JREE: Vol. 7, No. 2, (Spring 2020) 8-18

Journal of Renewable Energy and Environment

Research Article

Journal Homepage: www.jree.ir

Foreign Direct Investment, Stock Market Development, and Renewable Energy Consumption: Case Study of Iran

Mahdieh Rezagholizadeh[a*], Majid Aghaei[a], Omid Dehghan[b]

[a] *Department of Economics and Administrative Sciences, University of Mazandaran, Babolsar, Iran.*
[b] *Department of Energy Economics, Petroleum University of Technology, Tehran, Iran.*

PAPER INFO

Paper history:
Received 28 November 2019
Accepted in revised form 11 April 2020

Keywords:
Foreign Direct Investment
Stock Market
Renewable Energy
GDP
ARDL Test

ABSTRACT

Concerning environmental pollution issues derived from fossil energy consumption, the application of renewable energies plays an important role in countries, especially in their energy sector policymaking. Since determining the relationship between different variables and renewable energy not only has significant policy applications in energy sector but also is necessary in achieving sustainable development goals, this study assesses the impact of effective factors on the development of renewable energy consumption in Iran with emphasis on the role of foreign direct investment (FDI) and financial sector development (especially stock market development). This study applies Auto-Regressive Distributed Lag (ARDL) bounding test method over the period of 1978-2016. The research findings show that there is a causal relationship between foreign direct investment and the stock market and renewable energy consumption in Iran such that the increase of foreign direct investment and stock market development will increase the consumption of renewable energies in Iran. On the other hand, a growth in renewable energies consumption will significantly reduce CO_2 emission in the long run. Besides, increasing FDI and stock market development will raise the economic growth of a country and, in return, increase CO_2 emission.

1. INTRODUCTION

In recent years, numerous studies have estimated the relationship between energy consumption and economic growth in Iran. Most of them have indicated that energy use has an important role in increasing economic activities. Apart from energy security, environmental issues and climate changes arising from massive conventional energy consumption (like fossil fuel) represent another challenge for the Iranian economy. Therefore, the focus of energy economists and policy-makers has moved towards the use of renewable energies in the production process and consumption rather than the use of nonrenewable energy sources, e.g., fossil fuels. Because renewable energies can meet the increasing demand for energy, they can significantly reduce CO_2 emissions.

Since renewable energies are harmless in environmental pollution by decreasing the emission of CO_2 and other greenhouse gasses, their consumption is not limited and, finally, the ever-increasing energy demand for and the development and expansion of renewable energies are necessary for the sustainable development of developing countries as important factors. To reduce CO_2 emission, the consumption of renewable energies has become an important topic of interest among energy economists, environmental scientists, and policy-makers in developing countries, primarily due to increasing economic activities.

Therefore, policymakers have made an attempt to develop the use of these energies through different policies in Iran. Despite the governments' backbreaking efforts in the development of renewable energies, the ratio of the consumption share of renewable energies to total energy in Iran is still very low. One of the most important obstacles to the expansion of renewable energies includes a high initial investment and the lack of appropriate finance in this sector. The deployment of the renewable energy sector is one of the capital-intensive sectors in each country because renewable energy projects need a high amount of investment before production. Investing in the production of these energies is the same as infrastructure projects such as highways, airports, ports, and railways. For Youngho (2016), renewable energy projects are more dependent on high initial investment than other conventional energies. They also have low rates of return and long payback period of capital; therefore, investment in these projects that demand abundant financial resources would be risky. Some of the economic research studies (e.g., Jeayoon and Kwangwoo (2016); Paramati et al. (2016); Li (2013); Li and Wang (2011); Brunnschweiler (2010)) seek to answer whether there is a significant relationship between the financing of renewable energy projects (like foreign direct investment inflow or Stock market development) and the deployment of these energies and also reduction of environmental pollution in other countries. On the one hand, stock market development and the entrance of capital flow provide investment opportunities in a commercial and competitive environment in a country; moreover, by increasing the country's economic activities, energy demand will increase. On the other hand, some economic theories state that foreign direct investment in the host country and its stock market development through international finance can reduce the consumption of fossil fuels and affect the environment by financing renewable energy projects.

Therefore, this study argues that increasing both stock market developments and FDI inflows in Iranian market

*Corresponding Author's Email: m.gholizadeh@umz.ac.ir (M. Rezagholizadeh)

economies can lead this economy to enhance the use of advanced technologies in clean energy production and energy efficiency, leading to the significant reduction of CO_2 emissions. Regarding the importance of this issue, the relationship between foreign direct investment and country financial development (stock market in particular) with renewable energy consumption is analyzed from 1978 to 2016 in the Iranian economy by using economic theories and an econometric model in this study. To do so, time series data and ARDL bounding test will be used.

The rest of the paper is organized as follows. Following the presentation of the theoretical foundation and literature review, an appropriate empirical model will be discussed. Then, after data introduction and research methodology, the regression model will be estimated and the results will be analyzed.

2. LITERATURE REVIEW

Regarding the research goal, the literature review is divided into three parts. In the first group of studies, the relationship between foreign direct investment flow and energy consumption level and CO_2 emission is considered. This group aims to answer whether foreign direct investment can be an important factor in changing energy consumption. It should be noted that, generally, in most of these studies, the positive relationship among FDI, economic growth, and energy consumption has been concluded. The second group of studies investigates the effect of financial development (stock market growth in particular) on energy consumption seeking the reaction of energy consumption against the development of the financial sector. The third group of studies investigates the effect of FDI and financial development on energy consumption. Some of the most important studies related to each group are shown in Table 1 in Appendix. The main goal of this research is to investigate the effective factors in renewable energy consumption in Iran through Foreign Direct Investment and stock market development as a financial development index from 1978 to 2016. More specifically, to our knowledge, no study so far has empirically investigated the impact of both FDI inflows and stock market development on renewable energy use and CO_2 emissions in Iran.

Energy consumption trend in developed countries shows that despite an increase in energy consumption, fossil fuel consumption has decreased due to the emission of greenhouse gasses in recent years. According to the EIA report, the use of renewable energy resources is not available for all countries due to their high initial cost; however, developed countries invest in renewable energies through foreign direct investment and, as a result, energy production through renewable resources is increasing rapidly. Also, these countries attempt to increase their renewable energy resources and replace fossil fuels with them by attracting foreign investments, direct and indirect stock market development, energy security, and reducing greenhouse gasses emission (Constantini and Martini (2010); Inglesi-Lotz (2013)). According to that, it can be concluded that energy consumption – renewable energies in particular- can be affected by Foreign Direct Investment and stock market growth.

Renewable energy project developers need a combination of debt (loan) and stock investment (ownership) for a project building cost. A Loan is available through public markets (bonds) or private sector (bank loans or organization loans), and the stock is available by internal resources and foreign investors in public or private markets. Loans are less expensive than stocks. Therefore, developers prefer loans to finance the projects. Regarding technological issues, the financial period of renewable energies is important due to being capital intensive; therefore, it needs loan and stocks more than other plants. Some problematic factors that hinder alluring financial resources into renewable energies are as follows:

1) Project risks: most of the financial institutes do not have enough experience in risk assessment of renewable resources. Renewable projects failure leads to a more difficult and expensive increase in capital.
2) Industry size and investor attraction: the renewable industry is smaller than other energy sectors and investors are reluctant to invest in this sector.
3) Unpredictable policies: most of the renewable projects are dependent on government policies (tax credits, subsidies, etc.). These policies are almost unpredictable and have a negative effect on the investment in renewable energies.

