness and business regulations (Bakhtyar *et al.*, 2012).

The current study examines the relationship among FDI inflows, human capital, energy use, and economic growth for Malaysia as well as Thailand from 1975 to 2016. This study is different in three ways. First, the study empirically tests FDI, human capital, energy consumption, financial development, trade openness, and economic growth relationship for Malaysia as well as Thailand. Second, we use a large time period, which gives significantly robust results. Finally, this study's empirical methodology as well as estimation is different and well justified. Therefore, the outcomes of this study help guide management authorities that formulate the public policy for encouraging FDI, human capital, and energy to boost economic growth.

The rest of the paper is structured as follows. Section 2 deals with empirical literature review. Section 3 explains the data and methodological framework. Section 4 presents empirical findings and discussion. Section 5 concludes the study and suggests certain policy recommendations.

Literature Review

Based on theoretical foundations, FDI is considered as a tool to directly affect the growth process of an economy via the accumulation of capital, advanced technologies, and the importation and inclusion of new input factors in the domestic production. These theoretical benefits of FDI are long tested empirically via the models built under the endogenous growth theory and neoclassical theories. These models depicted contradictory results based on the differences in the estimation techniques, developed or developing countries, nature of data and time. To analyze this approach that FDI can promote economic growth, Azam *et al.* (2014) elucidate that that human capital and FDI inflow have significantly positive effects on

economic growth for seven Asian countries from 1990 to 2012. Similarly, Sbia et al. (2014) verify that FDI, openness to trade, and CO₂ decreased the energy demand in UAE from 1975Q1 to 2011Q4 and that aggregate output (economic growth) as well as clean energy have a significantly positive effect on energy use. Moreover, Azam and Ahmed (2015) validate that human capital and inward FDI have positive impacts on economic growth in 10 countries from the Commonwealth of Independent States. Alaali et al. (2015) prove that energy use and human capital (education) has a positive impact on per capita GDP growth for 130 countries from 1981 to 2009.

The Granger causality test results of Abidin et al. (2015) assert that unidirectional causality runs from FDI to energy consumption, energy consumption to financial development, and energy consumption to trade in five ASEAN countries from 1980 to 2014. Moreover, empirical results confirm the bidirectional causality between trade and energy consumption, between energy consumption and FDI, between trade and FDI, between energy consumption and financial development, as well as between trade and financial development. The empirical findings of Azam (2016) in 20 OIC countries from 1986 to 2012 assert that FDI is positively and significantly related to economic growth. Last but not the least, Abdouli and Hammami (2017) investigated the causal relationship between energy use, inward FDI, and economic growth and concluded a two-way causal link between inward FDI and economic growth as well as between energy use and economic growth for 17 countries over a period 1990 to 2012.

Worldwide, energy is considered as the backbone in the process of economic growth as all most of the industrial and production activities in an economy are based on the utilization energy resources either renewable or non-renewable. Energy is considered to push the process of manufacturing and industrial activities, thus leading to an increase in the overall productivity in the economy. To investigate the impact causal relationship between energy consumption and economic growth, Lau et al. (2011) inspect the case of 17 ASEAN countries and stated that causality runs from energy to growth (GDP) in the short-run, while in the long-run causality runs from growth to energy consumption. Furthermore, Mahalik and Mallick (2014) elucidate that energy use has a significantly positive effect on urban population proportion in the total population while the same has a significantly negative effect on financial development, economic growth, and the proportion of industrial production in the aggregate output in India from 1971 to 2009. In the case of Algeria and Egypt and Tunisia, Salman and Atya (2014) investigated the role of financial development and energy use in the process of economic

growth and confirmed a significantly positive impact of financial development and energy use on economic growth in Algeria and Tunisia, while in the case of Egypt, the study revealed a significantly negative link that relates energy use and financial development to economic growth.

Moreover, in the case of five South Asian countries over a period of 1980 to 2010, Siddique et al. (2015) verify that energy consumption, trade, and financial development positively affect the economic growth. In a similar way Zheng and Youngho (2016) explore the cointegration and causal association between energy use and economic growth in 16 Asia Pacific countries from 1970 to 2011. The FMOLS results confirmed the significance of accounting for interdependence in all countries. The Granger causality test detect that economic growth unidirectionally causes energy consumption in the region although the correlation fluctuates for individual countries. More recently, Ilesanmi and Tewari (2017) confirmed a long-run bidirectional link between economic growth and energy use in South Africa by analyzing a data set over a period 1960 to 2015. Furthermore, investigating the panel data set of 40 developing countries, Durusu-Ciftci et al. (2017) elucidate that both channels of financial development (debt from credit markets and equity from stock markets) has encouraging long-term impacts on the steady-state level of per capita GDP and the contribution of the credit markets is more significant.

Based on the above said empirical studies there is no single study that examines the relationship between FDI inflows, human capital, financial development, and economic growth in the context of Malaysia and Thailand. Accordingly, the present study aims to investigate the empirical relationship among these variables for Malaysia and Thailand.

Data and Model Specification

The current study investigates the time series (cross-sectional) data of Malaysia and Thailand from 1975 to 2021 by analyzing the relationship among economic growth, foreign direct investment, human capital, energy consumption, and financial development. The current study utilized the Cobb–Douglas production function with constant returns and aggregate output function in time t as follows.

$$Y_t = f(AK_t^\alpha, L_t^\beta), \quad (1)$$

where Y_t is the aggregate output at time t , A is the parameter of technology, K_t is the measure of capital, and L_t measures the labor efforts in an economy. α and β are the measures of elasticities of capital and labor, respectively.

The neo-classical growth model is the basis for the current economic growth. The importance of capital to develop the economy is emphasized, and considerable emphasis is given on the demographic features in explaining the dynamic economic growth under new growth theory (Brezis & Young, 2014; Solow, 1965). The current study focused on the neo-classical growth model, where capital and labor are considered less than one factor of production given that this study utilized the role of human capital, which covers capital and labor activities. Energy consumption is considered as a separate input factor in the process of production. Accordingly, we can write the model as follows.

$$Y_t = f(K_t E_t), \quad (2)$$

where Y_t is the real GDP, K_t is the human capital, and E_t is the total energy consumption.

The current study utilized real GDP per capita in the constant 2010 US\$ as a proxy to measure economic growth (Ali, Abdullah, & Azam, 2017ab; Saboori, Rasoulinezhad, & Sung, 2017; Sohag *et al.*, 2015). Energy consumption is measured in terms of the kilograms of oil equivalent per capita to cover the total consumption of energy (Ali, Abdullah, & Azam, 2016; Ali *et al.*, 2017b; Saboori, Sapri, & bin Baba, 2014; Bakhtyar *et al.*, 2014). This study utilized the human capital index to determine the impact of human capital on the economic growth of Malaysia and Thailand (Eesley, 2016; Fukuyama, Hashimoto, Tone, & Weber, 2017; Shapiro, 2006). Moreover, this study utilized the net inflow of foreign direct investment as a percent of GDP (Ali *et al.*, 2017a) to investigate the impact of FDI on economic growth in FDI, which is an important engine of economic growth (Azam, 2016). In addition, this study further utilized financial development in terms of broad money supply (M2) to investigate its relationship with economic growth given that, in previous literature, financial development is one of the basic input factors for improving the growth of the economy. The study also argued that trade openness can improve the economic condition of an economy. The study adopted trade openness as a control variable to cover the problem of omitted variable bias. This study further

utilized trade openness in terms of export as a fraction of GDP. Accordingly, the model of the study can be written as follows.

