

The relationship between energy and economic growth: case in Indonesia

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Abstract— This study is aimed to analyze the relationship between energy and economic growth in Indonesia. Data were collected from the Statistical Central Bureau for the period of 1999-2012. Gross Domestic Product (GDP) was used as an indicator of the economic growth, while energy which was used as parameter that contributes to the economic growth was crude oil production. The different test was applied to compare between the pre-crisis period (1999-2005) and the crisis period (2006-2012). The result shows that there are differences between crude oil production before and after the period of the energy crisis in Indonesia. In addition, crude oil production has contribution to the economic growth by 30.8%.

Keywords: *Gross Domestic Product (GDP), energy, energy crisis, economic growth.*

I. Introduction

Energy plays a very important role in economic growth of a country, because it is used in the production process and distribution of products. Thus, energy consumption is an important element for sustainable economic growth (Saboori et al, 2012). The increasing of economic growth shows that there is more energy consumption. Several studies conducted by Kraft and Kraft (1978) found a causal relationship between output and energy consumption in the United States of America. By using different econometric methodologies for different countries, Masih and Masih (1996), Wolde-Rufael (2006) and Narayan et al. (2008) examined the relationship between energy consumption and economic growth and found the varied and sometimes conflicting results.

The importance of energy in economic system is also proposed by Stern and Clevean (2004: 5), although constrained by the limitations of the amount of energy derived from fossil fuels. In Baily, (2013) it is stated that the growth in

productivity occurs largely in line with employment growth. Vlahinic-Dizdarevic (2010) in his research found the correlation between decreasing of energy and deindustrialization or decreasing productivity in industry in 1990 in Croatia. Likewise Pavlenko and Glukhareva (2010) in their research found the impact of economic growth in Russia due to declining oil production, and gas,. Therefore, the result of their research may help the use of efficiency and saving energy and developing new finding to substitute oil and gas energy. Energy contributes to the economic growth as part of the input (raw materials, labor and energy) in a production process. Economic growth increases as production increases leading to an increase in capital and labor thus improving the welfare of society.

Indonesia is a vast country of archipelago with 5 large islands and about 17,000 small islands that requires a large amount of energy for its economic activity and transportation. Although Indonesia is a natural energy-producing country such as petroleum, its energy production can not keep up with its energy consumption. It causes the reserve and production of petroleum fuels (fossil) in Indonesia decrease by 10% each year while the average oil consumption increase by 6% each year (Kuncahyo P., et al., 2013).

Indonesia has suffered from an energy crisis since 2006. The energy crisis in Indonesia is predicted to affect the national economic security. The national oil production has decreased permanently from 1.6 million barrels each day in 1995 and now in 2014 to 800 thousand barrels each day (Abdul Mu'im, Jakarta post, 2014). Now, Indonesia becomes a net importer of energy because the energy consumption of household and commercial sector is increasing. Petroleum needs increases (from 37 to 43.5%), Gas (61.7%), Electricity

(64.2%), LPG (130%), while the production continues to decline (8.53%), (Ahmad Ma'Ruf, 2014).

II. Literature Review

Economic growth is the result of output created by various sectors of economy how the progress or decline of the economic sector in a given period of time. Economic growth can be seen from the increase in various economic goods in the community. The increase in products or goods is due to the increasing economic productivity of industrial labor that can be estimated in Gross Domestic Product (GDP).

The method to measure economic growth (Tambunan, 2001) in absolute value and relative value in a simple way is as follow:

$$\Delta \text{GDP} (t) = (\text{GDP} (t) - \text{GDP} (t-1)) / \text{GDP} (t-1) \times 100\%$$

The increase in product demand in industry leads to the increasing need for energy as the major support in production process. Energy is an important source in GDP growth, so the reduced energy supply will cause a decline in GDP. Saboori (2012) found a relationship between energy consumption and foreign trade.

Economic growth and limitation of natural energy as a support has for a long time been the concern of experts. Sustainability of economic growth (sustainability) will be limited by the availability of natural resources (natural energy), such as published by Meadowet et al, (1972), entitled 'The Limit to Growth.' In a research conducted by Pavlenko and Glukhareva (2010) showed that prediction of environmental changes is due to the result of oil and gas production and its impact on environmental system. Their research will help to develop a new energy technology that will be more efficient and safer to Russia.

Limitation of fossil energy and ideas to find alternative for renewable energy has something to do with the law and the authority in a country (Autka, 2012) so that it becomes too late to promote renewable energy. Transition development of renewable energy can be obtained from plants which ensure that the natural assets will continue to provide resources and services to economic growth and investment.

III. THEORETICAL FRAMEWORK AND HYPOTHESIS FORMULATION

A. Theory of Economic Growth

The theory of economic growth often proposed by economic expert such as Adam Smith (1723-1790) or what so-called as classical theory. Adam Smith is known as the pioneer of economic development and policy of *laissez-faire*. In his book *An Inquiry into the Nature and Causes of the Wealth of*

Nations, Adam Smith delivered two aspects of economic growth they are the growth of total output and the principal element of a country's production system is natural resources that are available, the population, the stock of capital goods and natural resources are the "maximum limit" for the growth of economy.

David Ricardo, in Sukirno (2010) has almost the same view as Adam Smith, it is stated that limited natural resources will hinder the process of economic growth. While Robert Solow's neoclassical theory argued that economic growth is a series of activities that derives from the human, capital accumulation, the use of modern technology and the result or output. The impact of economic growth can be positive and negative.