Ryan and Steven (1997) and Brunnchweiler (2010) also divided the problem of renewable projects finance into two groups: first, availability of long-run loans for renewable companies, related to the development of the banking system. Second, limited financial resources are available for renewable companies because they are newer and more expensive than fossil fuel projects. According to the aforementioned reasons, the development of internal financial sectors is a very important factor in estimating the energy demand growth in less developed economies.

In developed economies, finance is mostly done through debt. However, in emergent economies, this study needs a greater stock market investment due to the disability in debt presentation (Thiam and Jacqueline (2016)). Therefore, foreign finance is available to a greater degree in countries with the advanced financial market and renewable sectors, which are highly dependent on foreign finance. The main reason for developing financial markets is to facilitate the process of less expensive finance in projects, which are compatible with the environment (Jiun and Kuangwoo (2016)).

Financial development is also considered as a significant factor in environmental performance such that higher financial development provides more financial resources for environmental projects with low financial costs. In a developed financial system, technological changes have significant effects on energy supply and CO_2 emission reduction. The capital market as an inseparable part of a financial system will react to the release of environmental performance information. Financial development in a country leads to foreign direct investment, research, and development that can increase economic growth level and also the dynamism of environmental performance (Abul and Mete (2011)). In most of the rural areas of developing countries, there is not appropriate infrastructure for renewable energy systems on a small scale. This lack of financial sources is one of the main obstacles to the application of renewable energies for final consumer and small entrepreneurs.

Commercial financial infrastructure is located mostly in large urban areas, and lending loan criteria to rural areas are limited to the needs and credits repayment opportunities. Finance should be cost effective for both lender and borrower in an appropriate time frame. Finance is not the only factor in

projects' success. Product quality, repair, and maintenance to increase trust and trained personnel for repair and maintenance are also needed in project success (Derrick (1998)).

In this part of the research, we will theoretically investigate the role and importance of financial development in the growth and development of renewable energies. Theoretical foundations of the relationship between financial development and renewable technologies development analyze how the development of financial markets overcomes adverse selection and moral hazard, resulting in the reduction of foreign finance cost in the renewable energy sector. Regarding the objective of this research, theoretical foundations of the relationship between stock market development and energy consumption (in particular renewable energies) will be presented, and the role of the stock market in the easy availability of foreign finance for renewable energies sector and their development will be investigated.

Generally, financial market development will have an effect on energy consumption directly and indirectly:

(A) Direct effect:

In developed stock markets, information will be presented based on rational expectation with respect to the balanced stock price. Therefore, investors recognize undesirable and incompatible information through balanced prices (Grossman 1976)). Besides, a quick balance of stock prices will provide valuable periodic information from enterprise investment opportunities (Hsu et al.) and gain investors' trust through the lack of information balance between investors and enterprises. Finally, developed stock markets with valuable balanced prices reduce the problem of incorrect choice. On the other hand, liquidity and other risks in developed stock markets will be reduced. In undeveloped stock markets, the investor refuses to invest in some of the projects due to a high risk of liquidity; however, in the developed stock market, liquidity risk is decreased by the facilitation of exchanges (Levin (1997)). As a result, investors will tend to invest more in projects when they are able to sell their stocks easily. Regarding risk management in developed stock markets, there is the possibility of reducing other risks in this market, too. Developed stock markets encourage investors to invest in high-risk projects by providing risk covers and various tools of diversification (Levin (2005)). Therefore, in terms of direct effect, developing the stock market by making a healthy competitive environment for factories and investors has a significant effect on energy consumption. Therefore, by listing factories' stock, it provides available and excess investments in the stock market. This will offer opportunities to internal and external investors that increase the economic activities of a country and lead to an increase in energy demand (Parmati et al. (2016)). Therefore, financing renewable energies projects, which need lots of funds, are more possible in developed financial markets. Developed financial markets with low liquidity risk, various tools of diversification, and risk cover will minimize side effects derived from undesirable choices.

The development of financial markets can also have an effect on energy demand by increasing the household budget. Based on microeconomics theories, lower limitations in the household budget will lead to an increase in their goods and services consumption. Financial markets lower the household budget limitation by providing loans with lower interest rates. This is how the demand for energy devices such as automobile, housing, electrical devices, etc. increases, which consequently affects the energy consumption directly and gives it a rise (Sadorsky (2012)).

Finally, it can be said that stock market development can lead to the development of advanced projects and superior technologies like renewable energy projects. Due to the fact that stockholders share stock financing in case of high returns, there are no collateral requirements in the stock market and, therefore, extra stock supply will not lead to chaos and financial indiscipline (Brown et al. (2009)). In return, financing high technology enterprises, which are sensitive to financial indiscipline, is useful.

(B) Indirect effect:

In terms of indirect effect, stock market development can increase investment and economic activities through quantity and efficiency effect and increase the demand. Stock market development and more investment together with more trade and consumption can create a wealth effect that stimulates consumption and leads to an increase in applying advanced technologies in clean energy products and, finally, reducing CO_2 emission significantly (Parmati et al. (2016)).

On the other hand, the financial market development can lead to an increase in energy consumption through an increase in investment and in economic growth. More developed financial markets provide enterprises with easier and less expensive financial resources. Enterprises expand their production units by hiring new staff and purchasing equipment and machinery. Therefore, by developing the financial market and reducing the cost of borrowing, investment activities along with the employment opportunities for skilled and unskilled workers will increase. This will lead to an increase in production and national income and, also, energy consumption (Kakar et al. (2011)).

Existing views revolve around the relationship between stock market development and the development of renewable energies technology. Under a common economic mechanism, in financial sectors that overcome undesirable choice and moral dangers, foreign financial costs decrease and developed stock markets make finance easier through stocks. Finally, it can be said that the greater development of financial markets can lead to the development of renewable technologies, which need lots of funds. Beck and Levine (2002) investigated the effect of financial system development (comprised of the stock market and credit market) on the growth and development of production industries, which are dependent on foreign finance. According to their study results, the development of the entire financial system will decrease the finance cost of production industries.

Despite the fact that capital is considered as the engine of growth and economic development, developing countries usually encounter with lack of investment and try to compensate it through foreign borrowing. However, foreign direct investment is now considered as an alternative to foreign borrowing due to the crisis derived from its repayment and is an instrument to achieve economic growth. Foreign direct investment booms economic growth by providing foreign investment and, as a result, affects energy consumption. Borensztein et al. (1998) stated that, generally, the addition of foreign direct investment in a healthy competitive environment of a country would result in economic growth and an increase in economic activities and energy consumption.

In every country, the consumption of renewable and non-renewable energies is highly dependent on the level of economic activities and that country's growth (Salim et al. (2014)) such that high economic rates will increase energy consumption by creating new demand. According to this fact, income, wealth, and households demand luxurious energy-intensive goods increase via an increase in economic growth. Energy consumption is also increased through consumption increase in the household and transportation sector, resulting from the income raise in the household's income (Barghi et al. (2013)).