$$Y_t = f(K_t, E_t, FDI_t, Exp_t, M2_t), \quad (3)$$

where HC_t represents human capital K_t , FDI_t is the net inflow foreign direct investment, Exp_t is the proxy for trade openness, and $M2_t$ represents the financial development in an economy. Therefore, we can convert the economic function into an econometric model by logging both sides to cover the problems of multicollinearity and autocorrelation, which is in line with the work of Ang (2009) and Shahbaz (2012). Accordingly, our model takes the form

$$\ln Y_t = \beta_0 + \beta_1 EC_t + \beta_2 HC_t + \beta_3 FDI_t + \beta_4 Exp_t + \beta_5 M2_t + \varepsilon_t. \quad (4)$$

Estimation Procedure

The current study opted to use the unit root tests to find out the level of stationarity of the variables. The study applied the augmented Dickey–Fuller (ADF) unit root and the Philips Perron (PP) unit root tests to investigate the level of stationarity of the study variables. After investigating the stationarity nature of the variables, the study adopted the well-known Johansen cointegration technique and autoregressive distributed lagged (ARDL) bounds test to determine the cointegration relationship among the study variables. A long-run cointegration exists between the variables and the level of stationarity; thus, the study applied the ARDL technique to investigate the short-run and long-run estimates of the model simultaneously. The ARDL approach has certain advantages over the VECM and Johansen cointegration technique given that the ARDL cointegration technique can be applied regardless of the nature of the stationarity of the data if they are $I(0)$ or $I(1)$ or even a mixture of $I(0)$ and $I(1)$ (Pesaran and Pesaran, 1997). The ARDL approach is also good to adopt because this method can generate a sufficient number of lags while shifting from a general to a specific framework. Third, the short-run adjustments can be drawn from the ARDL by a simple linear transformation to derive the VECM without disturbing the long-run equilibrium. The error correction term in the VECM mechanism is used to measure the adjustment speed of the short-term disequilibrium toward the long-term equilibrium. Fourth, no problem of endogeneity and residual correlation is found because the ARDL approach selects the appropriate lags itself (Pesaran, Shin, & Smith, 1999).

Fifth, the ARDL approach is superior to Johansen and Juselius's approach due to the small sample properties of the ARDL (Pesaran et al., 1999).

The general ARDL bound test can be estimated by solving the following equation.

$$\begin{aligned}
\ln GDP_t = & \beta_0 + \sum_{i=1}^p \beta_1 \Delta \ln GDP_{t-i} + \sum_{i=1}^p \beta_2 \Delta \ln EC_{t-i} + \sum_{i=1}^p \beta_3 \Delta \ln HC_{t-i} + \sum_{i=1}^p \beta_4 \Delta \ln FDI_{t-i} \\
& + \sum_{i=1}^p \beta_5 \Delta \ln EXP_{t-i} + \sum_{i=1}^p \beta_6 \Delta \ln M2_{t-i} + \lambda_1 \ln GDP_{t-i} + \lambda_2 \ln EC_{t-i} \\
& + \lambda_3 \ln HC_{t-i} + \lambda_4 \ln FDI_{t-i} + \lambda_5 \ln EXP_{t-i} + \lambda_6 \ln M2_{t-i} + \varepsilon_t, \quad (5)
\end{aligned}$$

where β_0 and ε_t are the drift component and the error term, respectively. The short-run dynamics are represented by the summation sign in the first half of Eq. (5) and the λ signs in the next half of the equation represent the long-run dynamics of the model. To determine the presence of a long-term relationship among the variables, joint F statistic and Wald statistic tests are employed under the null hypothesis of no cointegration; $H_0 = \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$; the alternative hypothesis is $H_1: \lambda_1 \neq 0, \lambda_2 \neq 0, \lambda_3 \neq 0, \lambda_4 \neq 0, \lambda_5 \neq 0, \lambda_6 \neq 0$. Two critical limits are used to compare the F-calculated values of the cointegration test (Pesaran, Shin, & Smith, 2001). The null hypothesis of no cointegration is rejected if the calculated value of the F-test is greater than the tabulated critical value. Therefore, the alternative hypothesis of cointegration is accepted. If the calculated F-statistics value is lower than the critical tabulated value, then we cannot reject the null hypothesis and no long-run cointegration exists among the variables of the study. This technique selects the optimum lag length under the Akaike information criteria for the maximum number of lags or the Schwartz–Bayesian criteria for the smallest possible number of lags. If the bounds test detects the presence of a long-term relationship, then the error correction model can be represented as follows after the selection of the proper lag length.

$$\begin{aligned}
\Delta \ln GDP_t = & \beta_0 + \sum_{i=1}^p \beta_1 \Delta \ln GDP_{t-i} + \sum_{i=1}^p \beta_2 \Delta \ln EC_{t-i} + \sum_{i=1}^p \beta_3 \Delta \ln HC_{t-i} + \sum_{i=1}^p \beta_4 \Delta \ln FDI_{t-i} \\
& + \sum_{i=1}^p \beta_5 \Delta \ln EXP_{t-i} + \sum_{i=1}^p \beta_6 \Delta \ln M2_{t-i} + \theta ECT_{t-i} + \varepsilon_t, \quad (6)
\end{aligned}$$

where ECT_{t-i} represents the speed of adjustment toward the long-run equilibrium if a short-run disequilibrium exists. The study further applied the Granger causality test to determine the direction of causality among the variables. Moreover, diagnostic tests include serial correlation, heteroscedasticity, normality, as well as Ramsey's RESET to investigate the overall stability and functional form of the model. The stability of the model is tested by applying the cumulative sum of recursive residuals and the cumulative sum of squares of recursive residual tests introduced by Brown, Durbin, and Evans (1975) and suggested by Pesaran and Pesaran (1997) for model stability.

Results and Discussion

Unit Root Results

The study applied the ADF and PP unit root tests to investigate the order of integration of the study variables. Table 1 presents the results of the ADF and PP tests. The ADF and PP tests of unit root confirmed that all the variables, except for FDI and HC in the case of Malaysia, are integrated into order I(1). The results concluded that all the variables are stationary at first difference, except for the FDI, which is stationary at levels. The unit root results of the ADF and PP tests confirm that all the variables in the case of Thailand are integrated into order I (1), that is, they are stationary at first difference and have unit root in their level form. Table 1 exhibits the results of the ADF and PP.

