The Impacts of Financial Development on Green and Non-Green Energy Consumption: Empirical Evidence From OPEC Countries

Faris Alshubiri (falshubiri@du.edu.om)
Dhofar University
Mohamed Elheddad
The University of Buckingham
Syed Jamil
Dhofar University
Nassima Djellouli
University of Saida

Research

Keywords: Financial development, Green energy consumption, Non-green energy consumption, behavior of energy economics, OPEC countries

Posted Date: August 3rd, 2020

DOI: https://doi.org/10.21203/rs.3.rs-49973/v1

The impacts of financial development on green and non-green energy consumption: Empirical evidence from OPEC countries

Abstract

This paper aims to examine the impact of financial development on green and non-green energy consumption in the Organization of the Petroleum Exporting Countries (OPEC) over the period of 1990–2015.The data was collected from the Green Growth Knowledge Platform Database and the World Development Indicators (WDI) of the World Bank for 14 OPEC countries over the period of 1990–2015.We used two different proxies for financial development: (1) domestic financial development, measured by domestic credit in the private sector as a percentage of gross domestic product(GDP), and (2)foreign financial development, measured by the foreign direct investment (FDI) stock as a share of GDP. The main model developed three hypotheses; the first two were sub-hypotheses that characterized green energy through proxies: access to improved sanitation and access to electricity. The third hypothesis was anon-green (brown) energy proxy using CO_2 emissions per capita. All three hypotheses used five control variables: by GDP per capita, urbanisation/total population ratio, oil rent/GDP ratio, investment/GDP per capita ratio and trade openness. In order to evaluate these hypotheses, we used the instrumental-variable (IV) approach with a fixed effect option to control for both endogeneity and heterogeneity, and we used the lags of the independent variables as instruments for financial development, as lagged variables are arguably exogenous. The impacts of financial development on environmental quality varied between foreign direct investments (foreign financial development) and the domestic credit ratio (domestic financial development). Our main results suggest that FDI degrades environmental quality in OPEC economies, and FDI represents a source of pollution by increasing CO_2 emissions per capita (non-renewable) by about 0.0224% and decreasing non-renewable energy consumption variables. In other words, FDI's non-renewable and renewable relationship supports the non-green growth hypothesis.

Keywords Financial development, Green energy consumption, Non-green energy consumption, behavior of energy economics, OPEC countries

JEL ClassificationB22. B26. D53. E21. F63. K32

1. Introduction

In the present era of hyper-globalization, multinational corporations (MNCs) can trade and expand their activities all over the world. The impact of the development of world trade is evident in the financial sector, which includes foreign and domestic investments (Sadorsky 2010). Moreover, foreign investments supplement domestic investments, enhancing the financial sector through the transformation of many positive external factors for investments, such as technological transformations and the introduction of new knowledge (Hasanov and Huseynov 2013).This effective financial development positively contributes to the creation of environment-friendly projects at low cost (Esso 2010). Moreover, foreign investment also contributes to bringing innovative technology to local markets where companies are working to reduce energy use (Fotourehchi2017). However, the view states that foreign direct investment could be a means of spreading clean industries, which could affect the environment, especially in emerging countries whose economiesarecharacterized by low growth (Rafindadi and Ozturk 2017). In addition, some foreign firms manipulate technology and do not sharetheir technological techniques.

Arevolution in financial development has taken place in most economic sectors, including the energy sector. The energy sector in any country is considered as one of the key drivers of the growth of its financial and economic sectors (Fang 2011). The process of production requires more energy consumption, especially at the early stage of economic growth, which, in turn, affects the level of energy consumption and the goods provided to the end customer (Lee and Chiu 2013).

Hence, financial development holds two different perspectives on energy consumption (Tugcu 2013). The first view deals with efficient growth through financial intermediation. This view supports increasing investment opportunities by providing loans to individuals and companies (Christopoulos and Tsionas 2004). In this case, the purchasing power of the consumer increases, which allows them to buy durable goods (hard items), including machinery and equipment, increasing energy consumption (Kalyoncuet al. 2013). This increase in energy consumption, in turn, produces carbon dioxide (CO2) emissions that pollute the environment in various forms (Karanfil 2009).

In contrast to the above argument, the evolution of financial institutions and capital markets provides countries with opportunities to lend money in the field of energy (Bhattacharya *et al.,* 2016). This lending formularizes the financing structure of the debt and equity of companies, which are considered as sources of financing for green energy projects (Kalyoncuet al. 2013).

Financial development focuses on how to reduce energy consumption by using substitutes for energy (Kalyoncuet al. 2013). At the same time, it measures the ability to lend money to companies in the energy sector, which increases energy use (Leitão2014). As per the two views discussed earlier, it is clear that the impact of the financial development sector on energy consumption is still ambiguous. This ambiguity requires more investigation.

This study aimed to investigate the impact of financial development (measured by domestic and foreign investment) on green and non-green energy in 14 members of the Organisation of the Petroleum Exporting Countries (OPEC) between 1990 and 2015. Utilizing the Green Growth Knowledge Platform Database (2019) and the World Development Indicators (WDI) of the World Bank Database(2018), this empirical study estimated the models using panel data techniques, which take into consideration issues of heterogeneity, endogeneity and multicollinearity. Moreover, this study has analysed the topic more broadly than previous studies, such as the one by Rafindadi and Ozturk (2017), which indicated a scenario for maximizing growth in the economy, which require large-scale energy consumption to maximize investments in the future. Therefore, the size of energy consumption should be determined by the market (Tugcu 2013). Opponents of this view hold that there is no consistent relationship between financial development and energy consumption through the economic index because the gross domestic product (GDP) measures the economic activity in society and links economic activities through different methods in different countries (Al-Mulali and Sab 2012). This economic indicator, therefore, has a low correlation in determining factors affecting energy consumption (Islam et al. 2013). In other words, infrastructure investments can have the greatest impact on energy consumption (Jebliet al.2016).

The OPEC region is an interesting case because OPEC countries are more open to economic problems related to energy and climate, so they always try to reduce the burden of production phases through the use of technology. Furthermore, OPEC countries do not only take into account the increase in the efficiency of fossil fuel production but also interfere with alternative energy supply methods. From this perspective, it is important to study the OPEC countries' vision (environmentally friendly) of renewable and green energy consumption. According to another perspective, financial growth in most countries of the world remains unstable due to dependence on fossil energy sources (oil, gas and coal) (Jebliet al. 2016). This instability comes from the high dependency of countries on imported energy sources, which are constantly changing in price on the global market (Karanfil 2009). This constitutes a negative shock to countries, such as the OPEC countries, in the field of exporting, which depends heavily on the revenue of these countries (Tugcuet al.2012).

This study contributes to the existing empirical literature in two aspects. First, to the best of our knowledge, this paper is among the pioneering studies that test the impact of financial development on green and non-green energy consumption using two different proxies of financial development: foreign and domestic indicators. Second, this empirical work is the first that considers the oil-rich region: OPEC economies, because these countries relay mainly on and use non-renewable energy (oil and petrochemicals). Therefore, this study sheds a light on the importance of using environmentally-friendly equipment to extract oil and befitting from the other clean production factors. The paper highlights that sustainability requires a comprehensive approach linking environmental protection with economic, financial and social growth. Therefore, the environment and green growth alone should not distract attention from other major global challenges.

The main findings of the current study are that the impacts of financial development on environmental quality vary between foreign direct investments (foreign financial development) and the domestic credit ratio (domestic financial development). Our main results suggest that foreign direct investment (FDI) degrades environmental quality in OPEC economies, and FDI represents a source of pollution by increasing CO_2 emissions per capita (non-renewable) by about 0.002% and decreasing non-renewable energy consumption variables. In other words, FDI's non-renewable and renewable relationship supports the non-green growth hypothesis. The findings of this study can contribute to understanding the most effective operations of financial institutions to achieve sustainable development. The results of the study may also reinforce the national strategies of each country and reduce the challenges facing OPEC countries in improving energy use while considering globalization. This requires attention to the field of technology, which must be carefully considered to achieve financial and economic services in a clean environment.

