Master's Thesis of Lida Irene Valdiviezo Quiroz

Assessing the Impact the Use of Renewable Energy Has on South Korea's Economic Growth

재생 에너지 사용이 한국 경제 성장에 미치는 영향 평가

August 2022

Graduate School of International Studies
Seoul National University
International Commerce Major

Lida Irene Valdiviezo Quiroz

Assessing the Impact the Use of Renewable Energy Has on South Korea's Economic Growth

Kim, Chong-Sup

Submitting a master's thesis of
International Studies

August 2022

Graduate School of International Studies
Seoul National University
International Commerce Major

Lida Irene Valdiviezo Quiroz

Confirming the master's thesis written by
Lida Irene Valdiviezo Quiroz
August 2022

Chair Rhee, Yeongseop (Seal)
Vice Chair Cho, Youngchul (Seal)
Examiner Kim, Chongsup (Seal)

Abstract

The present study proposes assessing the impact of the use of renewable energy on economic growth under the context of the 9th Basic Energy Plan which shifts its policies to prioritize change to renewable energy sources in South Korea. The variables GDP annual growth and renewable energy consumption on a time series from 1995 to 2018 are run through Granger´s Causality Test to determine, based on the historic data and Payne´s Hypotheses, the relationship between the two variables and subsequently assess how they impact each other. The results show no relationship between them aligning with Granger´s test null hypothesis and the neutrality hypothesis, meaning that the implementation of policies regarding renewable energy consumption does not have any impact on the country's economic growth.

Keywords: Renewable Energy, Economic Growth, South Korea
Student Number: 2019-25695

Table of content

List of Tables

List of Figures

I. Introduction

Background and Problem statement

South Korea´s economic development has been a subject of study due to its fast-paced growth. From the Japanese invasion to the Korean War to one of Asia's top developed economies, the country has shown great providence in academic and technological production. As a result, its commercial and infrastructural environment has seen the creation and expansion of businesses and companies. But this has also meant a fast growth of the energy industry to power and supply the country.

During its early stages of industrialization, the country established a traditional energy industry predominantly from non-renewable sources. As of 2020 35% of energy was supplied from crude oil, 25% from coal, 17% from gas, and 16% from nuclear energy, with only 1% deriving from renewable energy (Swingle, 2022). However, just as the name suggests, these non-renewable sources are not sustainable over time and some of its coal power plants are reaching the end of their 30-year operational life cycle (Swingle, 2022). Following the constantly growing demand for new energy sources as well as the global tendency towards sustainability South Korea has implemented assertive policies regarding this industry.

The country´s prime motivation toward renewable energy sources is not just a result of worldwide efforts but also regional experiences. As an active member of international community initiatives, South Korea historically supported the Kyoto Protocol and more recently, the Paris Agreement to reduce CO2 emissions and reduce global temperature. Additionally, Japan´s Fukushima nuclear disaster represented a clear example of the risks of the use of nuclear energy against natural disasters in the region. Moreover, the

economic and social characteristics of the rapidly growing country have also contributed to the ambitious goals of the 9th Basic Plan for electricity.

The reality of the lower class in South Korea is a key part of the internal factors that support the decision to enthusiastically prioritize the development of the renewable energy industry. The government and public institutions in charge of renewable energy have promoted and urged the use of solar panels and other renewable energy sources for agricultural and lower-class areas, with an economic incentive such as bill deductions. Last year electricity prices rose for the first time in almost a decade representing an extra 1,050 won for an average family. Adding to the context of the recent global COVID-19 pandemic, the gas, and oil shortage in Europe, and now the Russian-Ukraine conflict, the economy of South Korean households have been negatively affected, and oil and gas power sources costs might be on the rise. Adopting more drastic policies pro changing to renewable energy sources is part of the strategy to mitigate expenses for the lower economic class families.

The policies presented in October 2021, establish more ambitious goals than the 8th Basic plan willing to prioritize renewable energy over economic growth. The plan aims for a 2.7% annual capacity growth for new renewable energy plants. One of the general improvements of the plan is the goal from 22% to 35% for renewable energy capacity prioritizing solar and wind to almost double their current production (Lee K. (., n.d). This also includes the closure of coal and nuclear plants to reduce their dependence on these sources. However, in the next two years, coal and nuclear capacity are still to increase due to currently ongoing development projects.

