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Investigating the Efficiency of Government Expenditure on Energy Consumption (Fuel) Subsidy Policy in Indonesia: An Application of Stochastic Frontier Model

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ABSTRACT

The energy consumption is projected to improve living standards and the economy of society. However, for achieving this objective, the government should spend much money in kind of subsidies especially in fuel oil. In several previous studies, they stated that the Indonesia government was experiencing a budget deficit due to their policy about fuel oil subsidy policy. Thus, the purpose of this study is to examine the efficiency of government spending regarding fuel oil subsidy policy in Indonesia. This study designed by using quantitative analysis collected from three data sources, namely Bank Indonesia, Central Bureau of Statistics, and the Ministry of Energy and Mineral Resources. The quarterly data for 21 years which consists of 1996 to 2017 analysed using the stochastic frontier model by assisting statistical software, namely Eviews 10. In this study, we examine the relationship government expenditure via fuel subsidy policy (FUELsubs) on economics growth (GDPpc). Also, the relationship between unemployment (UNEMPLY) and inflation rates (INFL). Besides, for analysing the efficiency of government expenditure on energy consumption (FUEL) subsidy policy in Indonesia, we use the estimation values of the stochastic frontier model through error components, vi and ui . The results of this study found the fuel subsidy policy does not meet the energy subsidy target for the Indonesian economy. Then, there is inefficiency in subsidies that impacts the tradeoff between unemployment and inflation.

Keywords: Energy Consumption (Fuel), Fuel Policy, Fuel Subsidy, Government Expenditure, Unemployment, Economic Growth

JEL Classifications: Q41, Q43, Q48, E62, E24, O11

1. INTRODUCTION

The primary purpose of fuel subsidy is to distributing the output through the demand and supply elasticity, price stability and intervention mechanism (Secretariat General of National Energy Council, 2019). On the other hand, the fuel subsidy has negative externalities, such as not transparent and trigger distortion in the economy and inefficiency (Agarwal, 1987; Collier, 1987; Johansson and Kriström, 2019). For that, the fuel subsidy in Indonesia obtained from the selling of fuel by Pertamina (State-Owned Company) in

providing and distributing the fuel oil the whole area of Indonesia. It is lower than the costs incurred to produce and distribute the fuel. The energy subsidies are a part of fiscal policy and usually allocated a sizeable budget. Subsidies are sourced from government expenditure budget and one causes the government budget deficits.

The Indonesian government has often missed the target through subsidies in controlling inflation (Chan et al., 2017). Likewise, fuel subsidies are expected to increase efficiency in economical production and reduce unemployment. In this study, we examine

the effectiveness of fuel subsidies for controlling inflation stability and reducing the unemployment rates. It is due to an increase in the fuel oil subsidy spending, will give effect on government expenditure and also increase the amount of fuel consumption. Meanwhile, fluctuations in world oil prices have proven to be the cause of inefficiencies in fuel oil subsidies, which in fact can increase income inequality, especially in developing countries (Henseler and Maisonnave, 2018; You-how et al., 2018). Therefore, several developing countries, which the government has implemented a policy of cutting subsidies to improve the efficiency of the government budget.

Meanwhile, volatility in world oil prices causes a time of varying policy changes to uncertainty (Hailemariam et al., 2019). In several past studies, they confirmed that the fuel subsidy of Indonesia is a deficit. Also, the targeted subsidy was not effective. Thus, the subsidy components have transferred to infrastructure facilities (Secretariat General of National Energy Council, 2016; Wibert et al., 2018). The government projects about energy demand growth tend to increase through the use of transportation. So, the allocation of subsidies by the Indonesia government is more to the development and improvement of renewable energy sources facilities. Besides, the decreasing oil production affects the ratio of oil import dependency increase as much as 35% and it impacts on the government expenditure budget in the energy sector (Secretariat General of National Energy Council, 2019). In conjunction with the issue discussed, this study will investigate and examine the efficiency of government expenditure related to fuel subsidy policy in energy consumption in Indonesia. Also, analyse the relationship between unemployment and inflation as part of economics growth measurement.