The policy implications of energy efficiency have increased recently due to increased economic activity and globalisation. According to the International Energy Agency (IEA, 2009), energy demands are showing a predicted growth rate of 1.8% between 2005 and 2030. This development in the power sector was forced by globalisation in the OPEC energy markets, with technology developing efficiently and effectively in the private sector and complicating competition (Shahbazet al. 2010). The privatization of capital investments in emerging countries has been strong in the energy sector to varying degrees, resulting in considerable competition in these private sectors (Tugcu 2013). The privatization of capital investments depends on income, as Alvarado *et al.* (2019) explained; in low-income countries, there is a causal relationship between renewable energy and real production. The study recommended that high-income countries look for alternative sources of energy to achieve sustainable growth. All countries should encourage the use of clean energy, which contributes to economic growth. Dong et al. (2019) focused on the sustainability of the social and economic sectors with a view to the importance of the energy sector. The results of the study did not find any evidence of a non-linear relationship between them, but there is still a need to find sufficient and reliable energy inputs to maintain sustainable economic development. Dergiadeset al. (2013) pointed to new ways of realising energy efficiency in the environment by creating energy protection policies. These results are of value, as revealed by the unidirectional linear relationship with the nonlinear causal links that extended from beneficial energy use to economic growth.

This study is structured as follows: after this introduction, section 2 critically reviews previous studies on the financial development-energy relationship. Section 3 presents the data and methodology of this study, while the empirical results, including diagnostic tests and a discussion of the results, are reported in section 4. Finally, section 5 provides conclusions and policy implications.

2. Literature Review

The impact of financial development on energy demand can have several effects: a direct effect, a business effect and a wealth effect. For the direct effect, the development of the financial system eases the ability of consumers to borrow money to buy big-ticket items, such as automobiles, houses, refrigerators, air conditioners and washing machines. These kinds of goods typically require higher energy consumption, which can influence a country's overall demand for energy (Furuoka 2015; Sadorsky 2011; Mahaliket al. 2017).

Moreover, financial development can affect energy through the business effect. Having a well-managed financial market in an economy helps provide capital for firms at low cost, which leads to the expansion of existing businesses or the establishment of new plants. Furthermore, this process leads to a higher demand for energy (Sadorsky 2011; Dumrul 2018). Meanwhile, positive stock price growth affects customers and the business sector through increasing wealth, which is considered to be the main objective of organizations (Odusanyaet al. 2016). Based on these analytical channels, financial development positively affects energy use.

Technology plays a prominent role in influencing energy consumption, leading to the first step of financial development (Shahbaz et al. 2017). The financing of renewable energy projects is effectively influenced by the efficient regulation of financial management and financial markets that offer financing capital for green renewable energy. The industrial companies also seek to obtain loans at low costs to create a friendly environment for financial development (Shahbaz et al.2017; Dumrul 2018).

In addition, DI can be integrated with harmony with local companies in creating advanced technology for the labour market, which, in turn, has a negative impact on energy consumption (Chang 2015; Shahbaz et al. 2017). In other words, modern financial management seeks to develop its operations to reduce energy consumption and reduce cost through effective stimulation of the use of advanced technologies and low energy use (Shahbaz et al. 2017). This argument was proved by Mielnik (2002), who found a negative correlation between foreign investments in the energy sector and the energy density of companies. This finding was confirmed by diagnosing financial development in companies and stimulating the efficient use of energy (Islam et al. 2013).

Financial development may play an important impact in reducing energy consumption by deploying renewable energy. The staged financing from financial institutions encourages high-tech business. As financial institutions can reliably commit to offering additional financial support for the development of projects, financial institutions are working hard to provide the additional financial support required to build these projects. It is also possible, at a critical stage of financial development, to convert part of the financing source into innovative projects; thus, the financing works efficiently in these projects (Stulz 2000).

Furthermore, the development of financial credit markets is a smooth way to activate renewable energy projects. For example, Kim and Park (2016) explained that the degree of development of financial markets in the promotion of renewable energy consumption was examined globally. By analysing their results, they found that the renewable energy sector, which depends on external financing, is important in the revitalization and development of the financial sector. Ji and Zhang (2019) arrived at the same conclusion for the Chinese economy.

Additionally, FDI (foreign financial development) can be a source of innovation that encourages energy efficiency. Dyotch and Narrayan (2016), for a panel of 74 countries between 1985 and 2012, explain that foreign investments have been identified and reflected significantly on economic performance by improving financial services in reducing energy consumption from non-renewable sources of energy. Moreover, the role of foreign investments was activated through manufacturing processes that contributed effectively to the consumption of renewable energy.

Although there is no sequential direction for this relationship, as Karanfil (2009) indicates, the financial development index affects energy consumption because it depends on energy demand. It is clear that previous studies did not address OPEC countries as a sample population under the field of green energy. To address this research gap there is a need to examine green renewable energy in OPEC countries. The difference between the current study and previous international studies is that this study compares two proxies: domestic and foreign investment and green and non-green energy consumption. Therefore, this study examines the effect of domestic and foreign financial development on the green and non-green energy consumption through a comparative study of the selected 14 OPEC members applied IV estimators for the 14 OPEC countries. Specifically, the present study covers the research gap through three main hypotheses: (1) domestic-foreign financial development and green energy consumption, measured by improved sanitation; (2) domestic-foreign financial development and green energy, measured by access to electricity; and (3) domestic-foreign financial development and non-green energy, measured by CO_2 emissions per capita.

3. Data and Methodology

This study examines the impact of financial devlopment on green and non-green energy indicator across a panel of 14 oil-dependent economies in OPEC: Algeria, Angola, Ecuador, Equatorial Guinea, Gabon, Iran, Iraq, Libya, Nigeria, Qatar, the Republic of the Congo, Saudi Arabia, United Arab Emirates and Venezuela (Kuwait is the only excluded country). The data was collected from the Green Growth Knowledge Platform(GGKP) Database (2019) and the WDI of the World Bank database(2018) from 1990 to 2015. One of the justifications for choosing the study period between 1990-2015 is that OPEC countries that the collapse in oil prices were divided into four phases during the study period 1990-2015, which are 1980-1981, the period 1990-1991, the period 2008-2009 and finally in 2014. It was noted that from the first and last phase period are common in the economic reason's conditions, including the increase in US oil production, shifts in OPEC strategies and goals, a decrease in geopolitical risks and a noticeable increase in the dollar.After each period of decline and stagnation led to an economic and financial recovery, as the increase in oil prices after 1992, 2009 and 2015 led to the extraction of oil in unconventional methods and easier financing terms, which led to a recovery in aggregate demand and a gradual rise in oil prices. OPEC is trying to adapt to the changes, despite the lack of legal force to allow it to interfere in the market conditions.

OPEC countries characterized by a strong recovery in the oil market during the 1990s, and the market became more integrated and was marked by a revolution of communications and entering globalization. Interest in climate change began in this period, and countries became greatly interested in them because of their economic and financial impacts on financial development.

With the entry in 2000, oil prices were characterized by stability in OPEC countries as a result of innovation and a new mechanism that contributes to relative stability until the first five years until 2005, unless speculation and the market stayed in another direction, unless the prices rose in the crude oil markets and was used at this stage as part of the assets and extended that rise Until 2008, and then saw a significant decrease due to the global financial crisis and economic recession. Since 2008, OPEC countries have focused on sustainable development and the green environment as basic directions that they seek to achieve. However, the trend has increased for member states to adopt the same strategy. With the entry into the year 2010, the risk increased in the oil market and instability in the financial system has an impact on the economies of countries, including social instability, which affected the demand for oil and until 2015, but OPEC countries tried to keep the market balanced and then continued to drive growth and transformation from 2014 Demand growth has increased, interest has appeared in environmental problems, and we are always looking for more cooperation between consumers and producers outside OPEC.

The financial development also appears by increasing the strength of the local currency of oil in countries that are not pegged to the dollar, and thus demand decreases in those countries and increases the supply of producers, which limits all cost disruptions to the local currency. Also, OPEC has attempted to change its policy from trying to raise its prices to price differences to target relative stability in the market share. Thus, OPEC countries witnessed, away from the four decline periods, an increase and growth in financial liquidity, which contributed to the development of countries and the infrastructure. The financial recovery also appeared through the attempt of OPEC countries during the recovery periods to motivate non-traditional suppliers to reduce their production. In statistical numbers, the GGKP (2019) and WDI (2018) reports shows that the oil production increases to reach 74 million barrels/day in 2014 as 0.8 %; non-conventional oil production increased by 4%, World oil demand increased by 1.2% concentrated on middle east and china as well as exports of products petroleum countries increased 1.5% over 2013.

