JURNAL PENDIDIKAN EKONOMI, PERKANTORAN DAN AKUNTANSI
http://pub.unj.ac.id/index.php/jpepa

CAUSAL RELATIONSHIP BETWEEN RENEWABLE ENERGY CONSUMPTION, ECONOMIC WELFARE, AND FOREIGN DIRECT INVESTMENT IN 6 ASEAN COUNTRIES

Ghina Giartikasari[1], Sri Indah Nikensari[2], Herlitah[3]

[1]*Universitas Negri Jakarta, Indonesia*
[2]*Universitas Negri Jakarta, Indonesia*
[3]*Universitas Negri Jakarta, Indonesia*

Article Info

Article history:
Received: 16 February 2022
Accepted: 17 November 2022
Published: .

Keywords:
Renewable energy; Economic growth; FDI; VECM; ASEAN

Abstract

This is an empirical study on the causal relationship between renewable energy consumption, economic welfare, and foreign direct investment in 6 ASEAN countries over period 2005-2019 using Panel-Vector Error Correction Model. Specifically, the unit root test, cointegration test, Granger causality test, and vector error correction model are imployed for the estimations. Empirical results do not confirm feedback causality between renewable energy consumption and gross domestic product per capita. The empirical results indicate that there is causality, short-term and long-term relationship between renewable energy consumption, gross domestic product per capita, and foreign direct investment. Furthermore, the result for long run causality from renewable energy consumption have negative effect to gross domestic product per capita. Additionally, short-run causality from renewable energy consumption and gross domestic product per capita have positive effect to foreign direct investment. On the other hand, short-run causality from foreign direct investment have negative effect to gross domestic product per capita.

Abstrak

Ini adalah studi empiris tentang hubungan kausal antara konsumsi energi terbarukan, kesejahteraan ekonomi, dan investasi asing langsung di 6 negara ASEAN selama periode 2005-2019 menggunakan Panel-Vector Error Correction Model. Secara khusus, uji akar unit, uji kointegrasi, uji kausalitas Granger, dan model koreksi kesalahan vektor digunakan untuk estimasi. Hasil empiris tidak mengkonfirmasi kausalitas umpan balik antara konsumsi energi terbarukan dan produk domestik bruto per kapita. Hasil empiris menunjukkan bahwa terdapat hubungan kausalitas jangka pendek dan jangka panjang antara konsumsi energi terbarukan, produk domestik bruto per kapita, dan investasi asing langsung. Selanjutnya, akibat kausalitas jangka panjang dari konsumsi energi terbarukan berpengaruh negatif terhadap produk domestik bruto per kapita. Selain itu, kausalitas jangka pendek dari konsumsi energi terbarukan dan produk domestik bruto per kapita berpengaruh positif terhadap investasi asing langsung. Di sisi lain, kausalitas jangka pendek dari investasi asing langsung berpengaruh negatif terhadap produk domestik bruto per kapita.

How to Cite:

* Corresponding Author.

ISSN
2302-2663 (online)
DOI: doi.org/10.21009/JPEPA.007.x.x

INTRODUCTION PRELIMINARY

Energy has an important role in driving the economy and achieving prosperity (Apergis, 2014). Energy is closely related to all economic activities, such as agriculture, industry and household activities. Energy consumption determines economic growth and development (Salahuddin et al., 2018). The greater the energy consumption, the greater the increase in economic growth and development.

Many countries, both developed and developing, are finally trying to consume massive energy to achieve industrialization and prosperity. Consumption of primary energy such as oil, coal, as well as water and wind is converted into ready-to-use energy for electricity, transportation, and heating (Ritchie & Roser, 2020). However, the availability of energy is inversely proportional to the amount of energy demand.

Based on the World Resource Institute (Kahia et al., 2016), the availability of conventional energy is expected to run out in the next 30-50 years due to the limited nature of conventional energy. However, conventional energy consumption which includes natural gas, coal and oil still has the largest portion compared to the proportion of other energy sources. As can be seen in Figure 1.1, the world's energy consumption from fossil fuels is 79.9%.

Meanwhile, the world's consumption of renewable energy, which is an unlimited energy source, only accounts for 11% of all energy sources.

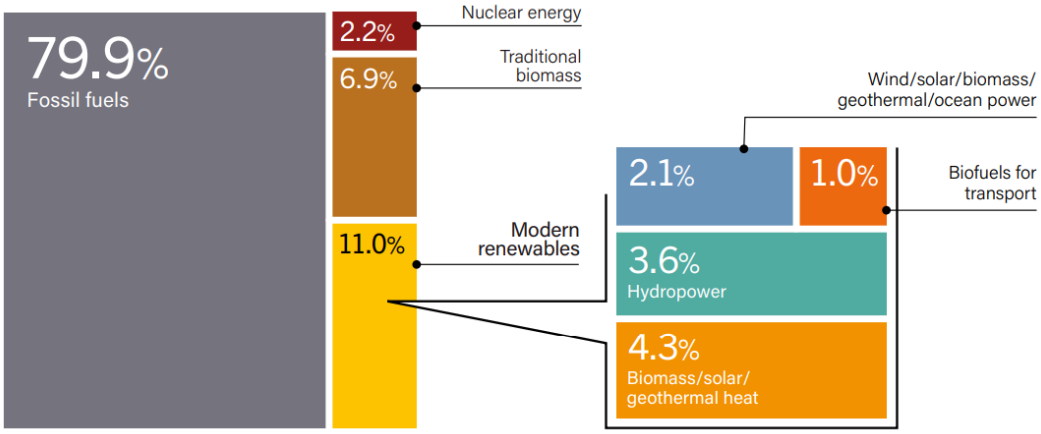

Figure 1.1 World percentage energy consumption by source

Apart from the dwindling availability of conventional energy, many studies mention the natural damage that arises due to the consumption of conventional energy. In general, there are two problems that arise as a result of conventional energy consumption: first, namely the depletion of non-renewable energy, such as gasoline, gas, coal which increases along with the increase in consumption; second, emissions from the effects of greenhouse gases such as carbon dioxide (CO^2) and methane (Venkatraja, 2020). These two problems indirectly cause externality costs.

One of the many costs of externalities due to environmental damage is the cost of damage due to CO2 emissions and energy depletion. Based on Figure I.1, it can be seen that in general the percentage of the cost of damage due to CO2 emissions has a positive trend every year. The cost of damage from CO2 emissions is estimated at US$30 per tonne of CO2 produced (World Bank, 2020). Meanwhile, the percentage of energy depletion in general is fluctuating, with quite extreme increases and decreases. The energies that are calculated in the percentage value of this energy depletion are oil, coal and natural gas.

