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Simulation of the Impacts of Fuel Pricing Policies towards Inflation in Indonesia

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ABSTRACT: This study was conducted to calculate the impacts of various policy options for determining the price of fuel oil on inflation in Indonesia. Calculations were carried out using the General Computable Equilibrium (CGE) model approach with the General Algebraic Modeling System (GAMS) software. Simulations were carried out using the CGE model to determine the impacts of fuel pricing policy options on inflation in Indonesia. This study utilizes the database from the 2015 updated base-year Indonesian Socio-Economic Accounting Matrix (Sistem Neraca Sosial Ekonomi, SNSE). The method used is the Static Computable General Equilibrium (Static CGE) model. Based on the simulation results, it was discovered that inflation in Indonesia is more greatly impacted by pricing policies on subsidized rather than non-subsidized fuel oil.

KEYWORDS: Fuel Price, Inflation, Static CGE

I. INTRODUCTION

Fuel oil pricing policy remains a persistent dilemma for every government administration. According to Partowidagdo in Partowidagdo Widjajono (2009), in the long run, the most serious problems in fuel oil management in Indonesia primarily have to do with pricing policies and sustainability of supplies. Fuel price subsidies have been provided by the government since the initial period of Indonesia's economic development. The policy was implemented to improve the purchasing power of households and the competitive ability of the industrial sector, which was the main foothold for economic growth at the time. Based on the condition of Indonesia's oil balance at that time, this option was deemed relevant because Indonesia's oil production at the time surpassed domestic oil consumption, reflected by Indonesia's membership in the Organization of thePetroleum Exporting Countries (OPEC). Nugrahanti (2011) has said that the Indonesian government plays a large role in establishing fuel oil prices. The positive impact of low fuel prices is that the people's purchasing power to procure goods and services within the country can be well- maintained.In its development, Indonesia's oil and gas production has been recorded as steadily decreasing due to its declining ability to discover new oil reserves, caused by the relative lack of exploration activities, the main instrument for increasing one's oil and gas reserves. Existing data have shown that throughout 1975-2000 Indonesia's oil balance surplus continued to decline. Post-2000, Indonesia's oil balance deficit continued to grow due to rising consumption and declining domestic production as shown in Table 1.

Table 1.
Developments in Indonesian Oil Production and Consumption in 1975-2018

Year	Indonesian Oil Balance (Thousand Barrels)		
	Producti on	Consump tion	Surplus/Deficit
1975	1,306	221	1,085
1980	1,577	386	1,191
1990	1,539	652	887
2000	1,456	1,148	308
2015	841	1,564	(724)
2016	882	1,580	(698)
2017	949	1,652	(703)
2018	808	1,785	(977)

Source: BP Statistical Review 2019 & Indonesian Ministry of Energy and Mineral Resources (MEMR)
In its development, while Indonesia's oil balance conditions have become skewed, the country has retained the

same policy pattern for fuel oil subsidies. It is recorded that almost all government administrations have maintained the same fuel pricing policy pattern where subsidies continue to be provided for certain fuel oil types sold domestically. The only relative difference between each government administration lies only in the fuel type, volume, and sum of subsidies per liter.From a fiscal standpoint, oil and gas play an important role for the State Budget (APBN) and the Indonesian economy as a whole. Income from the oil and gas sector have a critical role in the implementation of the Five-Year Development (Pelita) program imposed by the New Order government. At the time, the amount contributed by the oil and gas sector comprises about 60% of total

revenue in the Indonesian State Budget (realized State Budget of 1973-1983). According to the Central Government Financial Report (LKPP) of 2012-2014, before the downturn in global oil prices (in the years of 2012-2014), oil and gas revenue makes up a portion of around 19-22% of total revenue reported in the State Budget. As oil prices decreased, the amount of revenue contributed by the oil and gas sector is around 5-8.5% of total revenue in the 2015-2016 State Budget according to the LKPP (2015- 2016). The portion of revenue contributed by the oil and gas sector in the Indonesian State Budget tends to increase at the same time that global oil prices increase. Nevertheless, oil and gas continues to play a crucial role in Indonesia's economy, retaining a fairly significant portion in the Indonesian energy mix over the past ten years (2009-2018) in the range of 63.03 – 72.71% (Handbook of Energy and Economic Statistics of Indonesia, 2019). Indonesia's National Energy Plan (RUEN) has been reported to have set a target of maintaining the portion of oil and gas in the national energy mix at around 44% until 2050 (Presidential Regulation22/2017).