Table 1: Unit Root Results of ADF and PP for Malaysia and Thailand

variables	Malaysia				Thailand			
	Level		First Differenced		Level		First Differenced	
	ADF	PP	ADF	PP	ADF	PP	ADF	PP
GDP	-1.419 (0.563)	-1.361 (0.591)	-5.295 (0.000)* **	-5.295 (0.000)* **	-1.34 (0.5980)	- 1.667 (0.439)	-3.521 (0.012)* *	-3.521 (0.012)* *
EC	-1.831 (0.360)	-1.502 (0.522)	-6.535 (0.000)* **	-7.503 (0.000)	- 0.303	- 0.388	-4.553 (0.000)* **	-4.648 (0.000)* **

					(0.91 4)	(0.90 1)		
FDI	-5.375 (0.000)* **	-5.375 (0.000)* **	-	-	- 2.451 (0.13 4)	- 2.280 (0.18 3)	-8.515 (0.000)* **	-9.105 (0.000)* **
HC	-3.153 (0.031)* *	-3.719 (0.007)* **	-	-	- 2.004 (0.28 3)	- 0.525 (0.87 5)	-5.270 (0.000)* **	-3.062 (0.037)* *
EXP	-1.284 (0.627)	-1.818 (0.366)	-4.598 (0.000)* **	-4.909 (0.000)* **	- 1.321 (0.61 0)	- 1.321 (0.61 0)	-5.736 (0.000)* **	-5.736 (0.000)* **
M2	-2.353 (0.161)	-2.281 (0.182)	-5.957 (0.000)* **	-6.663 (0.000)* **	- 1.763 (0.39 2)	- 1.578 (0.48 4)	-4.418 (0.001)* **	-4.418 (0.001)* **
Note: **, and *** represent the level of significance at 5% and 1% respectively								

Cointegration Test Results

Most of the data of Malaysia and Thailand are integrated into order I (1). Therefore, the study opted to check for the possibility of the long-run cointegration among the variables of the study. All the variables, except for FDI in the case of Malaysia, are integrated into order I (1). Therefore, the only one possible cointegration test can be applied to determine the long-run cointegration among the variables of the study (i.e., the ARDL cointegration test). All the variables in Thailand are integrated into order I (1); therefore, the Johansen and ARDL cointegration techniques can be applied.

The ARDL bounds test for Malaysia shows a long-term relationship among the variables of the study, and all the variables move together in the long-run. The results of the ARDL bounds test confirm long-run cointegration among the variables of the study given that the calculated F-

statistics value of 3.54 is greater than the critical upper bound value of 3.35 at the 10% level. The results conclude that the value of F-statistics under constant and no trend is greater than the upper bounds' critical value in the table of Narayan and Smyth (2005). Table 2 presents the results of ARDL cointegration for Malaysia.

Table 2. ARDL cointegration Results for Malaysia

Model	ARDL ()	F-statistics	ECT_{t-i}	Conclusion
FlnGDP (lnGDP/lnEC lnHC lnFDI lnEXP lnM2	(1 0 0 0 1 0)	3.547415	- 0.3022(0.0483)	Cointegration
Critical Values	Lower Bound		Upper Bound	
10%	2.26		3.35	
5%	2.62		3.79	
1%	3.41		4.68	

The calculated F-statistics value of 6.52 in the case of Thailand is greater than the upper bounds' critical value of 4.68 at the 1% level in the table of Narayan and Smyth (2005); therefore, all the variables move together in the long-run, and a long-run cointegration among the variables of the study exists. Another way to detect the presence of the long-run cointegration among the variables is to look for the value of the lagged error correction term (ECT_{t-i}) of the cointegrating equations. The long-run cointegration among the variables exists if the value of the error correction term is negative and significant (Banerjee, Dolado, & Mestre, 1998). Table 3 exhibits the results of the ARDL cointegration test for Thailand.

Table 3. ARDL Cointegration Results for Thailand

Model	ARDL (AIC 2 lags)	F-statistics	ECT_{t-i}	Conclusion
FlnGDP (lnGDP/lnEC lnHC lnFDI lnEXP lnM2	(1 1 2 0 2 0)	6.528143	-0.20(0.006)	Cointegration
Critical Values	Lower Bound		Upper Bound	
10%	2.26		3.35	
5%	2.62		3.79	

1%	3.41	4.68
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The data for Thailand are integrated into order I (1). Therefore, the Johansen cointegration test is also applicable. The Johansen cointegration test detects the presence of two cointegrating equations for Thailand under the Trace statistics and Eigenvalue statistics given that the test rejects the null-hypothesis of one cointegrating vector, which accepts the alternative of two cointegrating vectors at most. Accordingly, the results confirmed the presence of the long-run cointegration among the variables of the study, which is consistent with the results of the ARDL cointegration test for Thailand. Table 4 presents the results of the Johansen cointegration test.

Table 4: Johansen Cointegration Results for Thailand

Hypothesized No of CE(s)	Eigenvalue	Trace Statistics	Critical Value (0.1)	Prob.
None *	0.615908	114.5648	91.11028	0.0014
At most 1 *	0.575437	77.24676	65.81970	0.0113
At most 2	0.358825	43.83570	44.49359	0.1135
At most 3	0.344621	26.50204	27.06695	0.1144
At most 4	0.212074	10.02291	13.42878	0.2790
At most 5	0.018474	0.727231	2.705545	0.3938
Maximum Eigenvalue Statistics				
Hypothesized No of CE(s)	Eigenvalue	Max-Eigen Statistics	Critical Value (0.1)	Prob.
None *	0.615908	37.31807	37.27779	0.0991
At most 1 *	0.575437	33.41107	31.23922	0.0567
At most 2	0.358825	17.33366	25.12408	0.5514
At most 3	0.344621	16.47913	18.89282	0.1981
At most 4	0.212074	9.295675	12.29652	0.2624
At most 5	0.018474	0.727231	2.705545	0.3938
Note: * shows the rejection of null-hypothesis				
Trace statistics indicates 2 cointegrating Equations at 0.1 level				

Max-Eigen statistics indicates 2 cointegrating Equations at 0.1 level

ARDL Long-run Results

Table 5 exhibits the long-run results of the ARDL model. The long-run results of the study corroborate that energy consumption in Malaysia has a positive and significant relationship with economic growth and that an increase of 1% in the energy consumption may lead to an increase of 0.38% in the growth of the economy in terms of GDP. The long-run results of the study in the case of Thailand also verify that an increase in the energy consumption can lead to an economically growing economy, which confirms a positive and significant relationship among the variables. An increase of 1% in energy consumption in Thailand can lead to an increase of 0.47% in the economic growth of the country. This outcome asserts that the consumption of energy is mostly related to the production and industrial activities in the country and that a further increase in industrial, manufacturing, and other economic activities leads to an increase in the economic growth of the countries. This outcome is similar to the previous work of Apergis and Payne (2009) as well as Zhang and Cheng (2009). The study results also validate that human capital has a positive and significant relationship with the economic growth in Malaysia and Thailand. This outcome concludes that the increasing utilization of human capital leads to a further increase in the economic growth of the country. An increase of 1% in human capital in Malaysia and Thailand leads to an increase of 1.44% and 0.129%, respectively. This result confirms that human capital is the main factor that drives economic growth, and this result supports the neo-classical model, which states that human capital is one of the input factors in achieving high economic growth. Accordingly, the study elucidates that the country is going along the right path in terms of the development of the human capital given that it promotes the growth of the economy. This outcome is similar to the work of Fleisher, Li, and Zhao (2010) as well as Whalley and Zhao (2013). This outcome supports the assumption of new growth theory that human capital accumulation can lead to the production of new innovation and, thus, improve the levels of technology as well as productivity.