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

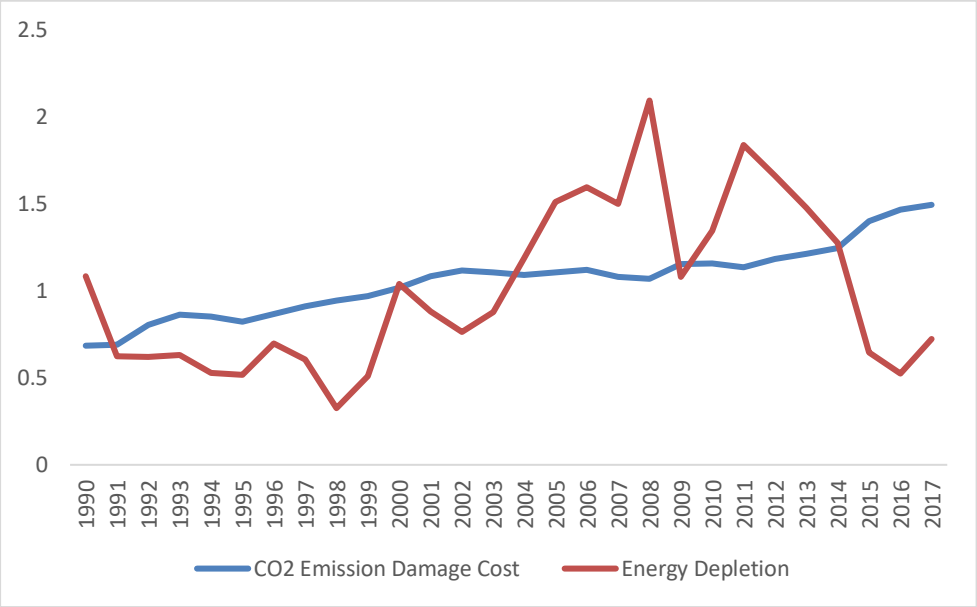

Figure 1.2 World CO2 emission damage cost and energy depletion

To overcome the problem of environmental damage and the costs of externalities caused, many countries have begun to look for alternatives to conventional energy and have begun to shift their energy use to more sustainable ones. Initial efforts to address environmental problems began with reducing fossil fuels listed in the 1997 Kyoto 1997 (Apergis, 2014). In the protocol, industry is forced to reduce greenhouse gas emissions, especially CO2. Various kinds of renewable energy are starting to be used as a substitute for conventional energy such as solar energy, biofuels, wind energy, water energy, and others. The use of renewable energy is one solution to reduce environmental damage. Renewable energy is considered to be in synergy with many aspects of sustainable development (Inglesi-Lotz, 2016b).

This is different from conventional energy which requires a long production process to get ready-to-use resources. Renewable energy such as water, wind, and solar heat can be directly used and then processed directly as needed. The term renewable energy consumption refers to the use of a number of energy from renewable sources that are used for electricity production, transportation, and heating (Ritchie & Roser, 2020).

The use of renewable energy has finally become a trend in order to reduce the impact of environmental damage. In a report by the International Renewable Energy Agency (IRENA), the use of clean energy can achieve 90% reduction in CO2 emissions in accordance with the main objectives of the 2015 Paris Climate Change Agreement (United Nation Climate Change, 2017). In the agreement, the countries agreed to limit the average temperature increase to a maximum of 2 degrees Celsius. Many developed countries have long replaced most of the use of non-renewable energy into the use of renewable energy. Meanwhile, developing countries are starting to plan steps and prepare themselves to make the transition.

ASEAN as one of the regions in the Asia Pacific region is an economic area that not only has a fairly high level of economic growth but also demographic, social, and energy problems. Fossil fuels or non-renewable energy still dominate the source of electrical energy in ASEAN. Meanwhile, based on several statistical results regarding energy, ASEAN countries have abundant renewable resources. However, these resources are not evenly distributed (Y. Chang & Li, 2015). For example, hydropower is abundant in Laos and Myanmar, while geothermal is abundant in Indonesia and the Philippines (IRENA, 2016).

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

Table 1. Renewable Energy Consumption Growth in terawatt-hours (TWh) in Several ASEAN Countries 2016-2019

	2016		2017		2018		2019	
	TWh	%	TWh	%	TWh	%	TWh	%
Indonesia	30.972	24.9	32.074	3.6	49.134	53.2	47.663	-2.9
Thailand	25.271	82.1	25.743	1.9	29.996	16.5	33.893	12.9
Filipina	21.898	4.9	23.092	5.5	22.66	-1.9	21.425	-5.5
Vietnam	65.358	15.1	88.5	35.4	83.929	-5.2	74.189	-11.6
Laos	17.54	26.1	19.929	13.7	22.167	11.2	19.409	-12.4
Kamboja	2.638	30.5	2.763	4.7	4.770	72.6	4.119	-13.6

Source: Our World in Data, 2022

The urgency of this study about causal relationship between renewable energy, economic welfare and FDI in 6 ASEAN countries is in accordance with the 2015 ASEAN Declaration in Kuala Lumpur. In the declaration, the vision of ASEAN 2025 was set out. The vision includes environmental preservation and human development embodied in the "ASEAN Socio-Cultural Community" and economic welfare in the "ASEAN Economic Community" (ASEAN, 2015). The targets set in the ASEAN Vision 2025 regarding environmental issues, economic welfare and the formation of an investment climate to attract FDI. The ASEAN Vision 2025 is also in line with the agenda set out in the SDGs.

LITERATURE REVIEW

Renewable energy is an important discussion for economists, environmentalists, and policy makers in developing countries, especially in order to increase economic activity (Rezagholizadeh et al., 2020). Efforts to increase renewable energy are not only beneficial for growth, but also increase food, reduce the risk of environmental damage, and improve several other aspects such as social, financial, and welfare in a country (Haseeb et al., 2019). Energy consumption by a country in this case also supports sustainable economic welfare which is the main focus of development.

The results of research regarding the relationship between renewable energy consumption and economic welfare are very diverse. Maamar Sebri (2015) states, there are 4 hypotheses related to renewable energy consumption and economic growth, namely: feedback hypothesis, conservation hypothesis, growth hypothesis, and neutrality hypothesis. The feedback hypothesis shows that there is a two-way causal relationship between these variables. The conservation hypothesis shows a one-way causality relationship from economic welfare to renewable energy consumption. The growth hypothesis shows that there is a one-way causality of renewable energy consumption on economic welfare. While the neutrality hypothesis does not show a one-way or two-way causal relationship, both renewable energy consumption on economic welfare and economic welfare on renewable energy consumption.