Consistent with recent literature, we used two different proxies for financial development. The proxy for domestic financial development was measured by domestic credit in the private sector as a percentage of GDP (Sadorsky 2010; Sadorsky2011), this variable has been used to represent financial development. This variable reflects financial intermediaries and their acheivemnets in developing private markets. This variable was collected from the World Bank WDI dataset(2018).

The second proxy, for foreign financial development, measured by the FDI stock as a share of GDP (Sadorsky 2010; Sadorsky 2011).FDI reflects part of the capital and retained earnings held by a company on the side of its holdings in addition to the liabilities of the parent company. We normalized these stocks to GDP (FDI stock inflow/GDP).

We categorised the main dependent variables into two groups, using green energy as a proxy for green economic growth and brown energy for non-green growth. We used CO_2 emissions per capita as a measure of non-green energy use; this variable is usually used as an indicator for the pollution level in an economy. CO_2 emissions are generated from the use and burning of fossil fuels and cement. This variable was extracted from the GGKP (2109). For the green growth indicators, we utilised two proxies: access to improved sanitation and access to electricity.

Green Growth Knowledge Platform Reports (2019) divide the environment quality of life indicators to access to electricity, improved sanitation; population exposure to air pollution and access to improve water. In this study we used two proxies: access to electricity, access to improved sanitation; as a green indicator to improve the quality of life and depend on social economic factor and analysis the social human well-being to decrease the inequality in the future to have resources with less environmental risk. The selection of these variables is consistent with previous studied such as Mihelcic et al. (2017) ;Weststrate, et al. (2019) ; UNCTAD secretariat. (1999) Mensah J. (2019). The other variables GGKP (2019) refer to environmental and resource productivity indicators as CO_2 emissions per capita and carbon productivity. The study used CO_2 emissions per capita proxy as non-green growth or brown energy; this variable used in Shafiei and Salim (2014); Long et al. (2015); Khan et al. (2020); Awodumia and. Adewuyib (2020) which pointed that non-renewable energy increase CO_2 emissions and as recommendations *show to reduce* use of non-renewable energy and the climate changes. Furthermore, the main contributors show that the level of pollution increase in non-renewable energy which lead to increase CO_2 *emissions. This enhanced to negative* economic growth compare with renewable energy.

The definitions of these variables are reported in Appendix 1, and the data was collected from the GGKP Dataset (2019). Five control variables were used following recent studies on financial development determinants: urbanisation, oil rents, economic growth, investment and trade.

Appendix 2 provides descriptive statistics for all variables under study over the sample period. As shown in Appendix 2.B, FDI negatively correlated with CO_2 emissions and improved sanitation and positively correlated with renewable consumption. Furthermore, FDI also positively correlated with oil rents, investment and trade, and the highest correlation coefficient was found with trade. This result implies that the FDI flowing in these countries was vertical and mostly in the oil sector. In contrast, the findings of the correlation show that credit positively correlated with CO_2 emissions and improved sanitation but not with renewable consumption. Besides, the correlation results indicate that credit had a positive correlation with urbanisation and economic growth and a negative correlation with oil rents and trade, which means that domestic credit, was negatively correlated with two important determinants of FDI in the selected countries. Moreover, the results of the correlation indicate that FDI and credit had a negative association.

Due to the inability of ordinary least squares (OLS) to control for the effect of issues of heterogeneity, reverse causality and omitted variables (endogeneity). For robustness, we used the IV approach to estimate our model with a fixed effect option to control for both endogeneity and heterogeneity, and we used the lags of the independent variables as instruments for financial development, as lagged variables are arguably exogenous.

This study proposes the following model:

$$\mathrm{Gr}'_{i,t} = \beta_0 + \beta_{i,j}\mathrm{FD}'_{i,t} + \beta_{i,j}\mathrm{X}'_{i,t} + \upsilon_i + \varepsilon_{i,t}$$

Where $\mathrm{Gr}'_{i,t}$indicates our dependent variables, namely, green growth measured by access to improved sanitation and access to renewable electricity, and non-green growth measured by CO_2 emissions per capita.$\mathrm{FD}'_{i,t}$ refers to financial development variables measured by domestic credit as a share of GDP and the Foreign direct investment stock(FDI)/GDP ratio, and$\mathrm{X}'_{i,t}$is a vector of our control variables, including by GDP per capita, urbanisation/total population ratio, oil rent/GDP ratio, investment/GDP per capita ratio and trade openness.$\upsilon_i$represents country-specific effects, and $\varepsilon_{i,t}$ is the error term. This study applied the Im-Pesaran-Shin (IPS) panel unit-root test for all variables to avoid spurious regression. Im *et al.* (2003), assume all panels have the *same* autoregressive parameter, which allows relaxing the assumption The IPS test, allowing for heterogeneous panels with serially uncorrelated errors, assumes that the number of periods, T, is fixed, so IPS does not require balanced datasets. The null hypothesis of IPS is that all panels contain a unit root.

Table 1 show that the results of the IPS unit-root tests, which present P-values, were more than conventional significance levels at the first difference. Hence, this result indicates thatall variables were stationary at the first difference. In other words, this means that all variables were integrated of order one I (1). Therefore, these variables had a long-run relationship.

Table 1: IPS unit root test.

Variable	level	1st difference
CO2E	-0.640	-11.62***
FDI	3.84	-4.48***
URB	2.452	-6.96***
OILR	-1.54	-9.86***
PGDP	2.736	-4.83***
INVS	1.15	-7.23***

TRD	-0.55	-8.464***
CREDIT	0.622	-4.8686***
AISANIT	-0.425	-11.20***
ATE	0.913	-6.940***

Source:STATA. Version 15 output, Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

4. Empirical Results and Discussion

In Table2, we present the results of the IV for domestic financial development (credit/GDP ratio) and foreign financial development (FDI) /GDP) ratio, along with the five control variables: urbanisation/total population ratio (URB), oil rent/GDP ratio (OILR), GDP per capita (PGDP), investment/GDP ratio (INVS) and trade openness (TRD). From the first specification of the results, where the dependent variable of the non-green growth indicators was CO_2 emissions per capita, the effect of FDI appeared positive and statistically significant at 1%. A 1% increase in the FDI ratio was linked to a CO_2 emission increase of 0.022 units according to the first model (2.1). Regarding the control variables, the effects appeared to have statistical significance at 1%, except for the investment/GDP ratio, which was significant at 5%. Our findings suggest positive effects of economic growth, oil rent and investment on per capita CO_2 emissions, but negative effects for both urbanization and trade openness.

Table 2: Financial Development and Non-Green Growth Indicator (CO_2 emissions (CO_2 E))

	(IV-FE) (2.1)	(IV-FE) (2.2)
VARIABLES	CO2	CO2
FDI	0.0224***	
	(0.00773)	
URB	-0.139***	-0.138***
	(0.0313)	(0.0318)
OILR	0.0273***	0.00735
	(0.00921)	(0.0110)
LogPGDP	1.272***	1.142***
	(0.165)	(0.165)
INVS	0.0248**	0.0174
	(0.0111)	(0.0113)
TRD	-0.0243***	-0.0164***
	(0.00548)	(0.00521)
CREDIT		-0.0144***
		(0.00467)
Cragg- Donald Wald F-stat	151.837	207.365
Sargan test	5.886	5.419
	(0.1186)	(0.1436)
Observations	250	256
R-squared	0.466	0.449
Number of id	13	13

Source: STATA. Version 15 output, Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

From the second model 2.2, where we estimated the impact of domestic financial development on CO_2 emissions, we concluded that credit had a negative and statistically significant impact (at a 1% level) on CO_2 emissions. An 1% increase in the credit ratio led to an increase of 0.0144 units in CO_2 emissions. In terms of the impact of the other variables on CO2 emissions, we found consistent results with 2.1, except for oil rent and investment/GDP ratio, which looked to be statistically insignificant.