2. LITERATURE REVIEW

World energy consumption is projected to increase the economy and improve the living standards of society (Silva et al., 2016). Along with that, it is necessary for investment to develop renewable energy sources such as bioenergy, because energy sources, especially the unrenovable energy, such as fossil fuels will be thinning and scarce. The policy of oil fuel subsidies, especially those that are not renewable, will undoubtedly require further study. If energy consumption is increasing forward, then the Government is on the option of increasing the investment of renewable bioenergy programs or still maintaining subsidies to grow the domestic economy. The investment can increase the economics activities. Energy subsidies are effective catalysts when done efficiently (Chan et al., 2017). However, there will be economic distortions characterised by increasing inflation and unemployment. Therefore, the reallocate of government expenditure is required when it is inefficient and not on target. It is the framework in research in which the labour sector and inflation are the leading indicators in identifying the effective allocation of oil-fuel subsidies in Indonesia.

The relationship between unemployment and wage rate was examined by Phillips (1958). This study plays an essential role especially on the analysis of monetary policy and the dynamics of inflation in macroeconomics. Essentially, the Phillips curve illustrates three links or linkages between (i) Unemployment and wages, (ii) unemployment and inflation; (iii) Total national

products and inflation (Xu et al., 2015). The negative relationship between wages or inflation with unemployment implicates the monetary policy (Sadiku et al., 2015). Unlike earlier research which focuses on unemployment and inflation, this study will focus on the central issue of Indonesia's economy that is a fiscal perspective (e.g., fuel subsidy). It is the fiscal components will be identified and it impacts the efficiency of government expenditure. Also, the trade-off condition in the Phillips theory is an indicator of the budget efficiency of government subsidies.

3. METHODOLOGY

This study designed using quarterly time-series data starting 1996-2017 that collected from three sources, namely bank Indonesia, central bureau of statistics, and the ministry of energy and mineral resources. For achieving the objective of this study, we use fuel subsidy (FUELsubs) proxies energy consumption, unemployment (UNEMPL), inflation (INFL) and economics growth (GDPpc). The data analysed using the method of the stochastic frontier model. It aims to analyzing the efficiency of government expenditure that measured with the estimation values of the error component v and u (See and Coelli, 2013; Greene, 2005). The parameter will be estimated with ordinary least square by assuming the half-normal distribution error. Furthermore, the Phillips theory (1958) used to analyse the relationship between labour (UNEMPL) and inflation rates (INFL). It is noticeable if subsidy expenditure is inefficient, then the tradeoff between the inflation rate and unemployment distorts the economy. The stochastic frontier model for this research can be written as below:

$$GDPpc_t = a_0 + a_1 FUELsubs_t + v_i - u_i \quad (1)$$

$$UNEMPL_t = a_0 + a_1 INFL_t + v_i - u_i \quad (2)$$

Assume the error term $v_i E(v_i)=0; E(v_i)=\sigma^2$ and $E(v_i v_j)=0$. While the inefficiency conditions of the models (1) and (2), via if $v_i=0$ and $u_i=0$; indicate that there is no effect of inefficiency. Meanwhile, $v_i - u_i > 0$; is positive inefficiency, and if $v_i - u_i < 0$; is negative inefficiency concerning deterministic components.

4. RESULTS AND DISCUSSION

By utilising the statistical software, in the first part, we present the result of descriptive statistics. It consists of mean, standard deviation, minimum and maximum. The result as seen in Table 1.

As mentioned in the previous part, we use four variables namely fuel subsidy (FUELsubs), Economics (GDPpc), inflation (INFL) and unemployment (UNEMPL). Table 1 showed that the mean value of FUELsubs is 10201.5 with the standard deviation is 88373.9 and minimum equal to 354 and maximum is 306478.8. The mean value of GDPpc is 109593.9 with the standard deviation is 26852.8 and the minimum value is equal to 69941.7 and the maximum value is 169252.1. The mean value of INFL is 11.0 with the standard deviation is 5.6 and the minimum value is equal to 2.75 and the maximum value is 18.3. Lastly, the mean value of UNEMPL is 99451.9 with the standard deviation is 10920.36 and the minimum value is equal to 82047 and the maximum value is 121022.

After reporting the descriptive statistics analysis, in the next paragraph, we present and discuss the results of hypotheses testing by using the model of the stochastic frontier. As mentioned before, we have two functions for testing the relationship of FUELsubs on GDPpc, and UNEMPL with INFL. Table 2 below shows the result of examining the relationship between FUELsubs and GDPpc and its efficiency of government expenditure about fuel subsidy policy.