Several studies suggest that there is a causal relationship between renewable energy and economic welfare. One of them is the research conducted by Dilek Temiz Dinç and Ece Akdoğan (2019). In a study conducted by Dilek Temiz Dinç and Ece Akdoğan through the VECM test, it is known that renewable energy and economic growth in Turkey have a

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

bidirectional relationship or a two-way relationship in the short term. This relationship shows that renewable energy is important for economic growth, and vice versa that economic growth will encourage more use of the renewable economy (Dinç & Akdoğan, 2019). In addition, in a study conducted by Dalia Ibrahiem (2015) through the Granger causality test, it is known that renewable energy consumption and economic growth in Egypt have a bidirectional relationship. The results of this study indicate that the policies carried out by the government related to energy conservation are appropriate (Ibrahiem, 2015). Another researches that show the results of Feedback Hypothesis are research conducted by Apergis and Payne (2010a)(2010b)(2011b), Lin and Moubarak (2014), Shabaz et al. (2015), T. Chang et al. (2015) and Tugcu et al. (2012).

Research conducted by Abdulkadir Abdulrashid Rafindadia and Ilhan Ozturk (2017) also seeks to reveal how important renewable energy is to economic growth in Germany. This study uses the ARDL approach and time series data from 1971 – 2013 obtained from the World Development Indicators. The causal relationship was also analyzed using the Granger causality test. The data used in this study are real GDP, renewable energy consumption, real capital stock and labor.

This study reveals that in the long term renewable energy consumption has a significant positive relationship on economic growth. Likewise with capital and labor. Meanwhile, in the short term, consumption of renewable energy has a positive but not significant relationship with economic growth. In contrast to the consumption of renewable energy, capital and labor in the short term have a significant positive relationship to economic growth. Another researches conducted by Ocal Aslan (2013) and Sadorsky (2010) show the result of Conservation Hypothesis which show that economic growth has an effect on renewable energy consumption.

On the other hand, studies that show the growth hypothesis Hypothesis which show that renewable energy consumption has an effect on economic growth include Payne (2011) and Inglesi-Lotz (2016a). Meanwhile the research conducted by Angeliki Menegaki shows Neutrality Hypothesis which does not show any relationship between renewable energy consumption and economic growth.

In addition to the causal relationship between renewable energy consumption and economic growth, the relationship between renewable energy consumption and investment also needs to be discussed, especially FDI. FDI is the main source of investment flows in developing countries (Parab et al., 2020). The influx of FDI in developing countries encourages energy consumption through the expansion of industry, transportation, and manufacturing. However, in the process of achieving sustainable economic welfare, energy availability needs to be considered in more detail. Therefore, to achieve sustainable aspects, the consumption of renewable energy is prioritized over conventional energy consumption. In addition to the effect of FDI on the consumption of renewable energy previously described, the opposite is also true. In this regard, ASEAN has built an investment climate to attract investment and accelerate the spread of renewable energy (IRENA, 2018).

Research conducted by Khandker et al. (2018) and Fethi Amri (2016) mention a causal relationship between FDI and consumption of renewable energy. Consumption of renewable energy can affect the amount of FDI inflows into a country. Countries that prioritize renewable energy consumption are more attractive to investors than countries with conventional energy consumption (Parab et al., 2020).

In addition, the discussion of the causal relationship between renewable energy and FDI, the relationship between FDI and economic welfare is also important to discuss. The role of FDI in improving economic welfare is considered a basic principle of economics (Omri & Kahouli, 2014). In examining the relationship between the two, many studies mention a

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

causal relationship between FDI and economic growth.

Research conducted by Weiyang Fan and Wu Hao (Fan & Hao, 2020)aims to quantitatively examine the relationship between total GDP, renewable energy consumption, and FDI in China. This research was conducted to 31 provinces in China with the period 2000-2015. All data were collected from the official website of the Statistical Office of the People's Republic of China, the statistical yearbook of China and the website of the Ministry of Commerce of the People's Republic of China. Vector error correction model (VECM) is used to determine the relationship between the three variables from a short-term and long-term perspective. In addition, the Granger causality test was also used to analyze the relationship between the three variables.

The results of this study indicate that the rate of GDP per capita, the rate of consumption of renewable energy and the rate of FDI per capita of China have a long-term stable relationship. In addition, based on the Granger causality test, all variables, both short term and long term, have a reciprocal relationship. In this study, the researcher also suggested several things, especially related to FDI. In order to increase the use of renewable energy and ensure energy availability, the government needs to increase FDI even further. However, in this regard the researcher also emphasizes that the government should pay more attention to the quality of FDI and its policies to prevent polluting companies from entering the market in the energy industry.

Some of these studies include research conducted by Moudatsou and Kyrkilis (2011); Rininta (2013); and Agrawal (2015). The amount of FDI in a country can affect the growth of the country's national income, and vice versa. Countries with a good level of economy, one of which is judged by the number of Gross Domestic Product (GDP) can attract investors to be able to invest in the country. Total GDP can describe the economic condition of a country.

DATA AND METHODOLOGY

DATA

The objects studied in this study are the consumption of renewable energy, economic welfare and foreign direct investment in ASEAN. This study uses 6 ASEAN countries as samples that are considered representative. These countries include Indonesia, Thailand, the Philippines, Vietnam, Laos, and Cambodia.

The data used in this study is secondary data obtained from various international institutions. Each variable uses a 15-year range, namely the period 2005-2019. The data range was chosen because it shows the current actual condition. In addition, this period is related to the ratification of the declaration of the Millennium Development Goals (MDGs) in 2000 and the Sustainable Development Goals (SDGs) in 2016.

The data in this study were obtained from various sources including the World Bank website https://data.worldbank.org/country/ for economic welfare variables and foreign investment and the Our World in Data website https://ourworldindata.org/ for renewable energy consumption.

METHODOLOGY

The method used in this research is descriptive quantitative method. Descriptive research is a type of research that studies phenomena in detail and distinguishes them from other phenomena (Siyoto & Sodik, 2015). While quantitative research is a type of research whose data analysis uses statistical tests. The process of data analysis in quantitative research includes data processing, data presentation, calculations and hypothesis testing.

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

This study seeks to determine the respective short-term and long-term effects and the causal relationship of the three variables studied, namely Economic Welfare (X), Foreign Direct Investment (Y), and Renewable Energy Consumption (Z).