In summary, a 1% increase in economic growth led to an increase in per capita CO_2 emissions by 1.142 units to 1.272 units. A 1% increases in the oil rent ratio led to an increase in CO_2 emissions by 0.00735 units to 0.0273 units, while a 1% increase in the investment ratio led to an increase in CO_2 emissions by 0.0174 units to 0.0248 units. Meanwhile, a 1% increase in the urbanisation ratio led to a decrease in CO_2 emissions by 0.138 units to 0.139 units, and a 1% increase in the trade ratio led to a decrease in CO_2 emissions by 0.0164 units to 0.0243 units. Therefore, a policy of increasing transparency and predictability in financial development over green growth is essential in policy formulation and implementation (Chang, 2015; Jebli *et al.*, 2016). These policies also affect future increases in CO_2 emissions due to increased industrial density. We noted that the OPEC countries focused on the agreements of both oil and natural gas to try to increase the growth of green and non-green energy, taking into account the requirements of a clean environment (OPEC Report, 2019). There are oil-producing Arab countries, such as the Gulf countries, that get high returns compared to non-producing countries, but they all work within the framework of an international agreement to maintain a green-friendly environment to reflect a positive picture of economic and social development, especially with regard to the diversification of local infrastructure (Yazdi and Shakouri 2017).

Table3 shows the results of the second specification, where the green growth indicator was renewable consumption (access to electricity) and using two models. The first model estimated the impact of foreign financial development on access to electricity, and the second estimated the impact of domestic financial development on access to electricity by utilising the IV. The findings confirm the negative impact of foreign financial development on the green economy, as the effect of FDI was shown to be negative and statistically significant at a 1% level of significance, where a 1% increase in FDI ratio drove a decrease in the renewable ratio of 0.153%.

Based on the results of models 3.1, we found that economic growth had a negative and significant effect at a 10% level of significance on renewable energy; the same effect was found for the urbanization ratio but was significant at 1%. The results also revealed that the investment/GDP ratio has a statistically positive effect on renewable energy at a 5% level of significance. However, the other determinants, oil rent and trade, seemed to have insignificant impacts on access to electricity.

The results related to domestic financial development are reported in models 3.2, the findings indicate that credit had no significant effect on access to electricity. Concerning other regressors, the findings of the IV estimation (model 3.2) indicate that each of the variables had an insignificant effect on access to electricity except for urbanisation and investment/GDP ratio. In sum, a 1% increase in urbanisation and economic growth reduced access to electricity by 1% to 1.078% and by 1.440%, respectively. Further, a 1% increase in investment may increase access to electricity by 0.112% to 0.139%.

The enhancement of green growth through access to electricity has led to increased forecasting of oil demand, predicting an increase in demand of 30 million barrels per day (MB/day) by 2025 (Rafindadi and Ozturk 2017). Oil demand in Asia about 200 million barrels while by 2025, may have risen by 17 MB/day. Although growth is rising in this region, OPEC countries will remain the dominant consumers of oil (OPEC Report, 2019). For example, the United States will continue to use around five times as much energy per person as China (Fotourehchi 2017).

Most of the new demand will be met by non-OPEC countries in the short and medium-term, while OPEC will meet this demand in the long term (OPEC Report 2019). According to forecasts, OPEC production, including natural gas liquids, will reach 54 MB/day by 2025 (OPEC Report 2019). However, until then, non-OPEC countries will remain responsible for the bulk of global production (Chang 2015).OPEC countries aim to diversify their energy sources and use more environmentally friendly sources than firewood and coal to obtain electricity, which negatively affects the green environment. As part of the National Action Plan for the Adaptation to International Development Programs, OPEC countries are trying to strengthen the capacity of national authorities to plan and implement an integrated approach to energy development and environmental management (Zeren and Koc 2013).

Table 3: Financial Development and Green Growth Indicator (Access to Electricity (ATE))

	(IV-FE) (3.1)	(IV-FE) (3.2)
VARIABLES	ATE	ATE
FDI	-0.153***	
	(0.0396)	
URB	-1.078***	-1.000***
	(0.156)	(0.163)
OILR	0.0650	0.0872
	(0.0449)	(0.0550)
LogPGDP	-1.440*	-1.354
	(0.837)	(0.856)
INVS	0.112**	0.139**
	(0.0562)	(0.0589)
TRD	0.00536	-0.0400
	(0.0277)	(0.0270)
CREDIT		0.0154
		(0.0237)
Cragg- Donald Wald F-stat	133.405	195.468
Sargan test	1.405	2.607
	(0.7043)	(0.4563)
Observations	237	242
R-squared	0.452	0.348
Number of id	13	13

Source: STATA. Version 15 output, Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Table 4 reports the results of the third specification where the green growth indicator was access to improved sanitation. The table presents the results of two models: 4.1, 4.2. The findings of models 4.1 show the impact of foreign financial development on improved access to sanitation, while the findings of models 4.2 show the impact of domestic financial development on improved access sanitation.

The results of models 4.1 indicate the negative and significant effect (at a 1% level of significance) of FDI on improved access to sanitation, which means that sanitation decreased as FDI increased. Furthermore, a 1% increase in FDI decreased sanitation by 0.139%. Concerning the other regressors, each was found to be significant except for trade. Further, urbanisation, oil rent and investment/GDP ratio had positive effects, and economic growth had a negative effect.

The results of models 4.2 indicate the positive and significant effect (at a 1% level of significance) of credit on improved sanitation. A 1% increase in the credit ratio increased sanitation by 0.0732%. Regarding other variables, the results of the IV estimation showed the significance of all variables at 1%, except for trade, this seemed to be significant at 10%. Besides this, these results showed positive effects of urbanisation, oil rent and investment, and a negative effect of economic growth and trade.

In sum, a 1% increase in urbanization, oil rent and investment and economic growth increased sanitation by 0.999% to 1.226%, by 0.124% to 0.272% , by 0.168% to 0.254%, and by 3,087% to 4,086% respectively. Further, a 1% increase in trade reduced sanitation by 0.0633%.

As per the previous results the OPEC Fund aims to improve living standards and infrastructure. It has also been asserted by OPEC governments that access to modern energy is essential for clean water and sanitation. In 2015, nearly 4.5 billion people did not have access to safe sanitation and about 2.1 billion lacked access to safely managed supplies (OPEC Report 2019).

Table 4: Financial Development and Green Growth Indicator (Access to Improved Sanitation (AISANIT)

	(IV-FE)	(IV-FE)
	(4.1)	(4.2)
VARIABLES	SANIT	SANIT
FDI	-0.139***	
	(0.0351)	
URB	1.226***	0.999***
	(0.230)	(0.232)
OILR	0.124**	0.272***
	(0.0627)	(0.0728)
LogPGDP	-4.086***	-3.089***
	(1.174)	(1.175)
INVS	0.168**	0.254***
	(0.0773)	(0.0780)
TRD	0.000943	-0.0633*
	(0.0374)	(0.0366)
CREDIT		0.0732**
		(0.0323)
	109.262	332.036
	3.579	6.162
	(0.3107)	(0.1040)
Cragg- Donald Wald F-stat	109.262	332.036
Sargan test	3.579	6.162
	(0.310)	(0.1040)
Observations	261	268
R-squared	0.273	0.261
Number of id	13	13

Source: STATA. Version 15 output, Standard errors in parentheses*** $p<0.01$, ** $p<0.05$, * $p<0.1$

4.1 Diagnostic tests

To check whether our results were consistent and unbiased, we used a range of diagnostic tests, focusing on Sargan and Cragg-Donald tests. Our results failed to reject the null hypothesis for all models. This confirmed that the instruments were exogenous and not over-identified. Additionally, by performing the Cragg-Donald test, which examines whether given instruments are weak or not. The Wald statistics showed that the instruments were not weak since all the statistics were greater than the Stock-Yogo critical values.

This study checks the slope heterogeneity and dependency among cross-sections. This study uses Cross-Section Dependency (CSD) tests popularized by Pesaran (2004). Determining the slope heterogeneity and cross-sectional dependency. We applied the Pesaran (2004) CD test for all our estimated models and the results are reported in table.5. As table 5 shows that the null hypothesis, namely; no cross-sectional dependence (De Hoyos and Sarafidis 2006) strongly accepted as the probability values are more than 5%. Therefore, we concluded that there is no cross-sectional dependence in our estimations.

Table5. The Pesaran (2004) Cross-sectional test

Modle	Pesarans test of cross sectional independence (Sig. Value)	Decision
Model 1. Dependent variable: CO_2 emissions per capita		
Independent variable: FDI	1.141 (0.0923)	No cross-sectional dependence
Independent variable: Credit	0.827 (0.236)	No cross-sectional dependence
Model 2. Dependent variable: Access to Electricity		
Independent variable: FDI	-0.165 (0.8686)	No cross-sectional dependence
Independent variable: Credit	0.992 (0.3210)	No cross-sectional dependence
Model 3. Dependent variable: Access to Improved Sanitation		
Independent variable: FDI	-1.354 (0.1758)	No cross-sectional dependence
Independent variable: Credit	-0.020 (0.9840)	No cross-sectional dependence

*Pesaran (2004) Null hypothesis: no cross-sectional dependence.

