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Article

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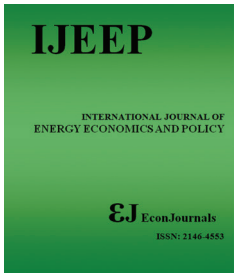

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The Impact of Fossil Energy Subsidies on Social Cost in Indonesia

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ABSTRACT

Subsidies for energy have driven the consumption of fossil energy to increase sharply. The increased use of fossil energy will increase social costs and negatively affect the environment. This study investigated the impact of fossil energy subsidies on social costs in Indonesia. The analysis used was multiple regression using secondary data from the World Bank and Ministry of Finance of the Republic of Indonesia. The results of the study showed that energy subsidies and air pollution (CO_2) in Indonesia have led to increased social costs. Meanwhile, the use of renewable energy has a negative effect on social costs in Indonesia.

Keywords: Energy Subsidy, Air Pollution, Renewable Energy, Social Cost
JEL Classifications: Q42, Q43

1. INTRODUCTION

In the last few decades, the use of energy to promote economic growth in emerging countries has been very massive. The studies of Sasana and Gozali (2017) in the BRICS countries proved that fossil energy consumption, especially coal energy, has a positive and significant impact on economic growth.Economic growth is the most powerful instrument for reducing poverty and improving the quality of life in developing countries. DFID (2017) has identified the relationship between economic growth and policy development: (1) Economic growth helps people to eradicate poverty, (2) economic growth transforms society, (3) economic growth creates jobs and drives human development, (5) economic growth improves health and education.

After the Second World War, many developing countries have sought to emulate the achievements of the developed world. Rapid industrialization is believed to bethe key to growth encouraged by a mixture of subsidies to industry, tariff protection and, in many cases state ownership. Zhongping et al. (2011) explained that as the boom of China's heavy industry has pushedthe industrial structure to be heavier, greatly increased energy consumption, as well as carbon emissions, takes place. Carbon emission is the cause of the environmental externalities that cause external costs.

External cost is a component of social cost, as Callan and Thomas (2013) described that social cost is the sum of the private cost and external cost. A study by the Ministry of Energy and Mineral Resources of Indonesia (2009) on the internalization of external costs of energy development proposeda prognosis that one of the causes of acute respiratory infections is the presence of pollutants in the surrounding community environment. Furthermore, the study of Awan (2013) in Pakistan concluded that the use of energy resources has two opposite effects; to reinforce the economic activities of the people, but aggravates the environmental conditions. Therefore, he suggested using energy resources in a sensible and environmentally friendly manner to keep environmental economics sustainable. Meanwhile, the study of Alberici et al. (2014) showed that in 2012 the total value of public intervention in energy in the EU-28 of 2012 was € 122 billion. Pubic interventions increased the external costs by € 200 billion, with a range of € 150-310 billion. Similarly, Davis study (2016)

identified that the external cost of global fuel subsidies is $ 44 billion annually. In this case, Government incentives do not reduce the cost of externalities; this is simply indirectly addressing carbon dioxide and local pollutants.

As the world have three major energy sources: Fossil fuels, renewables, and nuclear (Forsberg, 2009), the use of energy in Indonesia continues to increase in line with the pace of its economic development.The largest energy consumption in Indonesia is fossil energy, and followed by renewable energy, as shown in the following Graph 1.

Graph 1 shows that there was a very significant difference in the use of fossil energy and renewable energy in Indonesia during 1990-2014. The percentage of fossil energy usage in 1990 was 53.43%, and it increased to 65.56% in 2014. However, the percentage of renewable energy usage tended to decrease from 44.11% in 1990 to 26.2% in 2014. The increased use of the fossil energy was related to the Indonesian government fiscal policy that provided a substantial subsidy for fossil energy. In 2015, the allocation of fuel subsidy was IDR. 276.0 trillion (US $ 22.1 billion), and of electricity subsidies was IDR 68.7 trillion (US $ 5.5 billion), resulting in a total energy subsidy commitment was IDR 344.7 trillion (US $ 27.6 billion) (Ministry of Finance of the Republic of Indonesia, 2015). The increased use of fossil energy negatively affected the environment and increased social costs. Empirical data on energy subsidies and social costs in Indonesia are shown in Graph 2.