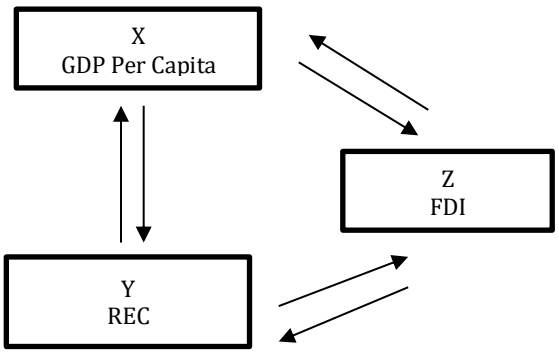

Figure 3. Research Design

This research was investigated using the P-VECM (Panel Vector Error Correction Model) analysis technique. This method was chosen to see the existence of cointegration or long-term and short-term relationships between each variable. The VECM method is a derivative method of VAR (Vector Autoregressive), or commonly referred to as restricted VAR. The VAR method is a non-structural or theoretical method that was built with the aim of understanding economic phenomena well (Ansofino et al., 2016). In addition, the Granger causality test was also used to examine the existence of a two-way relationship between variables in accordance with the theories and hypotheses previously mentioned. In conducting this research, the researcher used a calculation tool in the form of Eviews version 10 software.

EMPIRICAL RESULTS

Unit Root Test

Before the estimation, data are said to be stationary if the behavior of the process does not change with time or in other words the process is in equilibrium. If the estimate is made using non-stationary variables, it will result in spurious regression (Winarno, 2017).

Based on the results, it is known that the GDP the FDI, and the REC value at level probability value greater than 5% (0.05) so that it can be concluded that all variables are not stationary at the level and need to be tested for stationary on the first difference with a degree of confidence = 5%.

On the results at the first difference level, the GDP, FDI and REC variables have a probability value of 0.00. At the level of confidence = 5%, it is known that all variables have a probability value less than 5% (0.05) so that it can be concluded that all variables are stationary at the first difference level. Based on these results, it has been fulfilled that in conducting the VECM analysis, there is an assumption that must be fulfilled, namely that all independent variables must be stationary in the same order.

Cointegration Test

Based on the **Table 4.4** below, it is known that the probability value at the level of none to At most 2 has a value of 0.00 < 1, 5 or 10% so that it can be concluded that there is a long-term relationship on Economic Welfare, Foreign Direct Investment, and Renewable

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

Energy Consumption in 6 ASEAN Countries.

Table 4.4 Cointegration test results

Hypothesized No. of CE(s)	Fisher Stat.* (*from trace test*)	Prob.	Fisher Stat.* (*from max-eigen test*)	Prob.
None	59.42	0.0000	59.42	0.0000
At most 1	116.2	0.0000	116.2	0.0000
At most 2	61.41	0.0000	61.41	0.0000

Granger Causality Test

In order to to test the direction of causality between REC and GDP per capita and FDI, Granger causality test was employed. Granger Causality was used because of that ability to respond to both large and small sample sizes.

Table 4.5 Granger causality test results

Null Hypothesis:	Obs	F-Statistic	Prob.
GDP does not Granger Cause FDI	78	0.30283	0.7396
FDI does not Granger Cause GDP		2.94179	0.0591
REC does not Granger Cause FDI	78	3.50392	0.0352
FDI does not Granger Cause REC		0.90175	0.4103
REC does not Granger Cause GDP	78	0.79799	0.4541
GDP does not Granger Cause REC		0.21237	0.8092

According to **Table 4.5**, the causality test at the 5% level of significance show that the GDP per capita and FDI has a probability value of 0.7396 <0.05, it can be concluded that there is a causal relationship between GDP and FDI variables. But the FDI variable on GDP has a probability value of 0.0591 > 0.05, it is concluded that there is no causal relationship between the FDI variable and GDP.

While the GDP variable on REC has a probability value of 0.8092 > 0.05, it is concluded that there is no causal relationship between GDP and REC variables. But for the REC variable to GDP has a probability value of 0.4541 > 0.05, it is concluded that there is no causal relationship between the REC variable and GDP. So it can be concluded that there is no one-way or two-way relationship between GDP and REC.

While FDI variable on REC has a probability value of 0.4103 < 0.05, it can be concluded that there is a causal relationship between FDI and REC variables. But the REC variable on FDI has a probability value of 0.0352 < 0.05, it is concluded that there is a causal relationship between the REC variable and FDI. So it can be concluded that there is a one-way relationship between REC and FDI.

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

VECM Model

VECM is the development of a VAR model that is used for data that is not stationary at the level but is differentiated and has one or more cointegration relationships. The estimated long-term VECM results are as follows:

Table 4.6 VECM long-run estimation results.

Cointegrating Eq:	CointEq1
GDP(-1)	1.000000
REC(-1)	-190.1397 (75.0502) [-2.53350]
FDI(-1)	-1.59E-07 (1.6E-07) [-0.99629]
C	2498.722

The relationship and the magnitude of the influence on the FDI and REC variables on GDP are shown in the following equation:

$$GDP(-1) = 2498.722 - 1.59E\text{-}07^{*} FDI(-1) - 190.1397^{*} REC(-1)$$

From the model table above, it is known that in the long run, the REC variable has a negative effect on GDP. Furthermore, the results of the identification of the short-term relationship of the dependent variable to the independent variable can be shown in the table as follows:

Table 4.7 VECM short-run estimation results.

Error Correction:	D(GDP)	D(FDI)	D(REC)
CointEq1	0.007364 (0.00736) [1.00114]	-105851.2 (140617.) [-0.75276]	-0.000503 (0.00016) [-3.15538]
D(GDP(-1))	0.408393 (0.11805) [3.45961]	96964.63 (2256589) [0.04297]	-0.000722 (0.00256) [-0.28191]
D(GDP(-2))	-0.006157 (0.12654) [-0.04865]	7437313. (2419031) [3.07450]	0.002991 (0.00274) [1.08975]
D(GDP(-3))	0.069671 (0.12323)	-1029179. (2355757)	-0.001592 (0.00267)

