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Article

Effect of bilateral FDI, energy consumption, CO2 emission and capital on economic growth of Asia countries

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Review article

Effect of bilateral FDI, energy consumption, CO2 emission and capital on economic growth of Asia countries

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ABSTRACT

The current study objective is to contribute to the factors that make better the economic growth of the Asia countries with an importance on the frequently deserted bilateral FDI, energy use, CO2 emissions and capital role in the economic growth. This study applies generalized method of moments (GMM), OLS regression, fixed effect and random effect estimators with cross countries data for 34 host countries of Asia and 115 source countries over the period 2001–2012. The empirical results demonstrated that energy consumption, FDI inflows and FDI outflows, CO2 emission and capital play important role in economic growth of Asia countries. The current study suggest that make better policies for the utilization of energy, use of clean energy and use appropriate and advanced technology for energy in Asia countries and also encourage foreigner investors to their countries and invest in other countries which will increase their economy because economic growth increases due to both FDI inflows and outflows, energy use, CO2 emission, and capital of host countries and source countries.

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1. Introduction

Emerging and developing economies growingly attract FDI (UNCTAD 2012). Three major examples are helpful in the understanding of this trend in the UNCTAD (2012) data. First, the mostly FDI outflows are from developed countries, but their share in overall FDI outflows is falling over time. Whereas in 2003, the FDI outflows share of developing and emerging countries has regularly increased, declining the share of FDI in 2011 to 75% from developed countries. Second, mostly firms invest in the countries which have similar development level to their country. Above

than 70% FDI outward from developed and emerging countries goes to other developing and emerging counties, and 50% of the FDI outward goes to source economy's countries. Moreover, developed countries mostly invest in other developed countries. Third, developed countries have a superior ability to change their operations than developing and emerging countries. Around 45% of FDI outward from developed countries goes to developing and emerging countries. Furthermore, the main source of FDI for developing and emerging counties is developed countries.

In the last twenty years there has dramatic improvement in the environment of investment across the globe. Besides, it is recognized that crises of financial and economic, such as the one that hit the Asia financial markets in 1997 and more in 2008 the global financial crisis have had a huge effect on bilateral FDI and international capital movements. Financial crises have

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in universal had unfavorable effect on rising unemployment of growth; cause export growth to compute and as confirmation UNCTAD (2009) reduce in bilateral capital flows.

In the last thirty years, the relationship between energy consumption, CO₂ emissions, FDI and economic growth have become a subject incredibly significant both at the international and domestic level. While, due to the raise in the scale of manufacture it rotates an environmental poverty. This phenomenon is now part of the economic and political choice of our country. This anxiety obvious itself internationally while the institutes of conference in Durban in December, 2011, in Stockholm 1979, Copenhagen in 2009, Johannesburg in 2002 and Rio de Janeiro in 1992. Now a day's lots of countries, specifically developing countries are facing main challenges, such as, the multi directional relations between social, economic and environmental parts of development. They are struggling to fight poverty, protect the environment and raise the opportunities of economic.

Increase of the CO₂ emission is a most important threat of to the environment change which is the most important on-going anxiety of both the emerging countries to developed countries. The developed countries economic growth forces an exhaustive energy use and as a result, additional wastes and residues are throw nature that could lead to degradation of environment. The majority of the CO₂ emission comes from the use of fossil fuels for instance coal, the key power source of the industries of automobiles that is significantly linked with development and economic growth. While, played most important role in the process of economic growth through energy.

In the present years, private capital flows have been the topic of studies to Asia markets. The high volatile of these flows, the observed weakness of financial systems correlated with this volatile in emerging markets, and in Latin America, Asia and Russia, the adverse financial crises effect can be seen as motive for interest this topic has received. Amongst the three groups of private capital flows, i.e., foreign direct investment, portfolio investment, and bank loans, the latter has build up into the vital category as the mid-1990s. Its share in private capital flows to markets of emerging countries increased significantly, especially, decreased portfolio investment, reflecting a more careful manner of the investors of international stock market.

No comprehensive paper has been reported which has applied generalized method of moments (GMM), OLS regression, fixed effect and random effect to find out a cross countries effect of bilateral FDI, energy consumption, CO₂ emission, and capital on economic growth of Asia countries. To fulfill this gap we examine the relationship of bilateral FDI, energy consumption, CO₂ emission, and capital with economic growth in 34 host countries of Asia and 115 source countries over the period 2001–2012 by applying (Arellano and Bond, 1991) generalized method of moments (GMM), OLS regression, fixed effect and random effect. We examine the relationship in Asian countries due to a large use of energy, carbon dioxide emissions and natural resources. This study would be helpful for the policy makers to create superior policies for the use of energy and boost economy in Asian countries.

The current paper is structured as follows. Section 2 represents, the literature linked to energy use, CO₂ emission, FDI flows and economic growth. Section 3 represents the econometric models such as, OLS regression, fixed effect, random effect and difference GMM and dataset. Section 4, represents the results and discussion of the current study. The conclusion of the study is found in Section 5.

2. Literature

Most of studies have worked on causality link between energy consumption (EC), CO₂ emissions and economic growth. On the

opposing, this part evaluated of all those studies who worked on the effect of energy consumption (EC), CO₂ emissions, FDI flows, capital, financial development and trade openness on economic growth that have applied panel data modeling methods.

The relationship between economic growth, CO₂ emissions and energy use in developed, emerging and MENA countries over 2001 to 2017 examined by Muhammad (2019) and applied seemingly unrelated regression, GMM and System GMM and demonstrated that economic growth has direct significant effect on energy consumption but indirect significant effect on CO₂ emissions in emerging countries while indirect significant effect on energy consumption but direct significant effect on CO₂ emissions in developed and MENA countries but CO₂ emissions has direct significant effect on energy consumption in all developed, emerging and MENA countries while also direct significant effect on economic growth in developed and emerging countries. He also found direct significant effect of energy use on economic growth in developed and emerging countries but showed indirect significant on economic growth in MENA countries while also found direct significant effect of energy use on CO₂ emissions in all developed, emerging and MENA countries. He suggested that policy makers should adopt such policies that should focus to adopt advanced technologies to reduce CO₂ emissions and boost their economy. In developing countries of Asia, the relationship between renewable energy use and CO₂ emissions over 1980 to 2014 investigated by Hasnisah et al. (2019) and used dynamics OLS and OLS estimators and found very important role of economic growth and energy use in CO₂ emissions and indicated that economic growth and energy use decline environmental quality. In global and different regions Carbon dioxide emissions investigated by Dong et al. (2019) and found direct significant effect of economic growth, population, non-renewable energy and energy intensity on Carbon dioxide emissions in regional level and global while found reduction in carbon dioxide emissions due to renewable energy in global and Europe & Eurasia and S. & Cent.

The relationship between bilateral FDI and productivity growth between developed and developing countries investigated in the North and South over the period 1990 to 2012 by Demir and Duan (2018), and used 2 stage least square and GMM models and empirical results found that bilateral FDI has positive effect on human capital growth in South-South while no significant effect on productivity growth in host country and also found no significant effect on physical capital growth and found no significant effect at the sector level such as, agricultural, services or industry sectors. In Kuwait, the relationship between electricity use, financial development, economic growth, and FDI and CO₂ emissions over 1980 to 2013 investigated by Salahuddin et al. (2018), and used cointegration and ARDL estimators and VECM Granger causality and indicated that in both long and short run, CO₂ emissions increases due to electricity use, economic growth and FDI. In China and India, the relationship between technological innovations, energy use, trade and economic growth over 1974 to 2016 investigated by Fan and Hossain (2018), and applied ARDL and Toda–Yamamoto Granger Causality and indicated that in China, economic growth increases due to CO₂ emission, Trade and technological innovation in long run but found mixed results in short run but in India economic growth increases due to CO₂ emissions and trade in long run but in short run, declines due to CO₂ emissions. In China, the relationship between carbon dioxide emissions, economic growth, natural gas and renewable investigated by Dong et al. (2019) and found reduction in carbon dioxide emissions due to both renewable and natural gas in both short run and long run.