As the country acts towards the effective implementation of the new plan a case to analyze the relationship between renewable energy development and economic growth

surges. The process has a risk to increase consumers' costs of electricity and power shortages for bigger industries, creating slopes on the country´s economy. In addition to this, the public and private investment in the new plants are pertinent to assessing the impact of the use of renewable energy on economic growth.

The problem that motivates these types of studies has been brought up by industrialized countries, specifically around the Paris Agreement, who claim that the reduction of nonrenewable energy and oil dependency would impact negatively on their economies and that of their citizens. In consequence, studies that aim to identify the correlation between economic and environmental variables have been presented to fight these claims, sadly to no avail as results have shown to vary depending on another group of variables and characteristics. Nevertheless, it is known that correlation does not necessarily indicate causality although it widens areas of study and variables to keep in mind when analyzing a phenomenon, especially in the social sciences. It is still important to mention that regardless of the posture regarding climate change and global warming it is relevant as part of a responsible and considerate act to support action that holistically can bring better life quality to living beings.

As an alternative to the efforts to show correlation and causality between environmental policies and the economy, the present work proposes to use Granger´s causality test which simply allows identifying a historic trend in variables to analyze the relationship between them in case there is one. Depending on the results, a discussion regarding the impact of the variables amongst themselves could be held to better understand the context and possible outcomes of the country's most recent and ambitious energy plan.

II. Literature review

Payne and Ozturk's hypothesis and renewable energy

The present study is strongly encouraged by the hypotheses surrounding energy consumption and economic growth described by Payne (2010). The author considers the role of electricity in the economy. He points out some empirical studies regarding energy consumption and development from which he proposes four hypotheses: neutrality hypothesis, conservation hypothesis, growth hypothesis, and feedback hypothesis.

The neutrality hypothesis suggests that there is no causal relationship between economic growth and energy consumption which would align with the null hypothesis of Granger´s causality test. Meanwhile, the conservation hypothesis applies to a scenario where economic growth leads to energy consumption (Payne, 2010). The opposite occurs in the growth hypothesis which predicts unidirectional causality in which an increase in energy consumption leads to economic growth and vice versa. Finally, the feedback hypothesis proposes a bidirectional causal relationship between economic growth and energy consumption suggesting they are affected at the same time (Payne, 2010).

Complementary, Ozturk (2010) does a survey regarding the literature on the relationship between energy consumption and economic growth. He suggests as a methodological reservation to empirical studies that the causal studies have reached no consensus regarding their results (Ozturk, 2010). He further emphasizes the scope of studies is too broad with variances from countries, economies, and economic and energy variables. The author also points out how energy sources are numerous and their relationship with the economy as individual variables is different. He mentions how, when considering energy sources, the relationship between energy consumption and economic growth in developed countries will be positive, and suggests dividing energy

sources by their origin, bringing about the study of renewable energy as a variable. Finally, Ozturk does conclude that based in most cases economic growth runs from energy consumption suggesting electricity is a limiting variable to economic growth (Ozturk, 2010). The present study will use as a base the hypotheses and statements proposed by Payne and Ozturk to further discuss the results later.

State of art

Through the revision of the most recent studies, 2017 – 2020, there is a trend that suggests there is no link regarding the relationship between renewable energy and economic growth. Some papers directly study the case of South Korea and its policies, while others take a wider scope at studying energy production and consumption and economic growth. An example of the latter one is the work of Alfonso, Marques, and Fuinhas (2017) whose study object was the relationship between the economy and energy consumption. Their sample was the top ten countries based on electricity production from 1995 to 2016, these were: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Japan, South Korea, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, United Kingdom and the United States of America. Their variables were GDP, exports, population, and CO2 emissions per energy source. They used an Autoregressive Distributed Lag (ARDL) model to analyze the effect of the variables. Their results find a positive effect between CO2 emissions and economic activity, but the authors stand out that this is due to the known and existing worldwide dependency on fossil fuels and other non-renewable energy sources (L.Afonso, C.Marques, & A.Fuinhas, 2017).

More focused on South Korea´s context Eunil Park (2017) studied the economic feasibility of 17 cities to change and adapt to renewable energy sources. The author takes

as variables the cost of energy under the new renewable source, the net present cost, the gap between the two, and the total consumed. The simulation was made through HOMER software, and it focuses more on simply mapping the best scenario and location for investing in renewable sources rather than the overall economic impact. Aside from determining the cities best applicable for most renewable energy production based on its simulation, the study also mentions that strong capital investment is necessary to make changes plus subsidies to reduce the required amount (Park, 2017). Yet it looks to contribute to the effective implementation of the current energy plan policy regarding renewable energy in the country.