In addition, an increase in economic growth will raise energy consumption through the booming service sector, transportation, and commerce, which are energy consumers (Medlock and Soligo (2001)). On the other hand, with economic growth, countries seek to improve and increase the efficiency of energy consumption. They will reduce the final cost of energy through increased effectiveness and efficiency of energy and, finally, lead to an increase in energy consumption. This is known as Rebound effect (Brookes (2000); Manzur et al. (2012); Medlock and Soligo (2001)).

On the other hand, based on Porter Theory, Foreign direct investment, which accelerates the host country's economic growth as a production factor, will provide the host country with efficient technology in protecting the environment. The availability of clean and environmentally friendly technologies improves the quality of the environment and, therefore, it can be said that foreign direct investment facilitates the replacement of clean and environmentally friendly technology (Energy saver) with destructive and polluting technologies (Asghari and Rafsanjani pour (2014)).

3. DATA AND METHODLOGY

Because of the economic dependence on energy consumption and with respect to the lack of energy, particularly fossil fuels, determining the effective factors in renewable energies consumption has been always one of the most important issues between economists and politicians. Based on the considered theoretical foundations in the previous sector, i.e., the effect of foreign direct investment and stock market growth on energy consumption through various ways, with respect to previous studies (such as Sbia et al. (2014); Chang (2015)) and economic texts, the related model for determining the reaction of renewable energies consumption against foreign direct investment, stock price index, total energy consumption, CO_2 emission per capita, and gross domestic production per capita is given as follows:

$$CEC_t = f(ST_t, FDI_t, TEC_t, CO_t, GDPPC_t) \quad (1)$$

CEC: is renewable energy consumption, which is equal to renewable energy consumption ratio (total renewable energy to total energy consumption). ST: is the stock market development price. With respect to previous studies such as (Levine and Zervos (1998); Beck & Levine (2002); Hso et al. (2014); Jion and Kongvo (2016)), stock market investment GDP ratio and stock market transactions GDP ratio represent stock market development. According to Beck and Levin (2002) and Coban and Topcu (2013), by applying Principle Component Analysis (PCA), stock market development index, which is one of the sub-indices of Stock Market Capitalization and Stock Market Traded Value, is given as follows:

$$Equity_{i.t} = 1^{st} \text{ principal component of } \frac{market_{i.t}}{GDP_{i.t}} \times 100 \text{ and } \frac{markettrad_{i.t}}{GDP_{i.t}} \times 100 \quad (2)$$

where Marketcap: the stock market value equals the stock market value of the entire companies in Iran stock exchange market. Market trade: the total value of exchanged stocks over a specific period. Stock market value is the stock market size and exchanged stock value variable is the liquidity amount of market. Investment in the stock market represents the total size, and transaction value represents stock market liquidity. Stock market development index is calculated based on the first main component of these two variables regarding the covariance matrix. FDI: Foreign Direct Investment, GDPPC: is gross domestic product per capita, which is calculated by dividing GDP into country's population. This variable has been used as a substitution for economic growth in various studies (e.g., Tou et al. (2013); Omri and Chaibi (2014); Fotros et al. (2013)). Installing renewable energy technology is dependent on not only environmental finance but also the economic level of each country. Economic growth has a positive relationship with the development of renewable energies. CO: is Carbon dioxide emission per capita, which has been calculated by dividing total CO_2 into the country's population as Kilogram per each person. TEC: Total Energy Consumption (based on Million Barrels of Crude Oil Equivalent).

Required Data for modeling has been collected from Central Bank Statistical sources, World Bank, Securities, Exchange Organization, and Energy Balance sheet in this research.

In order to analyze the long-run and short-run dynamic relationship among Foreign Direct Investment variables, stock price index, total energy consumption, CO_2 Emission per capita, Gross Domestic Production per capita, and renewable energy consumption in Iran, Autoregressive Distributed Lag Bounding test method by Pesaran, Shin and Smith (2001) is used as the Time Series model. This method is the most appropriate co-integration estimation method in small samples (Haug (2002)). Unrestricted Error Correction Model that has been used in this research to investigate the long-run and short-run dynamic relationship between variables is as follows:

$$\Delta \ln CEC - \beta_1 + \beta_{CEC} \ln CEC_{t-1} + \beta_{FDI} \ln FDI_{t-1} + \beta_{ST} \ln ST_{t-1} + \beta_{TEC} \ln TEC + \beta_{CO} \ln CC_{t-1} + \beta_{GDPPC} \ln GDPPC_{t-1} + \sum_{i=1}^{p} \beta_i \Delta \ln CEC_{t-i} + \sum_{j=0}^{q} \beta_j \Delta FDI_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln ST_{t-k} + \sum_{l=0}^{u} \beta_1 \Delta TEC_{t-l} + \sum_{m=0}^{s} \beta_m \Delta \ln CO_{t-m} + \sum_{n=0}^{z} \beta_n \Delta \ln GDPPC_{t-n} + \mu_t \quad (3)$$

$$\Delta \ln CO_t = \gamma_1 + \gamma_{ECE} \ln CEC_{t-1} + \gamma_{FDI} \ln FDI_{t-1} + \gamma_{ST} \ln ST_{t-1} + \gamma_{TCE} \ln TEC_{t-1} + \gamma_{CO} \ln CO_{t-1} + \gamma_{GDPPC} \ln GDPPC_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta \ln CEC_{t-i} + \sum_{j=0}^{q} \gamma_j \Delta FDI_{t-j} + \sum_{k=0}^{r} \gamma_k \Delta \ln ST_{t-k} + \sum_{l=0}^{u} \gamma_l \ln TEC_{t-l} + \sum_{m=0}^{s} \gamma_m \Delta \ln CO_{t-m} + \sum_{n=0}^{z} \gamma_n \Delta \ln GDPPC_{t-n} + \mu_t \quad (4)$$

$$\Delta \ln GDPPC_t = \varphi_1 + \varphi_{CEC} \ln CEC_{t-1} + \varphi_{FDI} FDI_{t-1} + \varphi_{ST} \ln ST_{t-1} + \varphi_{TEC} \ln TEC_{t-1} + \varphi_{CO} \ln CO_{t-1} + \varphi_{GDPPC} \ln GDPPC_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta \ln CEC_{t-i} + \sum_{j=0}^{q} \varphi_j \Delta FDI_{t-j} + \sum_{k=0}^{r} \varphi_k \Delta \ln ST_{t-k} + \sum_{l=0}^{u} \varphi_j \Delta TEC_{t-l} + \sum_{m=0}^{s} \varphi_m \Delta \ln CO_{t-m} + \sum_{n=0}^{z} \varphi_n \Delta \ln GDPPC_{t-n} + \mu_t \quad (5)$$

In these equations, Δ is the difference operator and μ_t is the Error Correction component at t (time). In order to test the existence of Co-integration relationship between variables, each equation is estimated based on the significance of common F statistics of lagged variables coefficients in the model. With respect to the fact that the considered sample is

small, in order to distinguish co-integration, Narayan critical amounts will be used in this study (Narayan and Narayan (2005)).

