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Renewable Energy Consumption and Economic Growth in Asia Pacific

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Abstract

The problem of climate change is increasingly global and results in environmental damage due to the use of fossil energy in human activities. An increasing population will make energy consumption increase and can make things worse. Therefore, it is necessary to replace old energy with alternative energy that is more environmentally friendly and makes productivity effective and efficient. Renewable energy is pointed out as an alternative energy source that is environmentally friendly and the process is sustainable because it is always available in nature. Renewable energy is expected to increase the country's national income. This study aims to analyze the impact of renewable energy on economic growth in the Asia Pacific region as a whole. By using data from 2000-2015, panel data analysis in this study shows that Renewable Energy Consumption (REC) has a negative and significant relationship to economic growth, while renewable energy and combustible waste (CRW) has a significant and positive effect on economic growth.

Keywords: Renewable Energy, Sustainable, Economic Growth, Consumption

1. Introduction

Global warming which is increasingly becoming an international issue and a world problem today. This is due to the use of fossil energy which has been relied on by most human activities. Excessive and continuous use of fossil fuels can cause environmental problems, as well as the potential to create dangerous greenhouse effects and cause natural imbalances due to drastic weather changes.

IPCC (2007) states that human activities in practice consume energy with various factors that influence and have caused climate change in the last few decades. Energy consumption is also increasing where a country has a large population, such as countries in the Asia Pacific region. When Asia Pacific experiences an increasing middle-class population that continues to grow, and rapid urbanization, the demand for energy is also certain to continue to increase. To deal with this problem, efforts are needed to find alternative energy supplies that can replace energy sources that do not have a negative impact on the environment.

Finding other alternatives to energy use is very important to do, because in addition to avoiding bad effects on the environment, energy use is a basic necessity in carrying out economic activities. Renewable energy is pointed out as an alternative energy source that is environmentally friendly and the process is sustainable because it is always available in nature. Renewable energy is produced from energy resources that naturally will not run out and can reduce environmental pollution compared to non-renewable energy. (Shahbaz et al. 2020) stated that renewable energy technology is not only sustainable but also has an impact on the economy because it can be efficiently used by industry (production purposes) and households (daily use). Thus, energy technology not only affects the consumption side but also affects the production side which in turn has an impact on domestic production.

Although renewable energy has many advantages over traditional energy (fossil fuels), the fact is that this transition is still difficult and does not take time. Energy transition, namely the transition from a fossil energy system to a low-carbon energy system, has become the development agenda and strategy of many countries. The International Renewable Energy Agency in 2019, has made a roadmap towards the transition to low-carbon energy use by 2050. The Asia Pacific region has a major role in sustainable efforts for renewable energy on the global stage and there are considerable progress and strong potential for future developments. Countries with the highest share of renewable energy in total final energy consumption are Myanmar (68%), Sri Lanka (51.3%), the Philippines (47.5%) and Indonesia (47%), driven by hydropower and bioenergy (REN21 2019).

Although countries in Asia and the Pacific have made significant progress in connecting their populations to access to electricity. An estimated 350 million people still lack access across Asia. The remaining work towards electrification is a challenge and exacerbated by the fact that many households without access are located in very remote areas including mountains, islands or hamlets and isolated villages.

Socialization and energy transfer policies are still very much needed in order to maximize the benefits of renewable energy on the economy. Renewable energy is expected to increase the country's national income. Therefore, this study was conducted to confirm the impact of renewable energy on economic growth in Asia Pacific countries as a whole.

2. Literature Review

Several studies have been conducted to determine the relationship between energy consumption and the economy. In traditional economic literature, Dinda (2004) states that the relationship between economic growth and environmental degradation is understood in terms of the Environmental Kuznets Curve (EKC). EKC postulates, "Environmental degradation increases with increasing income to a threshold level, beyond that, environmental quality increases with higher per capita income." Research presented by several studies (Apergis and Payne 2009, Apergis and Payne 2010, Apergis and Payne 2014) found a two-way relationship between renewable energy consumption and economic growth, especially in China where real GDP growth was 0.12% with an increase in energy consumption. renewable by 1%. In the context of the panel, many have analyzed the consumption of renewable energy in OECD countries (Sadorsky, 2009; Apergis and Payne, 2010; Tiwari, 2011; Tugcu et al., 2012; Kula, 2014; Bhattacharya et al., 2016; Jebli et al., 2016; Rafindadi and Ozturk, 2017; Benavides et al., 2017; Taher, 2017; Hassine and Harrathi, 2017).

Renewable energy is considered to be in synergy with many aspects of sustainable development (Stiglitz, 2002). That is why sustainable development through renewable energy is at the center of policies around the world. Other research that has been done also shows the importance of renewable energy globally in relation to its relationship to the economic conditions of the country. Sadorsky (2009) also concluded that there is a positive relationship between real per capita income and per capita renewable energy consumption.