Similarly, Lee and Jung (2018) also focus on South Korea through the examination of the causal relationship between renewable energy consumption and economic growth. It took as variables the economic output, labor force, capital stock, and renewable energy. An autoregressive distributed lag (ARDL) bounds test was used with data from 1990 to 2012 which displayed a negative effect of renewable energy consumption on economic growth. This study stated as a limitation the small sample size as it had no data before 1995 available regarding renewable energy sources in South Korea. As part of their conclusion, the authors suggest focusing on overall economic developing policies rather than just renewable energy ones and to focus on market-driven renewable source development (Lee & Jung, 2018).

Another recent study that focuses outside South Korea and on renewable energy and economic growth is that by Zafar, Shahbaz, Hou, and Sinha (2018). This paper disaggregates renewable and nonrenewable energy consumption and analyzes their dynamic with economic growth. The sample is composed of the countries members of the Asia-Pacific Economic Cooperation (APEC) group due to their characteristics in both

energy consumption and development, then it determines estimation using a cross-examination and a second-generation panel unit root test. Its variables were GDP, renewable energy produced, non-renewable energy, capital, trade openness, and Research and development expenditure. As part of their overview results, the authors do recommend in general to APEC countries increase investment in renewable energy to support a sustainable economy (Zafar, Shahbaz, Hou, & Sinha, 2019). For South Korea´s case, the study recommends investing in trade openness to have positive economic growth while changing to renewable energy sources.

More recently and once again focused on South Korea, Koc and Bulus (2020) investigates GDP, energy consumption, trade openness, and CO2 per capita emissions from 1971 to 2017. The authors also apply autoregressive distributed lag (ARDL) bound tests which similarly to the other papers suggest that the country's exceptional economic growth has come at a price of environmental degradation (Koc & Bulus, 2020). Similarly, Zafar, Shahbaz, Hou, and Sinha (2018), authors also determined that open trade investment will be key in the short term to promote economic growth while changing to renewable energy production. Even though the mentioned recent studies do not empirically find a clear positive relation in short term between renewable energy and economic growth all recognize the importance of promoting a sustainable change for the country. Also, three out of the five papers used an ARDL with similar variables, specifically regarding South Korea to measure causality between renewable energy production and the economy.

III. Research Methodology

Based on the nature and processing of data within descriptive and inferential statistics, the present study is based on quantitative research. This type of methodology allows to confirm or deny the proposed hypothesis regarding the relationship between the selected variables and develop further discussions and analysis.

The type of research is correlational as the objective is to analyze the association between variables. To assess the effect between economic growth and renewable energy, Granger´s Causality test on time series data will be applied. As the method suggests correlation does not indicate causality, however, it can offer insights into the degree of the relationship between two variables. The variables that will be taken into consideration are the annual Gross Domestic Product Growth, as the dependent variable, and the Consumption of Renewable Energy, as the independent variable, from 1995 to 2018 as provided by the World Bank. The criteria to select the variables were the available time series and that both are presented as annual percentages.

Granger´s Causality Test

The test is based on an OLS regression model where causality might be indicated when the null hypothesis is rejected. To be applied to two variables time series the test assumes both are stationary. If the time series is not stationary, other techniques must be applied before validating the variables' characteristics for Granger´s test. The number of lags may lead to different test results, because of this it is advisable to run a full model to select the most convenient lag number. The possible outcomes may suggest unidirectional or bidirectional causality, or none.

Initially, both data time series will be graphed and analyzed to check empirically if they are stationary or not, meaning a trend repeats itself over a period. If both variables show stationary trends, the behavior of one could offer insight into analyzing the behavior of the other without presenting causality. In case it is not stationary, the Dickey-Fuller Test will be used to confirm if the variables are stationary or not. In the case of the times series do show trends, the differences in time series can be used to determine if they are stationary or not. The result of this test will vary based on the version, which is applied, the type 0 suggests there is no constant and no trend, type 1 shows a constant but no trend, and type 2 which shows a constant trend. Once validated and with the mapped regression, the Granger Causality will be applied to determine the p value of the test and the relationship of the variables. All these will be developed in Microsoft Excel through formulas and analysis add-ins to run the mentioned tests.

Data sample

To process the variables, the historic data of South Korea regarding GDP growth and the percentage of Renewable energy consumption were obtained from the World bank.