The strategic role and position of oil and gas in the national economy demands the formulation of an appropriate fuel pricing policy. Fuel pricing policy has a broad impact on the national economy, especially because of its potential impact towards inflation. In relation with this problem, it is important to conduct a study on the Correlation between Fuel Pricing Policy and Inflation in Indonesia. It is expected that this study would serve as an additional reference for policy makers in managing the national energy sector, especially in fuel oil management. Theoretical Framework According to Parsons (2001), public policy is an action carried out by the government, political parties, and policy makers for the sake of society as a whole. In addition, Boston, et al., (2010) describes public policy as an activity where government authorities determine what can and cannot be done by the society. Public policy in general encompasses several stages, including the formulation of problems, implementation and evaluation of policies. Public policy making is a complex process as it involves the study of processes as well as variables. The stages of public policy as a process start from the preparation of an agenda based on problems which have emerged, followed by the formulation of policies. After policy formulation, the next step is policy adoption, policy implementation, and the last stage is policy evaluation (Dunn, 2011).

The theory of government expenditure (public expenditure) pertains to the costs incurred by the government to provide goods and services through the public sector budget which has an impact on private sector spending (Ukwueze, 2015). Musgrave's theory of public spending discusses changes in the elasticity of demands for public services consisting of three ranges. Musgrave stated that, when per capita income is low, demand for public services tends to be similarly low. The reason is that, in this income range, people could only spend their income to meet their primary needs. When community income rises above the low-income bracket, demands for public service services such as health, education and transportation will increase, driving the government to increase public spending to meet the needs of the community. Musgrave's research discovered that, when per capita income reaches a high level like in developed countries, the need for public services also tends to decrease because their basic needs have already been met (Chude & Chude, 2013). State finance could simply be defined as the study of the role of government in

Economic activities. In general, studies in state finance encompass: (i) when the government intervenes in economic activities; (ii) how the government intervenes in economic activities; (iii) what the impacts of the intervention are on economic outcomes; and (iv) why the government has decided to intervene the way it has. The reason that the government intervenes in economic affairs is due to the emergence of market failures which prevent economic activities from attaining maximum efficiency. Another reason that the government intervenes in economic affairs is to conduct redistribution activities that shift resources from one community group to another community group. There are a few alternatives that the government could resort to in order to intervene in economic activities, one of which is to provide subsidies as a price mechanism to respond to failures in the private sector. Subsidy is defined as public expenditure aimed at individuals or companies to lower the cost of consumption or production (Gruber, 2011). The governmental policy is intended to reduce the price of goods or services so that the people would have greater purchasing power.There is a linear relation between energy, in this case, oil and gas, and development.

The ongoing debate on this relation is on whether economic growth promotes energy consumption or, conversely, energy consumption promotes economic growth. Biophysicists argue that the only primary production factor is energy (Stern, 1999). Stern views that the more energy consumed, the less energy is available and the lower the quality. Some of the theories developed that explain the role of energy in the economy come from Stiglitz (1974) and Tahvonen and Salo (2001). Experts have developed economic models to explain how energy affects economic growth by simulating replaceable as well as irreplaceable energy needs. These experts divided economic development into three stages, including pre- industrial, industrial, and post-industrial. At the pre-industrial stage, energy prices started out low before rising. The price of non- renewable fuel which was initially low would then also increase.