4.2 Discussion of results

To recap, this paper examines the impact of financial development, measured by both domestic and foreign proxies on green and non-green growth indicators for 14 OPEC countries, using panel data from 1990 to 2015. IV has been applied to account for heterogeneity and endogeneity issues.

The impacts of financial development on environmental quality varied between FDI (foreign financial development) and the domestic credit ratio (domestic financial development). Our main results suggest that FDI degrades the environmental quality in OPEC economies and that FDI is a source of pollution, increasing CO_2 emissions per capita (non-renewable) by about 0.0224% and decreasing non-renewable energy consumption variables. In other words, FDI's non-renewable and renewable relationship supports the non-green growth hypothesis. These findings are in line with several previous empirical studies, such as Acharyya (2009); Lan et al. (2012); Lee (2013); Shahbazet al. (2015); Keho (2015) and Koçak and Şarkgüneşi (2018).

Our results in table 2 explain the financial development, showing that FDI was positive while domestic credit was negative on CO_2 emissions, and under these results, the five control variables were positive except urbanization and trade openness, which were negative. Tables 3 and 4 show that FDI was negative while domestic credit was positive, even with access to improved sanitation or access to electricity, and under these results, the five control variables were positive except urbanization, economic growth and trade openness for table 4. The same is true for table 3, except trade openness was positive.

These results can be explained by the benefits and costs that can be transferred to the host countries. These results depend on the type of foreign investment, the size of the investment, the time to execute the investment, the infrastructure and location of the investment and the intensity of local companies in the same sector, as well as human capital, the trading system and the degree of economic openness, economic conditions, research and development, communications trade legislation and political stability (Mencinger 2003). Foreign investment is transferred to host countries depending on the agreements concluded between the countries. In general, the benefits and costs vary between the countries. Hence, the positive or negative impact of FDI or domestic credit related to other control variables on the host countries begins based on many factors. For example, if the technological gap is so strong that local investments cannot replicate this technology in the domestic economy and benefit from the new knowledge, this will be reflected in negative FDI in the host countries because these countries are unable to significantly absorb the modern techniques and methods of the MNCs (Chowdhury and Mavrotas 2003). Hence, a poor understanding of technology is a result of poor skills in host countries; therefore, developed countries benefit from foreign investment more than emerging countries because their human capital has higher capacity and skills to benefit from new knowledge (Makki and Somwaru 2004; Khawar 2005). However, developing individual skills depends on the individual's level of education, which affects their ability to absorb new knowledge (Li and Liu, 2005). Moreover, the high income of MNCs compared to local companies has negative effects on local companies because they cannot compete with foreign investments and thus disappear from the market (Hanson 2001; Zhang 2001).

Infrastructure and the location of the investment also determine the level of transfer of new knowledge to host countries. Lack of employment qualifications and mobility among MNCscreatesa significant gap in technology absorption in host countries. Other factors, such as the lack of research and development (R&D) in host countries and weak communication between domestic and foreign companies, contribute significantly to creating a gap that makes it difficult for them to benefit from foreign investment (Aitken and Harrison 1999). Foreign investment is sometimes reflected negatively on host countries by influencing the balance of payments due to the migration of foreign funds to the origin countries (Sen 1998).

The entry of FDI into the host countries urges domestic investments to moderate prices, but this may hurt them through their inability to compete and reduce prices due to the high cost of raw materials involved in the production (Pessoa, 2007). As a result, host countries seek to increase R&D to enhance their competition with MNCs. This creates another challenge that host countries can fail to achieve the healthy competition, making a foreign investment a detriment that negatively affects domestic investment. As another factor, laws may lead to the inability of foreign companies to compete with local companies, which reduces competition, keeps local companies dominant and inhibits the creation of healthy competition. This will be reflected positively in domestic investments.

Attracting foreign companies and investments has a cost to government authorities, weakening government support for local companies, which is reflected negatively in their performance (Vissak and Roolaht 2005). Also, foreign companies are working to provide credit to local institutions at reasonable prices, which these prices negatively affects the local financial institutions by decease the credit size; thus, foreign investment has a negative impact on host countries (Sylwester 2005). One of the positive effects of the entry of MNCs is the abolition of the monopoly of local companies in the provision of goods and services, which changes the structure of the national economy (Carkovic and Levine 2002).

Foreign companies may also include another challenge of host countries as structural changes to achieve efficiency, forcing local companies to follow suit, which incurs large costs and leads to adopting the privatization policy. This policy negatively affects local companies because they cannot meet the quality of the supply, as suppliers from host countries are not attractive to foreign companies(Hansen and Rand, 2006). Hence, governments abandon local companies; this reflects negative sign by decreasing local investments (Blomström and Kokko 1998).

It can sometimes be difficult to implement foreign investment policies in host countries, creating economic instability, as well as a sudden influx of capital, leading to increased inflation in cash flow (Hansen and Rand 2006).

It is also possible to create foreign control over local companies in terms of assets and job opportunities, which is negatively reflected in the stability of domestic investments and may conflict with local laws. It is often suggested to encourage exports in the host country rather than import substitution policy as an explanation for the success or failure of foreign investment (Vissak and Roolaht 2005).

It is well known that OPEC economies are oil-dependent, with around 43% of the world's total crude oil. OPEC also possesses 48% of the world’s natural gas reserves**.** Moreover, these countries are developing economies, which means that they lack technologies, especially in the oil extraction process. Foreign firms in oil-developing countries (Elheddad 2018), therefore, do most of the oil extraction, and the majority of FDI inflows focus on the resource sector (Poelhekke and van der Ploeg 2013) and are classified as flowing to non-green sectors.

Further, our empirical findings provide an indirect indicator of the pollution haven hypothesis (PHH) (Poelhekke and van der Ploeg 2015), which famously suggests that developed countries’ overseas investments bring polluting industries to developing countries because the environmental laws in developing countries are weak, leading to developing countries becoming polluters. It also considered in the PHH theory that FDI is the main reason for increased pollution problems in host countries (Hanna 2010; Keller and Levinson 2002).

Conversely, domestic financial development promotes environmental quality; domestic credit to banks leads to lower levels of CO_2 and more renewable energy consumption in the OPEC area. Based on our IV results, domestic financial development improved the environment by reducing CO_2 by 0.014% and led to between a 0.02% and 0.05% increase in renewable energy consumption. In other words, it supported green (clean) growth. These results are consistent with Tamazian and Rao (2010), Yuxianget al. (2011), Karanfil (2009) and Ritiet al. *(*2017). Several possible explanationsliebehind this relationship. For instance, Yuxianget al. (2011) and Tamazian and Rao (2010) focused on the fact that a sophisticated and robust financial system leads to the adoption of advanced technology with low carbon intensity. Moreover, the index of financial development contributes to reducing energy consumption by increasing energy efficiency and reducing the cost of borrowing (Karanfil 2009; Ritiet al. 2017). It is now clear that the regulatory policy of the financial sector paves the way for sustainable development (Rafindadi and Ozturk 2017). It is widely accepted that factors other than the fundamentals of the oil market played a disproportionately large role in achieving the movement of extreme oil prices in 2008(Chang 2015). Commodities were used as asset classes, and speculative movements drove prices (Fotourehchi 2017).

5. Conclusion and Policy Implications

This study is an empirical study, which contributes to improving knowledge about the impact of green and non-green growth on foreign and domestic financial development. It can enhance our understanding of the theory of the pollution haven hypothesis (PHH), which suggests that foreign investment increases pollution in the host country, affecting the macroeconomic. In addition to the methodological approach, this study has other practical implications through its ability to classify energy into two parts to diagnose sophisticated environmental complications and their impact on domestic and foreign investments.

Financial development contributes to the revitalization of all economic sectors, including the energy sector. The impact of the energy sector comes from production and economic growth.

The main motivation for the implementation of this study was to provide a broader analysis of the role of the financial sector in improving the growth of green and non-green energy in the OPEC countries than has been done in previous studies. To diagnose this effect, we collected data from the Green Growth Knowledge Platform Database and the WDI of the World Bank database for14 OPEC economies from 1990 to 2015. We applied IV estimations under five control variables to make our results robust. We used three hypotheses: (1) financial development on green energy growth, measured by access to improved sanitation; (2) financial development on green energy growth, measured by access to electricity; and (3) financial development on non-green energy growth, measured by CO_2 emissions per capita. Furthermore, these hypotheses were applied twice, first using domestic financial development measured by the private sector as a percentage of GDP and the using foreign financial development, measured by the FDI stock as a share of GDP.