Table 1. Variables time series

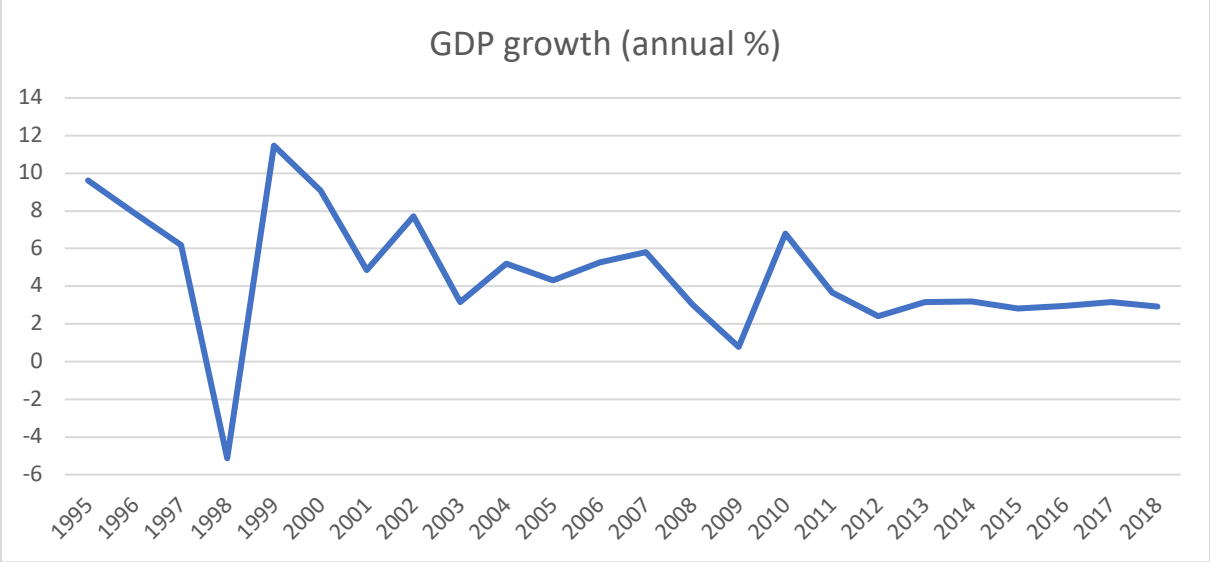
Year	GDP growth (annual %)	Renewable energy consumption (% of total final energy consumption)
1995	9.614565393	0.443590287
1996	7.890703326	0.60863812
1997	6.170552427	0.676453174
1998	-5.129448165	0.948920714
1999	11.46694243	0.787126862
2000	9.060833325	0.700500011
2001	4.852399572	0.692200005
2002	7.725142675	0.696699977
2003	3.147291194	0.845600009
2004	5.197391363	0.770200014
2005	4.308542714	0.873000026
2006	5.264326595	0.948700011
2007	5.799548415	1.024999976
2008	3.012984873	1.060799956
2009	0.79269899	1.206900001
2010	6.804824918	1.315000057
2011	3.685667782	1.347599983
2012	2.402530992	1.614300013
2013	3.164708636	1.915099978
2014	3.202453795	2.8677001
2015	2.809103268	2.743999958
2016	2.946881715	2.549799919
2017	3.15963574	2.844500065
2018	2.907403774	3.184000015

Source: (The World Bank, 2022)