Table 5: ARDL Long-Run Results for Malaysia and Thailand

Malaysia				
Variables	Coefficient	Std. Error	t-statistics	Probability
LNEC	0.383435	0.132141	2.901702	0.0067***
LNFDI	0.063346	0.029158	2.172545	0.0373**
LNHC	1.446512	0.269085	5.375674	0.0000***
LNEXP	-0.110559	0.051933	-2.128891	0.0411**
LM2	-0.149893	0.140280	-1.068529	0.2933
C	5.783884	0.738395	7.833045	0.0000***
Thailand				
lnEC	0.470031	0.160956	2.920250	0.0070***
lnHC	0.129517	0.059378	2.181221	0.0380**
lnFDI	2.679711	0.748848	3.578444	0.0013***
lnEXP	-0.254045	0.273117	-0.930169	0.3605
lnM2	-0.620022	0.245236	-2.528268	0.0176**
C	6.327219	1.504827	4.204616	0.0003***
Diagnostic Tests Results				
LM-Serial Corr.	Obs*R²	Prob. Chi-sq.	Obs*R²	Prob. Chi-sq.
	(3.806)	(0.14)	(4.4930)	(0.10)
Heteroscedasticity	0.0800	0.7773	8.27742	0.10357
Normality (JB)	3.60084	0.108541	0.591677	0.743908
Ramsey's RESET	2.108236	0.1425	2.173368	0.1348

Moreover, the long-term results prove that foreign direct investment in Malaysia and Thailand promotes the economic growth of the countries. The results further confirm that an increase of 1% in the foreign direct investment in Malaysia and Thailand results in an increase of 0.06% and 2.67% in economic growth, respectively. This outcome also supports the slogan that

foreign investments in different sectors of the economy can boost the economy and the hypothesis that an increase in FDI leads to an increase in the financially developed economies. Malaysia and Thailand are financially strong economies; thus, FDI can promote economic growth. Moreover, the countries are high on the human capital index. Therefore, human capital can play a critical role in achieving the growth benefits from FDI. Moreover, the inflows of FDI can boost the economic growth in the host countries by targeting capital stock improvement, increasing the job opportunities, and mediating the transfer of technology. This outcome is in line with the work of Vu and Noy (2009); Gomes, Neto, and Veiga (2013); as well as Farkas (2012). The results confirm that trade openness in terms of exports as a percentage of GDP in both economies has a negative relationship with economic growth in Malaysia. The results prove that the exports of the country are not on the helping side of the economy because of the fallrity of the exports. The contribution to the economic growth is that the strategy of the country may be dependent crucially upon traded goods dealt similarly to the primary exporting commodity. The exports of Thailand have no significant impact on the economic growth of the country.

Moreover, the study results corroborate that financial development in the shape of broad money deteriorates economic growth, that is, broad money supply has a negative but insignificant impact on the economic growth in Malaysia. Therefore, the results elucidate that financial development cannot significantly affect the growth of the economy in the case of Malaysia in the long-run. Malaysia's broad money supply may not be the sole financial development indicator, and other indicators may also contribute to the development of the economy. Accordingly, the economy cannot be dependent only on the broad money supply and cannot significantly affect the growth of the economy. Table 5 presents the long-run results of the study. The long-run results further verify that financial development in Thailand has a negative relationship with economic growth in the long-run. The lower part of Table 5 exhibits the diagnostic tests results and confirms the absence of problem in the data set of both countries. The results confirm the absence of serial correlation problem and heteroscedasticity in the model. The results validate that the data are normally distributed under the Jarque–Bera technique of normality. Moreover, the functional form of the model has no problem given that the results of Ramsey's RESET test confirm a stable overall model.

ARDL Short-run Results

The short-run results of the study confirm that energy consumption has a positive relationship

with economic growth in Malaysia and Thailand. The results verify that an increase of 1% in the energy consumption in the short-run in Malaysia and Thailand results in an increase in economic growth by 0.11% and 0.34%, respectively. This result is common given that energy is one of main engines and factors of economic growth. The short-run results also corroborate that human capital has a positive and significant relationship with economic growth in Malaysia and Thailand and affirm that an increase in human capital can lead to a significant increase in the economic growth of both countries. This outcome can be supported by the neo-classical model given that human capital is considered one of the main input factors that contributes toward economic growth. Moreover, the short-run results of the study assert that an increasing FDI can lead to an increase in the economic growth of the country. The results elucidate that FDI has a positive and significant impact on the economic growth in Malaysia as well as Thailand and is a common outcome in financially strong economies, such as Malaysia and Thailand. The results prove that an increase of 1% in the human capital leads to an increase by 0.43% and 0.56% in the economic growth of the Malaysia and Thailand, respectively.

The short-run results affirm that exports as a percent of GDP have no significant impact on the economic growth in Malaysia. The short-run results of the study validate that Thailand's exports have a negative relationship with its economic growth. This outcome confirms that exports in Thailand are not growth-friendly and that an increase in the exports of the country may lead to a decrease in its economic growth. The short-run results of the study further prove that the financial development of the country in the shape of the broad money supply does not have a significant impact on its economic growth. The results corroborate that this outcome may have resulted from the fact that the broad money supply is not the sole indicator of financial development and that broad money supply in Malaysia as well as Thailand is not a perfect indicator of financial development given that the countries are financially developed, and that financial development can have a positive impact on economic growth.

Table 6. ARDL Short-Run Results for Malaysia and Thailand

Malaysia				
Variables	Coefficient	Std. Error	t-statistics	Probability
D(LNEC)	0.115900	0.078903	1.468892	0.1516
D(LNFDI)	0.019148	0.004024	4.758540	0.0000

D(LNHC)	0.437234	0.202720	2.156833	0.0386
D(LNEXP)	-0.153283	0.139859	-1.095986	0.2813
D(LNM2)	-0.045308	0.046176	-0.981200	0.3339
CointEq(-1)	-0.302268	0.147222	-2.053144	0.0483
Thailand				
D(LNEC)	0.349569	0.084023	4.160406	0.0003
D(LNFDI)	0.015635	0.006499	2.405658	0.0233
D(LNFDI(-1))	-0.013416	0.005918	-2.266893	0.0316
D(LNHC)	0.561275	0.128123	4.380743	0.0002
D(LNM2)	-0.278163	0.084500	-3.291876	0.0028
D(LNM2(-1))	-0.203215	0.081208	-2.502402	0.0187
D(LNEXP)	-0.129866	0.046336	-2.802730	0.0093
CointEq(-1)	-0.209454	0.070310	-2.979013	0.0060
Diagnostic Results				
Malaysia		Thailand		
R-squared	0.678473	R-squared	0.808004	
Adjusted R-squared	0.610639	Adjusted R-squared	0.729784	
S.E. of regression	0.033648	S.E. of regression	0.019103	
Sum squared resid	0.036229	Sum squared resid	0.009853	
Prob(F-statistic)	0.002291	Prob(F-statistic)	0.000000	
Durbin-Watson stat	1.873860	Durbin-Watson stat	1.949063	

Granger Causality Results

The long-run association among the variables infers the presence of the causal relationship among the variables either unidirectional or bidirectional (Engle & Granger, 1987; Johansen & Juselius, 1990). The current study analyzes the model for a causal relationship by applying the Granger causality test within the VECM framework. The long-run causal relationship is calculated by the error correction term of the VECM model, and the F-statistics of the Wald test are used to calculate the short-run causal relationship among the variables. The results of the granger causality test confirm a long-run bidirectional causality between energy consumption and economic growth and that FDI, human capital, exports, and a financially

developed unidirectional Granger causality affect the economic growth in Malaysia. The results confirm that energy consumption and economy have a feedback relationship between them given those changes in either of them significantly affect the other. An increase or decrease in FDI, human capital, exports, and financial development can affect the economic growth in Malaysia, whereas economic growth cannot cause changes in these macroeconomic indicators.