After investigating the existence of the co-integration relationship between effective factors in renewable energy consumption, the causal relationship between model variables should be analyzed. Based on Granger (1969) study, in the co-integrated variables that are of first order, Vector Error Correction Method (VECM) is the best method to recognize the causal relationship between variables (Narayan and Narayan (2004)). VECM model of variables to investigate the long-run relationship is as follows:

$$\Delta \ln CEC_t = \alpha_{01} + \sum_{i=1}^{I} \alpha_{11} \Delta \ln CEC_{t-i} + \sum_{j=1}^{m} \alpha_{22} \Delta FDI_{t-j} + \sum_{k=1}^{n} \alpha_{33} \Delta \ln ST_{t-k} + \sum_{l=1}^{o} \alpha_{44} \Delta TEC_{t-1} + \sum_{m=1}^{n} \alpha_{55} \Delta \ln CO_{t-k} + \sum_{n=1}^{o} \alpha_{66} \Delta GDPPC_{t-1} + \eta_1 ECT_{t-1} + \mu_t \quad (6)$$

where Δ is the difference operator and μ_{it} is the model's residual component with normal and independence distribution.

4. RESULTS AND DISCUSSION

4.1. Stationary test of variables

This study starts the investigation by checking the order of integration for variables included in the model. This step is necessary because the tabulated critical value bounds in bounds testing can be only applicable to I (0) and I (1) variables. To determine the order of integration, this study applies Dickey-Fuller Generalised Least Square tests and unit root test with structural breaks including Ng-Perron Unit Root Test and reports the test results for the intercept-and-trend case in Table 1.

Based on the results of Unit Root Tests, all variables are stationary considering intercept and time trend at the level or by one difference. Therefore, there would not be any concerns about the unreliability of Pesaran F statistics, and the research models can be estimated and analyzed through the ARDL Bounding Test.

Table 1. Unit root test results.

Variable	Ng-Perron test						DF-GLS test		
	Optimum lag	MZa	MZt	MSB	MPT	Integration degree	DF-GLS statistic	Optimum lag	Integration degree
Renewable Energy Consumption (CEC)	0	-1.3653	-0.477	0.34992	10.5398*	I(0)	-6.4413*	1	I(1)
Foreign Direct Investment (FDI)	0	-0.4415	-0.412	0.93372	162.142*	I(0)	-5.7158*	1	I(1)
Stock Index (ST)	0	0.1289	0.8921	6.91937	243.03	I(0)	-2.164780*	0	I(0)
Total Energy Consumption (TEC)	0	-3.314	-0.977	0.29504	7.15026*	I(0)	-1.797973*	0	I(0)
CO_2 Emission (CO)	0	0.8276	0.6171	0.74561	40.3379*	I(0)	-3.547831*	0	I(0)
Gross Domestic Production Per Capita (GDPPC)	0	-0.781	-0.480	0.61441	21.2916*	I(0)	-2.325043**	0	I(0)

Source: Author's calculations. The * and ** denote rejection of the null at 1 % and 5 % levels, respectively.

4.2. Determining optimum lags, co-integration test result and other diagnostic statistics

After conducting stationary test and making sure that all of our selected variables are integrated at either I(0) or I(1), in this section, in order to assure the stability of each model, this study begins with identifying optimal lag structure and choosing Co-integration test between variables and other diagnostic tests. The results of co-integration test, which is presented in the third column, are based on the long-run relationship between renewable energy consumption and Foreign Direct Investment, Stock market growth, total energy consumption, CO_2 Emission, and Gross domestic production, and indicate that the co-integration relationship between variables is confirmed based on various equations and is significant at a 1 % level based on Pesaran Bounding test. Other tables' columns represent model diagnostic statistics in order to investigate the classic assumptions and validity of estimated models. The diagnostic tests indicate that all Equations are correctly specified, and all Gaussian errors are normally distributed, homoscedastic, and not serially correlated.

4.3. Estimation of long-run and short-run coefficients

Table 3 shows the short-run and long-run causal relationship from foreign direct investment, stock market development index, total energy consumption, carbon dioxide emission, and gross domestic production to renewable energy consumption in Iran. As can be observed from the table, the coefficient of foreign direct investment in the short run is 0.024 and statistically significant. According to this estimation, a one percent increase in FDI leads to a 0.02 % increase in the consumption of renewable energies. The estimation of long-run coefficients in this equation indicates that FDI has a positive and significant impact on renewable energy consumption in the long run in Iran so it can be inferred that an increase in FDI in Iran will result in energy consumption increase in both short-run and long-run terms. Increasing FDI through clean and environmentally friendly technology replacement with destructive and pollutant technology can lead to an increase in clean energy consumption.

The Coefficient of stock market development is positive and equal to 0.019, which is statistically insignificant in the short run, but as it can be observed, lagged stock market development variable has a positive and significant effect on

renewable energy consumption. On the other hand, the estimation of long-run coefficients in this equation represents that stock market growth has had a positive and significant effect on energy consumption in this country over the research period. Financial market development increases investment activities and expands employment opportunities for skilled and unskilled workers by decreasing the cost of borrowing, resulting in an increase in production and national income and high energy consumption.

Table 2. Results of ARDL co-integration test and other diagnostic tests.

Estimated model	Optimum lag length	Pesaran F statistic	Normality test	ARCH test statistic	LM test	Reset test	DW-statistic	F-stat	Adjusted R-squared
$F_{CEC}(L_{CEC}/FDI,L_{ST},L_{TEC},L_{CO},L_{GDPPC})$	(2,4,1,4,4,1)	21.56*	0.09 (0.9517)	0.48 (0.9314)	2.59 (0.1196)	7.22 (0.0797)	2.61	2895.46*	0.99
$F_{GDPPC}(L_{GDPPC}/L_{CEC},FDI,L_{ST},L_{TEC},L_{CO})$	(3,3,2,2,0,1)	7.65*	1.09 (0.5772)	0.64 (0.8061)	2.32 (0.1280)	0.75 (0.3959)	2.22	425.428*	0.99
$F_{CO}(L_{CO}/L_{CEC},FDI,L_{ST},L_{TEC},L_{GDPPC})$	(4,3,4,4,2,3)	5.52*	1.39 (0.4980)	0.63 (0.8222)	1.14 (0.3706)	6.33 (0.1360)	2.55	716.154*	0.99
The optimal lag structure of the ARDL model is determined by AIC. The asterisks * and ** denote significance at 1 % and 5 % levels, respectively. The Normality, LM, ARCH, and RESET tests represent the normality test, the Breusch-Godfrey Lagrange multiplier test, the autoregressive conditional heteroscedastic Lagrange multiplier test, and the Ramsey specification test, respectively. F-stat indicates Fisher F test to determine the significance of all variables in the model. The figures in parenthesis represent the probability of diagnostic tests.									

Table 3. The ARDL long-run and short-run estimates.