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

	[0.56536]	[-0.43688]	[-0.59543]
D(FDI(-1))	-1.11E-08	-0.550034	-4.19E-11
	(6.9E-09)	(0.13156)	(1.5E-10)
	[-1.60577]	[-4.18099]	[-0.28101]
D(FDI(-2))	-9.72E-09	-0.341578	-5.91E-10
	(7.1E-09)	(0.13664)	(1.6E-10)
	[-1.36016]	[-2.49988]	[-3.81376]
D(FDI(-3))	-3.32E-09	0.051043	-3.31E-10
	(7.4E-09)	(0.14137)	(1.6E-10)
	[-0.44874]	[0.36106]	[-2.06071]
D(REC(-1))	8.924504	2.05E+08	-0.248823
	(6.09055)	(1.2E+08)	(0.13210)
	[1.46530]	[1.75903]	[-1.88354]
D(REC(-2))	6.509637	-26725971	-0.558443
	(6.74854)	(1.3E+08)	(0.14638)
	[0.96460]	[-0.20717]	[-3.81514]
D(REC(-3))	2.538945	-1.91E+08	0.216580
	(7.41742)	(1.4E+08)	(0.16088)
	[0.34229]	[-1.34921]	[1.34619]
C	84.98182	-77456882	2.668503
	(31.7835)	(6.1E+08)	(0.68938)
	[2.67377]	[-0.12748]	[3.87086]

According to the results in **Table 4.7** explains that the GDP variable is only significantly influenced by GDP itself in the previous period. While the FDI variable is significantly influenced by GDP in the previous two periods, REC in the previous period and by itself in the previous period and the two previous periods. The REC variable is significantly influenced by FDI in the previous two and three periods and also by REC itself in the previous period and the two previous periods.

Discussion

Relationship REC-EW

Based on the results of the causality test above, it is known that the consumption of renewable energy with economic welfare in 6 ASEAN countries does not have a one-way or two-way causality relationship. However, based on the results of the long-term VECM modeling test, renewable energy consumption has a significant negative effect on economic welfare. Meanwhile, in the short term, no effect was found, both on renewable energy consumption and economic welfare projected by GDP per capita.

These results contradict the research conducted by Apergis (2014), Dalia Ibrahiem (2015) and several other studies which state that the consumption of renewable energy and economic welfare has a two-way causal relationship or also known as the feedback

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

hypothesis. In this regard, the absence of a relationship between renewable energy consumption and economic welfare can be referred to as the neutrality hypothesis (Apergis, 2014). Several other studies that support the neutrality hypothesis include research conducted by Apergis Payne (2011) and Maamar Sebri (2015).
Similar results were also found in a study conducted by Gulfen and V. E. Tuna (2019) regarding the causality between renewable energy consumption and economic growth in 5 ASEAN countries. Four of the five countries studied including Indonesia, Malaysia, Singapore and Thailand do not have a causal relationship between renewable energy consumption and economic growth. Only the Philippines shows the relationship of economic growth to renewable energy consumption but does not show the opposite direction.
This can be seen from the use of renewable energy in several ASEAN countries such as Indonesia, Thailand and the Philippines which is smaller than non-renewable energy and tends to fluctuate. Meanwhile, non-renewable energy consumption continues to increase from year to year.

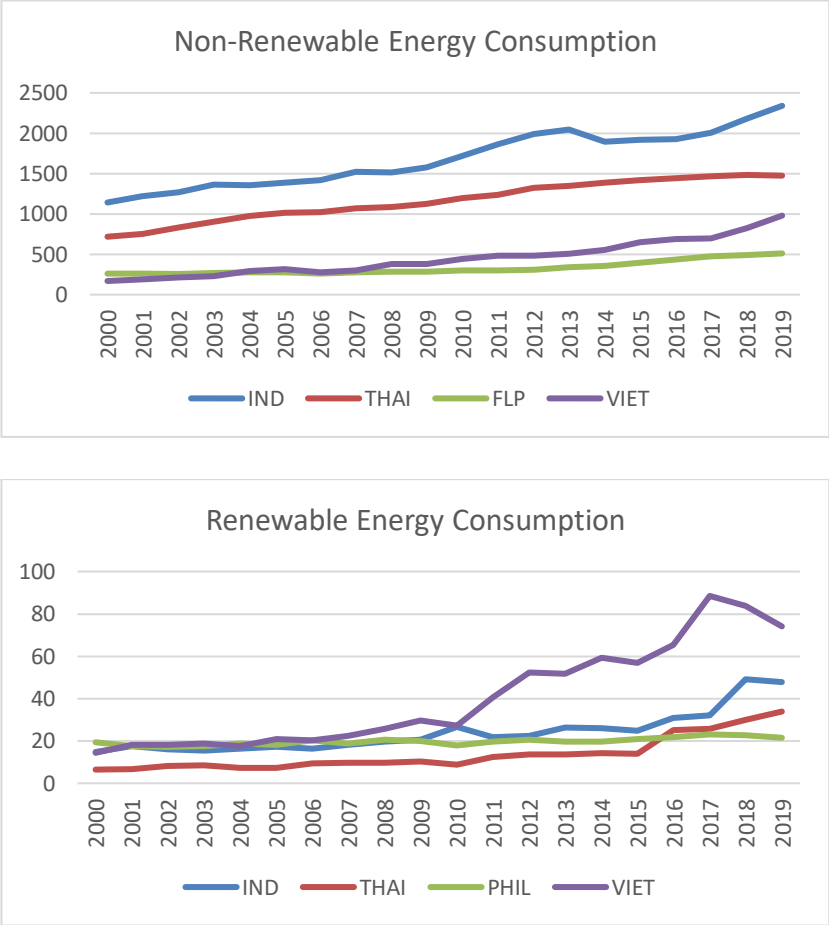

Figure 4.2 Non-renewable energy consumption and renewable energy consumption of 4 ASEAN countries

Based on Figure 4.2, it can be seen that the proportion of renewable energy consumption is much smaller than that of non-renewable energy consumption. The much larger proportion of non-renewable energy consumption causes the consumption of renewable energy to have a much greater influence on economic welfare as measured by GDP per capita (Tuna & Tuna, 2019).

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

The negative long-term effect that appears can be caused by the price of renewable energy which is much cheaper than non-renewable energy. In the World Economic Forum, it is stated that wind energy, solar thermal and other renewable energy are much cheaper, around 62% cheaper even when compared to the cheapest fossil fuel prices. This in the long term can cause the value of quantitative economic welfare projected by GDP per capita to decline. GDP per capita which is the sum of the value of goods and services divided by the total population decreases as the price of renewable energy consumption gets cheaper along with the increase and transition from non-renewable energy consumption to renewable energy consumption.

However, in the long term, qualitative welfare will increase along with improving environmental conditions. Through the transition to renewable energy consumption, one of the environmental problems can be reduced, namely the greenhouse effect. According to an article published by the Health and Environment Alliance, reducing the greenhouse effect and switching to renewable energy has a good impact on health which in turn will affect welfare including the economy.