The short-run results of the study confirmed that energy consumption and FDI can unidirectionally Granger cause economic growth. Economic growths can unidirectionally Granger cause human capital in the short-run. Moreover, the short-run Granger causality results confirmed bidirectional causal relationships between human capital and energy consumption as well as between exports and energy consumption and that FDI and financial development unidirectionally Granger cause economic growth in Malaysia. Moreover, the short-term results of the Granger causality test for Malaysia prove that human capital can cause exports in the short-run and that a short-run unidirectional causality runs from financial development toward the exports of the country. This outcome of the study asserts that exports of the country can be affected by the increase or decrease in its financial performance.

Table 7: Granger Causality Results for Malaysia

Short-run Granger causality						Long-run (ECT _{t-1})	
Variables	$\Delta \ln \text{GDP}$	$\Delta \ln \text{Ec}$	$\Delta \ln \text{FDI}$	$\Delta \ln \text{HC}$	ΔEXP	$\Delta \ln \text{M2}$	ECT _{t-1}
$\Delta \ln \text{GDP}$	-	0.962(0.61)	1.592(0.45)	8.851(0.01)	3.677(0.15)	0.590(0.74)	0.17(0.68)
$\Delta \ln \text{EC}$	1.554(0.05)	-	0.898(0.63)	19.389(0.00)	10.57(0.00)	2.028(0.36)	-0.59(-2.11)**
$\Delta \ln \text{FDI}$	1.623(0.04)	6.920(0.03)	-	6.699(0.03)	0.289(0.86)	1.314(0.51)	-5.599(-0.75)
$\Delta \ln \text{HC}$	0.641(0.72)	5.929(0.05)	2.157(0.34)	-	3.096(0.21)	1.334(0.51)	0.53(5.06)
ΔEXP	0.264(0.87)	12.35(0.00)	0.101(0.95)	0.312(0.85)	-	0.689(0.70)	-0.53(-1.43)
$\Delta \ln \text{M2}$	0.815(0.66)	9.776(0.00)	0.329(0.84)	3.145(0.20)	7.668(0.02)	-	1.66(1.44)

In the case of Thailand, the long-term results of the study confirm four bidirectional causality relationships among the variables of the study. The first bidirectional causal relationship is between energy consumption and economic growth, which reveals a feedback relationship between the variables, and any change in one of the macroeconomic indicators, affects the other significantly. The feedback relationship shows that an increase in the economic activities to promote growth affects energy consumption by utilizing additional units of energy. The long-term results confirm a bidirectional causal relationship between FDI and economic growth and a feedback relationship between them; any change in one variable affects the other. This outcome can be supported because FDI inflows in a country can increase economic growth. Moreover, highly economically progressive countries attract considerable FDI given that investment opportunities are available in the host country. The current study confirms a bidirectional causal relationship between FDI and energy consumption and that a feedback relationship is between the variables, which can be supported given that Thailand is an energy abundant country and that increasing exploration as well as consumption of energy attract the multinational companies for exploration and other purposes. A feedback causal relationship is between FDI and energy consumption; an increase in FDI increases energy consumption. This feedback relationship can be supported given that the increased utilization of energy resources to cope increases energy demand when several multinational companies as well as small and medium foreign companies are involved in the energy and technology sectors of the economy.

The results also confirm unidirectional causalities that run from human capital, the exports of the country, and the financial development of the country toward its economic growth. Therefore, any change in human capital, exports, and financial development leads to certain changes in the economic growth of the country. This outcome can be supported by the common results of the previous literature that a financially developed country becomes economically developed, and a country that is high on the human capital index has high per capita income. Similarly, the economy can grow on a fast track when the country is export-oriented and when the percentage share of exports is higher than that of imports.

Table 8: Granger causality Results for Thailand

Short-run Granger Causality						Long-run ECT_{t-1}	
Variables	$\Delta \ln GDP$	$\Delta \ln Ec$	$\Delta \ln FDI$	$\Delta \ln HC$	ΔEXP	$\Delta \ln M2$	ECT_{t-1}

$\Delta \ln GDP$	-	0.332 (0.56)	0.209(0.64)	0.282(0.59)	0.715(0.39)	0.222(0.63)	-0.19(- 2.62) **
$\Delta \ln EC$	1.074 (0.29)	-	0.627(0.42)	1.506(0.21)	1.706(0.19)	0.644(0.42)	-0.39(- 3.82)***
$\Delta \ln FDI$	0.024 (0.87)	4.300 (0.03)	-	4.613(0.03)	0.030(0.86)	0.019(0.88)	-4.70(- 3.58)***
$\Delta \ln HC$	4.506 (0.03)	11.57 (0.00)	0.013(0.90)	-	0.946(0.33)	10.388(0.00)	-0.02(- 1.81)
ΔEXP	0.899 (0.34)	6.450 (0.01)	0.000(0.98)	0.113(0.73)		0.078(0.77)	0.18(1.58)
$\Delta \ln M2$	1.038 (0.30)	0.027 (0.86)	7.107(0.00)	0.141(0.70)	0.008(0.92)	-	0.008(0.04)

The short-run results of the study confirm a unidirectional causal relationship that runs from human capital toward economic growth in Thailand. This result is in line with the assumptions of the neo-classical model given that human capital is considered a key input factor in the production function. The study further confirms unidirectional causalities that run from FDI, human capital, and exports of the country toward energy consumption. The unidirectional causality from FDI toward energy consumption can be justified given that increasing investments in the new technologies and exploration activities in Thailand lead to an increase in energy consumption. Moreover, an increase or decrease in the quality of the human capital index affects the energy consumption of the country given that human capital plays a vital role in determining energy consumption. Moreover, the results assert that exports of the country can lead to an increase in energy consumption given that a rise in the demand for the goods and services exported to other countries leads to an increase in the production activities to meet the required demand. Accordingly, the utilization of energy resources is increased.

The short-run Granger causality results further confirm that financial development can Granger cause FDI in Thailand. The result affirms that broad money supply can affect the composition and attraction of FDI in the country. This outcome can be justified given that a financially developed economy can attract several investors and MNCs to invest in the new as well as growing projects and technologies, which can lead to an increase in the country's economic

growth. The results further elucidate that FDI can Granger cause human capital in Thailand given that additional inflows of FDI can affect the human capital index of a country by improving the education system through building colleges as well as universities and investing in new technologies in the research and development field. The FDI inflows can lead to an increase in human capital by targeting the educated and research related sectors of the economy. Moreover, the short-run results confirm a unidirectional causality that runs from human capital toward financial development in Thailand. This result asserts that a country with a developed human capital index can lead to its financial development.