The results for the first hypothesis, domestic-FDI and non-green growth measured by CO_2 emissions per capita, show that FDI appeared positive and statistically significant at a 1% level. Regarding the control variables, these appeared to be significant at 1%, except for investment, which seemed to be significant at 5%. Our findings suggest positive effects for economic growth, oil rent and investment on per capita CO_2 emissions, but negative effects for both urbanization and trade. Meanwhile, another financial development indicator explained the domestic financial development on CO_2. Those results show that credit had a negative and statistically significant effect at a 1% level. In terms of the impact of the other variables on pollution, we found consistent results with models 2.1, except for oil rent and investment, which appeared to be statistically insignificant in the IV estimation.

For the second hypothesis, domestic-FDI and green growth measured by access to electricity, we found that economic growth had a negative and significant effect at a 10% level of significance on renewable energy. The same effect was found for the urbanization ratio, but this was significant at 1%. The results also revealed that investment had a statistically positive effect on renewable energy at a 5% level of significance, However, the other determinants represented in oil rent and trade openness to have insignificant impacts on renewable energy.

The results related to domestic financial development indicate that credit had no significant effect on renewable energy. Concerning the other regressors, the findings of the IV estimation indicate that the variables had insignificant effects on renewable energy, except for urbanization and investment, in which urbanisation had negative effects on renewable energy, while investment had a positive effect.

For the third hypothesis, domestic-FDI and green growth measured by improved sanitation, the findings indicate a negative and significant effect, at a 1% level of significance, of FDI on sanitation. Concerning the other regressors, all were found to be significant except for trade. Further, urbanisation, oil rent and investment had positive effects, and economic growth had a negative effect. The effect of urbanisation and economic growth was significant at a 1% level, and the effects of oil rent and investment were significant at a 5% level.

Other results indicate the positive and significant effect, at a 1% level of significance, of domestic credit on improved sanitation. Regarding the other variables, the results of the IV estimation showed the significance of all variables at a 1% level except trade, which seemed to be significant at 10%. Besides this, these results showed the positive effects of urbanisation, oil rent and investment, and the negative effects of economic growth and trade.

The correlation matrix shows that the FDI flows in these countries are vertical and are mostly in the oil sector. In contrast, the findings of the correlation show that domestic credit positively correlated with CO_2 emission and improved sanitation but not renewable consumption. Besides, domestic credit negatively correlated with FDI in selected countries. Moreover, the results of the correlation indicate that FDI and credit had a negative association.

The findings of the current study can be explained by the argument of Asif and Muneer (2007), who suggested that OPEC countries may not suffer from low oil reserves like the United States and the United Kingdom, but they may face long-term concerns due to difficulties in relying on fossil fuels when reserves fall further in the coming years. Therefore, all OPEC policies are geared towards encouraging efficient energy consumption methods, taking into account the specific characteristics of each country in terms of population size, economic and financial growth and technology levels when applying policies that reduce oil consumption. Effective policy lies in the ability of countries to adopt sustainable energy supply methods, such as renewable energy sources and promote the concept of green growth.

Due to IV estimations results, the policy implication suggests that the source of the green energy is an important factor in economic growth and this is required in OPEC countries. However, some delays in oil supplies and fluctuations in oil prices due to high taxes may delay the revenues of countries, which may give a negative indicator of performance. Despite empirical studies that give strong support to the hypotheses of the economic growth of energy, a policy of caution should be applied when using these results to propose concrete economic models and energy conservation policies In addition, OPEC countries trying to build a strategic policy for how to invest in human capital to take advantage of energy consumption. Meanwhile, positive or negative results do not imply conflict with energy conservation policy, but rather a mechanism for designing a model geared towards promoting economic growth through energy conservation so the high-quality services sector can stimulate economic growth in a holistic manner. In addition, determining the proper mix in the formation of energy input is an important decision in designing an effective energy policy.

Therefore, transitioning to more efficient energy in light of financial development to create a less polluted environment is certainly a viable policy for economic growth. These can all be achieved through energy consumption data within macroeconomic standards using the most advanced and reliable econometric techniques.

The early decline in fiscal stimulus packages around the world remains a major challenge. Besides, concerns about high levels of unemployment remain around the world (Mielnik and Goldemberg 2002). The utmost importance should be placed on energy for the development of humanity, who will always need energy (Islam *et al.,* 2013). Therefore, a career dedicated to the energy industry has its role, because, in the final analysis, countries provide a basic service for human needs (Sadorsky, 2010). There are exciting challenges in the coming years in a highly competitive industry operating at the end of sharp technology(Shahbazet al. 2010). Producers, for example, must balance meeting expectations for the high demand for oil on time with objectives, such as sustainable development and social, economic and environmental harmony (Yazdi and Shakouri 2017), since oil is a strong commercial source and will remain so over time (OPEC Report 2019).

The limitation of this study is the lack of post-2015 data in the World Bank database for the selected OPEC sample. In future studies, variables can be developed to include the geographical dimension to draw similar and different results based on the same geographic area.

Compliance with ethical standards

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical standard: The authors declare that this research article complies with the ethical standards of this journal.

Informed consent: This article does not contain any information that requires informed consent.

Funding: There is no funding for this manuscript.

Author's contributions: All authors have the same contribution. All authors read and approved the final manuscript

References

Aitken B, Harrison A (1999) Do domestic firms benefit from FDI? Evidence from Venezuela. American Economic Review, 89 (3): 605 – 618

Awodumia O. Adewuyib A. (2020). The role of non-renewable energy consumption in economic growth and carbon emission: Evidence from oil producing economies in Africa, Energy Strategy Reviews, 27, 100434. https://doi.org/10.1016/j.esr.2019.100434

Alvarado R, Ponce P, Alvarado R, Ponce K., Huachizaca V, Toledo E (2019) Sustainable and non-sustainable energy and output in Latin America: A cointegration and causality approach with panel data,Energy Strategy Reviews, 26, p.100369.

Acharyya J (2009) FDI, growth and the environment: Evidence from India on CO2 emission during the last two decades. Journal of Economic Development, 34 (1):43-58.

Arellano M, Bover O (1995)Another look at the instrumental variable estimation of error componentsmodels,Journal of Econometrics,68 (1):29–52.

Asif M, Muneer T (2007) Energy supply, its demand and security issues for developed and emerging economies, Renewable, 11 (7):1388-1413.

Al-Mulali U, Sab C.N.B (2012) The impact of energy consumption and CO2 emission on the economic and financial development in 19 selected countries",Renewable and Sustainable Energy Reviews, 16 (7):.4365-4369.

Bhattacharya M, Paramati S.R, Ozturk I, Bhattacharya S (2016) The effect of renewable energy consumption on economic growth: Evidence from top 38 countries,Applied Energy, 162:733-741.

Blundell R, Bond, S (1998)Initial conditions and moment restrictions in dynamic panel data models,Journal of Econometrics, 87 (1):115–143.

Baltagi B. H (2008)Forecasting with panel data,Journal of Forecasting, 27 (2):153–173.

Blomström M, Kokko A (1998) Multinational corporations and spillovers, Journal of Economic Surveys, 12 (3): 247 – 277

Christopoulos D. K, Tsionas E. G (2004) Financial development and economic growth: Evidence from panel unit root and co integration tests,Journal ofDevelopment Economics, 73(94):55–74.

Carkovic M,Levine R (2002) Does foreign direct investment accelerate growth? in: *Does Foreign Direct Investment Promote Development?*,Ed. T. Moran, E. Graham and M. Blomstrom, Washigton

Chowdhury A, Mavrotas G (2003) FDI and growth: what causes what?" WIDER conference on "Sharing global prosperity", WIDER, Helsínquia, Setembro 1 to 18

Chang S.C (2015) Effects of financial developments and income on energy consumption,International Review of Economics and Finance,35: 28-44.

Doytch N,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.

Dumrul Y (2018) Estimating the Impact of the Financial Development on Energy Consumption: A Co-integration Analysis", *International*Journal of Energy Economics and Policy, 8 (5):294-299.