Research Methods : The data used from the Socio-Economic Accounting Matrix (SNSE) comes from the 2015 update of SNSE Indonesia, which is an update of the data from 2008. As for several other parameters such as constant elasticity of substitution (CES) and constant elasticity of transformation (CET), a few assumptions have been adopted. The CES and CET values are assumed to be 0.5 for twenty-three sectors, except for the food and beverage and tobacco industry sectors, where they are assumed to be 1.5.SNSE data is updated by inputting renewed data and adjusting data classification lines and columns used in the 2008 SNSE. To start with, the production sector block, domestic commodity block, and imported commodity blocks are merged into one new block. Second, the lines and columns for trade and transport margins (TTM) are deleted, followed by a move away from consumer price- based to producer price-based transactions between production sectors/production and commodity sectors. Third, disaggregation of lines and columns for indirect taxes to net indirect taxes and net import tariffs.The comparative static CGE analysis tool is appropriate to be used for observing the impacts of policy implementation or the impacts of changes in external variables towards the economy, comparing conditions when a policy is implemented and when it is not. CGE is considered a deterministic model which prioritizes comparison of changes in variables focused upon in the study between the

initial equilibrium conditions (base) and the new equilibrium (shock simulation results). Compared to other deterministic models such as the input-output (IO) table model or the SNSE model and its derivatives, the CGE model has incorporated several factors such as price and exchange rate variables and explains the cause for differences in consumption behavior among community groups as utility maximization. Utility maximizing behavior is considered to represent welfare, which is the goal of policy implementation (Hosoe et al, 2010:1-2). Static CGE is performed using the General Algebraic Modeling System (gams) software. The Energy Economy CGE model is constructed using general equations (formulae) used in the typical (basic) CGE model. The model was developed by expanding the database using transactions from both the IO Table and the SNSE Table. In addition to database expansion using the IO and SNSE Tables, modifications were also made to the formulae/equations, which were adjusted to existing needs and expansion of the database. The formulas used in the CGE model are as follows:In this study, the model used was adapted from the model constructed by Hosoe et al. (2010: 87-121), then adjusted to adapt to the economic characteristics, analysis needs, and availability of Indonesian SNSE data. The adjustments mentioned were made towards several aspects,

which are: Modification of Goods and Services Market Specifications for Several Sectors, from Perfect Competition to Monopoly; Addition to the Number of Categories of Household Institutions from a Single Household to Several Household Categories;

Addition of Enterprise Institutions (Establishments) in the Model;
Addition of Service Compensation Transactions with Overseas Factor; and

Addition of Transfer Transactions within One Institution and Across Institutions (Households, Companies, Governments, and Overseas). To better visualize this concept, it is described that the production sector in an economy only produces two outputs consisting of goods 1 (BRD) and goods 2 (MLK). To further simplify the illustration, the only process stage shown is the production of goods 1 (BRD), although the same process actually applies as well for the production of goods 2 (MLK).Based on the flowchart sequence of the CGE model, functions are then arranged in a way that represents the behavior of each element involved in the general equilibrium of the economy. These functions are grouped according to blocks which are similar to one another, namely the domestic production block, the export commodity and domestic commodity transformation block, the substitution between imported commodities and domestic commodities block (Armington composite), the government institutions block, the savings and investment block, the household institution block, the export and import commodity price balance of payment (BOP) block, and the market clearing conditions block.In addition to compiling functions into each block, during the preparation of this model, a calibration procedure is also needed for the parameters required. The parameters which have been calibrated and functions used to obtain them are as follows: Calibration towards the Leontief production function coefficients, as such:

$$ax_{ij} = \frac{X_{ij}^0}{Z_j^0} \qquad \forall i, j$$

$$ay_j = \frac{Y_j^0}{Z_j^0} \qquad \forall j$$

axi: : input coefficient (i-th good used to produce one good from the j-th sector)
ayj : input coefficient (i-th composite good used to produce one good from the j-th sector)
X0ij : intermediate input (amount of i-th goods used to produce goods in the j-th sector goods) under initial equilibrium conditions
Z0j : gross domestic output of the j-th sector under
initial equilibrium conditions
Y0j :composite factor of the j-th sector under initial equilibrium conditions

Calibration towards coefficients of the CES function, as such:

$$\delta m_i = \frac{(1+\tau_i^m) p_i^{m0} M_i^{0(1-\eta_i)}}{(1+\tau_i^m) p_i^{m0} M_i^{0(1-\eta_i)} + p_i^{d0} D_i^{0(1-\eta_i)}} \qquad \forall i$$

$$\delta d_i = \frac{p_i^{d0} D_i^{0(1-\eta_i)}}{(1+\tau_i^m) p_i^{m0} M_i^{0(1-\eta_i)} + p_i^{d0} D_i^{0(1-\eta_i)}} \qquad \forall i$$

$$\eta_i = \frac{(\sigma_i - 1)}{\sigma_i} \qquad \forall i$$

where σi is obtained from the results of previous studies

$$\gamma_i = \frac{Arm_i^0}{\left(\delta m_i M_i^{0\eta_i} + \delta d_i D_i^{0\acute{\eta}_i}\right)^{1/\eta_i}} \qquad \forall i$$