Conclusions

This study examined the relationship among FDI, energy use, human capital, and economic growth for Malaysia and Thailand using an annual time series from 1975 to 2021. The study confirmed using the ADF and PP unit root tests that all the variables, except for FDI and HC in the case of Malaysia, are integrated into order I (1). The data confirm that this study opted to check for the possibility of long-run cointegration among the variables. Therefore, this study implemented the ARDL cointegration test. All the variables in the case of Thailand are integrated into order I (1). Therefore, the study applied the Johansen and ARDL cointegration techniques.

The ARDL bounds test for Malaysia and Thailand shows a long-run relationship among the variables of the study, and all the variables move together in the long-run. The long-run ARDL results corroborate that energy consumption in Malaysia has a positive and significant relationship with economic growth. The long-run results of the study in the case of Thailand also assert that an increase in the energy consumption can lead to a highly economically growing economy. Accordingly, a positive and significant relationship exists among the variables. The study, hence, concludes that energy consumption is the main engine of economic growth. The results also elucidate that human capital has a positive and significant relationship with economic growth in Malaysia and Thailand. Therefore, human capital accumulation can lead to innovation and technology improvements, which foster productivity and output. The long-term results confirm that FDI inflow in Malaysia and Thailand promotes the economic growth of the country, which supports the FDI-led growth hypothesis in Malaysia and Thailand. The results confirm trade openness in terms of exports given that a percentage of GDP in both economies have a negative relationship with the economic growth in Malaysia. The exports in Thailand have no significant impact on its economic growth. Moreover, the

study results verify that financial development in the shape of broad money supply has a negative but insignificant impact on in Malaysia's economic growth. Accordingly, the results validate that financial development cannot significantly affect the growth of the economy in Malaysia in the long-run. The long-term results further affirm that financial development in Thailand has a negative relationship with economic growth in the long-run.

The Granger causality test results confirm a bidirectional causality between energy consumption and economic growth in the long-run and that FDI inflow, human capital, exports, and a financially developed unidirectionally Granger causality affect the economic growth in Malaysia. The results prove that energy consumption and the economy have a feedback relationship given that a change in either of them significantly affects the other. This feedback relationship between energy consumption and economic growth concludes that energy policy that is oriented toward improvements in energy consumption efficiency may not adversely affect the real GDP. An increase or decrease in FDI, human capital, exports, and financial development can affect the economic growth in Malaysia, whereas economic growth cannot cause changes in these macroeconomic indicators. The short-run Granger causality results confirmed bidirectional causal relationships between human capital and energy consumption as well as between exports and energy consumption and that FDI and financial development unidirectional Granger causality affect the economic growth in Malaysia. Moreover, the short-run results of Granger causality test for Malaysia assert that human capital can cause exports in the short-run and that a short-run unidirectional causality runs from financial development toward the exports of the country.

The long-run results of the study in Thailand confirm four bidirectional causality relationships among the variables of the study. The feedback relationship shows whether an increase in the economic activities can promote growth. The long-run results confirm a bidirectional causal relationship between FDI and economic growth and a feedback relationship between them, and any change in one variable affects the other. The results confirm a bidirectional causal relationship and a feedback relationship between FDI and energy consumption. The feedback relationship among the variables can be supported given that Thailand is an energy abundant country and that the increasing exploration as well as consumption of energy attract the multinational companies for exploration and other purposes. The results also confirm unidirectional causalities that run from human capital, exports, and financial development toward the economic growth of the country. This outcome concludes that any change in human

capital, exports, and financial development leads to a certain change in the economic growth of the country. Empirical findings assert that appropriate public policy must be formulated to stimulate inward FDI, human capital, trade, financial development, and energy to foster economic growth as well as development.

References

- Abdouli, M., and Hammami, S., (2017). Exploring links between FDI inflows, energy consumption, and economic growth: further evidence from MENA countries. *Journal of Economic Development*, 42(1), 95-117
- Abidin, ISZ., Haseeb, M., Azam, M., and Islam, R., (2015). Foreign direct investment, financial development, international trade and energy consumption: panel data evidence from selected ASEAN countries. *International Journal of Energy Economics and Policy*, 5(3), 841-850.
- Achour, H., and Belloumi, M., (2016). Investigating the causal relationship between transport infrastructure, transport energy consumption and economic growth in Tunisia. *Renewable and Sustainable Energy Reviews*, 56, 988-998.
- Alfaro, L. (2003). Foreign direct investment and growth: Does the sector matter. Harvard Business School (2003): 1-31. Harvard Business School, Morgan 263, Boston, MA 02163.
- Ahmed, M., and Azam, M., (2016). Causal nexus between energy consumption and economic growth for high, middle and low income countries using frequency domain analysis. *Renewable and Sustainable Energy Reviews*, 60 (2016), 653–678
- Alaali, F., Roberts, J., and Taylor, K., (2015). The effect of energy consumption and human capital on economic growth: an exploration of oil exporting and developed countries. Sheffield Economic Research papers Series (SERPS) No. 2015015. Department of Economics, University of Sheffield, UK.
- Akinlo, A.E. (2008). Energy consumption and economic growth: evidence from 11 Sub-Saharan African Countries. *Energy Economics*, 30, 2391-2400
- Adams, S. (2009). Foreign Direct investment, domestic investment, and economic growth in Sub-Saharan Africa. *Journal of Policy Modeling*, 31(6), 939–949.
- Ali, W., Abdullah, A., & Azam, M. (2016). The Dynamic Linkage between Technological Innovation and carbon dioxide emissions in Malaysia: An Autoregressive Distributed Lagged Bound Approach. *International Journal of Energy Economics and Policy*, 6(63),

389–400.

- Ali, W., Abdullah, A., and Azam, M. (2017a). Re-visiting the environmental Kuznets curve hypothesis for Malaysia: Fresh evidence from ARDL bounds testing approach. *Renewable and Sustainable Energy Reviews*, 77(December 2016), 990–1000.
- Ali, W., Abdullah, A., and Azam, M. (2017b). The dynamic relationship between structural change and CO₂ emissions in Malaysia: a cointegrating approach. *Environmental Science and Pollution Research*, 24(14), 12723–12739
- Ang, J. B. (2009). Analysis CO₂ emissions, research and technology transfer in China. *Ecological Economics*, 68, 2658–2665
- Apergis, N., and Payne, J.E. (2009). Energy consumption and economic growth: Evidence from the Commonwealth of Independent States. *Energy Economics*, 31(5), 641–647
- ASEAN (2017). Investing in ASEAN-2017. Retrieved <http://asean.org/storage/2017/01/Investing-in-ASEAN-2017-.pdf>
- Azam, M. (2016). Does governance and foreign capital Inflows affect economic development in OIC countries? *Journal of Economic Cooperation and Development*, 37(4) 21-50
- Azam, M. (2016). Does environmental degradation shackle economic growth? A panel data investigation on 11 Asian countries. *Renewable & Sustainable Energy Reviews*, 65(2016), 175-182
- Azam, M., Qayyum, K. Bakhtayar, B. and Emirullah, C (2015). The causal relationship between energy consumption and Economic Growth in the ASEAN-5 countries. *Renewable & Sustainable Energy Reviews*, 47: 732–745
- Azam, M. and Ahmad, M. A., (2015). Role of human capital and foreign direct investment in promoting economic growth: evidence from Commonwealth of Independent States. *International Journal of Social Economics*, 42(2), 89-111
- Azam, M., Ibrahim, Y. and Bakhtyar B., (2014). Foreign direct investment and economic growth in Asia. *Actual Problems of Economics* 11(161), 58-67
- Aziz, O. G. and Mishra, A. V. (2016). Determinants of FDI inflows to Arab economies. *The Journal of International Trade & Economic Development*, 25(3), 325-356
- Bakhtyar, B., Ibrahim, Y., Alghoul, M. A., Aziz, N., Fudholi, A., & Sopian, K. (2014). Estimating the CO₂ abatement cost: Substitute Price of Avoiding CO₂ Emission (SPAEC) by Renewable Energy's Feed in Tariff in selected countries. *Renewable and Sustainable Energy Reviews*, 35, 205-210.
- Bakhtyar, B., Zaharim, A., Sopian, K., Saadatian, O., & Ludin, N. (2012). The effects of feed in tariff on foreign direct investment in Malaysia. *Therm Eng Environ*.