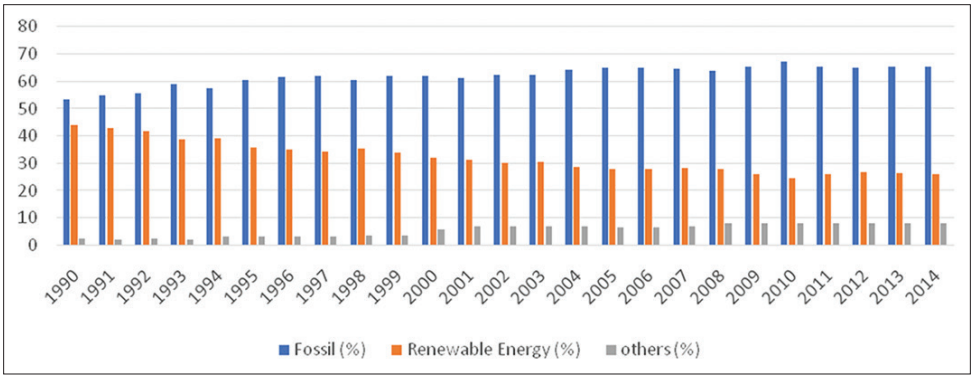
Graph 2 shows that within the last two decades subsidy on energy in Indonesia greatly increased and burdened the state finances indicated by the increase of inefficiency and social cost. The increased social costs were reflected in expense incurred in treating ARD, lung disease, and others.

As discussed, the higher the government subsidizes fossil energy, the higher the fossil energy consumption will be that resulted in the more negative impact the environment will be exposed and, consequently, the more social cost the government should be taken care of. Previously, Ellis (2010) has warned that subsidies are responsible to environment damage causing local air pollution related premature deaths, exacerbating congestion, adverse side effects of transportation systems, and greenhouse gas emissions effects.Given this situation, the objective of this study was to analyze the influence of energy subsidy, carbon dioxide emission, and renewable energy consumption on social cost in Indonesia.

2. LITERATURE REVIEW

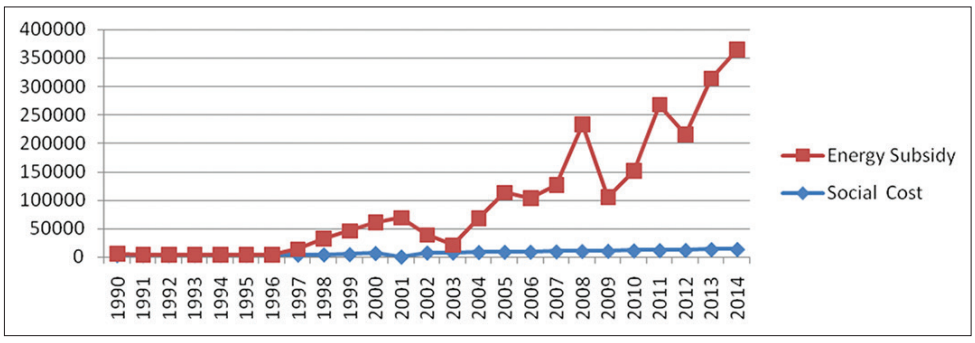
The rapid and advanced growth of technology underlying continuing development of industrial economy revolution has caused natural environment to be given up. Manufacturing processes, mass transportation systems, telecommunications, and synthetic chemicals are among technological products enjoyed by society; yet, at the same time, create environmental damage. With 20/20 hindsight, the trade-off between economic growth

Graph 1: Fossil energy, renewable energy, and other energy in indonesia during 1990-2014



Source: World Bank, processed

Graph 2: Energy Subsidy and Social Cost in Indonesia in 1990-2014 (IDR billion)



Source: Kementrian Ministry of Financial Republic of Indonesia, processed

and environmental quality has been significant (Callan and Thomas, 2013).