Calibration towards coefficients of the CET function, as such:

$$\xi e_i = \frac{p_i^{e0} E_i^{0(1-\Phi_i)}}{p_i^{e0} E_i^{0(1-\Phi_i)} + p_i^{d0} D_i^{0(1-\Phi_i)}} \qquad \forall i$$

$$\xi d_i = \frac{p_i^{d0} D_i^{0(1-\Phi_i)}}{p_i^{e0} E_i^{0(1-\Phi_i)} + p_i^{d0} D_i^{0(1-\Phi_i)}} \qquad \forall i$$

$$\theta_i = \frac{Z_i^0}{(\xi e_i E_i^{0\Phi_i} + \xi d_i D_i^{0\Phi_i})^{1/\Phi_i}} \qquad \forall i$$

estimation of savings rates and indirect tax rates

$$S_r^p = \frac{S_r^{p0}}{\begin{array}{c}(\sum_h p_h^f FF_{h,r} + trhhr(r) + trhohest(r) \\ + trhohgov(r) + \varepsilon.trhohext(r))\end{array}}$$

$$ss^g = \frac{S^{g0}}{\left(\begin{array}{c}\sum_h p_h^{f0} FF_{gov} + \sum_q T_q^{d0} + \sum_j T_j^{z0} \\ + \sum_j T_j^{m0} + T_{est}^{d0} - S^{g0}\end{array}\right)}$$

$$\tau_r^d = \frac{T_r^{d0}}{\begin{array}{c}(\sum_h p_h^{f0} FF_{est} + \sum_r tresthoh0(r) + trestest0 \\ + trestgov0 + \varepsilon.trestext0)\end{array}}$$

From these functions, endogenous variables contained in the model include:

Y_j, $F_{h,j}$, X_{ij}, Z_j, X_i^p, X_i^g, X_i^v, E_i, M_i, Arm_i, D_i, p_h^f, p_j^y, p_j^z, p_i^q, p_i^e, p_i^m, p_i^d, ε, S_r^p, S^g, T_r^d, T_j^z, T_i^m

While the exogenous variables include:

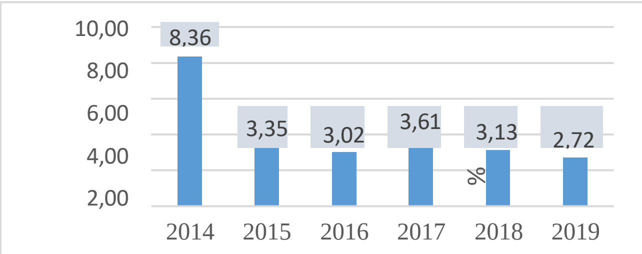
FF_{rh}, $FFest$, $FFgov$, $FFext$, NL^f, p_i^{We}, p_i^{Wm}, τ_r^d, τ_j^z, τ_i^m, $trhohhoh_{qr}$, $trhohext$, $trestext$, $trgovext$

In this model, price variables are expressed as numeraires and expressed in units of one (unity), while other variables are expressed in certain amounts. The consequence of expressing all prices in unity units is that price changes caused by a policy (shock) become relative. The numeraire process implemented is a reference to Walras's law, which states that if there are n markets in the economy and n-1 of them are in equilibrium, then the one remaining market (n-th market) is also in equilibrium.The application of Walras's law is helpful to solutions of CGE model developments. As in the model used in this study, the solution to an optimization model aims to obtain feasible and unique results mandates that the number of variables be equal to the number of functions. With the price variable transformed into a numeraire, this means that one endogenous variable is missing from the model and thus the number of variables is no longer equal to the number of functions as it originally was. The advantage of using Walras's law is that if there is an n number of markets, only n-1 markets need to reach equilibrium, as the nth market would then automatically reach equilibrium. The n-th market is therefore not actually independent but reliant on the equilibrium of n- 1 markets. Dependency of the nth market is the same as having one redundant function in the model, which must consequentially be removed from the model. This eventually makes the number of variables equal once more to the number of functions (Burfisher, 2011:38).