B. The Relation of Oil Production as a Source of Energy and Gross Domestic Product

Elinur; et all (2010) in his research stated that energy is consumed by all sectors in Indonesia such as the industrial household ,agricultural and other sectors,. Thus, that the demand for energy increases in line with the incread level of consumption. Indonesia is a country possessing both non-renewable and renewable resources.However, the non renewable energy exploration is prefered causing a shortage of fossil energy especially crude oil.

Data from the National Development and Planning Bureau (Bappenas, 2013) shows that Indonesia's oil production reached 306.6 million barrels. Oil production continues to decline each year since 2005 due to the large scale of exploitation for decades. Karen Agustawan (CEO of Pertamina, 2014) in her speech presenting three areas to help to secure the future of energy in Indonesia by (1) reducing dependency on petroleum, (2) focusing on natural gas and unconventional gas (3) Creating diversified mixed energy through renewable energy.

C. Theory of Renewable Energy

Limitation of natural energy that comes from fossil in Indonesia forced the government to make Government Regulation about new energy and renewable energy to substitute fossil fuel energy with 3 kinds of new energy like nuclear energy, hydrogen, and methane (coal bed methane, liquefied coal, gasified coal). While renewable energy derives from nature such as biodiesel, bioethanol, bio oil, biogas, geothermal, wind, solar energy and waterfall. Public policy in a country that determines the technological innovation and the use of renewable energy that will be used in this study has been proved by Johnstone et al. (2009).

Renewable energy is energy that can be obtained again and again (renewable) such as sunlight and wind. The source of energy is environmentally friendly and does not contribute to climate change and global warming as natural sources from fossil. There has been Various discourse on renewable energy. Kurnia Ramadan (2013) made a model to support the implementation of renewable energy development and energy

conversion program. Wenandia Nurfala (2013) in an analysis showed the potential waste of nata de coco as a new bioethanol energy. And Hae-Kyong Bang et al (2000), in his study using the theoretical framework of the theory of action to demonstrate awareness and public acceptance of renewable energy that are more environmentally friendly as replacement for fossil energy.

Based on the literature review and theoretical framework above, hypotheses can be formulated as follow;
 HA1: There are differences in the production of oil as a source of energy before and after the energy crisis
 HA2: There is an influence of energy use on the economic growth.

IV. DATA AND METHODOLOGY

A. Data.

This research uses secondary data from the Statistical Central Bureau (BPS) in the form of the growth rate of Gross Domestic Product (GDP) as an indicator of economic growth and oil production as a contributing sector to economic growth. The data used describes the condition over the period of 1999 to 2012.

B. Methodology.

The method used is a different test sample of T test to compare the average oil production before and after the crisis and linear regression analysis to examine the influence of oil as a source of energy to economic growth before and after the crisis.

C. RESULT

The result of different test method on the production of petroleum as a source of energy that is used as the supporting sector in economic growth shows the difference between the period before and after the crisis can be seen as follows;

stblm dan sdth krisis	N	Mean	Std. Deviation	Std. Error Mean
Minyak sebelum krisis	7	460622.4286	48293.98933	17497.48328
sesudah krisis	7	324061.8571	13390.16359	6194.88954

	Levene's Test for Equality of Variances		t-Test for Equality of Means						95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper	
Minyak	9.256	.010	7.357	12	.000	1.36561E5	18661.75373	96117.98426	1.77003E5	
Equal variances assumed										
Equal variances not assumed			7.357	7.481	.000	1.36561E5	18661.75373	93234.55322	1.78867E5	

The result of linear regression test shows oil
 sors).

production influence on the economic growth

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.801 ^a	.382	.308	1.58011

a. Predictors: (Constant), Oil

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.548	1	16.548	6.799	.023 ^a
	Residual	29.207	12	2.434		
	Total	45.755	13			

a. Predictors: (Constant), Oil

b. Dependent Variable: Increase

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-4.899	2.207		-2.219	.046
	Oil	1.441E-5	.000	.801	2.607	.023

a. Dependent Variable: Increase

DISCUSSION

Energy is a very important part of the basis for economic activity, because it is used in the production process and transportation. Disruption to energy supply will affect the operational capability of manufacturing company and the household sector as a sector that contributes greatly to the economic growth. If the supply of energy decreases, will lead to rising energy prices resulting in a decline in the purchasing power of energy. This will impact on the collapse of economic activity and is destructive to the activities of production and consumption.

The research results showed that oil production in Indonesia which is used as the primary energy has decreased. However, Indonesia has been using fossil oil as the main energy, especially for transportation. To meet domestic needs, Indonesia conducted a policy of import of fuel and provides fuel subsidies. If this policy continues, it will be more dependent on imported fuels, resulting in a difficulty to get rid of the energy crisis. Therefore, the government should immediately undertake a program of energy diversification, followed by a reduction or elimination of the subsidies. Indonesia also needs to think an alternative energy in order to decrease fossil energy. Natural gas, Geothermal, Solar energy, Water energy and Bio-energy can be used as an alternative energy to solve the energy crisis in Indonesia.

CONCLUSION

1. Oil production as a source of energy has decreased in the period before and after the crisis
2. Petroleum as a source of energy influences economic growth

3. Renewable energy that derives from non-fossil fuels is needed such as natural gas and the use of unconventional gas, geothermal sources, solar energy, water energy and bio energy use; bioethanol, biogas

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