- Banerjee, A., Dolado, J., and Mestre, R. (1998). Error-correction Mechanism Tests for Cointegration in a Single-equation Framework. *Journal of Time Series Analysis*, 19(3), 267–283
- Bojanic, A. N. (2012). The impact of financial development and trade on the economic growth of Bolivia. *Journal of Applied Economics*, 15(1), 51-70.
- Borensztein, E., Gregorio, J. De, and Lee, J.W. (1998). How does foreign direct investment affect economic growth? *Journal of International Economics*, 45,115-135.
- Brown, R. . L. ., Durbin, J. ., & Evans, J. . M. . (1975). Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society. Series B (Methodological)*, 37(2), 149–192.
- Brezis, E. S., and Young, W. (2014). Population and economic growth: Ancient and modern. *The European Journal of the History of Economic Thought*, 2567(October), 1–27
- Calderon, C., and Liu, L. (2003). The direction of causality between financial development and economic growth. *Journal of Development Economics*, 72(1), 321-334.
- De Mello, L.R. (1997). Foreign direct investment in developing countries and growth: a selective survey. *Journal of Development Studies*, 34, 1-34.
- Doytch, N., and Narayan S. (2016). Does FDI influence renewable energy consumption? an analysis of sectoral FDI Impact on renewable and non-renewable industrial energy consumption. *Energy Economics*, 54, 291-301
- Durusu-Ciftci, D., SerdarIspir M., and Yetkiner, H., (2017). Financial development and economic growth: Some theory and more evidence. *Journal of Policy Modeling*, 39(2), 290-306
- Eesley, C. (2016). Institutional barriers to growth: entrepreneurship, human capital and institutional change. *Organization Science, Articles in Advance*, (September), 1–17.
- Engle, R. F., and Granger, C. W. J. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica*, 55(2), 251–276. <https://doi.org/10.2307/1913236>
- Farkas, B. (2012). *Absorptive Capacities and the Impact of FDI on Economic Growth*. SSRN *Electronic Journal*. <https://doi.org/10.2139/ssrn.2038182>
- Fleisher, B., Li, H., & Zhao, M. Q. (2010). Human capital, economic growth, and regional inequality in China. *Journal of Development Economics*, 92(2), 215–231.
- Fukuyama, H., Hashimoto, A., Tone, K., & Weber, W. L. (2017). Does human capital or physical capital constrain output in Japanese prefectures? *Empirical Economics*. <https://doi.org/10.1007/s00181-016-1202-5>
- Gomes Neto, D., & Veiga, F. J. (2013). Financial globalization, convergence and growth: The

- role of foreign direct investment. *Journal of International Money and Finance*, 37, 161–186.
- Handley, H. (2017). Malaysia's FDI Outlook for 2017: Trends and Opportunities. ASEAN Briefing. Retrieved from <http://www.aseanbriefing.com/news/2017/02/24/malaysia-fdi-2017.html>
- Hassan, M. K., Sanchez, B., and Yu, J. S. (2011). Financial development and economic growth: New evidence from panel data. *The Quarterly Review of economics and finance*, 51(1), 88-104.
- Ilesanmi, K.D., and Tewari, D., D., (2017). Energy consumption, human capital investment and economic growth in South Africa: a vector error correction model Analysis. *OPEC Energy Review*, 41(1), 55–70
- Johansen, S., & Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration - With Applications To the Demand for Money. *Oxford Bulletin of Economics and Statistics*. <https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x>
- Kizilkaya, O., (2017). The impact of economic growth and foreign direct investment on CO2 emissions: the case of Turkey. *Turkish Economic Review*, 4(1), 106-118
- Kraft, J., and Kraft, A., (1978). On the relationship between energy and GNP. *Journal of Energy and Development*, 3 (2), 401-403.
- Lau, E., Chye, X.-H., and Choong, C.-K., (2011). Energy-growth causality: a panel analysis. *International Conference On Applied Economics – ICOAE*, pp. 355-361
- Mahalik, MK., and Mallick, H., (2014). Energy consumption, economic growth and financial development: exploring the empirical linkages for India. *The Journal of Developing Areas*, 48(4), 139-159
- Mielnik, O., and Goldemberg J. (2000). Converging to a common pattern of energy use in developing and industrialized countries. *Energy Policy*, 28, 503-508.
- Mayer, D., Mora, H., Cermeno, R., Barona, A.B. and Duryeau, S. (2001), ‘‘Health, growth and income distribution in Latin America and the Caribbean: a study of determinants and regional local behavior’’, in *Investment in Health: Social and Economic Returns*, Pan American Health Organization, Washington, DC.
- Narayan, P. K., & Smyth, R. (2005). Electricity consumption, employment and real income in Australia evidence from multivariate Granger causality tests. *Energy Policy*, 33(9), 1109–1116
- Nelson, R. and Phelps, E., (1966). Investment in humans, technological diffusion and economic growth. *American Economic Review*, 61, 69-75

- Omri, A. (2013). CO2 emissions, energy consumption and economic growth nexus in MENA countries: evidence from simultaneous equations models. *Energy Economics*, 40, 657-664.
- Omri, A., and Kahouli B. (2013). The nexus among foreign investment, domestic capital and economic growth: empirical evidence from the MENA Region. *Research in Economics*, 68, 257-263
- Pesaran, M., and Pesaran, B. (1997). *Working with Microfit 4.0: Interactive Economic Analysis*. Oxford University Press,.
- Pesaran, M. H., Shin, Y., and Smith, R. J. (1999). *Bound Testing Approaches to the Analysis of Long Run Relationships*. *Edinburgh School of Economics Discussion Paper Series Number 46*. <https://doi.org/10.1002/jae.616>
- Pesaran, M. H., Shin, Y., and Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289–326.
- Said, K; Mbarek, M.B. and Amamri, M. (2015). Causal dynamics between energy consumption, ICT, FDI, and economic growth: case study of 13 MENA countries. *Journal of the Knowledge Economy*, pp 1–11
- Saidi, S., and Hammami S. (2015). The impact of CO₂ emissions and economic growth on energy consumption in 58 Countries. *Energy Reports*, 1, 62-70.
- Salman, D. M., and Atya, E. M., (2014). What is the role of financial development and energy consumption on economic growth? New evidence from North African countries. *International Journal of Finance & Banking Studies*, 3 (1), 137-149
- Shahbaz, M., (2012). *Multivariate Granger Causality between CO2 Emissions, Energy Intensity, Financial Development and Economic Growth: Evidence from Portugal* Muhammad. MPRA
- Slaus, I and Jacobs, G., (2011). Human capital and sustainability. *Sustainability* ,3 (2011), 97-154
- Sbia, R., Shahbaz, M., and Hamdi, H. (2014). A contribution of foreign direct investment, clean energy, trade openness, carbon emissions and economic growth to energy demand in UAE. *Economic Modelling*, 36(2014), 191-197
- Siddique, HMA., and Majeed, MT., (2015). Energy consumption, economic growth, trade and financial development nexus in South Asia. *Pakistan Journal of Commerce and Social Sciences*, 9 (2), 658-682
- Adams, S. (2009). Foreign Direct investment, domestic investment, and economic growth in Sub-Saharan Africa. *Journal of Policy Modeling*, 31(6), 939–949.