Relationship between REC-FDI

Based on the results of the research above, it is known that the consumption of renewable energy with direct investment in 6 ASEAN countries has a one-way causality relationship from the consumption of renewable energy to foreign direct investment. These results contradict the research conducted by Omri and Kahouli (2014) and Khandker, et al. (2018) which suggests that renewable energy and direct investment have a two-way causal relationship. These results are similar to the research conducted by Narayan Parab et al. (2020) that the consumption of renewable energy affects foreign direct investment.

The amount of use of renewable energy can attract foreign direct investment into the host country. This is related to the concept of Green FDI made by the United Nations in achieving the SDGs and the dimension of sustainable energy. There are three dimensions of energy that need to be considered in development or commonly referred to as the Energy Trilemma ie. energy security, energy distribution, and environmental sustainability (World Energy Council, 2013).

Research conducted by Nadia Doytch and Narayan (2016) states that foreign direct investment tends to increase green energy practices and reduce the amount of conventional energy consumption. Other studies also mention that the expansion of industrialization, transportation and urbanization, FDI tends to induce energy consumption (Sadorsky, 2010). Based on this, the amount of renewable energy consumption can attract investors to invest in the host country with the aim of finding resources as an alternative to conventional energy (Stöbich, 2017).

On the other hand, the results show that foreign direct investment has a negative effect on renewable energy consumption in the short term. Similar results were found in a study conducted by Mohammad Khudari (2019) in Malaysia. In addition, research conducted by Okwasha (2020) also found similar results, this is in accordance with the Pollution Haven hypothesis.

The Pollution Haven hypothesis states that foreign companies from developed countries will avoid environmental policies by investing in developing countries that have looser environmental policies (Tawiah et al., 2021).. In addition, foreign direct investment made by developed countries towards developing countries also increases conventional energy consumption and causes CO2 emissions (Sarkodie et al., 2020). Therefore, foreign direct investment can have a negative effect on renewable energy consumption in the short term.

Relationship between EW-FDI

Based on the results of the research above, it is known that economic welfare with direct

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

investment in 6 ASEAN countries has a one-way causality relationship, namely the GDP per capita variable has an effect on FDI. These results are contrary to research conducted by Owusu (2020) and research by Anwar and Nguyen (2010) in which both studies suggest that GDP per capita and FDI have a two-way causality relationship.

The results of this study are similar to those of Wenfei He et al. (2012) in Shanghai. The research of Wenfei et al. states that there is a one-way relationship between GDP and FDI. So it can be concluded that the existence of economic growth in a country can increase FDI. This influence can be caused by the environment and policies that have prioritized investors (Gupta & Singh, 2016). Some of them are economic stability, broad market, adequate infrastructure as well as monetary and fiscal policies that favor investors.

An increase in GDP will result in an increase in FDI due to high return receipts. These results are also in line with the research of Dewi & Triaryati (2015) which shows that economic growth has a significant positive effect on direct investment. High economic growth describes the ability of a country to increase its economic capacity so that it attracts investors to invest their funds because high economic growth will produce goods and services so that it will be profitable for investors to invest in the country.

According to Bado (2016), the negative influence of foreign direct investment on economic welfare is caused by investments that are not well targeted. In addition, the negative results are also in line with research conducted by Sulistiawati (2012) which shows that the effect of investment on economic growth has a negative influence on the Indonesian state in 2000-2010. Some of them are caused by the impact of the global economic crisis, the uneven distribution of investment, and the average economic growth that is not proportional to the average investment growth.

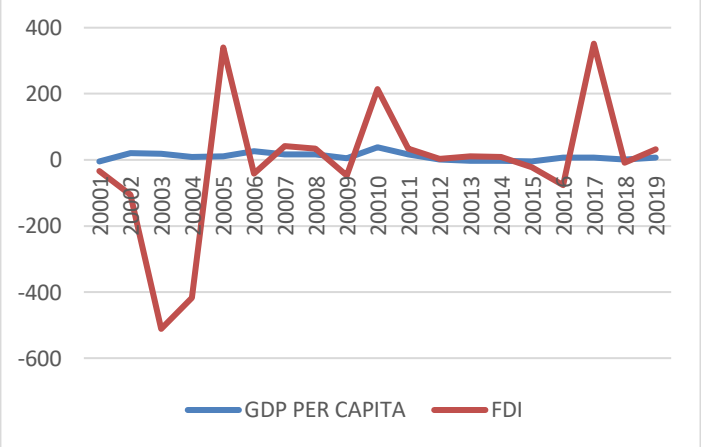

Figure 4.4 Indonesia Per capita GDP and FDI Growth 2001-2019.

Figure 4.4 shows the magnitude of GDP per capita and FDI growth in Indonesia in 2001-2019. It can be clearly seen that GDP per capita growth is quite stable with a growth rate of around 9.7%, while FDI growth is quite volatile compared to GDP per capita growth. The average FDI growth in Indonesia itself is around -10.29. The average FDI growth rate which is quite volatile and has a negative average is not enough to have an effect on GDP per capita. In addition, the annual population growth rate can also affect the relationship between FDI and GDP per capita. According to world population data provided by the World Bank, the average population of Indonesia in 2001-2019 increased by about 1.3 per year. This average population growth rate is much greater than the average FDI data in Indonesia, so that the projected economic welfare with GDP per capita has no relationship

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

and even has a negative effect in the short term.

Another study conducted by Rui Moura and Rosa Forte (2013) states that the negative influence of FDI can be caused by the implementation of government policies and technology transfers that can increase unemployment. In a study conducted by UNCTAD, it was found that 30 out of 183 countries had a negative effect on FDI on economic growth. In another study, Rashid and Hossen (2020) also found a negative effect of FDI on GDP in Bangladesh. The study states that the negative effect of FDI on GDP can be caused by investments made by foreign companies that can monopolize the host country's economy and the failure of local companies to compete with foreign companies. Similar to the research of Rui Moura and Rosa Forte, Rashid and Hossen also mention that the negative effect of FDI on GDP can also be caused by rising unemployment and high technology costs.

Conclusion

This study aims to determine the causal relationship as well as the short-term and long-term relationship of renewable energy consumption, economic welfare and foreign direct investment in 6 ASEAN countries including Indonesia, Thailand, Philippines, Vietnam, Laos, and Cambodia in 2000-2019. Based on the results of the previous analysis, this study resulted in several conclusions.