II. RESULTS AND DISCUSSION

Over the period of 2015-2019, inflation growth rate has been relatively maintained in the range of 3%. Existing data show that inflation in 2015 was 3.5%, a significant decrease from the previous year's rate reported at 8.36%. The declining inflation rate was influenced by the government's policy to reduce fuel subsidies at the end of 2014 at the same time as a downward trend in global crude oil prices. In 2016, inflation decreased once more to 3.02% as one of the impacts of an energy price management policy reform by the Indonesian government implemented as oil prices were in decline at the time.

Figure 1.
Indonesia's Inflation Rate in 2010 – 2019



Source : Statistics Indonesia/ (2020)

Subsidized Fuel Increased by 5%	0.0572%
Subsidized Fuel Increased by 10%	0.1141%
Subsidized Fuel Increased by 20%	0.2266%
Subsidized Fuel Increased by 30%	0.3377%
Non-Subsidized Fuel Increased by 2%	0.0224%
Non-Subsidized Fuel Increased by 5%	0.0559%
Non-Subsidized Fuel Increased by 10%	0.114%
Non-Subsidized Fuel Increased by 20%	0.2212%
Non-Subsidized Fuel Increased by 30%	0.3297%

Table 2.

Simulation Results of the Impact of Increasing Fuel Prices on Indonesia's Inflation

In 2017, the inflation rate was again recorded to be increasing, but still remained in stable condition within the range of 3%. Inflationary stability is driven by commodity price stability, especially of food commodities, as well as the enactment of electricity tariff adjustments for consumers with 900 VA power capacities as a derivation of targeted subsidy policies. A positive trend also occurred in 2018 with inflation recorded at 3.13%, lower than the previous year. Similarly, in 2019, with the consistent implementation of the government's price management policy, inflation rate remained a positive value even as it was recorded as the lowest rate over the past five years.The simulation results show that the relation between fuel oil price and inflation rate is directly proportional. As fuel prices increase, inflation would also increase. The results of the simulation are in accordance with the economic theory that one of the causes of inflation is rising production costs. The simulation results also show that the policy scenario of increasing the price of subsidized fuel oil has a greater impact on increasing the inflation rate compared to increasing the price of non- subsidized fuel at the same percentage. The simulation results show that in scenarios with prices increasing at different levels, the inflation impact still exhibits the same pattern, in that increasing the price of subsidized fuel prices has a greater impact on increasing the inflation rate compared to the impacts of increasing the price of non-subsidized fuel.

Based on the results in Table 2, the impacts of price increase policies for all types of fuel towards Indonesia's inflation rate show a relatively similar pattern and applies to price increase scenarios above 10% as well as below 10%. The impacts of increasing subsidized fuel prices by less than 10% and more than 10% on Indonesia's inflation rate shows relatively the same pattern. Increasing subsidized fuel prices by more than 10% and less than 10% would both result in an increased inflation rate. The impact of increasing non-subsidized fuel prices on inflation is also relatively identical the impact caused by increasing subsidized fuel prices. Increasing non-subsidized fuel prices by less than 10% and more than 10% would also result in an increased inflation rate in Indonesia.

III. CONCLUSIONS AND RECOMMENDATIONS

Source: Results of CGE model simulation (2020)

Price Increase Policy Simulation	Impact on Inflation
Subsidized Fuel Increased by 2%	0.0230%

Based on the simulation results, explanation and discussion of the analysis of the impacts of fuel oil pricing policies on inflation, it was found that fuel prices are directly proportional to the level of inflation. Policies concerning subsidized fuel pricing has a relatively greater impact on inflation than those concerning non-subsidized fuel types.The simulation results show that policies that simultaneously increase the prices of subsidized and non-subsidized fuel have a greater impact on inflation than policies that only increase the price of one of them.Simulation results show that there are several different policy options which could be taken with various combinations of price increases for subsidized and non-subsidized fuel, with diverse consequences towards inflation.

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