Dependent variable: log of renewable energy consumption (Causality from stock market growth, foreign direct investment, CO_2 emission, total energy consumption and gross domestic production to renewable energy consumption).				
Short-run coefficient estimates				
Variables	**Coefficient**	**Standard error deviation**	**T statistic**	**Probability**
D(LCEC(-1))	0/7423	0/0818	9/0671	0/0000
D(LST)	0.0199	0.0097	0.0561	0.0284
D(LST (-1))	0.2160	0.0180	11.9727	0.0000
D(LST (-2))	0.1452	0.0166	8.7000	0.0000
D(LST (-3))	0.1032	0.0124	8.2997	0.0000
D(FDI)	0.0245	0.0059	4.1388	0.0012
D(LCO)	0.2817	0.1804	1.5612	0.0839
D(LCO(-1))	0.0093	0.0677	0.1376	0.8927
D(LCO(-2))	0.1361	0.0726	1.8740	0.0836
D(LCO(-3))	-0.6987	0.0612	-11.4145	0.0000
D(LTEC)	0.04922	0.01456	3.3786	0.0036
D(LTEC(-1))	-1.4805	0.1402	-10.5582	0.0000
D(LTEC(-2))	-0.6524	0.0974	-6.6925	0.0000
D(LTEC(-3))	-0.1714	0.1092	-1.5699	0.1404
D(LGDP)	0.0036	0.0214	0.1709	0.8669
CointEq(-1)	-0.4421	0.0903	-4.8939	0.0020
Cointeq = LCEC - (-0.1913*LST1 + 0.0079*LFDI2 -0.1924*LCO +0.0237*LTEC +0. 0568*LGDP -1.5696)				
Long-run coefficient estimates				
Variables	**Coefficient**	**Standard error deviation**	**T statistic**	**probability**
LST	-0.1912	0.0530	-3.6031	0.0032
FDI	0.0079	0.0040	1.9550	0.0724
LCO	0.1924	0.0879	-2.1878	0.0259
LTEC	0.0236	0.0088	2.6697	0.0203
LGDP	0.0568	0.0202	2.8118	0.0180
constant	-1.5695	0.4442	-3.5331	0.0034

According to the results, the coefficient of Co emission in the short run is 0.281, which is statistically insignificant. On the other hand, this coefficient in the long run is equal to -0.192, which is statistically significant and indicates that a one percent decrease in CO_2 emission in the long run will lead to a 0.192 % increase in renewable energy consumption, which shows the relatively high impact of this variable on energy consumption in the country. In other words, the coefficient of this variable indicates that by decreasing the emission of greenhouse gasses, renewable energy sources will increase and gradually become the alternative to fossil fuels and non-renewable energies.

According to the results, the coefficients of total energy consumption in the short and long run are 0.049 and 0.023, respectively, which are statistically at a high level of significance. The positive coefficients indicate that total energy consumption in the country has a positive and significant effect on renewable energy consumption. As can be seen from the table, economic growth has positive, but insignificant, effect on renewable energy consumption in the short run, while the coefficient of this variable in the long run is 0.056 and statistically significant. It is implied that renewable energy consumption is dependent on the level of economic activities and its growth in the country such that

high economic growth rates will increase energy consumption and clean energy consumption by creating new demands.

ECT coefficient is –0.442 and significant at all conventional levels, corroborating the established cointegration relationship between underlying variables. It is also implied that a 44.2 % change in renewable energy consumption is corrected by deviations in the short run towards the long-run equilibrium path.

The causal relationship from renewable energy consumption, total energy consumption, foreign direct investment, stock market development index, and CO_2 emission to the log of gross domestic product per capita (as an index for economic growth) is presented in Table 4. The results of the long-run elasticity of gross domestic products in the table indicate that renewable energy consumption, total energy consumption, foreign direct investment, and stock market index growth have a positive and significant effect on GDP and lead to more economic growth in Iran, while CO emission has a negative and significant effect on GDP. According to these results, a one percent increase in renewable energy consumption, total energy consumption, FDI, and stock market development will lead to increasing GDP for 0.337, 0.231, 0.17, and 0.417 percents, respectively, and a one percent decrease in CO_2 emission will lead to a 0.428 percent increase in GDP.

Table 4. The ARDL long-run and short-run estimates.

Dependent variable: log of gross domestic production (causality from stock market growth, foreign direct investment, CO emission, total energy consumption, and renewable energy consumption to gross domestic production).				
Short-run coefficient estimates				
Variables	**Coefficient**	**Standard error deviation**	**T statistic**	**Probability**
D(LGDP(-1))	0/3942	0/0921	4/2788	0/0004
D(LGDP(-2))	-0.1765	0.0960	-1.8378	0.0818
D(LST)	0.3323	0.0461	7.1998	0.0000
D(LST (-1))	0.4630	0.0812	5.7019	0.0000
D(LST (-2))	0.1340	0.0601	2.2264	0.0383
D(FDI)	0.1104	0.0353	3.1301	0.0055
D(FDI (-1))	0.1820	0.0384	4.7384	0.0001
D(LCEC)	0.3697	0.2785	1.3275	0.2001
D(LCEC(-1))	0.7031	0.3469	2.0267	0.0001
D(LTEC)	0.0828	0.5846	0.1416	0.0796
D(LCO)	-0.7599	0.2869	-2.6483	0.0000
CointEq(-1)	-0.6546	0.0774	-8.4553	0.0000
Cointeq = LGDP - (0.4177*LST1 +0.1701*LFDI2 +0.3373*LCEC +0.2312*LTEC – 0.4288*LCO -5.5286)				
Long-run coefficient estimates				
Variables	**Coefficient**	**Standard error deviation**	**T statistic**	**Probability**
LST	0.4176	0.1747	2.3896	0.0000
FDI	0.1700	0.0557	3.0516	0.0066
LCEC	0.3373	0.1449	2.3264	0.0018
LTEC	0.2312	0.1137	2.0325	0.0498
LCO	-0.4287	0.1201	-3.5675	0.0000
constant	-5.5285	2.3242	-2.3786	0.0000

Table 5 shows the result of a causal relationship of renewable energy consumption, total energy consumption, foreign direct investment, stock market index, and economic growth and CO emission. The results indicate that an increase in clean energy consumption in the long run significantly reduces Carbon emission, because an increasing share of this energy in total energy consumption has a negative effect on greenhouse gasses emission and will result in a considerable reduction in CO_2 emission. On the other hand, the results show that an increase in economic growth, foreign direct investment, and stock market development has a positive and significant relationship with CO_2 emission because, by increasing these variables, economic activities will increase and, finally, CO_2 emission will be increased. The results also indicate that the effect of total energy consumption on CO_2 emission is positive in the long run and is statistically significant.

5. CONCLUSIONS

With respect to the importance of investigating the relationship between financing renewable energy projects (such as foreign direct investments inflow or stock market development) and deployment of renewable and clean energy use, the current study analyzed the relationship between foreign direct investment and financial development (particularly stock market) with renewable energy consumption based on existing economic theories and an econometric model from 1978-2016 in Iran.

In order to analyze that, this study used time series data and ARDL Bounding test method. The results showed that there was a causal relationship of foreign direct investment and stock market and renewable energy consumption in Iran, such that an increase in foreign investment and stock market development led to an increase in the consumption of these kinds of energies in the country. On the other hand, an increase in them in the long run significantly decreases CO_2 emission, increases foreign direct investment, stock market development, and economic growth of the country and, in return, it will increase CO_2 emission. FDI inflows and stock market developments substantially increased the economic activities and, therefore, led to the increasing demand for energy on the one hand and emittance of more CO_2 into the atmosphere on the other hand. As a result, to reduce CO_2 emissions and maintain the level of economic activities, the only possible way is increasing the share of clean and renewable energy in total energy consumption and the adaptation of modern (green) technologies.

Table 5. The ARDL long-run and short-run estimates.