Table 2 displayed that fuel subsidy (FUELsubs) has a significant and positive relationship on economic growth (GDPpc). Whereas, the value regression coefficient (FUELsubs) is 0.2131 with standard error as much as 0.0230 and z-stat is equal to 9.26 significant at the level of 1%. It means that when the variable of FUELsubs increase 1 USD and it will increase the economic growth (GDPpc) as much as 21.34 USD. The value of coefficient estimation categorised as small and inelastic. For those, it is necessary to test the accuracy and consistency of the model proposed i.e. The relationship between FUELsubs and GDPpc by using the Wald χ^2 test and the likelihood ratio test (LR test). The result of the wald test indicated that the model proposed using stochastic frontier is accurate and consistent.

The finding of this study similar to Kouton (2019), which also found that significant long-term effects between FUELsubs and GDPpc. It is because the relationship between both variables is asymmetry. Further, a study by Hailemariam et al. (2019) explained its condition was caused by uncertainty, in the term of development of world oil prices. Also, the ratio of estimated error values u_i and v_i can refer to the lambda value (Coelli et al., 2005). It shows that fuel oil subsidies are inefficient positively. It means that there are technical factors that cause inefficiencies in fuel oil energy subsidies in Indonesia. In line with Johansson and Kriström (2019) that subsidies have the opposite effect than expected. The next Table 3 is the result of testing the relationship between unemployment (UNEMPL) and inflation (INFL).

Table 1: The results of descriptive statistics (Obs. = 88)

Variable	Mean	Std. deviation	Min.	Max.
FUELsubs	10201.5	88373.9	354	306478.8
GDPpc	109593.9	26852.8	69941.7	169252.1
INFL	11.0	5.6	2.75	18.3
UNEMPL	99451.9	10920.36	82047	121022

Table 2: The result of the efficiency of government expenditure through fuel subsidy policy (FUELsubs) and its relationship on economic growth (GDPpc)

Variable	Coefficient	Standard error	z	P> z
FUELsubs	0.2134	0.0230	9.26	0.000
constant	87819.84	70734.64	1.24	0.214
lnsig ² v_i	19.7048	0.1507		
lnsig ² u_i	-5.2151	2402924		
Sigma v_i	19003.93	1432.4750		
Sigma u_i	0.0737	88567.32		
Sigma ²	3.61e+08	5.44e+07		
lambda	3.88e-06	88579.03		
LR test of sigma $u = 0$: $\chi^2=0.000$ Prob. $\chi^2=1.000$				
Wald $\chi^2=85.70$: Prob. $\chi^2>0.000$				

Dependent variable is GDPpc

Having discussed the issue of fuel prices, this study also tests the effect of its fuel subsidy policy in the relationship between inflation (INFL) and unemployment (UNEMPL). Table 3 displayed that INFL has a significant and negative relationship on UNEMPL. Whereas, the value regression coefficient (INFL) is -1711.146 with standard error as much as 108.7565 and z-stat is equal to -15.73 significant at the level of 1%. The results of this study supported theoretically with Phillips curve theory (1958) and Xu et al. (2015) which also found that inflation has a significant negative relationship on unemployment. Further, the value of coefficient estimation categorised as small and inelastic. For those, it is necessary to test the accuracy and consistency of the model proposed i.e., The relationship between INFL and UNEMPL by using the Wald χ^2 test and the likelihood ratio test (LR test). The result of the Wald test indicated that the model proposed using stochastic frontier is accurate and consistent also.

The estimated results of the unemployment relationship with inflation are negative, in line with the theory of Philips (1958) and previous studies e.g., Xu et al. (2015) Figure 1 a and b displayed the estimation using stochastic frontier finds inefficiencies higher than one, so that technological factors dominate the inefficiencies in the estimation results from the model. This inefficiency can be explained by the fact that fuel subsidies are not effective in reducing unemployment. Inflation stability through subsidies and increasing national per capita income is not the expected target. On the contrary, it can increase income inequality because subsidies are not on target. This condition often occurs in developing countries (Adom, 2016; Henseler and Maisonnave, 2018); we're supposed to be able to increase macroeconomic stability further reduces macroeconomic performance.