- Ali, W., Abdullah, A., and Azam, M. (2016). The dynamic linkage between technological innovation and carbon dioxide emissions in Malaysia: An Autoregressive Distributed Lagged Bound Approach. *International Journal of Energy Economics and Policy*, 6(63), 389–400.
- Ali, W., Abdullah, A., & Azam, M. (2017a). Re-visiting the environmental Kuznets curve hypothesis for Malaysia: Fresh evidence from ARDL bounds testing approach. *Renewable and Sustainable Energy Reviews*, 77(December 2016), 990–1000.
- Ali, W., Abdullah, A., & Azam, M. (2017b). The dynamic relationship between structural change and CO2 emissions in Malaysia: a cointegrating approach. *Environmental Science and Pollution Research*, 24(14), 12723–12739.
- Ang, J. B. (2009). Analysis CO2 emissions, research and technology transfer in China. *Ecological Economics*, 68, 2658–2665.
- Apergis, N., and Payne, J. E. (2009). Energy consumption and economic growth in Central America: Evidence from a panel cointegration and error correction model. *Energy Economics*, 31(2), 211–216. <https://doi.org/10.1016/j.eneco.2008.09.002>
- Banerjee, A., Dolado, J., and Mestre, R. (1998). Error-correction Mechanism Tests for Cointegration in a Single-equation Framework. *Journal of Time Series Analysis*, 19(3), 267–283. <https://doi.org/10.1111/1467-9892.00091>
- Brezis, E. S., and Young, W. (2014). Population and economic growth: Ancient and modern. *The European Journal of the History of Economic Thought*, 2567(October), 1–27. <https://doi.org/10.1080/09672567.2014.881897>
- Brown, R. . L. ., Durbin, J. ., & Evans, J. . M. . (1975). Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society. Series B (Methodological)*, 37(2), 149–192.
- Eesley, C. (2016). Institutional Barriers to Growth: Entrepreneurship, Human Capital and Institutional Change. *Organization Science, Articles in Advance*, (September), 1–17. <https://doi.org/10.1287/orsc.2016.1077>
- Engle, R. F., and Granger, C. W. J. (1987). Co-integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, 55(2), 251–276. <https://doi.org/10.2307/1913236>
- Farkas, B. (2012). *Absorptive Capacities and the Impact of FDI on Economic Growth*. SSRN *Electronic Journal*. <https://doi.org/10.2139/ssrn.2038182>
- Fleisher, B., Li, H., and Zhao, M. Q. (2010). Human capital, economic growth, and regional inequality in China. *Journal of Development Economics*, 92(2), 215–231.

<https://doi.org/10.1016/j.jdeveco.2009.01.010>

- Fukuyama, H., Hashimoto, A., Tone, K., & Weber, W. L. (2017). Does human capital or physical capital constrain output in Japanese prefectures? *Empirical Economics*. <https://doi.org/10.1007/s00181-016-1202-5>
- Gomes Neto, D., and Veiga, F. J. (2013). Financial globalization, convergence and growth: The role of foreign direct investment. *Journal of International Money and Finance*, 37, 161–186. <https://doi.org/10.1016/j.jimonfin.2013.04.005>
- Johansen, S., and Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration - With Applications To the Demand for Money. *Oxford Bulletin of Economics and Statistics*. <https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x>
- Narayan, P. K., and Smyth, R. (2005). Electricity consumption, employment and real income in Australia evidence from multivariate Granger causality tests. *Energy Policy*, 33(9), 1109–1116. <https://doi.org/10.1016/j.enpol.2003.11.010>
- Pesaran, M., Pesaran, B. (1997). *Working with Microfit 4.0: Interactive Economic Analysis*. Oxford University Press,.
- Pesaran, M. H., Shin, Y., and Smith, R. J. (1999). *Bound Testing Approaches to the Analysis of Long Run Relationships*. *Edinburgh School of Economics Discussion Paper Series Number 46*. <https://doi.org/10.1002/jae.616>
- Pesaran, M. H., Shin, Y., and Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289–326. <https://doi.org/10.1002/jae.616>
- Saboori, B., Rasoulinezhad, E., & Sung, J. (2017). The nexus of oil consumption, CO2 emissions and economic growth in China, Japan and South Korea. *Environmental Science and Pollution Research*. <https://doi.org/10.1007/s11356-017-8428-4>
- Saboori, B., Sapri, M., and Baba, M. (2014). Economic growth, energy consumption and CO2 emissions in OECD (Organization for Economic Co-operation and Development)'s transport sector: A fully modified bi-directional relationship approach. *Energy*, 66, 150–161.
- Shapiro, J. (2006). Smart cities: quality of life, productivity, and the growth effects of human capital. *The Review of Economics and Statistics*, 88(May), 324–335. <https://doi.org/10.2307/40042998>
- Sohag, K., Ara, R., Mastura, S., Abdullah, S. S. M. S., Begum, R. A., Abdullah, S. S. M. S., and Jaafar, M. (2015). Dynamics of energy use, technological innovation, economic growth and trade openness in Malaysia. *Energy*, 90(July), 1497–1507.

<https://doi.org/10.1016/j.energy.2015.06.101>

- Solow, R. (1965). A Contribution to the Theory of Economic Growth. *Journal of Political Economy*, 73(5), 552–553. Retrieved from <http://www.jstor.org/stable/1829145>
- Vu, T. B., and Noy, I. (2009). Sectoral analysis of foreign direct investment and growth in the developed countries. *Journal of International Financial Markets, Institutions and Money*, 19(2), 402–413. <https://doi.org/10.1016/j.intfin.2008.04.002>
- Whalley, J., and Zhao, X. (2013). The Contribution of Human Capital To China’S Economic Growth. *China Economic Policy Review*, 2(1), 1350001-1-1350001–2. <https://doi.org/10.1142/S1793969013500015>
- Woodhall, M., (2001) Human capital: educational aspects. In SMELSER N.J. and BALTES P.B. (Ed.) *International Encyclopaedia of the Social and Behavioural Sciences* (Oxford: Elsevier), 10: 6951-6955
- World Development Indicators (2017),
- World Bank. (2013). *Middle East and North Africa Region (MENA): A Regional Economic Developments and Prospects Report: Investing in Turbulent Times*. Washington, DC: The World Bank
- Zheng, F., and Youngho, C., (2016). Energy, human capital and economic growth in Asia Pacific countries - evidence from a panel cointegration and causality analysis. *Energy Economics*, 56 (2016), 177-184