Dependent variable: log of CO_2 emission (Causality from renewable energy consumption, stock market growth, foreign direct investment, total energy consumption, and gross domestic production to carbon emission).				
Short-run coefficient estimates				
Variables	**Coefficient**	**Standard error deviation**	**T statistic**	**Probability**
D(LCO(-1))	0.2019	0.0963	2.0961	0.0285
D(LCO(-2))	-0.1415	0.1074	-1.3171	0.2203
D(LCO(-3))	0.5381	0.0968	5.5559	0.0004
D(LST)	0.0935	0.0119	7.8122	0.0000
D(LST (-1))	0.1528	0.0238	6.4179	0.0001
D(LST (-2))	0.0555	0.0183	3.0296	0.0143
D(FDI)	0.0172	0.0121	1.4219	0.1887
D(FDI (-1))	0.0572	0.0196	2.9105	0.0202
D(FDI (-2))	0.0057	0.0112	2.5074	0.6240
D(LFDI2(-3))	0.0423	0.0118	3.5710	0.0114
D(LCEC)	-0.4457	0.1107	-4.0251	0.0050
D(LCEC(-1))	-0.9415	0.1432	-6.5707	0.0001
D(LCEC(-2))	-0.1616	0.1149	-1.4065	0.1931
D(LCEC(-3))	-0.2609	0.0795	-3.2810	0.0095
D(LTEC)	0.4967	0.1766	2.8119	0.0213
D(LTEC(-1))	0.9270	0.1735	5.3422	0.0005
D(LGDP)	0.1521	0.0250	6.0801	0.0002
D(LGDP(-1))	0.1214	0.0271	4.4772	0.0015
D(LGDP(-2))	0.1104	0.0232	4.7540	0.0010
CointEq(-1)	-0.6576	0.0819	-8.0261	0.0000
Cointeq = LCO - (0.0424*LST1 + 0.0601*LFDI2 -0.0299*LCEC+0.1042*LTEC + 0.2899*LGDP + 18.4379)				
Long-run coefficient estimates				
Variables	**Coefficient**	**Standard error deviation**	**T statistic**	**Probability**
LST	0.0424	0.0197	2.1484	0.0260
LFDI	0.0600	0.0277	2.1679	0.0268
LCEC	-0.0299	0.0093	-3.2002	0.0184
LTEC	0.1041	0.0385	0.6991	0.0247
LGDP	0.2898	0.0451	6.4196	0.0001
constant	18.4379	2.9914	6.1635	0.0002

Regarding the research findings, more foreign direct investments inflow and stock market development in Iran can lead to an increase in clean energy consumption and a decrease in the emission of pollutant gasses through the replacement of clean and environmentally friendly technologies with pollutant technologies; therefore, there should be regular policy makings regarding investment in renewable energies. On the other hand, findings show that increasing foreign direct investment and stock market development will increase economic activities and, finally, result in an increase in CO_2 emission. It also should be noted that a country's policymakers should orient investments and the benefits derived from stock market development toward financing renewable projects; furthermore, they should place the priorities of financial institutions on these projects and, finally, encourage the private sector to invest in this sector.

6. ACKNOWLEDGEMENT

The authors would like to thank all organizations that provided data for this research.

APPENDICES

Table 1. Summary of previous studies.

The first group of empirical studies: the relationship between foreign direct investment flow with energy consumption and CO_2 Emission.			
Author/Authors	**Country and time period**	**Methodology**	**Research findings**
Ben Jebli, M. et al. (2019)	USA 1995-2010	Granger causality test	Short-run Granger causality tests illustrate positive relationship between variables. In the long run, bidirectional causality between renewable energy, tourism, FDI, trade, and CO_2 emissions should be considered.
Khandker, L.L. et al. (2018)	Bangladesh 1980-2015	Johansen's cointegration and Granger causality test	Johansen's cointegration test confirms that variables are cointegrated in the long run and Granger causality test reveals that there is a bidirectional causality between variables of interest. Through Vector Error Correction Model (VECM) found no causality between the variables in the short run.

Ghazouani, T. (2018)	MENA 1990-2015	ARDL	The long run analysis found the evidence of cointegraion for all of the MENA coteries Variables. The short-run Granger-causality reveals varied nature of direction of causality between Foreign direct investment, Renewable energy consumption, and economic growth and that is different among countries.
Chor, F.T. and Bee, W.T. (2015)	Vietnam 1976–2009	Granger causality test	There is a long-run balance between energy consumption, income, foreign direct investment, and CO_2 emission.
Sbia, R. et al. (2014)	UAE 1975-2011	Autoregressive distribute lag model (ARDL) and Vector Error correction model (VECM)	There is a Mutual Causality relationship between foreign direct investment and clean energy consumption in UAE economics. Also, clean energy and economic growth have a positive and significant effect on energy consumption.
Hsiago, T.P. and Chung, M.T. (2011)	Brazil, Russia, India and China 1980-2007	Panel cointegration test and Granger causality test	In long-run balance, CO_2 emission is elastic with energy consumption and not elastic on FDI. There is a long-run and short-run mutual causality relationship between FDI and energy consumption, CO_2 emission, and GDP.
Asadpour and Eskruchi (2016)	1977-2013	Vector Autoregressive (VAR) and Vector Error Correction (VEC)	There is a positive relationship between FDI, trade openness, CO_2 emission, and economic growth with energy demand.
Sadeghi et al. (2013)	Iran 1981-2008	Toda – Yamamoto test	The causality relationship between CO_2 emission and GDP is not confirmed.
Barghi et al. (2013)	D8 countries 1990-2010	Generalized method of moments	Variables have a positive and significant relationship between CO_2 emission and other variables except for FDI.
The second group of empirical studies: the effect of financial development (stock market in particular) on energy consumption.			
Researcher name	**Country and time period**	**Research method**	**Research findings**
Shujing, Sh. et al. (2019)	21 transitional countries 2006-2015	Panel data	Stock markets development led to decreased energy consumption in China and Poland. Financial openness development reduced energy use except in Georgia and the Kygyz Republic.
Gomez, M. and Rodriguez, C.J. (2019)	USA 1971-2015	Panel data	There is a positive relationship between GDP and EC, while there is a negative relationship among FD, CPI, URB, and TO and Energy Consumption.
Saini, S. and Nego, Y. (2018)	India 1978-2014	Granger causality test	There is no long-run causality between the variables, but there exists bi-directional short-run causality relationship between financial development and energy consumption in India.
Jeayoon and Kwangwoo (2016)	30 countries 2000-2013	Tobin panel model	With respect to the results, renewable energy sectors need foreign finance and developed financial market strongly. In countries with developed financial markets, renewable energies have been more developed.
Suh, C.C. (2015)	53 countries (countries with low and high income) 1999-2008	Threshold panel regression	Stock market development- as a financial development factor- in emergent economics with high income leads to an increase in energy consumption.
Serap, C. and Mert, T. (2013)	27 of European Union countries 1990-2011	GMM model	Financial development leads to an increase in energy consumption in these countries regardless of its source whether it derives from bank sector or stock market.
Sadorsky (2011)	9 European countries 1996-2006	Dynamic panel Demand	Only stock market turnover has a positive and significant effect on energy consumption.
Zhang, Y.J. et al. (2011)	1992- 2009	Granger causality test	There is a unilateral causality relationship between stock market development and energy consumption.
Farazmand et al. (2016)	Iran 1977-2010	Unbound Error correction model (UECM) and Toda-Yamamoto Granger causality test	Financial development indices such as allocated credit to private sector- GDP ratio, Cash, traded stocks to stock market total trades ratio and economic growth have a long-run relationship with energy consumption and also unilateral causality relationship from financial development and economic growth to energy consumption.
Oladi et al. (2013)	Iran 1981-2008	ARDL model	There is a positive and significant statistical relationship between financial development and energy demand.
Ebrahimi and Al morad Jabdarghi (2013)	D8 countries 1988-2008	Panel data pattern	Financial market development has a positive and significant effect on energy consumption.
The third group of empirical studies: investigation of simultaneous effect of FDI and stock market development on energy consumption.			