Environment Kuznets Curve (EKC) describes that stage 1 corresponds to countries in a rapid growth of the emission, and stage 2 means the stabilization phase (Robalino-López et al., 2015). Other possible explanations of the shape of the EKC including Lewis Growth Model is that Stage 1 corresponds to society concentrated resources in the primary sector (i.e., extraction, agriculture) to satisfy necessary consumption. Stage 2 means that resources are switched to the secondary sectors (i.e., manufacturing) as basic needs to be satisfied and consumption is concentrated on consumption of goods; while,Stage 3 relates to society swapped movement from the secondary to the tertiary sector (i.e., services) characterized by much lower levels of pollution (Everett, et al., 2010)

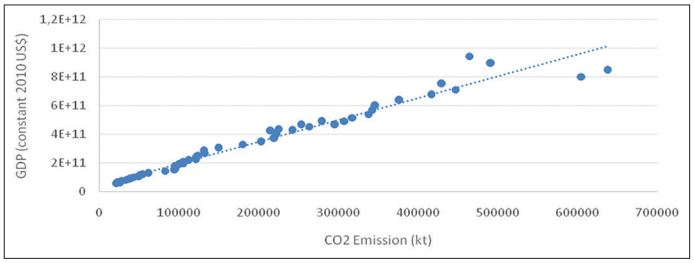
As developing country, Indonesia belongs to stage 2, in which the gradient formed from the GDP relationship to CO_2 emission is <1 (Graph 3).

Graph 3 describes that there was a direct relationship between Indonesian GDP and CO_2 emissions from 1960 to 2014; the higher the GDP was, the higher the emissions produced.This state indicated that Indonesiawas in Stage 2 according to EKC.

In order to pursuit for the economic growth, the government policy should put emphasis on maintaining environment sustainable. A policy that might be taken to encourage economic growth was to provide energy subsidies to the community; so that, the price of energy would be cheaper and the supply would always be available. The World Trade Organization defines subsidy as a financial contribution provided by government, or agent of government that confers benefits on its recipients (Kojima and Koplow, 2015). Meanwhile, the United Nations and International Energy Agency defines subsidy on energy as any measure that keeps prices for consumers below market levels, or for producers above market levels, or that reduces costs for consumers and producers (United Nations Environment Program Division of Technology, 2002).

Subsidy on energy was a fiscal policy usually applied to push economic growth developed. However, according to Asian Development Bank (2015), subsidy contributes to fiscal imbalances in many countries and increases operating losses for utilities. Furthermore, fossil fuel subsidy has other unintended negative consequences asit restricts public expenditure on development

Graph 3: Relationship between GDP and CO_2 Emission in Indonesiaduring 1960-2014



priorities such as education, health, and infrastructure. Therefore, subsidy becomes expensive means of supporting low-income households and encourages excessive consumption through low energy prices, which increases air pollution and greenhouse gas emissions. The need to reform fossil fuel subsidy has been increasingly recognized nationally and internationally to phase out inefficient subsidy. That was a tradeoff between economic growth and environmental quality.

Araghi and Barkhordari (2012) proved that highprice of energy will decrease energy consumption by households over in the long run. Similarly, Kojima (2017) in his case study claimed that removing energy subsidy affects the welfare of the poor. Furthermore, Oktaviani et al. (2007) and Abouleinein et al. (2009) confirmed that the removal of energy subsidy inducesthe decrease in welfare for all income classes, the increase in poverty, the decline of household incomes, and the reduction in inequality and average annual GDP growth. Moreover, the study of Lin and Jiang (2011) using a CGE model to analyze economic impacts of energy subsidy reforms showed that removing energy subsidy will result in a significant fall in energy demand and emissions, but it will create negative impacts on macroeconomic variables.

According to Asian Development Bank (2015), fossil fuel subsidyhas become a prominent feature of many Asian economies and not just Indonesia. The subsidycan be categorizedinto either consumer subsidy benefiting users such as transport and manufacturing industries and electricity generation; and producer subsidies to lower costs for producers involved in the exploration, extraction, or processing of energy products.

Government should take into account their decision to provide subsidy in term of costs of the program, costs of transaction and administration, as well as social costs; however, government often keeps subsidies “off-budget” for political reasons (UNEP-IEA, 2002). The policy of subsidy on energy would increase energy consumption resulted in the increase on pollution of environmental destruction that brought consequence on the increase of social cost.