The causal relationship between economic growth, CO₂ emission and health spending examined in 51 countries over 1995 to 2013 (Chaabouni and Saidi, 2017), and used GMM model

and simultaneous equations. They empirical results found significant relationship between CO2 emissions and GDP per capita and also found significant relationship between health spending and economic growth while on the other side, the relationship between FDI, energy consumption, and economic growth investigated in seventeen countries of Middle Eastern over the period from 1990–2012 by [Abdouli and Hammami \(2017\)](#), and used GMM model and empirical results found bidirectional causality relationship between economic growth and FDI and between economic growth and energy consumption. While, there is unidirectional causality of energy consumption on FDI. The relationship between energy use, economic growth, CO2 emission and trade in Asian countries over 1985 to 2015 investigated by [Ahmed et al. \(2017\)](#), and used panel estimation, cointegration and FEVDM causality and found unidirectional causality to trade and CO2 emissions from economic growth and direct relationship between energy use and CO2 emissions and indicated that for most of the countries, economic growth environmental consequences are significant and showed energy use as a key variable in the direction of environmental decline in the ASEAN countries. The relationship between economic growth, CO₂ emissions, energy consumption and financial stability over 1980 to 2012 investigated by [Nasreen et al. \(2017\)](#), and used Granger causality and cointegration approach and showed improvement in the quality of environmental due to financial stability while the quality of environmental declines due to energy use, population and economic growth and indicated that in Pakistan and Sri Lanka, unidirectional causality running to CO2 emissions from financial stability. In South Africa, the relationship between trade, financial development, economic growth and energy consumption over 1970 to 2011 investigated by [Rafindadi and Ozturk \(2017\)](#), and applied unit root test, cointegration, VECM Granger causality and ARDL approach and found direct significant effect of trade on energy use. The relationship between energy and economic growth in Asia Pacific, Europe and Central Asia, South and North America and Middle East Africa over 1968 to 2013 investigated by [Marques et al. \(2017\)](#), and applied unit root tests, Diagnostic tests and ARDL estimator and found criticism hypothesis in Asia Pacific and America and maintenance hypothesis in Central Asia and Europe and Africa in long run and suggested that historical events, for example in 1970 and 1980 the oil shocks and financial crisis in 2008, have heterogeneous affects crosswise the world. In BRICS countries, the relationship of renewable use of energy and natural gas with carbon dioxide emissions investigated by [Dong et al. \(2019\)](#) and found important role of renewable use of energy and natural gas in carbon dioxide emissions and also indicated that in BRICS countries, carbon dioxide emissions reduce due to increase in renewable use of energy and natural gas.

The relationship between energy use, CO2 emission and economic growth examined in 58 countries over the period 1990 to 2012 by [Saidi and Hammami \(2015\)](#), and used GMM estimator and found positive effect of energy consumption on economic growth and negative relationship between CO2 emissions and economic growth but on the other side, the causal relationship between energy use, CO2 emission, urbanization, trade openness and economic growth investigated in EU member and candidate countries over the period 1992 to 2010 by [Kasman and Duman \(2015\)](#), and used panel co integration methods, panel causality tests and unit root test and empirical results found that energy consumption, CO2 emission, trade openness and GDP are significant in EU member and candidate countries. In Asian countries, Environmental Kuznets Curve over 1990–2011 investigated by [Apergis and Ozturk \(2015\)](#), and used GMM estimator and indicated that institutional boundaries play a vital role that make possible transfer and diffusion of technology, distributing

of knowledge on efficiency of energy and abatement of emissions, and strengthening of institutional and capacity building for countries of Asia.

The relationship between energy consumption, CO2 emissions and economic growth in Gulf Cooperation council countries investigated over the period 1980 to 2012 by [Salahuddin and Gow \(2014\)](#), and used panel co integration test, Panel unit root test and PMG estimator and empirical results found direct significant relationship between CO2 emissions and energy consumption and also direct significant relationship between energy consumption and economic growth both in the long run and short run.

There is positive but not significant relationship between capital and economic growth ([Shahbaz et al., 2011](#)) while on the other side ([Olumuyiwa, 2012](#)) found that economic growth positively affects due to capital, labor and energy consumption but In Five south Asia countries ([Noor and Siddiqi, 2010](#)) found positive and significant effect of capital on economic growth while in China ([Shahbaz and Lean, 2012](#)) found a positive effect of capital on economic growth but ([Narayan and Smyth, 2008](#)) found a positive effect of capital and energy consumption on economic growth in long run. In Taiwan, economic growth affected positively and significantly due to energy consumption ([Lee and Chang, 2005](#)). In China economic growth affected due to oil consumption ([Zou and Chau, 2006](#)). On the other hand in Taiwan ([Lee and Chang, 2007](#)) found that economic growth affected positively due to energy consumption while [Squalli \(2007\)](#) found negative effect of energy consumption on economic growth. Economic growth positively and significantly affected due to electricity and oil in Turkey, [Erbaykal \(2008\)](#). The previous studies ([Apergis and Payne, 2010](#); [Yingzi and Yuying, 2011](#); [Dantama et al., 2012](#); [Yuan et al., 2010](#)) found positive relationship between energy consumption and economic growth while [Bhusal \(2010\)](#) found positive and significant relationship between energy consumption and economic growth. The previous studies ([Ang, 2008](#); [Say and Yucel, 2006](#); [Fodha and Zaghdoud, 2010a](#)) found positive link between CO2 emission and economic growth while [Chebbi et al. \(2009\)](#), found negative link between CO2 emission and economic growth. There is positive link between FDI and economic growth ([Borensztein et al., 1998](#); [Chakraborty and Parantap, 2002](#); [Marwah and Tavakoli, 2004](#); [Sackey et al., 2012](#); [Ayanwale, 2007](#)), while [Shujaat \(2011\)](#), [Ayanwale \(2007\)](#) and [Akinolo \(2004\)](#); found insignificant link between FDI and economic growth but [Hermes and Lensink \(2003\)](#) found negative and significant effect on economic growth of host countries. On the other side, [Vu et al. \(2006\)](#) and [Gudaro et al. \(2010\)](#) found direct positive effect of FDI on economic growth but indirectly affects labor productivity. There is positive relationship between energy consumption and economic growth ([Mallik, 2007](#)). There is negative relationship between energy consumption and economic growth ([Squalli, 2007](#)). There is positive and significant relationship between energy consumption and economic growth ([Bhusal, 2010](#)), and found positive relationship between per capita of income and energy consumption. The energy consumption has positive and significant effect on economic growth in Indonesia and India ([Fatai et al., 2004](#)). The relationship between FDI and energy consumption investigated in UAE over the period 1975 to 2011 by [Sbia et al. \(2014\)](#) and found a negative relationship between energy consumption and FDI. According to previous research studies, economic growth positively affected due to energy consumption in many countries ([Francis et al., 2010](#); [Belke et al., 2011](#)).