Researcher name	Country and time period	Research method	Research findings
Razmi, S.F. et al. (2020)	Iran 1990-2014	ARDL	Growth rate significantly affects total hydropower, wind, solar, and nuclear energies in both the short and long run, although it is only significant in the short run for combustible renewable and waste energies. Neither type of renewable energy consumption affects growth in either the short or long run.
Kutan, A.M. et al. (2018)	Brazil, China, India, and South Africa 1990-2012	panel	Renewable energy consumption helps to mitigate the growth of CO_2 emissions and promotes economic development.
Paramati, R.S. et al. (2016)	20 emergent economics 1991- 2012	Heterogeneity test panel	Economic production, FDI, and stock market development have a positive and significant effect on clean energy consumption and, in the short run, there is a unilateral causality relationship between FDI and clean energy consumption.

REFERENCES

1. Asadpour, A.A. and Eskruchi, E., "Investigation of the relationship between foreign direct investment, clean energy, trade openness, economic growth with energy demand in Iran", ***Quarterly Journal of Government Management***, Vol. 4, No. 9-10, (2013), 16-22. (http://noo.rs/vsZ0d).
2. Asghari, M. and Nazar Rafsanjani Pour, S., "The effect of foreign direct investment on environmental quality of selected countries", ***Quarterly Journal of Economic Development Research***, No. 9, (2013), 1-30. (http://noo.rs/KEvPp).
3. Barghi, O., Mohammad Mahdi, F.F. and Zhende Khatibi, S., "The effect of factory production and foreign direct investment on CO_2 emission in D8 countries", ***Quarterly Journal of Economic Modelling***, Vol. 6, No. 4, (2012), 93-109. (magiran.com/p1131949).
4. Beck, T. and Levine, R., "Industry growth and capital allocation: Does having a market-or bank-based system matter?", ***Journal of Financial Economics***, Vol. 64, (2002), 147-180. (https://doi.org/10.1016/S0304-405X(02)00074-0).
5. Ben, J.M., Youssef, S.B. and Apergis, P., "The dynamic linkage between renewable energy, tourism, CO_2 emissions, economic growth, foreign direct investment and trade", ***Latin American Economic Review***, Vol. 28, No. 2, (2019), 2182-2195. (https://doi.org/ 10.1186/s40503-019-0063-7).
6. Bornesztein, E., Gregorio, J. and De Lee, J.W., "How does foreign direct investment effect economic growth?", ***Journal of International Economics***, Vol. 45, No. 1, (1998), 115-135. (https://doi.org/10.1016/S0022-1996(97)00033-0).
7. Brookes, L.G., "Energy efficiency fallacies revisited", ***Energy Policy***, Vol. 28, (2000), 355-366. (https://doi.org/10.1016/S0301-4215(00)00030-6).
8. Brown, J.R., Fazzari, S.M. and Petersen, B.C., "Financing innovation and growth: Cash flow, external equity, and the 1990s R&D boom", ***The Journal of Finance***, Vol. 64, No. 1, (2009), 151-185. (https://doi.org/10.1111/j.1540-6261.2008.01431.x).
9. Brunnschweiler, C.N., "Finance for renewable energy: An empirical analysis of developing and transition economies", ***Environment and Development Economics***, Vol. 15, (2010), 241-274. (https://doi.org/10.1017/S1355770X1000001X).
10. Chang, S.C., "Effects of financial developments and income on energy consumption", ***The International Review of Economics & Finance***, Vol. 35, (2015), 28-44. (https://doi.org/10.1016/j.iref.2014.08.011).
11. Chor, F.T. and Bee, W.T., "The impact of energy consumption, income and foreign direct investment on carbon dioxide emissions in Vietnam", ***Energy Economics***, Vol. 79, (2015), 447-454. (https://doi.org/ 10.1016/j.energy.2014.11.033).
12. Coban, S. and Topcu, M., "The nexus between financial development and energy consumption in the EU: A dynamic panel data analysis", ***Energy Economics***, Vol. 39, (2015), 81-88. (https://doi.org/ 10.1016/j.eneco.2013.04.001).
13. Costantini, V. and Martini, C., "The causality between energy consumption and economic growth: A multi-sectoral analysis using nonstationary cointegrated panel data", ***Energy Economics***, Vol. 32, (2010), 591-603. (https://doi.org/10.1016/j.eneco.2009.09.013).
14. Derrick, A., "Financing mechanisms for renewable energy", ***Renewable Energy***, Vol. 15, (1998), 211-214. (https://doi.org/10.1016/S0960-1481(98)00159-1).
15. Ebrahimi, M. and Ebrahimi Al Morad, M., "Development of financial markets and energy consumption in D8 countries", ***Quarterly Journal of Economic Policies***, Vol. 20, No. 61, (2019), 159-174. (http://noo.rs/biO5Q).
16. International Energy Statistics, U.S. Energy Information Administartion (EIA), (2015).
17. Farazmand, H., KamranPour, S. and Ghorban Nezhad, M., "The relationship between financial development, economic growth and energy consumption in Iran, Toda-Yamamuto and Bond test", ***Quarterly Journal of Economics (Former Economics Investigations)***, Vol. 10, No. 1, (2015), 33-58. (http://noo.rs/PB0wi).
18. Fotros, M.H., Aghazadeh, A. and Jebraeeli, S., "Investigation of the effect of renewable and non-renewable energies consumption on economic growth of selected developing countries (including Iran)", ***Quarterly Journal of Energy Economics Studies***, Vol. 9, No. 32, (2012), 51-72. (https://doi.org/10.22055/JQE.2013.12284).
19. Ghazouani, T., "Re-examining the foreign direct investment, renewable energy consumption and economic growth nexus: Evidence from a new bootstrap ARDL test for cointegration, MIPRA 89975", (2018), 1-27. (https://mpra.ub.uni-muenchen.de/id/eprint/89975).
20. Gomez. M. and Jose, R.C., "Energy consumption and financial development in NAFTA countries, 1971-2015", ***Economic and Business Research Institute***, Vol. 9, No. 2, (2019), 302-314. (https://doi.org/10.3390/app9020302).
21. Grossman, S., "On the efficiency of competitive stock markets where trades have diverse", (1976). (https://doi.org/10.1111/j.1540-6261.1976.tb01907.x).
22. Hasiao-Tien, P. and Chung-Ming, T., "Multivariate granger causality between CO_2 emission, energy consumption, FDI (foreign direct investment) and GDP (gross domestic product): Evidence from a panel of BRIC (Brazil, Russian Federation, India, and China)", ***Countries Energy Policy***, Vol. 36, (2011), 685-693. (https://doi.org/ 10.1016/j.energy.2010.09.041).
23. Hsu, P.H., Tian, X. and Xu, Y., "Financial development and innovation: Cross-country evidence", ***Journal of Financial Economics***, Vol. 112, No. 1, (2014), 116-135. (https://doi.org/10.1016/j.jfineco.2013.12.002).
24. Inglesi-Lotz, R., "The impact of renewable energy consumption to economic welfare: A panel data application", ***Energy Economics***, Elsevier, Vol. 53, No. C, (2015), 58-63. (https://doi.org/10.1016/ j.eneco.2015.01.003).
25. Kakar, K., Khilji, B. and Khan, M., "Financial development and energy consumption: Empirical evidence from Pakistan", ***International Journal of Trade, Economics and Finance***, (2011), 2-6. (https://doi.org/10.1080/15567249.2011.603020).
26. Khandker, L., Sakib, B.A. and Khan, F., "Renewable energy consumption and foreign direct investment: Reports from Bangladesh", ***Journal of Accounting, Finance and Economics***, Vol. 8, No. 3, (2018), 72-87. (https://doi.org/10.1016/j.rser.2015.08.017).
27. Kim, J. and Park, K., "Financial development and deployment of renewable energy technologies", ***Energy Economics***, Vol. 59, (2018), 238-250. (https://doi.org/10.1016/j.eneco.2016.08.012).