Results

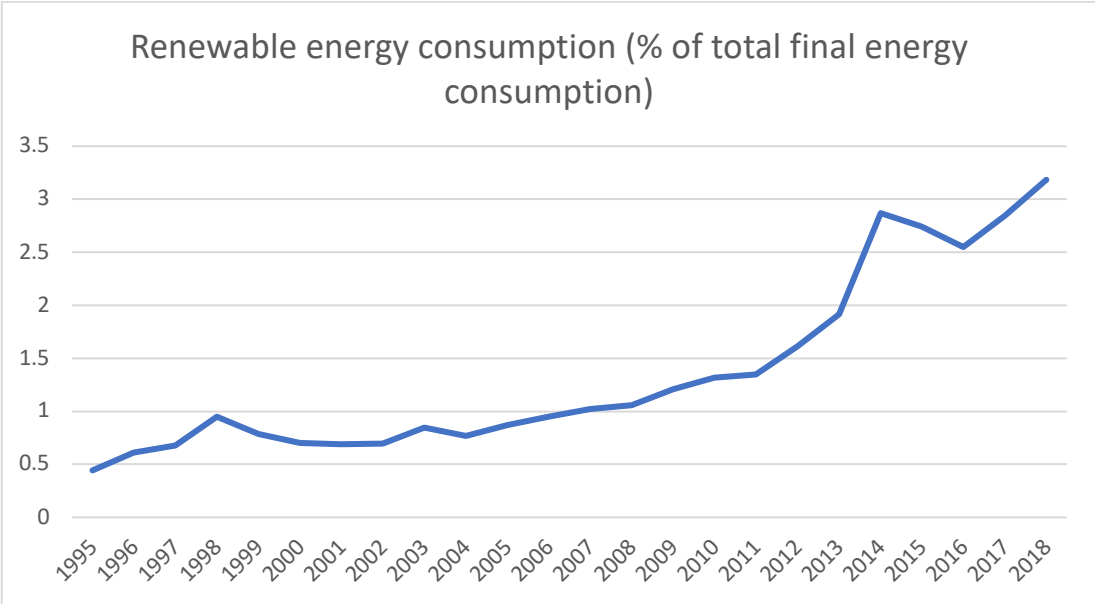
Initially, the data for GDP and Renewable energy consumption in South Korea were graphed to be analyzed. The historical data of both variables do not result as stationary under the Augmented Dickey-Fuller Test (ADF Test), to check the feasibility of analyzing the relationship between the two selected variables, the difference between the time difference of both variables was obtained by subtracting the first year to the second and so on.

Figure 1. GDP growth annual percentage



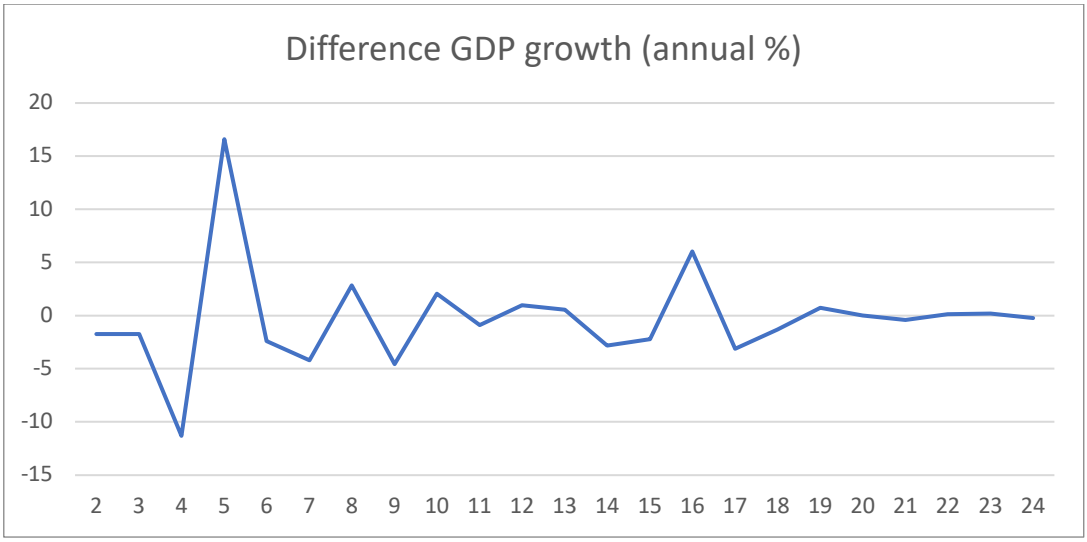
Source: (The World Bank, 2022)