Dong X.Y, Ran Q ,Hao Y(2019)On the nonlinear relationship between energy consumption and economic development in China: new evidence from panel data threshold estimations, Quality & Quantity, 53 (4):1837-1857.

Dergiades T, Martinopoulos G,Tsoulfidis L (2013) Energy consumption and economic growth: Parametric and non-parametric causality testing for the case of Greece,Energy economics, 36:686-697.

De Hoyos R.E, Sarafidis V (2006) Testing for cross-sectional dependence in panel-data models. The stata journal, 6(4):482-496.

Esso J.L (2010)The energy consumption-growth nexus on seven Sub- Sahara African countries,Economic Bulletin, 30:1191-1209.

Elheddad M.M (2018)What determines FDI inflow to MENA countries? Empirical study on Gulf countries: Sectoral level analysis. Research in International Business and Finance*,* 44 (C):332-339.

Fotourehchi Z (2017) Renewable energy consumption and economic growth: A case study for developing countries,International Journal of Energy Economics and Policy, 7 (2):61-64.

Furuoka F (2015) Financial development and energy consumption: evidence from a heterogeneous panel of Asian countries",Renewable and Sustainable Energy Reviews, 52:430-444.

Fung M (2009)Financial development and economic growth: Convergence or divergence?"Journal of International Money and Finance,28 (1):56-67

Green Growth Knowledge Platform (GGKP) Reports (2019) http://www.greengrowthknowledge.org/dataexplorer#/line?startYear=2000&endYear=2015 Retrieved 01-10-2018. World Development Indicators (WDI) 1990-2016. World Bank, retrieved on 01-10-2018 from https://data.worldbank.org/

Hasanov F, Huseynov F (2013) Bank credits and non-oil economic growth: Evidence from Azerbaijan,International Review of Economics and Finance, 27: 597–610.

Hansen H, Rand J (2006) On the casual links between FDI and growth in developing countries, World Economy, 29 (1): 21 – 41

Hanson G (2001) Should countries promote foreign direct investment?" *G-24* Discussion Paper Series*,* nº 9

Hanna R (2010)US environmental regulation and FDI: evidence from a panel of US-based multi-national firms, American Economic Journal: Applied Economics*,* 2 (3):158–89.

IEA (2009) World Energy Outlook. Paris, France: International Energy Agency.

Islam F, Shahbaz M, Ahmed A. U, Alam M. M (2013)Financial development and energy consumption nexus in Malaysia: A multivariate time series analysis,Economic Modelling, 30(C) : 435–441.

ImK, Pesaran M,Shin Y (2003)Testing for Unit Roots in Heterogeneous Panels, Journal of Econometrics, 115 (1): 53-74.

Jebli M.B, Youssef S.B, Ozturk I (2016)Testing environmental Kuznets curve hypothesis: The role of renewable and non-renewable energy consumption and trade in OECD countries, Ecological Indicators, 60, :824-831.

Ji Q,Zhang D (2019) How much does financial development contribute to renewable energy growth and upgrading of energy structure in China?,Energy Policy,128: 114-124.

Kim J,Park K (2016) Financial development and deployment of renewable energy technologies, Energy Economics, 59:238-250.

Khawar M (2005) Foreign direct investment and economic growth: a cross country analysis, Global Economy Journal, 5 (1): 1 – 11.

Kalyoncu H, Gürsoy F, Göcen H (2013)Causality relationship between GDP and energy consumption in Georgia, Azerbaijan and Armenia", International Journal of Energy Economics and Policy, 3(1):111–117.

Khan, M.K., Khan, M.I. & Rehan, M. (2020). The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan. *Financial Innov*ation, 6, 1, https://doi.org/10.1186/s40854-019-0162-0

Karanfil F (2009) How many times again will we examine the energy-income nexus using a limited range of traditional econometric tools? Energy Policy, 37(4): 1191–1194.

Karanfil F (2008) Energy consumption and economic growth revisited: Does the size of unrecorded economy matter?Energy Policy, 36(8): 3019–3025.

Keho Y (2015)Is foreign direct investment good or bad for the environment? Times series evidence from ECOWAS countries, *Economic Bulletin*, (3):1916–1927.

Keller W,Levinson A (2002) Pollution abatement costs and foreign direct investment inflows to US states,Review of Economics and Statistics, 84 (4):691–703.

Koçak E,Şarkgüneşi A (2018)The impact of foreign direct investment on CO2 emissions in Turkey: new evidence from co integration and bootstrap causality analysis, Environmental Science and Pollution Research, *25*(1):790-804.

Lan J, Kakinaka M, Huang X (2012) Foreign direct investment, human capital and environ- mental pollution in China,Energy Policy, 55: 483–489.

Long X. Naminse E. Du J. Zhuang J (2015) Non-renewable energy, renewable energy, carbon dioxide emissions and economic growth in China from 1952 to 2012, Renewable and Sustainable Energy Reviews, 52, 680-688

Li X,Liu X (2005) Foreign direct investment and economic growth: an increasingly endogenous relationship, World Development, 33 (3):393 – 407

Lee C.C, Chiu, Y. B (2013) Modeling OECD energy demand: An international panel smooth transition error-correction model,International Review of Economics and Finance, 25:372–383.

Leitão N.C (2014) Economic growth, carbon dioxide emissions, renewable energy and globalization,International Journal of Energy Economics and Policy, 4 (3):391-399.

Mielnik O, Goldemberg J (2002)Foreign direct investment and decoupling between energy and gross domestic product in developing countries,Energy Policy,30(2):87–89.

Mahalik M.K, Babu M.S, Loganathan N, Shahbaz M(2017) Does financial development intensify energy consumption in Saudi Arabia?,Renewable and Sustainable Energy Reviews*,*75: 1022-1034.

Makki S,Somwaru A (2004) Impact of foreign direct investment and trade on economic growth: evidence from developing countries, American Journal of Agricultural Economics, 86 (3): 795 – 801

Mensah J. (2019). Improving environmental sanitation in the catchment area of Benya Lagoon, Ghana: the non-household stakeholder role and participation dimension, Journal of Water, Sanitation and Hygiene for Development , 9 (4): 714–730.

Mihelcic J. Naughton C Verbyla M. Zhang Q Schweitzer R. Oakley S Wells E. Whiteford L/ (2017) The Grandest Challenge of All: The Role of Environmental Engineering to Achieve Sustainability in the World's Developing Regions, Environmental Engineering Science, 34, (1), 16-41, DOI: 10.1089/ees.2015.0334

Mencinger J (2003) Does foreign direct investment always enhance economic growth?,*Kilkos*, 56 (4):491 – 508.

Organization of the Petroleum Exporting Countries (OPEC) Report 2019, https://www.opec.org/opec_web/en/ , Retrieved 01-03-2019.

Odusanya I.A, Osisanwo B.G, Tijani J.O (2016) Financial development and energy consumption nexus in Nigeria,AUDŒ, 12 (5): 155-165.

Poelhekke S,Van der Ploeg F (2015)Green Havens and Pollution Havens", 38 The World Economy 1159

Pessoa A (2007) FDI and host country productivity: a review". *Working Paper da Faculdade de Economia da Universidade do Porto* nº 251

Roodman D (2009a)A note on the theme of too many instruments,Oxford Bulletin of Economics and Statistics, 71 (1):135–158.

Pesaran H.M (2004) General diagnostic tests for cross-sectional dependence in panels. University of Cambridge, Cambridge Working Papers in Economics, 435.

Riti J. S, Shu Y, Song D. K (2017)The contribution of energy use and financial develop- ment by source in climate change mitigation process: a global empirical perspective ,Journal of Cleaner Production, 148: 882–894.

Rafindadi A.A, Ozturk I (2017) Impacts of renewable energy consumption on the German economic growth: Evidence from combined co integration test,Renewable and Sustainable EnergyReviews, 75:1130-1141.

Shahbaz M, Nasreen S, Abbas F, Anis O (2015) Does foreign direct investment impede environmental quality in high-, middle-, and low-income countries?"Energy Economics, 51: 275–287.

Shahbaz M, Hoang T.H.V, Mahalik M.K, Roubaud D (2017)Energy consumption, financial development and economic growth in India: New evidence from a nonlinear and asymmetric analysis, Energy Economics, 63:199-212.

Shafiei S Salim R. (2014) Non-renewable and renewable energy consumption and CO_2 emissions in OECD countries: A comparative analysis, Energy Policy, 66 ,547-556.