In fact, subsidy increases the volume of fuel consumed, an increases the magnitude of the associated negatives externalities (Peltovuori, 2017). Therefore, the government had to be reconsidered any energy policies issued to resolve negative effects of the fossil energy used. One possible solution to the environmental risks brought by the escalating demand for energy is to consider immediate change in the composition of an energy resource portfolio (Abulfotuh, 2007). In this case, the increased use of renewable energy in power industries had been seriously reviewed by some countries, as it had great potential to solve a major part of global energy sustainability.

Economists considered subsidy on fossil fuels not only increased greenhouse gas emissions contributing to climate change, but also encouraged consumption wasteful resources, as itis often politically motivated and justified by assisting the poor (Sdralevich et al., 2014). Coady et al. (2017) stated that economic efficiency requires energy prices reflect not only supply costs but also environmental costs like global warming and air pollution, and

taxes applied to consumer goods in general. Borenstein (2012) argued that the primary goal of policies to promote renewable energy is to correct pollution externalities from burning fossil fuels. Moreover, Myojo and Ohashi (2014) simulated, based on estimates during 1997-2007 to increase residential installations of solar panels, that the emission reduction was a one third percent of annual emissions in Japan.

3. ANALYSIS METHOD

This study examined the effect of energy subsidy, carbon dioxide, and renewable energy on social cost in Indonesia from 1990 to 2014. Secondary data used were obtained from various sources such as World Bank and Indonesian Finance Ministry. In analyzing the effect of the independent variables (energy subsidy, carbon dioxide, and renewable energy consumption) on the dependent variable (social cost), multiple linear regression analysis (OLS) with time series data was used. The research model is as follows:

$$SC = f(CO_2, Subs, RE) \quad (1)$$

$$\text{Log } SC_t = \beta o + \beta_1 \text{Log } CO_{2t} + \beta_2 \text{LogSubs}_t + \beta_3 RE_t + \mu_t \quad (2)$$

Note:
SC: Social Cost (billionIDR)
CO_2: Carbon Dioxide (CO_2) emissions generated from energy consumption (kt)
Subs: Subsidy on Energy in Indonesia (billionIDR)
RE: Share of renewable energy consumption to total energy consumption (%)
β_0: Intercept
β: Value of variable coefficients
Log: logaritma
t: 1,2,3....,, 25 (time series data from 1990 to 2014)
μ: Error term.

4. RESULTS AND DISCUSSIONS

As many countries continued to provide subsidies for gasoline and diesel, quantifying the social costs of energy subsidies in Indonesia was the focus of the discussion. Table 1 shows thatthe value of the standard deviation had a wide variant from the mean. As the mean and mode had a small value difference, the values of the mean and median laid at one point in the frequency distribution curveandthe frequency distribution curve would form symmetrically.

Table 1 shows that based on 1990-2014 data, in Indonesia, the average social cost was IDR 7575.954 billion, the average CO_2 emissions was 330159.7 kt, the average energy subsidy was IDR 87,809,863,000, and the average consumption of renewable energy was 32.16%. next, the result of the normality test showed that the variables of social cost, CO_2 emission, and renewable energy passed the normality test as the probability value of Jarque-Bera was >0.05.

In this study, three independent variables and one dependent variable were used. The independent variables were energy subsidy, CO_2 emission, and renewable energy consumption, while the dependent variable was social cost. These variables were analyzed using multiple linear regression or Ordinary Least Square (OLS). The estimation result of the independent variables to the dependent variable is shown in Table 2.

Based on the estimation results presented in Table 2, the following equation was obtained:

$$\text{Log (SC)} = 3.33315 + 0.447123 \text{ Log}(CO_2) + 0.083325 \text{ Log(Subs)} - 0.031456 \text{ RE}$$
$$(1.3512)\ (2.671003)\ (4.060265)\ (-2.466782)$$

The result of the regression estimation showed that if CO_2emission increases by 1%, the social cost will rise by 0.447%. Bergh and Botzen (2015) stated that the societal cost of every additional ton of CO_2 is what is called the Social Cost of Carbon. An additional ton of CO_2 emission will affect the climate associated with damage over a very long time (Montenegro et al., 2007). The relationship between CO_2 concentration and temperature rise is not precisely linear, nor is that between temperature rise and the economic damage predicted (Price, 2017). No predictions are offered, the working premise being that the mapping from CO_2 concentration through to economic damage is approximately linear (Price and Willis, 1993).