Figure 2. Renewable energy consumption percentage



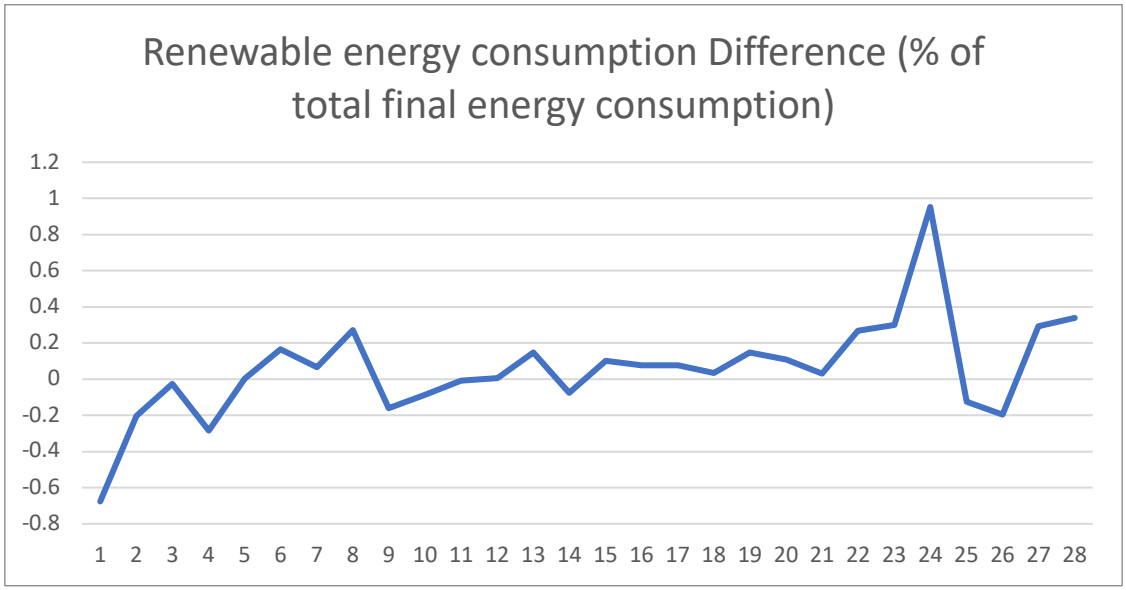
Source: (The World Bank, 2022)

Figure 3. Time series difference GDP growth



Source: (The World Bank, 2022)

Figure 4. Time series difference renewable energy



Sources: (The World Bank, 2022)

Once graphed the difference time series columns the ADF Test was run. During the complementary White noise test, the ljung-box text displayed a 0.0887 p-value meaning the variables are independent enough to go on with the test. Upon graphing the differences in time series and running the ADF test both variables' time series is stationary. This is confirmed by the tau-stat being smaller than the tau-crit for both variables. Regarding the lag, the default value for the lag is 0, if the lag is 0 the value will calculate as proposed by Schwert, which gave as a result 9. Additionally, both showed significance with a p-value below 0.05 and the Renewable Energy Consumption Variables showed smaller AIC and BIC with a lag of 3, which means it is the recommended number of lags to run Granger´s test.

Table 2. Augmented Dickey-Fuller Test results

ADF Test	GDP Annual Growth	Renewable Energy Consumption
criteria	Schwert	Schwert
drift	yes	yes
trend	yes	yes
lag	9	9
alpha	0.05	0.05
tau-stat	-5.0835	-3.670268531
tau-crit	-3.56833	-3.568333903
stationary	yes	yes
aic	2.577808	0.033507973
bic	3.171389	0.32802143
lags	9	3
coeff	-9.74451	-2.059615502
p-value	< .01	0.042510527

Source: author

The ANOVA test ran for the feasibility of the regression output significant p-values under 0.05 allowing to proceed with Granger´s test. In both cases, it showed significance with values close to 0.

Table 3. ANOVA for GDP annual growth

ANOVA GDP				Alpha	0.05	
	df	*SS*	*MS*	*F*	*p-value*	*sig*
Regression	1	229.4774	229.4774	18.30683	0.000225	yes
Residual	26	325.9119	12.53507			
Total	27	555.3893				
	coeff	*std err*	*t stat*	*p-value*	*lower*	*upper*
Intercept	*-4.606*	*1.21847*	*-3.78015*	*0.00083*	-7.11061	-2.1014
GDP growth (annual %)	0.850868	0.198864	*4.27865*	*0.00023*	0.442098	1.259639

Source: author

Table 4. ANOVA for Renewable energy source consumption

ANOVA	RES			Alpha	0.05	
	df	*SS*	*MS*	*F*	*p-value*	*sig*
Regression	1	0.583721	0.583721	10.39807	0.003389	yes
Residual	26	1.459574	0.056137			
Total	27	2.043295				
	coeff	*std err*	*t stat*	*p-value*	*lower*	*upper*
Intercept	-0.20375	0.092006	-2.21451	0.035765	-0.39287	-0.01463
Time period	0.017874	0.005543	3.224603	0.003389	0.00648	0.029269

Source: author

Granger´s Causality test was applied to the regression up to lag 7 although the suggested amount of lag 3 however the p-value results show there is no significant p-value that may show a relationship between the variables. There is no causal relationship explanation based on Granger´s tests. Neither variable has a statistical influence on the behavior of the other as the p-values are closer to 1.