On the other hand, the causality between energy consumption and economic growth has also been shown to be neutral in several studies. Yildirim et al. (2014) examined the causality between renewable energy and economic growth in the US. They found no causality between economic growth and total renewable energy consumption. Ocal & Aslan (2013) found that renewable energy consumption has a negative impact on economic growth in the case of Turkey. Chang et al. (2009) attempted to investigate the development of the renewable energy sector under

different economic growth rate regimes by applying a panel threshold regression model (PTR) in OECD member countries. The results showed that countries with high economic growth were able to increase the use of renewable energy, while countries with low economic growth were unable to grow their consumption of renewable energy. Another study by Al-Mulali et al. (2014) shows that the consumption of renewable electricity is more significant than the consumption of non-renewable electricity in driving economic growth in 18 Latin American countries in the long and short term. Then, Al-Mulali et al. (2013) studied the case of high-income, upper middle, lower middle and low-income countries using the fully modified ordinary least square (FMOLS) method. This study determines the two-way causality running between renewable energy and GDP growth for the majority (79%) of the country. However, the results show a unidirectional long-term relationship of GDP growth with renewable energy consumption for 2% of countries and fail to establish a long-term relationship between these variables for 19% of countries. The conclusions suggest that the level of significance of the long-term bidirectional relationship between variables gradually becomes more important when moving from low-income to high-income countries.

3. Method

In this study the data used are secondary data in the form of economic growth, Renewable Energy Consumption, and Combustible renewables and waste in the Asia Pacific countries in the period 2000-2015 obtained from website www.worldbank.org.

The approach used in this research is quantitative, using panel data analysis by analyzing the influence of the variable consumption of renewable energy and combustible renewables and waste consisting of solid biomass, liquid biomass, biogas, industrial waste and municipal waste on GDP growth. This study uses GDP growth as a dependent variable and consumption of renewable energy and combustible renewables and waste as independent variables.

1. GDP (Y). Annual percentage growth rate of GDP at constant market prices based on local currency. Aggregates are based on constant 2010 US dollars. GDP is the sum of gross value added by all resident producers in the economy plus product taxes and less subsidies that are not included in the value of the product. This is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.
2. Consumption of renewable energy (X1). The purpose of renewable energy consumption is energy consumption that uses renewable resources such as the use of water, wind or solar energy in the period 2000 - 2015 in the Asia Pacific region.
3. Combustible renewables and waste (X2). It consists of solid biomass, liquid biomass, biogas, industrial waste and municipal waste, measured as a percentage of total energy use in the 2000 - 2015 period in Asia Pacific countries.

In this study, a classical assumption test was also carried out, testing through classical assumptions aims to determine whether there is interference between time series disturbances and individuals (cross-sectional disturbances), or both. The assumption tests carried out are autocorrelation, heteroscedasticity, and multicollinearity tests.

The equation model in this study:

$$GDP_{i,t} = \alpha_{i,t} + \beta_1 REC_{i,t} + \beta_2 CRW_{i,t} + \epsilon_{i,t}$$

Where:

$GDP_{i,t}$: The economic growth of country i in year t
 $REC_{i,t}$: Renewable Energy Consumption country i in year t
 $CRW_{i,t}$: Combustible renewables and waste country i in year t
 $\epsilon_{i,t}$:: Error term

4. Results and Discussion

4.1 Classic Assumption Test

In the first step, it is necessary to test the classical assumptions of the data to be processed. In this study, the multicollinearity test was enforced. To test for multicollinearity, namely by looking at the VIF value of each independent variable, if the VIF value is <10 , it can be concluded that the data is free from multicollinearity symptoms. The results of the multicollinearity test in this study showed that there was no correlation between the independent variables because the VIF value was <10 , here is the table of results:

Table 1: Multicollinearity Test

Variable	VIF
REC	6.07
CRW	6.07
Mean VIF	6.07

Source: author's calculation

Before carrying out the significance test, the best model selection test, which is generally used on panel data is hausman test. The hausman test is a form of chi-square test that is carried out based on the quadratic form and the difference between the consistent estimator and the efficient estimator. In the panel data analysis model using the Fixed Effect Method (FEM) approach, a consistent estimator is obtained, while in the analysis model with the Random Effect Method (REM) an efficient estimator is obtained. From the results of the Hausman test, the value of prob is 0.9441 or more than the significance used, which is 5% or 0.05. then the random effect model is chosen instead of the fixed effect model.

4.2 Significance Test

By selecting the random effect model, it is not relevant for other Classical Assumption tests to be carried out. This is because the random effect model uses the Generalized Least Square (GLS) estimation method. GLS technique is believed to overcome the existence of time series autocorrelation (time series) and correlation between observations (cross section). The GLS method produces an estimator to meet the properties of Best Linear Unavailable Estimation (BLUE), which is a treatment method to overcome heteroscedasticity and autocorrelation assumption violations (Gujarati, 2004). Table 2 below shows the results of the regression analysis using the random effect model approach.