1. Consumption of renewable energy with economic welfare in the 6 ASEAN countries does not have a one-way or two-way causal relationship. In the long term, consumption of renewable energy has a negative effect on economic welfare. Meanwhile, in the short term, economic welfare has a significant positive effect on economic welfare itself in the previous period. While the consumption of renewable energy has a significant negative effect on the consumption of renewable energy itself in the previous period and the two previous periods.
2. Consumption of renewable energy with foreign direct investment in 6 ASEAN countries has a one-way relationship from renewable energy consumtion to foreign direct investment. In the short term, the consumption of renewable energy has a significant positive effect on foreign direct investment and negatively affects the consumption of renewable energy itself. Meanwhile, foreign direct investment has a negative effect on the consumption of renewable energy and foreign direct investment itself.
3. Economic welfare with foreign direct investment in 6 ASEAN countries does not have a one-way or two-way causal relationship. In the short run, foreign direct investment has a negative effect on economic welfare. Meanwhile, economic welfare has a positive influence on foreign direct investment.

Policy Recommendations

According to the results, it can reflect the influence of ineffective energy conservation policies on economic growth (Ibrahiem, 2015). The government's role in supporting the renewable energy sector has not been maximized so that energy consumption has not been effective and efficient. The government should be able to increase the use of renewable energy and renewable energy efficiency so as to increase economic growth. Energy conservation policies are indispensable in order to achieve economic welfare and sustainable development. The government should also formulate appropriate policies so that foreign direct investment can be targeted and then can improve economic welfare in ASEAN.

The need for collaboration between foreign investors and the government as well as domestic investors so that the realization of investment entering ASEAN countries can be absorbed as much as possible. For further researchers, it is expected to examine the

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

relationship of renewable energy consumption with other variables that may have a related relationship, in connection with the limited research on energy, especially renewable energy and the environment as well as sustainable development and welfare qualitatively. In addition, further research is also expected to increase the object and scope of research in other areas

REFERENCES

Agrawal, G. (2015). Foreign Direct Investment and Economic Growth in BRICS Economies: A Panel Data Analysis. Journal of Economics, Business and Management, 3(4), 421–424. https://doi.org/10.7763/JOEBM.2015.V3.221

Amri, F. (2016). The relationship amongst energy consumption, foreign direct investment and output in developed and developing Countries. Renewable and Sustainable Energy Reviews, 64, 694–702. https://doi.org/10.1016/j.rser.2016.06.065

Anwar, S., & Nguyen, L. P. (2010). Foreign direct investment and economic growth in Vietnam. Asia Pacific Business Review, 16(1–2), 183–202. https://doi.org/10.1080/10438590802511031

Apergis, N. (2014). Renewable Energy and Economic Growth : Evidence from the Sign of Panel Long-Run Causality. 4(4), 578–587.

Apergis, N., & Payne, J. E. (2010a). Renewable energy consumption and economic growth: Evidence from a panel of OECD countries. Energy Policy, 38(1), 656–660. https://doi.org/10.1016/j.enpol.2009.09.002

Apergis, N., & Payne, J. E. (2010b). Renewable energy consumption and growth in Eurasia. Energy Economics, 32(6), 1392–1397. https://doi.org/10.1016/j.eneco.2010.06.001

Apergis, N., & Payne, J. E. (2011a). On the causal dynamics between renewable and non-renewable energy consumption and economic growth in developed and developing countries. Energy Systems, 2(3–4), 299–312. https://doi.org/10.1007/s12667-011-0037-6

Apergis, N., & Payne, J. E. (2011b). The renewable energy consumption–growth nexus in Central America. Applied Energy, 88(1), 343–347. https://doi.org/10.1016/j.apenergy.2010.07.013

ASEAN. (2015). Asean 2025: Forging Ahead Together. In Statistical Field Theor (Vol. 53, Issue 9). https://doi.org/10.1017/CBO9781107415324.004

Bank, W. (2020). Adjusted savings: carbon dioxide damage (% of GNI). https://data.worldbank.org/indicator/NY.ADJ.DCO2.GN.ZS

Chang, T., Gupta, R., Inglesi-Lotz, R., Simo-Kengne, B., Smithers, D., & Trembling, A. (2015). Renewable energy and growth: Evidence from heterogeneous panel of G7 countries using Granger causality. Renewable and Sustainable Energy Reviews, 52, 1405–1412. https://doi.org/10.1016/j.rser.2015.08.022

Chang, Y., & Li, Y. (2015). Renewable energy and policy options in an integrated ASEAN elec- tricity market : Quantitative assessments and policy implications. Energy Policy, 85, 39–49. https://doi.org/10.1016/j.enpol.2015.05.011

Dinç, D. T., & Akdoğan, E. C. (2019). Renewable energy production, energy consumption and sustainable economic growth in Turkey: A VECM approach. Sustainability (Switzerland), 11(5). https://doi.org/10.3390/su11051273

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. https://doi.org/10.1016/j.eneco.2015.12.010

ISSN 2302-2663 (online)

DOI: doi.org/10.21009/JPEB.007.2.3

Fan, W., & Hao, Y. (2020). An empirical research on the relationship amongst renewable energy consumption, economic growth and foreign direct investment in China. Renewable Energy, 146, 598–609. https://doi.org/10.1016/j.renene.2019.06.170

Forte, R., & Moura, R. (2013). The effects of foreign direct investment on the host country's economic growth: Theory and empirical evidence. Singapore Economic Review, 58(3). https://doi.org/10.1142/S0217590813500173

Gupta, P., & Singh, A. (2016). Causal nexus between foreign direct investment and economic growth. Journal of Advances in Management Research, 13(2), 179–202. https://doi.org/10.1108/JAMR-04-2015-0028

Haseeb, M., Shah, I., Abidin, Z., Muhammad, Q., Hye, A., & Hartani, N. H. (2019). The Impact of Renewable Energy on Economic Well-Being of Malaysia : Fresh Evidence from Auto Regressive Distributed Lag Bound Testing Approach. 9(1), 269–275.

He, W., Gao, G., & Wang, Y. (2012). The relationship of energy consumption, economic growth and foreign direct investment in Shanghai. Advances in Applied Economics and Finance, 3(1), 507–512.

Ibrahiem, D. M. (2015). Renewable Electricity Consumption, Foreign Direct Investment and Economic Growth in Egypt: An ARDL Approach. Procedia Economics and Finance, 30(15), 313–323. https://doi.org/10.1016/s2212-5671(15)01299-x

Inglesi-Lotz, R. (2016a). The impact of renewable energy consumption to economic growth: A panel data application. Energy Economics, 53, 58–63. https://doi.org/10.1016/j.eneco.2015.01.003

Inglesi-Lotz, R. (2016b). The impact of renewable energy consumption to economic growth: A panel data application. Energy Economics, 53(March), 58–63. https://doi.org/10.1016/j.eneco.2015.01.003

IRENA. (2016). REmap - Renewable Energy Outlook for ASEAN. In International Renewable Energy Agency (IRENA), Abu Dhabi and ASEAN Centre for Energy (ACE), Jakarta.