Table 5. Granger´s Causality Test Results p-value

Lag	GDP to RES	RES to GDP
1	0.836621674	0.61693397
2	0.908829717	0.956991445
3	0.982679634	0.920310976
4	0.61179482	0.909171077
5	0.876616974	0.690051574
6	0.946419388	0.341043228
7	0.955597248	0.252518321

Source: author

IV. Discussion

It is known that correlation does not signify causality in most cases, as in the case of suggesting that fossil fuel consumption correlates positively with economic growth which could be explained by the worldwide dependency on these traditional energy sources as stated by Otzurk (2010). For the present study, Granger´s test resulted in p-values well over 0.05 for GDP growth in relation to Renewable energy consumption and vice versa. As a result, the null hypothesis is failed to be rejected. This result resonates with the neutrality hypothesis proposed by Payne (2010) suggesting that policies regarding energy changes and expansion, such as the 9th Energy Plan of South Korea will not directly or significantly influence the country's economic growth.

Other studies have shown different results based on the number of variables, the time period of longitudinal studies, and of course the country. Alfonso, Marques & Fuinhas (2017) ran a study with a sample of 28 countries in which they found that non-renewable energy contributed to economic growth while renewable energy did not. Meanwhile, Zafar and other (2018) studies on the APEC member countries showed that both renewable and non-renewable energy consumption contributed to economic growth. There is still not a full consensus as to the role or degree of influence on the economy of renewable energy consumption. And though it might not have a direct effect, studies like Eunil Park´s (2017) present a technical perspective of how renewable energy production and consumption could improve the lives of South Korean citizens and positively contribute to the country's economies.

The economy is dynamic and has multiple dimensional variables which can affect it but continuing similar studies allow us to understand the relationship between them and better forecast the impact of economic policies. This presents a limitation for these types

of studies since the change of energy sources does have financial implications i.e., investing in infrastructure, job opportunities, technology development, etc., however, these do not exclusively are causal to economic growth or recession. The active and productive economy of South Korea is diverse enough that it has allowed a slow development of renewable energy production and consumption without restraining or holding back industries currently dependent on traditional non-renewable energy sources. This, however, is a different context from other countries where a shift to renewable energy might have a stronger impact due to technical, cultural, or infrastructural limitations.

Initially, the present study hypothesized that there was a relationship between the consumption of renewable energy and annual GDP growth in South Korea, to offer a ground of analysis under the current context of the 9th Energy Plan. However, after failing to reject the null hypothesis, it can be suggested that since there is no causal relationship between the two variables, the implementation of the new policies in favor of focusing on renewable energy sources will not decrease or slow down the economic growth of the country. As a complement, the empiric trends of the chosen variables did show that while the consumption of renewable energy has increased over the years the GDP annual growth remained stable.

V. Conclusion and recommendations

The present study assessed the impact of renewable energy consumption in South Korea on its economic growth. This was done through the application of Granger´s Causality test and GDP annual growth and the renewable energy consumption percentage as variables on a yearly period from 1995 to 2018. The statistical analysis concluded that there is no significant relationship between the two variables. The null hypothesis of Granger´s test failed to be rejected and it coincides with similar studies as well as the neutrality hypothesis on economic growth and energy consumption.

Complementing its findings, the results suggest that investing in renewable energy does not mean hindering the economy, therefore a government is not choosing one over the other but rather just prioritizing according to its goals and objectives. Further studies that disaggregate renewable energy and non-renewable energy consumption and their relationship with economic growth are needed to better understand just which variables carry more significance and how each context affects them. Future researchers should consider complementing correlational studies between renewable sources and economic growth variables with efficiency studies to propose and find better ways to implement these types of policies toward a positive industrial change away from traditional energy sources while adapting to the unique context of the country. Lastly, we encourage the implementation of renewable energy policies to promote a more responsible, sustainable, and socially aware economic development worldwide.

VI. References

Bayar, Y., & Gavriletea, M. D. (2019). Energy efficiency, renewable energy, economic growth: evidence from emerging market economies. *Quality & Quantity*, 2221–2234.

Destek, M. A., & Aslan, A. (2017). Renewable and non-renewable energy consumption and economic growth in emerging economies: Evidence from bootstrap panel causality. *Renewable Energy*, 757-763.