3. Econometric method and data

3.1. Econometric modeling

The objective of the study is to investigate the effect of bilateral FDI, energy consumption, CO2 emission and capital on

economic growth of host countries of Asia. The previous studies (Yingzi and Yuying, 2011; Fodha and Zaghoud, 2010a; Belloumi, 2009; Ang, 2008) have investigated the effect of energy consumption, and CO₂ emissions on economic growth and found important role on economic growth while on the other side, Sackey et al. (2012), Zakia and Ziad (2007), and Vu et al. (2006) found significant effect of FDI on economic growth. Therefore, our model, consistent with the wide literature on economic growth determinant which cited above, takes the following from:

3.1.1. Generalized method of moments (GMM)

GMM model has formalized by Hansen in 1982. The GMM is in general working procedure to estimate the parameters with endogenous regressors in panel data model and unobserved individual accurate heterogeneity. In this type of model LSE, i.e. random or fixed effects estimator, are not consistent for a finite numbers of time period and a huge number of observations of cross-section. Although in micro economics the typical dimension of panel data is little time span for a large cross-section alternative consistent estimators of GMM has been proposed by Arellano and Bond (1991). In the current study, we have taken lagged levels of per capita of GDP (economic growth) by applying the Arellano and Bond (1991) GMM estimator.

The effect of bilateral FDI, energy consumption, CO₂ emission, and capital on economic growth of Asia countries is empirically observed by use of the following equation.

$$\begin{aligned} \text{Log(GDPP)}_{h,t} = & \beta_0 + \beta_1 \text{Log(GDPP)}_{h,t-1} + \beta_2 \text{DEC}_{h,st} + \beta_3 \text{EC}_{h,t} \\ & + \beta_4 \text{EC}_{s,t} + \beta_5 \text{DCO2}_{h,st} + \beta_6 \text{CO2}_{h,t} + \beta_7 \text{CO2}_{s,t} + \beta_8 \text{D(logFDI)}_{h,st} \\ & + \beta_9 \text{log(FDI)}_{h,t} + \beta_{10} \text{log(FDI)}_{s,t} + \beta_{11} \text{D(logK)}_{h,st} + \beta_{12} \text{log(K)}_{h,t} \\ & + \beta_{13} \text{log(K)}_{s,t} + \beta_{14} \text{DFD}_{h,st} + \beta_{15} \text{FD}_{h,t} + \beta_{16} \text{FD}_{s,t} + \beta_{17} \text{DTO}_{h,st} \\ & + \beta_{18} \text{TO}_{h,t} + \beta_{19} \text{TO}_{s,t} + \mu_{h,t} \end{aligned} \quad (1)$$

The above Eq. (1) is generalized method of moments (GMM) equation. Where, h stands for the host countries and s stand for the source countries, t stand for the time, D stands for the difference between host countries and source countries, log stands for logarithm, β_0 stands for constant, β_i stands for the coefficients correlated with different type of variable, and $\mu_{h,t}$ stands for the error term. The above equation examines the effect of different variables such as, difference energy consumption (DEC), energy consumption of host countries (EC_h) and source countries (EC_s), difference CO₂ emission (DCO₂), CO₂ emission of host countries (CO2_h) and source countries (CO2_s), difference FDI flows (DFDI), FDI inflows in host countries (FDI_h) and FDI outflows in source countries (FDI_s), difference capital (DK), capital of host countries (K_h) and source countries (K_s), difference financial development (DFD), financial development of host countries (FD_h) and source countries (FD_s), difference trade openness (DTO) and trade openness of host countries (TO_h) and source countries (TO_s) on economic growth of host countries of Asia (GDPP_h).

3.1.2. Static model

As mentioned above, economic growth is the dependent variable of the model. It is measured using GDP per capita (GDPP). The model investigates the effect of bilateral FDI, energy consumption, CO₂ emission and capital on economic growth of host countries of Asia can be represented as follows:

$$\begin{aligned} \text{Log(GDPP)}_{h,t} = & \beta_0 + \beta_1 \text{DEC}_{h,st} + \beta_2 \text{EC}_{h,t} + \beta_3 \text{EC}_{s,t} + \beta_4 \text{DCO2}_{h,st} \\ & + \beta_5 \text{CO2}_{h,t} + \beta_6 \text{CO2}_{s,t} + \beta_7 \text{D(logFDI)}_{h,st} + \beta_8 \text{log(FDI)}_{h,t} \\ & + \beta_9 \text{log(FDI)}_{s,t} + \beta_{10} \text{D(logK)}_{h,st} + \beta_{11} \text{log(K)}_{h,t} + \beta_{12} \text{log(K)}_{s,t} \\ & + \beta_{13} \text{DFD}_{h,st} + \beta_{14} \text{FD}_{h,t} + \beta_{15} \text{FD}_{s,t} + \beta_{16} \text{DTO}_{h,st} + \beta_{17} \text{TO}_{h,t} \\ & + \beta_{18} \text{TO}_{s,t} + \mu_{h,t} \end{aligned} \quad (2)$$

where h represents host country and s represents source country, and $i = 1, \dots, T$ refers to time period. Parameter β_0 represents constant. Parameter β_1 denotes coefficient of corresponding variable. $\mu_{h,t}$ is the error term. Log represents logarithm. In this research, the log transformed dependent variable is used to deal with highly skewed data (Manning, 1998).

3.2. Data collection

We used a panel data of 35 host countries and 118 source countries. We collected the data over the period 2001–2012 because of availability. All the data was collected from the database of UNCTAD Statistics, World Bank and World development indicators (WDI). The annual data on GDP per capita, in constant 2010 US dollars are applied for economic growth. In this research, the GDP per capita data was collected from the World Development Indicators. Bilateral FDI flows are applied for FDI inflows in host countries and FDI outflows to source countries. The bilateral FDI data was collected from recent database of UNCTAD Statistics. The energy consumption per capita in kg of oil equivalent is applied for energy consumption (EC), and the energy consumption data was collected from the World Development Indicators. The per capita of carbon dioxide emissions in metric tons is applied for (CO₂ emission), the CO₂ emission data was collected from the World Development Indicators. Capital formation in constant 2010 US dollars is applied for capital (K), the capital data was collected from the World Development Indicators. Financial development (FD) data was collected from the World Development Indicators., and Trade openness (TO) data was collected from the World Development Indicators. Fig. 1 shows the sum of FDI inflows in Asian countries and FDI outflows from Asian countries but Fig. 2 shows the sum of GDP per capita of Asian countries.

4. Results and discussion

In the current study, we investigated the effect of different variables such as, difference energy consumption (DEC), energy consumption of host countries (EC_h) and source countries (EC_s), difference CO₂ emission (DCO₂), CO₂ emission of host countries (CO2_h) and source countries (CO2_s), difference FDI flows (DFDI), FDI inflows in host countries (FDI_h) and FDI outflows in source countries (FDI_s), difference capital (DK), capital of host countries (K_h) and source countries (K_s), difference financial development (DFD), financial development of host countries (FD_h) and source countries (FD_s), difference trade openness (DTO) and trade openness of host countries (TO_h) and source countries (TO_s) on economic growth of host countries of Asia (GDPP_h) for 35 host countries of Asia and 118 source countries by using OLS regression, fixed effect and random effect and a generalized method of moments (GMM) where lagged levels of the economic growth has taken into account by using the Arellano and Bond (1991) GMM estimator. I use Hausman test to random effect and fixed effect and the Hausman test is significant in Table 2 which shows that Hausman rejected the correlated statement in Table 2. The results proved that the random effect is not correlated with the instructive variables in the sample of Asia countries. So the Hausman results point out in the sample of Asia countries that fixed effect is the suitable model for the analysis of Asia countries. Table 1 shows the results of static model but Table 2 shows the results of difference GMM while Table 3 shows the summary results of all models.