IRENA. (2018). Renewable Energy Market Analysis: Southeast Asia. In Irena. www.irena.org

Kahia, M., Ben Aïssa, M. S., & Charfeddine, L. (2016). Impact of renewable and non-renewable energy consumption on economic growth: New evidence from the MENA Net Oil Exporting Countries (NOECs). Energy, 116, 102–115. https://doi.org/10.1016/j.energy.2016.07.126

Khandker, L. L., Amin, S. B., & Khan, F. (2018). Renewable Energy Consumption and Foreign Direct Investment : Reports from Journal of Accounting , Finance and Economics Renewable Energy Consumption and Foreign Direct Investment : Reports from Bangladesh Field of Research : Economics. September.

Khudari, M. (2019). The Effect of Foreign Direct Investment on Renewable Energy Consumption in Malaysia. Test Engineering and Management, 5847–5853.

Lin, B., & Moubarak, M. (2014). Renewable energy consumption - Economic growth nexus for China. Renewable and Sustainable Energy Reviews, 40, 111–117. https://doi.org/10.1016/j.rser.2014.07.128

Moudatsou, A., & Kyrkilis, D. (2011). FDI and Economic Growth: Causality for the EU and ASEAN. Journal of Economic Integration, 26(3), 554–577. https://doi.org/10.11130/jei.2011.26.3.554

Ocal, O., & Aslan, A. (2013). Renewable energy consumption–economic growth nexus in Turkey. Renewable and Sustainable Energy Reviews, 28, 494–499. https://doi.org/10.1016/j.rser.2013.08.036

Okwosha, P. (2020). The Impact Of Foreign Direct Investment On Renewable Energy

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

Consumption In Nigeria. Kyklos, 62(2), 239–257.

Omri, A., & Kahouli, B. (2014). Causal relationships between energy consumption, foreign direct investment and economic growth: Fresh evidence from dynamic simultaneous-equations models. Energy Policy, 67, 913–922. https://doi.org/10.1016/j.enpol.2013.11.067

Owusu, E. L. (2020). The relationship between foreign direct investment and economic growth: A multivariate causality approach from Namibia. International Journal of Finance and Economics, June, 1–8. https://doi.org/10.1002/ijfe.1946

Parab, N., Naik, R., & Reddy, Y. V. (2020). Renewable energy, foreign direct investment and sustainable development: An empirical evidence. International Journal of Energy Economics and Policy, 10(5), 479–484. https://doi.org/10.32479/ijeep.10206

Payne, J. E. (2011). On Biomass Energy Consumption and Real Output in the US. Energy Sources, Part B: Economics, Planning, and Policy, 6(1), 47–52. https://doi.org/10.1080/15567240903160906

Rafindadi, A. A., & Ozturk, I. (2017). Impacts of renewable energy consumption on the German economic growth: Evidence from combined cointegration test. Renewable and Sustainable Energy Reviews, 75(January 2015), 1130–1141. https://doi.org/10.1016/j.rser.2016.11.093

Rashid, R., & Hossen, S. S. (2020). Effect of Foreign Direct Investment on Bangladesh Economy: a Time Series Analysis from 1972 to 2013. December, 1–26. https://doi.org/10.20944/preprints202012.0611.v1

Rezagholizadeh, M., Aghaei, M., & Dehghan, O. (2020). Journal of Renewable Foreign Direct Investment , Stock Market Development , and Renewable Energy Consumption : Case Study of Iran. 7(2), 8–18.

Rininta, N. (2013). The Causality of FDI Inflow and Economic Growth in Indonesia. Munich Personal RePEc Archive, 46572.

Ritchie, H., & Roser, M. (2020). Renewable Energy. Our World in Data. https://ourworldindata.org/renewable-energy

Sadorsky, P. (2010). The impact of financial development on energy consumption in emerging economies. Energy Policy, 38(5), 2528–2535. https://doi.org/10.1016/j.enpol.2009.12.048

Salahuddin, M., Alam, K., Ozturk, I., & Sohag, K. (2018). The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO2 emissions in Kuwait. Renewable and Sustainable Energy Reviews, 81(June), 2002–2010. https://doi.org/10.1016/j.rser.2017.06.009

Sarkodie, S. A., Adams, S., & Leirvik, T. (2020). Foreign direct investment and renewable energy in climate change mitigation: Does governance matter? Journal of Cleaner Production, 263, 121262. https://doi.org/10.1016/j.jclepro.2020.121262

Sebri, M. (2015). Use renewables to be cleaner: Meta-analysis of the renewable energy consumption-economic growth nexus. Renewable and Sustainable Energy Reviews, 42, 657–665. https://doi.org/10.1016/j.rser.2014.10.042

Shahbaz, M., Loganathan, N., Zeshan, M., & Zaman, K. (2015). Does renewable energy consumption add in economic growth? An application of auto-regressive distributed lag model in Pakistan. Renewable and Sustainable Energy Reviews, 44, 576–585. https://doi.org/10.1016/j.rser.2015.01.017

Siyoto, S., & Sodik, M. A. (2015). Dasar Metodologi Penelitian (1st ed.). Literasi Media Publishing.

Stöbich, C. (2017). Foreign direct investment in developing countries. Copenhagen Business School.

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/JPEB.007.2.3

Tawiah, V., Zakari, A., & Adedoyin, F. F. (2021). Determinants of green growth in developed and developing countries. Environmental Science and Pollution Research, Oecd 2020. https://doi.org/10.1007/s11356-021-13429-0

Tugcu, C. T., 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. https://doi.org/10.1016/j.eneco.2012.08.021

United Ntion Climate Change. (2017). Clean Energy Can Meet 90% of Paris Energy-Related Goals. https://unfccc.int/news/clean-energy-can-meet-90-of-paris-energy-related-goals

Venkatraja, B. (2020). Does renewable energy affect economic growth? Evidence from panel data estimation of BRIC countries. International Journal of Sustainable Development and World Ecology, 27(2), 107–113. https://doi.org/10.1080/13504509.2019.1679274

Winarno, W. W. (2017). Analisis Ekonometrika dan Statistika dengan Eviews (Edisi 5). UPP STIM YKPN.

World Energy Council. (2013). Time to get real – the case for sustainable energy investment Officers of the World Energy Council. 8–9. http://www.worldenergy.org/publications/2013/world-energy-trilemma-2013/

ISSN 2302-2663 (online)
DOI: doi.org/10.21009/**J**PEB.007.2.3