Stulz R.M (2000) Financial structure, corporate finance and economic growth,International Review of Finance, 1(1):11-38.

Sadorsky P (2011)Financial development and energy consumption in Central and Eastern European frontier economies,Energy Policy, 39 (2):999-1006.

Sadorsky P (2010) The impact of financial development on energy consumption in emerging economies,Energy policy, 38 (5):.2528-2535.

Sen H (1998)Different arguments for and against the role and impact of foreign direct investment on the development potentials of developing countries: an overview. Journal of Economics and Administrative Sciences, 13(1): 181 – 190

Sylwester K (2005) Foreign direct investment, growth and income inequality in less developed countries, International Review of Applied Economics, 19 (3): 289 - 300

Shahbaz M, Islam F, Islam M.M (2010) The impact of financial development on energy consumption in Pakistan: Evidence from ARDL bounds testing approach to co integration,Proceedings of the Second International Conference on the Role of Social Sciences and Humanities in Engineering 2010, 12–14 November 2010. Penang, Malaysia: Bayview Beach Resort

Tamazian A. R,Rao B (2010) "Do economic, financial and institutional developments matter for environmental degradation? Evidence from transitional economies,Energy Economics, 32 (1):137-145.

Tugcu C.C, Ozturk I, Aslan A (2012)Renewable and non-renewable energy consumption and economic growth relationship revisited: Evidence from G7 countries,Energy Economics, 34 (6):1942-1950.

Tugcu T (2013) Disaggregate energy consumption and total factor productivity: A co integration and causality analysis for the Turkish economy, International Journal of Energy Economics and Policy, 3:307-314.

UNCTAD secretariat. (1999) Green and renewable technologies as energy solutions for rural development , United Nations Conference on Trade and Development, retrieved from https://unctad.org/en/Docs/ciem3d2_en.pdf

Vissak T, Roolaht T (2005)The negative impact of foreign direct investment on the Estonian economy, Problems of Economic Transition, 48 (2):43 – 66

World Development Indicators (WDI) (2018) from period 1990-2016, "World *Bank*, retrieved on 01-10-2018 from https://data.worldbank.org/

Weststrate, J., Dijkstra, G., Eshuis, J. *Gianoli A. Rusca M.* (2019) The Sustainable Development Goal on Water and Sanitation: Learning from the Millennium Development Goals. Social indicators research 143, 795–810 (2019). https://doi.org/10.1007/s11205-018-1965-5

Yazdi S, Shakouri B (2017) Renewable energy, nonrenewable energy consumption, and economic growth,Energy Sources, Part B: Economics, Planning, and Policy, In Press. Doi:10.1080/15567249.2017.1316795.

Yuxiang K,Chen, Z (2011)Financial development and environmental performance: evidence from China,Environment and Development Economics, 16 (1):93-111.

Zhang K (2001) Does foreign direct investment promote economic growth? Evidence from East Asia and Latina America. Contemporary Economic Policy, 19 (2): 175 – 18.5.

Appendix 1: Variable Definitions

Variable	Definition	Source
CO_2 emissions per capita (metric tons per capita)- (CO2E)	Expressed through the burning of fossil fuels and the consumption of gases and liquids and all cement activities.	GGKPdatabase (2019)
Access to improved sanitation – (AISANIT)	Expressed as a percentage of the population.	GGKP database (2019)
Access to renewable electricity- (ATE)	Indicates the percentage of electricity obtained by the population.	GGKP database (2019)
Foreign direct investment stock/GDP ratio (%) – (FDI)	Refers to the value of share capital and stock reserves as direct foreign investments in addition to the indebtedness of the affiliated companies attributable to the parent company.	WDI (1990-2016)
Credit/GDP ratio (%)- (CREDIT)	Refers to the domestic credit portfolio in the private sector as a percentage of GDP.	WDI (1990-2016)
GDP per capita (constant in Millions of US Dollars)- (logPGDP)	The aggregate added tax is expressed by resident producers and product taxes minus any subsidies not included in the value of the product in the country's economy.	WDI (1990-2016)
Investment/GDP ratio (%)- (INVS)	Includes all components of fixed capital, which consists of many investments for equipment purchases, road construction, infrastructure work, construction and real estate.	WDI (1990-2016)
Urbanization/total population ratio (%)- (URB)	Indicates the number of people living in urban areas, according to national statistics.	WDI (1990-2016)
Oil rents/GDP ratio (%)- (OILR)	Reflects the difference between the revenues of oil rents from the value of crude oil production at regional prices and total production costs.	WDI (1990-2016)
Trade openness (%) - (TRD)	Trade openness is the value of total exports and imports of goods and services measured as a share of GDP.	WDI (1990-2016)

Appendix.2 A:Descriptive Statistics

Variable | Mean Std. Dev. Min Max|Observations
CO_2E overall | 9.618051 14.4769 .085 7|N = 336
between | 14.53032 .4470833 54.23333|n = 14
within |3.598082 -19.91528 26.38472|T = 24
ATE overall | 29.90881 33.45516 0 1N = 320
between | 33.89627 0 87.30435|n = 14
within |6.78651 -2.595535 47.3957|T = 22.8571
AISANIT overall |71.73912 27.71098 2.16 100 |N = 352
between | 28.28549 13.63684 99.05769 |n = 14
within | 8.62091 7.288735 87.33143 |T-bar =25.1429
FDI overa| 23.72845 28.26012 .6467939 303.9296 |N = 344
between | 20.65429 4.658209 70.11923 |n = 14
within |19.78345 -27.00578 257.5388 |T-bar =24.5714

<table>
<tr><td>URB   overall | 66.46849 18.93495   25.582   99.244 |N = 364</td></tr>
<tr><td>between | 19.2541 34.47912 96.6915 |n = 14</td></tr>
<tr><td>within |3.652898 55.0778   76.54223 |T = 26</td></tr>
<tr><td>OILR   overall | 26.98378 15.06912   .3803545 83.50863 |N =337</td></tr>
<tr><td>between | 11.56106   9.27958 45.10558 |n =14</td></tr>
<tr><td>within |10.39766   -9.12082 74.89916 |T-bar =24.0714</td></tr>
<tr><td>logPGDP overall | 8.403606 1.345766   5.031091 11.4797 |N = 346</td></tr>
<tr><td>between | 1.140016   6.48366 10.49781 |n = 14</td></tr>
<tr><td>within | .7346447   5.812756 10.42126 |T-bar =24.7143</td></tr>
<tr><td>INVS   overall | 26.88683 26.25858   2.918034 219.0694 |N = 306</td></tr>
<tr><td>between | 19.43373   10.62988 87.83661 |n = 13</td></tr>
<tr><td>within |17.69249 -39.35772 158.1197 |T-bar =23.5385</td></tr>
<tr><td>TRD   overall | 90.59092 63.97348   .0209992 531.7374 |N = 342</td></tr>
<tr><td>between | 50.57834   43.39 232.0638 |n =14</td></tr>
<tr><td>within |40.7851 -36.31729 390.2645 |T-bar =24.4286</td></tr>
<tr><td>CREDIT overall | 25.80213 29.14554 -114.6937 121.8539 |N = 339</td></tr>
<tr><td>between | 17.57967 -2.554739 60.66747 |n = 14</td></tr>
<tr><td>within | 23.97064   -115.415 107.2309 |T-bar =24.2143</td></tr>
</table>

Source: STATA. Version 15 output.

Appendix.2B: Pairwise Correlation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) CO_2E	1.000									
(2) ATE	-0.440***	1.000								
(3) AISANIT	0.516***	-0.702***	1.000							
(4) FDI	-0.252***	0.383***	-0.456***	1.000						
(5) CREDIT	0.363***	-0.259***	0.341***	-0.293***	1.000					
(6) URB	0.608***	-0.295***	0.616***	-0.336***	0.289***	1.000				
(7) OILR	-0.134**	0.096*	-0.246***	0.255***	-0.523***	-0.197***	1.000			
(8) logPGDP	0.686***	-0.475***	0.567***	-0.266***	0.204***	0.743***	-0.102**	1.000		
(9) INVS	-0.105*	-0.119*	0.103*	0.449***	-0.065	-0.233***	0.096	-0.170***	1.000	
(10) TRD	-0.019	0.025	-0.099*	0.614***	-0.151***	-0.269***	0.424***	-0.095*	0.807***	1.000

Source: STATA. Version 15 output, Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1