Table 1, shows the results of regression, fixed effect and random effect which investigated the effect of energy consumption, CO₂ emission, bilateral FDI and capital on economic growth of host countries in Asia countries. All models showed that difference energy consumption has negative and significant effect on

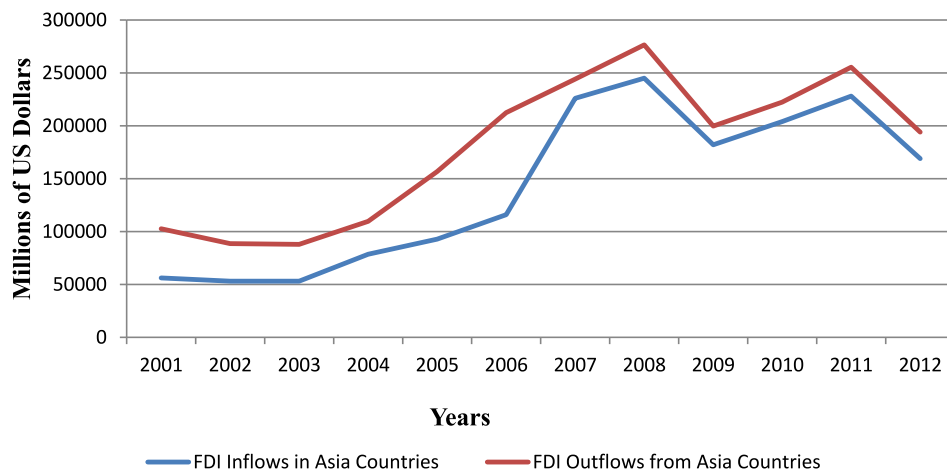


Fig. 1. The sum of FDI inflows in Asia and FDI outflows from Asia. Note: Based on UNCTAD.

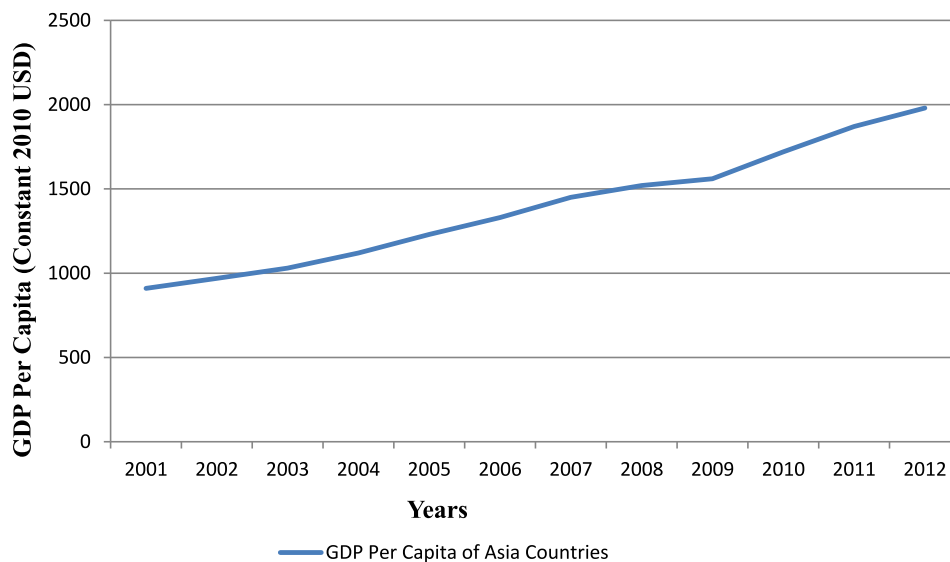


Fig. 2. The sum of GDP per capita of Asia countries. Note: Based on World Bank, World development indicators.

economic growth of host countries. The results of regression and fixed effect showed that energy consumption of host countries has positive and significant effect on economic growth of host countries while random effect showed positive relationship of host countries energy consumption with economic growth of host countries but showed no significant effect on economic growth of host countries. The results identified that increase in energy consumption of host countries increases economic growth. Our results are consistent with the previous studies (Apergis and Payne, 2010; Lee and Chang, 2007; Masih and Masih, 1998); which also investigated that economic growth increases due to increase in energy consumption. The results of regression and random effect showed that energy consumption of source countries has negative relationship while fixed effect showed positive relationship but showed no significant effect on economic growth of host countries in any model. All models showed that difference CO₂ emission has positive and significant effect on economic growth of host countries. The results of regression showed that CO₂ emission of host countries has negative and significant effect on economic growth of host countries while fixed effect showed positive and significant effect of host countries CO₂ emission on economic growth of host countries but on the other side, random effect showed positive relationship of host countries

CO₂ emission but showed no significant effect of host countries CO₂ emission on economic growth of host countries. CO₂ emission of source countries showed negative relationship in all models but only showed significant effect on economic growth of host countries in random effect but in regression and fixed effect showed no significant effect on economic growth of host countries. All models demonstrated that difference FDI flows and FDI inflows in host countries have positive and significant effect on economic growth of host countries while FDI outflows in source countries showed positive and significant effect on economic growth of host countries in regression and random effect but in fixed effect model showed positive relationship but not significant effect on economic growth of host countries. The results identified that increase in difference FDI or FDI inflow or FDI outflow increases economic growth of host countries. The previous studies (Vu et al., 2006; Marwah and Tavakoli, 2004; Chakraborty and Parantap, 2002; Borensztein et al., 1998), also investigated positive effect of FDI on economic growth. The results of regression showed that difference capital has positive and significant effect on economic growth of host countries while fixed effect and random effect showed that difference capital has negative and significant effect on economic growth of host countries. All models showed that capital of host countries has positive and significant effect on economic growth of host

Table 1
Effect of different variables on economic growth of Asia countries (Static model).

	(Regression)	(Fixed effect)	(Random effect)
Dependent variable: Economic growth			
Difference energy consumption	−0.001*** (0.001)	−0.001*** (0.001)	−0.001*** (0.001)
Energy consumption of host countries	0.001*** (0.001)	0.001** (0.001)	0.001 (0.001)
Energy consumption of source countries	−0.001 (0.001)	0.001 (0.001)	−0.001 (0.001)
Difference CO2 emission	0.008*** (0.003)	0.013*** (0.003)	0.015*** (0.003)
CO2 emission of host countries	−0.010** (0.004)	0.013*** (0.004)	0.005 (0.004)
CO2 emission of source countries	−0.003 (0.003)	−0.004 (0.005)	−0.008** (0.004)
Difference FDI flows	0.015*** (0.004)	0.005* (0.003)	0.008*** (0.003)
FDI inflows in host countries	0.019*** (0.003)	0.009*** (0.003)	0.017*** (0.003)
FDI outflows in source countries	0.018*** (0.004)	0.004 (0.003)	0.011*** (0.003)
Difference capital	0.010** (0.005)	−0.245*** (0.027)	−0.021** (0.009)
Capital of host countries	0.969*** (0.005)	0.971*** (0.031)	0.996*** (0.009)
Capital of source countries	0.004 (0.006)	0.275*** (0.044)	0.044*** (0.010)
Difference financial development	−0.001 (0.001)	0.001*** (0.001)	0.001*** (0.001)
Financial development of host countries	−0.004*** (0.001)	−0.001*** (0.001)	−0.002*** (0.001)
Financial development of source countries	−0.001 (0.001)	−0.001 (0.001)	0.001 (0.001)
Difference trade openness	0.001 (0.001)	−0.001 (0.001)	−0.001* (0.001)
Trade openness of host countries	−0.002*** (0.001)	−0.001 (0.001)	−0.001*** (0.001)
Trade openness of source countries	0.001 (0.001)	0.002*** (0.001)	0.002*** (0.001)
Constant	−0.376*** (0.129)	−4.713*** (0.532)	−1.761*** (0.207)
Observations	1,732	1,732	1,732
R-squared	0.978	0.790	
Hausman test		0.000	