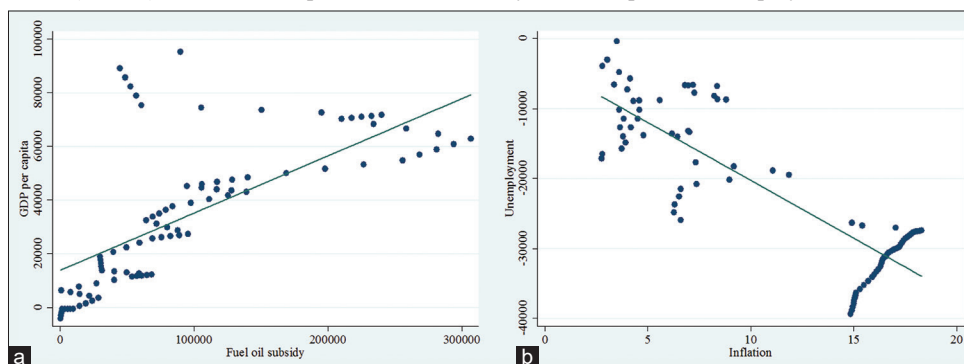
The elimination of fuel subsidies in developing countries (Adom, 2016), this condition has been studied and found in previous studies (Greeley, 1987; Wisner, 1987). Therefore, assessments of effective subsidies support simulation and estimation of targets in the sectors that are needed. Also, the uncertainty of the world oil market situation, specifically world oil prices, is affecting the ineffective of fuel subsidy policies. In other words, the fuel subsidy causes crowding out in addressing growth in employment opportunities. The fuel subsidy policy needs to be evaluated and needs to pay attention to policies in other sectors, such as investment, infrastructure and the eradication of corruption

Table 3: The result of the efficiency of government expenditure (investment) for reducing inflation (INFL) and its effect on unemployment (UNEMPL)

Variable	Coefficient	Standard error	z	P> z
INFL	-1711.146	108.7565	-15.73	0.000
constant	124964.9	2153.612	58.03	0.000
lnsig ² v	15.9902	0.7345		
lnsig ² u	18.0374	0.3911		
Sigma v	2966.408	1089.459		
Sigma u	8255.978	1614.363		
Sigma ²	7.70e+07	2.17e+07		
lambda	2.783157	2579.849		
LR test of sigma $u = 0$: $\chi^2=2.42$ Prob. $\chi^2>1.000$				
Wald $\chi^2=247.55$: Prob. $\chi^2=0.000$				

Dependent variable: Unemployment (UNEMPL)

Figure 1: (a and b) The relationship between fuel subsidy and its impact on unemployment and inflation rate



connected with subsidy policies. The elimination of inefficiencies in fuel subsidy policies has become the plan and commitment of G20 countries (Piggot et al., 2017) such as the European Union, United State, China and India countries. However, the condition of developing countries in general that uses energy subsidy policies to increase development acceleration and address inequality also occurs inefficiencies and ineffectiveness in policy achievement targets.

Therefore, eliminating energy subsidies requires a comprehensive study. If the subsidy is not on target, a solution for controlling and monitoring the target of fuel subsidies needs to be prepared. Conversely, if inefficiency occurs as a result of the scale of link and matches government development programs, it is necessary to prioritise the level of development. As we know, energy consumption in Indonesia is mainly for the industrial, transportation, household, commercial and other sectors. The target of absorbing labour from the industrial sector and the business sector is the target issue achieved, while the household sector is offering a job. Thus, the main target of improving infrastructure is transportation to connect the household sector to the industrial and commercial sectors. For example, the use and beneficiaries of oil subsidy policies are to increase production and mobilisation of input production to augment productivity, so infrastructure and public transportation are priorities.

5. CONCLUSIONS

Fuel subsidies in Indonesia are inefficient from any government expenditure. The impact of inefficiency can be seen from the tradeoff between the inflation rate and unemployment which also experiencing inefficiency. The cause of this inefficiency is that subsidies should be able to increase employment through infrastructure and reduce inequality of income per capita of the Indonesian population. Future subsidy policies are recommended so that they can be controlled and supervised according to the expected targets. The fuel subsidy policy is related to decreasing unemployment and inflation, starting with building a means of connecting between the recipient household sector and the industrial and commercial sectors to engage potential surplus labour in the household sector. The fuel subsidy policy, in the long run, should trade-off with bioenergy. Therefore, the allocation of bioenergy development that results in the provision of more sustainable fuel oil energy. For those, this study recommends

future research to analyse the transfer of fossil fuel subsidy by developing bioenergy and its impact on macroeconomic indicators in the short and long term relationships.

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