Table 2: Results of Random Effects Model (REM) Estimation

Independent Variable	Dependent Variable	
	GDP	
	Coefficient	Probability
Constant	3.977342	0.000
Renewable Energy Consumption	-.0559157	0.037
Combustible renewables and waste	.1534541	0.000
R-sq	0.0941	

Note : Significance at $\alpha = 5\%$

Source: author's calculation (STATA, 2020)

From the estimation results that have been obtained, the consumption of renewable energy has a negative contribution to economic growth in Asia Pacific countries, this can be seen from table 2 where the P-value of renewable energy consumption (REC) is less than (0.037 <0.05), Meanwhile the coefficient is negative (-

.0559157), meaning that when an increase in renewable energy consumption occurs, economic growth will decline. This is because there are still countries that still use non-renewable energy sources for industry and other economic activities that increase CO₂ emissions in the community, thus requiring a shift in investment from fossil fuels to renewable energy. It is necessary to invest in cost-effective energy use and infrastructure in renewable energy. However, an energy system that relies heavily on renewable energy will be different from the previous system and will require significant investment in the power grid, complementary infrastructure and energy flexibility. Investment decisions require data, documentation and analysis that need to be supported to encourage better investment absorption and increase project confidence. The lack of reliable, comparable data sets against resource availability, capital and operating expenditures, and energy prices at the local level, hinders access to renewable energy finance and energy efficiency. For emerging markets, the risk of sovereignty and the absence of local currency financing can create problems as well (REN21 2019).

It seems that although the benefits of clean and renewable energy are obvious, the shift in the use of fossil fuels by renewable energy sources is occurring at a very low rate even though the economic impact of economic development on renewable energy will ultimately feed back into economic development because many studies have stated that that renewable energy will increase economic growth in the long run.

This study is not in accordance with the findings of several studies that support the positive impact of renewable energy on economic growth. The results of this study corroborate the findings of Silva et al. (2012) which also has evidence from a study of four countries, namely the United States, Denmark, Spain and Portugal to support the economic growth hypothesis. It can be implied that increasing investment in the production and use of renewable energy entails an economic cost in terms of GDP per capita.

On the other hand, according to Venkatraja (2020), in the results of his research in BRIC countries (Brazil, Russia, India and China), it was found that renewable energy has a negative relationship with economic growth. Contrary to the widely accepted theory, which states that investment in the production and consumption of renewable energy will accelerate growth, it has not been supported by the findings of this study. It has been found that countries transitioning from traditional to renewable energy must bear the increased economic costs and reduced economic growth.

5. Conclusion

The Asia Pacific covers a large area and accounts for most of the world's population and population growth. The region's economic transformation, and the speed with which it transitions to cleaner energy sources, are critical to the success of global efforts to reduce greenhouse gas emissions. Asia Pacific countries must quickly shift from consuming non-renewable energy to renewable energy consumption and need to pay certain economic costs to increase the consumption of renewable energy, which will ensure a quality environment and pave the way to sustainable development.

This study discusses the relationship between two types of renewable energy consumption, including the consumption of hydropower, solar, wind and nuclear as well as Combustible renewables and waste on economic growth in the Asia Pacific region during the period 2000-2015 using Panel Data. The results show that it turns out that the consumption of renewable energy has not yet increased economic growth because there is still a shift to switch from traditional energy to renewable energy, so it needs infrastructure and financing for that. The inversely proportional to the consumption of renewable energy, renewable energy and combustible waste shows a positive effect on economic growth and this is in line with existing previous research.

The central government's budget allocation for developing the renewable energy sector is on the rise. Harnessing solar energy, wind energy and bio energy has become a priority in the national government's energy policy. However, the transition was not smooth and created inequality in the economy. Higher electricity production costs, higher costs for different and country-specific energy consumption have a negative impact on industrial investment and employment. The contradiction between the widely claimed benefits of renewable energy and the

sustainability of economic growth and the findings of this study can be attributed to the ineffectiveness of the government's renewable energy policy design.

The policy of replacing non-renewable energy with renewable energy is needed not only to avoid catastrophes in the atmosphere but also to stimulate long-term economic growth. The implementation of renewable energy policies is based on several factors within and across countries, it is important to develop long-term plans to address capacity, costs, regulatory constraints, infrastructure and the country's institutional structures.

Future research could focus on environmental factors to reflect the sustainable growth caused by renewable energy. Investigations can be carried out to identify the factors that influence economic growth by increasing the share of renewable energy in total energy. Research can also be part of the socialization for the use of renewable energy for the community.

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