Notes: *** = Significance at 0.01 level, ** = Significance at 0.05 level and , * = Significance at 0.1 level.

countries. Capital of source countries also showed positive and significant effect on economic growth of host countries in all models except regression because in regression showed positive relationship but not significant effect on economic growth of host countries. The results identified that economic growth of host countries increases due to increase in capital of host countries or source countries. The previous studies (Noor and Siddiqi, 2010; Shahbaz et al., 2011; Shahbaz and Lean, 2012; Narayan and Smyth, 2008), also demonstrated that capital has positive effect on economic growth. The regression showed negative relationship of difference financial development but not significant effect on economic growth of host countries while fixed effect and random effect showed positive and significant effect of difference financial development on economic growth of host countries. All models showed that financial development of host countries has negative and significant effect on economic growth of host countries. Financial development of source countries showed negative relationship in regression and fixed effect while positive relationship in random effect but showed no significant effect on economic growth of host countries in any model. Difference trade openness only showed negative and significant effect on economic growth of host countries in random effect while in fixed effect showed negative relationship but not significant and in regression showed positive relationship but not significant effect on economic growth of host countries. Trade openness of host countries showed negative and significant effect on economic

growth of host countries in regression and random effect while in fixed effect showed negative relationship but not significant effect on economic growth of host countries. Trade openness of source countries showed positive and significant effect on economic growth of host countries in fixed effect and random effect while in regression showed positive relationship but not significant effect on economic growth of host countries.

Table 2, shows the results of difference GMM which investigated the effect of energy consumption, CO2 emission, bilateral FDI and capital on economic growth of host countries of Asia. The results of diagnostic tests (the Sargan test for over identification) showed a superior statistical performance. The values of $\log\text{GDPPC}_{ht-1}$ in host countries of Asia (0.895), (0.903), (0.804), (0.853) and (0.540) implied that GDP per capita is corrected each year by 89.5%, 90.3%, 80.4%, 85.3% and 54% in host countries of Asia. In column 1 and column 5, the results showed that difference energy consumption negatively and significantly affects economic growth of host countries while both energy consumption of host countries and source countries positively and significantly affects economic growth of host countries. The results identified that economic growth of host countries increases due to increase in energy consumption of host countries or source countries. Our results are consistent with the previous studies (Asafu-Adjaye, 2000; Fatai et al., 2004; Erbaykal, 2008; Apergis and Payne, 2010; Lee and Chang, 2007; Masih and Masih, 1998; Shahbaz et al., 2012, 2013); which also investigate that economic growth increase due to increase in energy consumption.

Table 2

Effect of different variables on economic growth of Asia countries (GMM).

	(1)	(2)	(3)	(4)	(5)
Dependent variable: Economic growth					
logGDPPC _{ht-1}	0.895*** (0.005)	0.903*** (0.005)	0.804*** (0.017)	0.853*** (0.006)	0.540*** (0.021)
Difference energy consumption	-0.001*** (0.001)				-0.001*** (0.001)
Energy consumption of host countries	0.001*** (0.001)				0.001*** (0.001)
Energy consumption of source countries	0.001*** (0.001)				0.001*** (0.001)
Difference CO2 emission		-0.008*** (0.001)			0.007*** (0.002)
CO2 emission of host countries		0.021*** (0.001)			0.013*** (0.003)
CO2 emission of source countries		0.012*** (0.001)			-0.001 (0.003)
Difference FDI flows			0.001 (0.003)		0.003** (0.002)
FDI inflows in host countries			0.009*** (0.003)		0.004** (0.002)
FDI outflows in source countries			0.015*** (0.003)		0.006*** (0.002)
Difference capital				-0.018** (0.008)	-0.162*** (0.023)
Capital of host countries				0.132*** (0.009)	0.342*** (0.032)
Capital of source countries				0.027*** (0.010)	0.206*** (0.041)
Difference financial development	0.00*** (0.001)	0.001*** (0.001)	0.001 (0.001)	0.001*** (0.001)	0.001*** (0.001)
Financial development of host countries	-0.001*** (0.001)	-0.001*** (0.001)	-0.001** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)
Financial development of source countries	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001*** (0.001)	-0.001*** (0.001)
Difference trade openness	-0.001*** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)
Trade openness of host countries	0.001*** (0.001)	0.001*** (0.001)	0.001*** (0.001)	0.001*** (0.001)	0.001** (0.001)
Trade openness of source countries	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)
Observations	6,423	6,598	972	6,568	961

Notes: *** = Significance at 0.01 level, ** = Significance at 0.05 level and , * = Significance at 0.1 level.

Table 3

Summary results of all models.

	Regression	Fixed effect	GMM	GMM
Dependent variable: Economic growth	Full model	Full model	Full model	Individual
Difference energy consumption	Sig(-)	Sig(-)	Sig(-)	Sig(-)
Energy consumption of host countries	Sig(+)	Sig(+)	Sig(+)	Sig(+)
Energy consumption of source countries	(-)	(+)	Sig(+)	Sig(+)
Difference CO2 emission	Sig(+)	Sig(+)	Sig(+)	Sig(-)
CO2 emission of host countries	Sig(-)	Sig(+)	Sig(+)	Sig(+)
CO2 emission of source countries	(-)	(-)	(-)	Sig(+)
Difference FDI flows	Sig(+)	Sig(+)	Sig(+)	(+)
FDI inflows in host countries	Sig(+)	Sig(+)	Sig(+)	Sig(+)
FDI outflows in source countries	Sig(+)	(+)	Sig(+)	Sig(+)
Difference capital	Sig(+)	Sig(-)	Sig(-)	Sig(-)
Capital of host countries	Sig(+)	Sig(+)	Sig(+)	Sig(+)
Capital of source countries	(+)	Sig(+)	Sig(+)	Sig(+)
Difference financial development	(-)	Sig(+)	Sig(+)	Sig(+)
Financial development of host countries	Sig(-)	Sig(-)	Sig(-)	Sig(-)
Financial development of source countries	(-)	(-)	Sig(-)	(-)
Difference trade openness	(+)	(-)	Sig(-)	Sig(-)
Trade openness of host countries	Sig(-)	(-)	Sig(+)	Sig(+)
Trade openness of source countries	(+)	Sig(+)	Sig(+)	Sig(+)

‘Sig’ stand for significance and (+)/(-) stand for it has positive or negative effect on the dependent variable.

While increase in difference energy consumption implies reduce economic growth of host countries. In column 2, difference CO2 emission showed negative and significant effect on economic growth of host countries while CO2 emission of host countries and source countries showed positive and significant effect on economic growth of host countries but in column 5, difference