International Renewable Energy Agency. (2021). Retrieved from https://www.irena.org/IRENADocuments/Statistical_Profiles/Asia/Republic%20of%20Korea_Asia_RE_SP.pdf

International Trade Administration. (2021). Retrieved from Energy: New and Renewable: https://www.trade.gov/country-commercial-guides/south-korea-energy-new-and-renewable

Koc, S., & Bulus, G. C. (2020). Testing validity of the EKC hypothesis in South Korea: role of renewable energy and trade openness. *Environmental Science and Pollution Research*, 29043–29054.

Korea Energy Agency. (2015). Retrieved from Renewable Portfolio Standards(RPS): https://dco.energy.or.kr/renew_eng/new/standards.aspx

L.Afonso, T., C.Marques, A., & A.Fuinhas, J. (2017). Strategies to make renewable energy sources compatible with economic growth. *Energy Strategy Reviews*, 121-126.

Lee, C. (2021). S Korea raises the electricity rate for the first time in around 8 years on fuel costs.

Lee, K. (. (n.d). *Woodmac*. Retrieved from https://www.woodmac.com/our-expertise/focus/Power--Renewables/south-koreas-9th-basic-plan-for-electricity--a-step-closer-to-carbon-neutrality/

Lee, S.-H., & Jung, Y. (2018). Causal dynamics between renewable energy consumption and economic growth in South Korea: Empirical analysis and policy implications. *Energy & Environment*, 1298-1315.

Maennel, A., & Kim, H.-G. (2018). Comparison of Greenhouse Gas Reduction Potential through Renewable Energy Transition in South Korea and Germany. *Energies*.

MitaBhattacharya, ReddyParamati, S., IlhanOzturk, & SankarBhattacharya. (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. *Applied Energy*, 733-741.

Ozturk, I. (2010). A literature survey on energy–growth nexus. *Energy Policy*, 340–349.

Park, E. (2017). Potentiality of renewable resources: Economic feasibility perspectives in South Korea. *Renewable and Sustainable Energy Reviews*, 61-70.

Payne, J. E. (2010). A survey of the electricity consumption-growth literature. *Applied Energy*, 723–731.

Real Statistics. (2022). Retrieved from https://www.real-statistics.com/time-series-analysis/time-series-miscellaneous/granger-causality/

Sung-YoonHuh, & Chul-YongLee. (2014). Diffusion of renewable energy technologies in South Korea on incorporating their competitive interrelationships. *Energy Policy*, 248-257.

Swingle, K. (2022, February 28). *The Borgen Project*. Retrieved from https://borgenproject.org/renewable-energy-in-south-korea/

The World Bank. (2022). *The World Bank*. Retrieved from https://www.worldbank.org/en/home

Wei-MingChen, HanaKim, & HidekaYamaguchi. (2014). Renewable energy in eastern Asia: Renewable energy policy review and comparative SWOT analysis for promoting renewable energy in Japan, South Korea, and Taiwan. *Energy Policy*, 319-329.

YongPark, S., Bo-YeongYun, YeolYun, C., HeeLee, D., & GuChoi, D. (2016). An analysis of the optimum renewable energy portfolio using the bottom–up model: Focusing on the electricity generation sector in South Korea. *Renewable and Sustainable Energy Reviews*, 319-329.

Zafar, M. W., Shahbaz, M., Hou, F., & Sinha, A. (2019). From nonrenewable to renewable energy and its impact on economic growth: The role of research & development expenditures in Asia-Pacific Economic Cooperation countries. *Journal of Cleaner Production*, 1166-1178.

초록

본 연구는 한국의 재생에너지원으로의 전환을 우선시하는 정책을 전환하는 제9차 에너지기본계획의 맥락에서 재생에너지 사용이 경제성장에 미치는 영향을 평가한다. 1995년부터 2018년까지 시계열에 대한 변수인 GDP 연간 성장률과 재생 가능 에너지 소비는 Granger의 인과 관계 검증을 통해 실행되어 역사적 데이터와 Payne의 가설을 기반으로 두 변수 간의 관계를 결정한 후 이들이 각각에 미치는 영향을 평가한다. 결과는 Granger의 검정 귀무 가설과 중립 가설이 일치하는 관계가 없음을 보여준다. 즉, 재생 에너지 소비에 관한 정책의 시행이 국가의 경제 성장에 영향을 미치지 않는다는 의미이다.

키워드: 재생 에너지, 경제 성장, 한국