The second finding of this study was that energy subsidy had a positive and significant impact on social cost level. The result of this study indicated that the increase of the subsidy energy by 1% multiplied social cost by 0.083%. This result was in line with the study of Turton (2002) that in Australia, cheap subsidies for coal-fired electricity have resulted in a smelting industry that produces 2.5 times as many greenhouse gas emissions per ton of

Table 1: Descriptive statistics of variables

Measurement data	Social cost	CO_2 emissions	Subsidy energy	Renewable energy
Mean	7575.954	330159.7	87809.86	32.16540
Median	7849.230	306737.2	53809.60	30.55476
Maximum	13950.44	637078.9	350379.6	44.11099
Minimum	3223.450	149565.9	161.6000	24.55229
Standard deviation	3628.418	127285.1	102638.2	5.758294
Jarque-Bera	1.940827	2.943649	6.130660	2.304839
Probability	0.378926	0.229506	0.046638	0.315872

Source: World Bank and Ministry of FinanceIndonesia, processed

Table 2: Estimation results of the dependent variable: Social cost

Independent variable	Co effficient	Standard error	T-statistic	P
Constanta	3.33315	2.466857	1.351173	0.1910
Log (CO_2)	0.447123	0.167399	2.671003	0.0143*)
Log (Subs)	0.083325	0.020522	4.060265	0.0006*)
RE	−0.031456	0.012752	−2.466782	0.0223*)
Adjusted R^2	0.948609			
F-Statistic	148.6694			
N	25			

Source: Secondary data, processed, *significance at α=5%

manufactured aluminum as the world average. Peltovuori (2017) using long-run price elasticity of demand found that the subsidies in Kiribati increased CO_2 emissions from three fuels by 2.4% (or 1.5 t) in 2015 and 5.0% (2.9 t per year on average) over a five year period (2011–2015). The study of Dartanto (2013) in Indonesia proposed that the removal of fuel subsidy could reduce poverty if the savings were allocated to government spending, or transferring them to renewable one.Meanwhile, Sasana et al.(2017) proved that subsidy on energy positively and significantly affects CO_2 emission; while, renewable energy consumption negatively affects CO_2 emission in Indonesia.

The third finding of this study was that renewable energy consumption has a negative and significant impact on social cost. The estimation result indicated that if renewable energy consumption increases by 1%, the social cost decreases by 0.0315%. The result of this study was in line with the result proposed by Myojo and Ohashi (2014). They identified, based on estimates from 1997 to 2007, the increased demand of more than tenfold of solar panels installations for residences by 350 MW through Residential Photovoltaics Dissemination (RPVD) Program resulted in carbon emissions reduction by approximately 2.8 million tons or a one third of one percent of annual emissions in Japan. As this trend changed when the RPVD Program was terminated in 2005, the Japanese market declined from 260 MW in 2005 to 180 MW in 2007.

Borenstein's (2012) finding stated that if the government implements a power plant policy with renewable energy, it is important to understand the costs and benefits of technology in the context of modern power systems. The results of the Moula (2013) study on the implementation of renewable energy technology in Finland found that 62% respondents are willing to pay additional fees to obtain green energy; while,more than half (52.4%) of the respondents stated that the public sector should take the first step towards renewable energy production.

5. CONCLUSSION

Public policy arguments for promoting the use of renewable energy and reducing fossil energy subsidies are vital in terms of both economic and environmental aspects. Based on the research results discussed, some conclusions have been drawn:

1. The results of this study show that the variations of CO_2 emissions and energy subsidy had a positive impact on social costs in Indonesia in the period 1990-2014.
2. The variable of renewable energy consumption had a significant impact on social cost in Indonesia in 1990-2014.

Based on the conclusions, several suggestions are proposed:

1. The Government of Indonesia should provide a more environmentally sound policy for sustainable development by reducing fossil fuel subsidy, and diverted for infrastructure development and provision of basic educational and health facilities.
2. The Government of Indonesia should increase incentives for the development of technological innovations to increase the use of renewable energy.

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