CO2 emission and CO2 emission of host countries demonstrated positive and significant effect on economic growth of host countries while CO2 emission of source countries showed negative relationship but not significant effect on economic growth of host countries. The results identified that economic growth increases due to increase in CO2 emission of host countries or

source countries. The previous studies (Khan et al., 2019; Al-mulali and Sab, 2012a; Al-Mulali and Sab, 2012b; Say and Yucel, 2006; Fodha and Zaghdoud, 2010a) also investigated that Carbon dioxide emission positively and significantly affects economic growth. In column 3, difference FDI demonstrated positive but not significant effect on economic growth of host countries while FDI inflows in host countries and FDI outflows in source countries showed positive and significant effect on economic growth of host countries. In column 5, difference FDI flows, FDI inflows in host countries and FDI outflows in source countries showed positive and significant effect on economic growth of host countries. The results identified that economic growth of host countries increases due to increase in difference FDI flows or FDI inflows in host countries or FDI outflows in source countries. Our results are also consistent with the previous studies (Sackey et al., 2012; Christopher, 2012; Ayanwale, 2007; Vu et al., 2006; Marwah and Tavakoli, 2004; Chakraborty and Parantap, 2002; Borensztein et al., 1998), which also investigated that FDI positively affects economic growth. In both column 4 and column 5, difference capital showed negative and significant effect on economic growth of host countries while both capital of host countries and source countries showed positive and significant effect on economic growth of host countries. The results identified that economic growth of host countries reduces due to increase in difference capital but increases due to increase in capital of host countries or source countries. The previous studies, (Noor and Siddiqi, 2010; Shahbaz et al., 2011; Shahbaz and Lean, 2012; Narayan and Smyth, 2008), also demonstrated positive effect of capital on economic growth. In all columns except column 3, difference financial development showed positive and significant effect on economic growth of host countries but in column 3, showed positive relationship but not significant effect on economic growth of host countries. In all columns, financial development of host countries showed negative and significant effect on economic growth of host countries. In column 4 and column 5, financial development of source countries demonstrated negative and significant effect on economic growth of host countries while in other columns only showed negative relationship but not significant effect on economic growth of host countries. The results identified that economic growth of host countries increases due to increase in difference financial development but increase in financial development of host countries or source countries reduces economic growth of host countries. In all columns, difference trade openness showed negative and significant effect on economic growth of host countries while both trade openness of host countries and source countries showed positive and significant effect on economic growth of host countries. The results identified that increase in trade openness of host countries or source countries increases economic growth of host countries. The previous studies (Ibrahim and Alagidede, 2018; Malefane, 2018), also investigated that trade openness has positive and significant effect on economic growth while increase in difference trade openness reduces economic growth of host countries.

Table 3 summarizes the result as consider the effect of energy consumption, CO2 emission, bilateral FDI and capital on economic growth of host countries of Asia through regression, fixed effect and difference GMM. The main independent variable of interest is GDP per capita which applied for economic growth. The difference energy consumption shows negative and significant relationship with economic growth in all models. The results of difference energy consumption indicate that a raise in difference energy consumption implies reduce economic growth in Asia countries. The energy consumption of host countries shows positive and significant relationship with economic growth in all models. The result of energy consumption of host countries indicates that economic growth boost due to energy consumption

of host countries and on the other side; energy consumption of source countries shows positive and significant relationship with economic growth in both full model and individual model of GMM but in fixed effect shows only positive but insignificant effect on economic growth while in regression shows negative but insignificant effect on economic growth. The result of energy consumption of source countries specifies in GMM that economic growth increases due to increase in energy consumption of source countries. The difference carbon dioxide (CO2) emissions show positive and significant relationship with economic growth in all models except individual GMM because in individual GMM model shows negative and significant effect on economic growth. The result of difference carbon dioxide) emissions indicates in all models except individual GMM model that economic growth increases due to increase in difference carbon dioxide emissions. The carbon dioxide emissions of host countries show positive and significant relationship with economic growth in all models except regression because in regression model shows negative and significant effect on economic growth. The result of carbon dioxide emissions of host countries indicates in all models except regression model that economic growth increases due to increase in carbon dioxide emissions of host countries. The carbon dioxide emissions of source countries only show positive and significant relationship with economic growth in individual GMM model but in all other models show negative but insignificant effect on economic growth. The difference FDI flows shows positive and significant relationship with economic growth in all models except individual GMM because in individual GMM model shows positive but insignificant effect on economic growth. The result of difference FDI flows indicates that increase in difference FDI flows boost economic growth. The FDI inflows in host countries show positive and significant relationship with economic growth in all models which specifies that economic growth increases due to increase in FDI inflows in host countries. The FDI outflows in source countries show positive and significant relationship with economic growth in all models except fixed effect because in fixed effect shows positive but insignificant effect on economic growth. The results of FDI outflows in source countries indicate that a raise in FDI outflows in source countries implies a raise in economic growth. The difference capital shows negative and significant relationship with economic growth in all models except regression because in regression model shows positive and significant effect on economic growth. The result of difference capital indicates in all models except regression model that economic growth reduces due to increase in difference capital. The capital of host countries shows positive and significant relationship with economic growth in all models which specifies that economic growth increases due to increase in capital of host countries. The capital of source countries shows positive and significant relationship with economic growth in all models except regression because in regression shows positive but insignificant effect on economic growth. The results of capital of source countries specify that economic growth increases due to a 1% increase in capital of source countries. The difference financial development shows positive and significant relationship with economic growth in all models except regression because in regression model shows negative but insignificant effect on economic growth. The results of difference financial development indicated that increase in difference financial development increases economic growth. The financial development of host countries shows negative and significant relationship with economic growth in all models which indicates that economic growth increases due to increase in financial development of host countries. The financial development of source countries only shows negative and significant relationship with economic growth in GMM model but in all other models shows negative but insignificant effect on economic growth. The

difference trade openness shows negative and significant relationship with economic growth in both full model and individual model of GMM but in fixed effect shows only negative but insignificant effect on economic growth while in regression shows positive but insignificant effect on economic growth. The results of difference trade openness specify in GMM that economic growth increases due to increase in difference trade openness. The trade openness of host countries shows positive and significant relationship with economic growth in both full model and individual model of GMM while in regression shows negative and significant effect on economic growth but in fixed effect shows negative but insignificant effect on economic growth. The result of trade openness of host countries indicates in GMM that economic growth increases due to increase in trade openness of host countries. The trade openness of source countries shows positive and significant relationship with economic growth in all models except regression because in regression shows positive but insignificant effect on economic growth. The results of trade openness of source countries indicate that economic growth increases due to a 1% increase in trade openness of source countries.

The study suggest that policy makers of Asian countries have to create superior policies for the utilization of energy, make use of clean energy and use appropriate and advanced technology for energy in Asia countries and foreign investors play very important role in economic growth of Asian countries so Asian countries have to encourage foreigner investors to their countries and also invest in other countries which will increase their economy because economic growth increase due to both FDI inflows and outflows, energy use, CO2 emission, and capital of host countries and source countries.

5. Conclusion

This study focused on cross countries analysis of bilateral FDI, energy consumption, CO2 emission, capital and economic growth for 35 host countries of Asia and 118 source countries. The current study applies generalized method of moments (GMM), OLS regression, fixed effect and random effect models and data used over the period 2001–2012. The results demonstrated that both difference energy consumption and difference capital have negative and significant effect on economic growth of host countries of Asia, implying that a raise in difference energy consumption or difference capital declines economic growth of host countries of Asia. While energy consumption of host countries and source countries and capital of host countries and source countries have positive and significant effect on economic growth of host countries of Asia, which implying that economic growth of host countries of Asia increases due to increase in energy consumption of host countries or source countries or capital of host countries or source countries. The difference CO2 emission and CO2 emission of host countries have positive and significant effect on economic growth of host countries of Asia, which implying that an increase in difference CO2 emission or CO2 emission of host countries increases economic growth of host countries of Asia while CO2 emission of source countries has negative effect on economic growth of host countries but showed no significant effect on economic growth of host countries of Asia. The difference FDI flows, FDI inflows and FDI outflows demonstrated positive and significant effect on economic growth of host countries of Asia, which implying that an increase in difference FDI flows or FDI inflows or FDI outflows increase economic growth of host countries of Asia. The difference financial development has positive and significant effect on economic growth of host countries of Asia while difference trade openness has negative and significant effect on economic growth of host

countries, which implying that economic growth of Asia countries raises due to increase in difference financial development while economic growth of Asia countries declines due to increase in difference trade openness. The financial developments of host countries and source countries have negative and significant effect on economic growth of host countries of Asia while trade openness of host countries and source countries have positive and significant effect on economic growth of host countries and of Asia, which implying that an increase in financial developments of host countries or source countries decrease economic growth of Asia countries while increase in trade openness of host countries or source countries increases economic growth of Asia countries.