28. Kutan, M.A., Sudharshan, P.R., Mallesh, U. and Abdulrasheed, Z., "Financing renewable energy projects in major emerging market economies: Evidence in the perspective of sustainable economic development", ***Energy Finance***, Vol. 54, No. 8, (2018), 1761-1777. (https://econpapers.repec.org/RePEc:mes:emfitr:v:54:y:2018:i:8:p:1761-1777).
29. Lee, J.W., "The contribution of foreign direct investment to clean energy use, carbon emissions and economic growth", ***Energy Policy***, Vol. 55, (2013), 483-489. (https://doi.org/10.1016/j.enpol.2012.12.039).
30. Levine, R., "Financial development and economic growth: Views and agenda", ***Journal of Economic Literature***, Vol. 35, No. 2, (1997), 688-726. (https://EconPapers.repec.org/RePEc:aea:jeclit:v:35:y:1997:i:2:p:688-726).
31. Levine, R., "Finance and growth: Theory and evidence", Handbook of economic growth, Vol. 1, (2005), 865-934. (https://econpapers.repec.org/RePEc:eee:grochp:1-12).
32. Levine, R. and Zervos S., "Stock markets, banks, and economic growth", ***The American Economic Review***, Vol. 88, No. 3, (1998), 537-558. (https://www.jstor.org/stable/116848).
33. Manzour, D., Aghababayi, M.E. and Haghighi, I., "Analyzing the recursive effects of efficiency improvement in electricity consumption in Iran: Computable general balance patter", ***Quarterly Journal of Energy Studies***, Vol. 8, No. 29, (2011), 1-23. (http://noo.rs/8xLcE).
34. Marin, D., "Is the export-led hypothesis valid for industrialize countries?", ***Review of Economics and Statistics***, Vol. 74, (1992), 678-688. (https://doi.org/10.2307/2109382).
35. Medlock, K.B. and Soligo, R., "Economic development and end-use energy demand", ***The Energy Journal***, Vol. 22, (2001), 77-105. (https://www.jstor.org/publisher/iaee?refreqid=excelsior%3A76fb53a6726075823818c1df33e9bbae).
36. Moradpour Oladi, M., Ebrahimi, M. and Tarkaman Ahmadi, M., "Financial market development and energy demand in Iran", ***Quarterly Journal of Energy and Environmental Economics***, Vol. 2, No. 5, (2012), 187-209. (http://jiee.atu.ac.ir/article_779.html).
37. Narayan, P.K. and Smyth, R., "Electricity consumption, employment and real income in Australia evidences from multivariate granger causality tests", ***Energy Policy***, Vol. 33, No. 9, (2005), 1109-1116. (https://doi.org/10.1016/j.enpol.2003.11.010).
38. Omri, A. and Chaibi, N., "Nuclear energy, renewable energy, and economic growth in developed and developing countries: A modelling analysis from simultaneous-equation models", ***Ipag Business School, and Working Paper***, (2014), 2014-188. (https://EconPapers.repec.org/RePEc:ipg:wpaper:2014-188).
39. Pesaran, M., Shin, Y. and Smith, R., "Bounds testing approaches to the analysis of level relationships", ***Journal of Applied Econometrics***, Vol. 16, (2001), 289-326. (https://doi.org/10.1002/jae.616).
40. Razmi, S.F., Ramezanian Bajgiran, B., Behname, M., Ebrahimi Salari, T. and Razmi, S.M.J., "The relationship of renewable energy consumption to stock market development and economic growth in Iran", ***Renewable Energy***, Vol. 145, (2020), 2019-2024. (https://doi.org/10.1016/j.renene.2019.06.166).
41. Sadeghi, S.K., Motefakker Azad, M.A., Pour Ebadolahian Kouch, M. and Shahbaz Zadeh, A., "Investigation the causal relationship between CO_2 emission, foreign direct investment, Energy consumption per capita and gross domestic production in Iran (Toda-Yamamuto causality test)", ***Quarterly Journal of Energy and Environment Economics***, Vol. 1, No. 4, (2012), 101-116. (http://jiee.atu.ac.ir/article_601.html).
42. Sadorsky, P., "Financial development and energy consumption in central and eastern european frontier economies", ***Energy Policy***, Vol. 39, (2011), 999-1006. (https://doi.org/10.1016/j.enpol.2010.11.034).
43. Sadorsky, P., "Correlations and volatility spillovers between oil prices and the stock prices of clean energy and technology companies", ***Energy Economics***, Vol. 34, (2012), 248-255. (https://doi.org/10.1016/j.eneco.2011.03.006).
44. Saini, S. and Yadawananda, N., "Examining the linkages between financial development and energy consumption in India", ***Proceedings of International Conference on Economics and Finance***, (2018), 119-130.
45. Salim, R.A., Hassan, K. and Shafiei, S., "Renewable and nonrenewable energy consumption and economic activities: Further evidence from OECD countries", ***Energy Economics***, Vol. 44, (2014), 350-360. (https://doi.org/10.1016/j.eneco.2014.05.001).
46. Sbia, R., Shahbaz, M. and Hamdi, H., "A contribution of foreign direct investment, clean energy, trade openness, carbon emissions and economic growth to energy demand in UAE", ***Economic Modeling***, Vol. 36, (2014), 191-197. (https://doi.org/10.1016/j.econmod.2013.09.047).
47. Serap, C. and Topcu, M., "The nexus between financial development and energy consumption in the EU: A dynamic panel data analysis", ***Energy Economics***, Vol. 39, (2013), 81-88. (https://doi.org/10.1016/j.eneco.2013.04.001).
48. To, H., Wijeweera, A. and Charles, M.B., "Energy consumption and economic growth– The case of australia", ***Proceedings of The 42nd Australian Conference of Economists, Conference Proceedings Beyond the Frontiers, New Directions in Economics***, Murdoch University, Perth, Western Australia, (2013).
49. Yue, S., Lu. R., Yongchan, Sh. and Hongtao, Ch., "How does financial development affect energy consumption? Evidence from 21 transitional countries", ***Energy Policy***, Vol. 130, (2019), 253-262. (https://doi.org/10.1016/j.enpol.2019.03.029).
50. Zhang, Y.J., Fan, J.L. and Chang, H.R., "Impact of China's stock market development on energy consumption: An empirical analysis", ***Energy Procedia***, Vol. 5, (2011), 1927–1931. (https://doi.org/10.1016/j.egypro.2011.03.331).