First, the FDI results indicated that FDI inflows and FDI outflows have direct significant effect on economic growth in Asian countries so we suggest that Asian countries have to encourage foreign investors to their countries and also invest in other countries in order to boost up their economy as well as increase the trust between host and source countries.

Secondly, the energy consumption results indicated that both energy consumption of host countries and source countries have direct significant effect on economic growth in Asian countries. Therefore, we suggest that both countries (host and source) should make efficient and effective polices and use of renewable energy resources such as solar, geothermal and wind energy. Furthermore, use of clean energy and use appropriate and advanced technology for energy purposes in host and source countries.

Third, the CO2 emissions results indicated that only host countries of CO2 emissions has direct significant effect on economic growth, as a result we suggest that Asian countries should use the advance technology, as well as clean energy in order to alleviate the environmental pressure resultant better economic growth and environmental protection, particularly China and India. Furthermore, developed countries have to transfer of sophisticated technology to emerging and less developed countries which would help to avoid unsafe climate change.

Our study has few limitations. First, we have ignored cross sectional independence and slope homogeneity because our main model is GMM and GMM model do not allow us for cross sectional independence and slope homogeneity. Second, our sampled is limited to Asians countries, so we suggest that other researchers can extend our study to the globe, as well as by using multiple specifications analysis such as robustness check.

Appendix

Table A.1
List of abbreviations.

FDI	Foreign direct investment
GMM	Generalized method of moments
UNCTAD	United Nations Conference on Trade and Development
LSE	Least Squares Estimator
WDI	World development indicators
GDPP	GDP per capita
EC	Energy consumption
DEC	Difference energy consumption
CO2	Carbon dioxide
DCO2	Difference Carbon dioxide
K	Physical capital
DK	Difference physical capital
FD	Financial development
DFD	Difference financial development
TO	Trade openness
DTO	Difference trade openness
Sig	Significant

Table A.2
Descriptive statistics.

Variables	Obs	Mean	Std. Dev
Economic growth of host countries	8724	13.04939	1.951533
Economic growth of source countries	8568	12.70924	2.1467
Difference energy consumption	8048	2976.449	2475.948
Energy consumption of host countries	8724	2907.445	2378.464
Energy consumption of source countries	8048	3970.244	2701.838
Difference CO2 emission	8670	7.055996	6.493499
CO2 emission of host countries	8724	7.600023	6.102057
CO2 emission of source countries	8670	8.984009	7.015762
Difference FDI flows	1912	2.097139	1.592117
FDI inflows in host countries	4725	3.689927	2.256654
FDI outflows in source countries	3712	3.63971	2.309532
Difference capital	8568	2.555708	1.863529
Capital of host countries	8724	14.17509	1.999428
Capital of source countries	8568	14.01405	2.159144
Difference financial development	7954	65.74745	46.78407
Financial development of host countries	8694	73.33811	53.94537
Financial development of source countries	7984	89.43978	51.42548
Difference trade openness	8225	63.16514	77.82909
Trade openness of host countries	8694	86.53457	68.35189
Trade openness of source countries	8255	95.92927	70.39318

Note: Obs stands for Observation, Mean stands for average of different variables, Std. Dev stands for standard deviation of different variables.

References

- Abdoul, M., Hammami, S., 2017. Exploring links between fdi inflows, energy consumption, and economic growth: further evidence MENA countries. *J. Econ. Dev.* 42 (1), 95–117.
- Ahmed, K., Bhattacharya, M., Shaikh, Z., Ramzan, M., Ozturk, I., 2017. Emission intensive growth and trade in the era of the association of southeast asian nations (ASEAN) integration: An empirical investigation from ASEAN-8. *J. Cleaner Prod.* 154, 530–540.
- Akinola, A., 2004. Foreign direct investment and growth in Nigeria: An empirical investigation. *J. Policy Model.* 26, 627–639.
- Al-mulali, U., Sab, C.N.B.C., 2012a. The impact of energy consumption and co2 emission on the economic and financial development in 19 selected countries. *Renew. Sustain. Energy Rev.* 16 (7), 4365–4369.
- Al-Mulali, U., Sab, C.N.B.C., 2012b. The impact of energy consumption and co2 emission on the economic growth and financial development in the sub saharan african countries. *Energy* 39 (1), 180–186.
- Ang, J.B., 2008. Economic development, pollutant emissions and energy consumption in Malaysia. *J. Policy Model.* 30 (2), 271–278.
- Apergis, N., Ozturk, I., 2015. Testing environmental kuznets curve hypothesis in asian countries. *Ecol. Indic.* 52, 16–22.
- Apergis, N., Payne, J.E., 2010. The emissions, energy consumption, and growth nexus: evidence from the commonwealth of independent states. *Energy Policy* 38 (1), 650–655.
- Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Rev. Econ. Stud.* 58 (2), 277–297.
- Asafu-Adjaye, J., 2000. The relationship between energy consumption, energy prices and economic growth: Time series evidence from asian developing coun-tries. *Energy Econ.* 22, 615–625.
- Ayanwale, A.B., 2007. FDI and economic growth: Evidence from Nigeria AERC Research Paper 165. Nairobi: African Economic Research Consortium.
- Belke, A., Dobnik, F., Dreger, C., 2011. Energy consumption and economic growth: New insights into the co-integration relationship. *Energy Econ.* 33, 782–789.
- Belloumi, M., 2009. Energy consumption and GDP in Tunisia: Co-integration and causality analysis. *Energy Policy* 37 (7), 2745–2753.
- Bhusal, T.P., 2010. Econometric analysis of oil consumption and economic growth in nepal. *Econ. J. Dev.* 12, 1–2.
- Borensztein, E., Gregorio, J., Lee, D.J.W., 1998. How does foreign direct investment affect economic growth?. *J. Int. Econ.* 45, 115–135.
- Chaabouni, S., Saidi, K., 2017. The dynamic links between carbon dioxide (co2) emissions, health spending and GDP growth: a case study for 51 countries.. *Environ. Res.* 158, 137–144.
- Chakraborty, C., Parantap, B., 2002. FDI And growth in India: A co-integration approach. *Appl. Econ.* 34, 1061–1073.
- Chebbi, H., Olarreaga, M., Zitouna, H., 2009. Trade openness and co2emissions inTunisia. In: *Proceedings of the ERF16 the Annual Conference November*. pp. 7–9.
- Christopher, A.J., 2012. Impact of foreign direct investment on economic growthin Nigeria. *Interdiscip. J. Contemp. Res. Bus.* 4 (5).
- Dantama, Y.U., Umar, Y., Abdullahi, Y.Z., Nasiru, I., 2012. Energy consumption–economic growth nexus in Nigeria: An empirical assessment based on ARDL bound test approach. *Eur. Sci. J.* 8, 141–157.
- Demir, F., Duan, Y., 2018. Bilateral fdi flows, productivity growth, and convergence: The north vs. the south. *World Dev.* 101, 235–249.
- Dong, K., Dong, X., Dong, C., 2019. Determinants of the global and regional co2 emissions: What causes what and where?. *Appl. Econ.* 1–14.
- Erbaykal, E., 2008. Disaggregate energy consumption and economic growth: evidence from Turkey. *Int. Res. J. Financ. Econ.* 20 (20), 172–179.
- Fan, H., Hossain, M.I., 2018. Technological innovation, trade openness, co2 emission and economic growth: Comparative analysis between China and India. *Int. J. Energy Econ. Policy* 8 (6), 240–257.
- Fatai, K., Oxley, L., Scrimgeour, F.G., 2004. Modeling the causal relation-ship between energy consumption and GDP in new zealand, Australia, India, Indonesia, the Philippines and thailand. *Math. Comput. Simulation* 64, 431–445.
- Fodha, M., Zaghdoud, O., 2010a. Economic growth and environmental degrada-tion in Tunisia: An empirical analysis of the environmental kuznets curve. *Energy Policy* 38, 1150–1156.
- Francis, B.M., Moseley, L., Iyare, S.O., 2010. Energy consumption and projected growth in selected Caribbean countries. *Energy Econ.* 29, 1224–1232.
- Gudaro, A.M., Chhapra, I.U., Sheikh, S.A., 2010. Impact of foreign direct invest-ment on economic growth: A case study of Pakistan. *J. Manag. Soc. Sci.* 2, 84–92.
- Hasnisah, A., Azlina, A.A., Taib, C.M.I.C., 2019. The impact of renewable en-ergy consumption on Carbon dioxide emissions: Empirical evidence from developing countries in asia. *Int. J. Energy Econ. Policy* 9 (3), 135–143.
- Hermes, N., Lensink, R., 2003. Foreign direct investment, financial growth and economic growth. *J. Growth Stud.* 40, 142–163.
- Ibrahim, M., Alagidede, P., 2018. Effect of financial development on economic growth in sub-saharan africa. *J. Policy Model.* 40 (6), 1104–1125.
- Kasman, A., Duman, Y.S., 2015. Co2 emissions, economic growth, energy consumption, trade and urbanization in new EU member and candidate countries: a panel data analysis. *Econ. Model.* 44, 97–103.
- Khan, S., Peng, Z., Li, Y., 2019. Energy consumption, environmental degradation, economic growth and financial development in globe: Dynamic simultaneous equations panel analysis. *Energy Reports* 5, 1089–1102.
- Lee, C.C., Chang, C.P., 2005. Structural breaks, energy consumption, and economic growth revisited: Evidence from Taiwan. *Energy Econ.* 27, 857–872.
- Lee, C., Chang, C., 2007. The impact of energy consumption on economic growth: Evidence from linear and nonlinear models in Taiwan. *Energy* 32, 2282–2294.
- Malefane, M.R., 2018. Impact of Trade Openness On Economic Growth: Empirical Evidence From South Africa.
- Mallik, H., 2007. Does Energy Consumption Fuel Economic Growth in India. Co-integration and Causality Analysis Center For development Studies MPRA Paper No. 28.
- Manning, W.G., 1998. The logged dependent variable, heteroscedasticity, and the retransformation problem. *J. Health Econ.* 17 (3), 283–295.
- Marques, L.M., Fuinhas, J.A., Marques, A.C., 2017. On the dynamics of energy-growth nexus: Evidence from a world divided into four regions. *Int. J. Energy Econ. Policy* 7 (3), 208–215.
- Marwah, K., Tavakoli, A., 2004. The effects of foreign capital and imports on economic growth. *J. Asian Econ.* 15, 399–413.
- Masih, A.M.M., Masih, R., 1998. A multivariate co-integrated modeling approach in testing temporal causality between energy consumption, real income and prices with an application to two asian LDCs. *Appl. Econ.* 30, 1287–1298.

- Muhammad, B., 2019. Energy consumption, co2 emissions and economic growth in developed, emerging and middle east and north africa countries. *Energy* 179, 232–245.
- Narayan, P.K., Smyth, R., 2008. Energy consumption and real GDP in g7 countries: New evidence from panel co-integration with structural breaks. *Energy Econ.* 30, 2331–2341.
- Nasreen, S., Anwar, S., Ozturk, I., 2017. Financial stability, energy consumption and environmental quality: Evidence from South Asian economies. *Renew. Sustain. Energy Rev.* 67, 1105–1122.
- Noor, S., Siddiqi, M.W., 2010. Energy consumption and economic growth in south asian countries: A co-integrated panel analysis. *Int. J. Hum. Soc. Sci.* 5 (14).
- Olumuyiwa, O.S., 2012. Long run relationship between energy consumption and economic growth: Evidence from Nigeria. *IOSR J. Humanities Soc. Sci.* 3, 40–51.
- Rafindadi, A.A., Ozturk, I., 2017. Dynamic effects of financial development, trade openness and economic growth on energy consumption: Evidence from South Africa. *Int. J. Energy Econ. Policy* 7 (3), 74–85.
- Sackey, F.G., Compah-Keye, G., Nsoah, J., 2012. Foreign direct investment and economic growth in Ghana. *J. Econ. Sustain. Dev.* 3, 120–133.
- Saidi, K., Hammami, S., 2015. The impact of CO₂ emissions and economic growth on energy consumption in 58 countries. *Energy Rep.* 1, 62–70.
- Salahuddin, M., Alam, K., Ozturk, I., Sohag, K., 2018. The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO₂ emissions in Kuwait. *Renew. Sustain. Energy Rev.* 81, 2002–2010.
- Salahuddin, M., Gow, J., 2014. Economic growth, energy consumption and CO₂ emissions in Gulf Cooperation Council countries. *Energy* 73, 44–58.
- Say, N.P., Yucel, M., 2006. Energy consumption and CO₂ emissions in Turkey: Empirical analysis and future projection based on economic growth. *Energy Policy* 34, 3870–3876.
- Sbia, R., Shahbaz, M., Hamdi, H., 2014. A contribution of foreign direct investment, clean energy, trade openness, Carbon emissions and economic growth to energy demand in UAE. *Econ. Model.* 36, 191–197.
- Shahbaz, M., Hye, Q.M.A., Tiwari, A.K., Leitão, N.C., 2013. Economic growth, energy consumption, financial development, international trade and CO₂ emissions in Indonesia. *Renew. Sustain. Energy Rev.* 25, 109–121.
- Shahbaz, M., Lean, H.H., 2012. Does financial development increase energy consumption? the role of industrialization and urbanization in Tunisia. *Energy Policy* 40, 473–479.
- Shahbaz, M., Tang, C.F., Shabbir, M.S., 2011. Electricity consumption and economic growth nexus in Portugal using cointegration and causality approaches. *Energy Policy* 39, 3529–3536.
- Shahbaz, M., Zeshan, M., Afza, T., 2012. Is energy consumption effective to spur economic growth in Pakistan? new evidence from bounds test to level relationships and granger causality tests. *Econ. Model.* 29 (6), 2310–2319.
- Shujaat, A., 2011. Foreign direct investment and economic growth in Pakistan: Sectoral analysis PIDE Working Paper 67.
- Squalli, J., 2007. Electricity consumption and economic growth: Bounds and causality analyses of OPEC countries. *Energy Econ.* 29, 1192–1205.
- Vu, T.B., Gangnes, B., Noy, I., 2006. Is foreign direct investment good for growth?. In: *Answers using Sectoral Data from China and Vietnam*.
- Yingzi, N.A.N., Yuying, G.A.O., 2011. Statistical and econometric analysis of the impact of China's energy, environment on the economic development. *Energy Procedia* 5, 2358–2362.
- Yuan, C., Liu, S., Fang, Z., Xie, N., 2010. The relation between Chinese economic development and energy consumption in the different periods. *Energy Policy* 38, 5189–5198.
- Zakia, M., Ziad, A., 2007. The impact of foreign direct investment and imports on economic growth: The case of Jordan. *J. Econ. Adm. Sci.* 23, 1–31.
- Zou, G., Chau, K.W., 2006. Short- and long-run effects between oil consumption and economic growth in China. *Energy Policy* 34, 3644–3655.