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Assessing the Energy Subsidy Reform in Indonesia through Different Scenarios

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ABSTRACT

This paper provides a comprehensive study on energy subsidy reform simulations in Indonesia by employing two new approaches, namely, the Almost-Ideal Demand System Iterated Linear Least-Square and SUBSIM. Periods of low and high oil prices are also accounted in this paper; further, it reveals that in 1999, when oil prices were low, this reform was possible due to Indonesia's status as a net oil exporter and precise selected-reformed energy goods; however, the major concerns were the unsupporting welfare situations and the depreciation of the rupiah after the Asian Financial Crisis in 1997. In 2012, the evidence shows that despite high oil prices and Indonesia being a net oil importer, this reform saved more for the government and made significant welfare impacts. Overall, this paper suggests that this reform is feasible when at least some factors, i.e., stable national exchange rate, conducive welfare situations, availability of potential recipients' database, and functioning government, are well-established.

Keywords: Almost-ideal Demand System, Energy Goods, Simulation, Subsidy Reform, Indonesia
JEL Classifications: D12, H53, I38, Q48

1. INTRODUCTION

The energy subsidy in Indonesia has been poured since the 1960s (Beaton and Lontoh, 2010; Vagliasindi, 2013). However, an official documentation (i.e. The Financial Notes of Indonesian Ministry of Finance) on the energy subsidy in Indonesia noted that this subsidy began in 1977 as a fuel subsidy. The magnitude of the energy subsidy throughout its time frame became alarming when the Asian Financial Crisis hit Indonesia in 1997. The depreciation of the rupiah followed by high inflation exerted a higher fiscal strain on the government's budget. Indonesia, indeed, not only export oil at that time but also imported it. It is no wonder that oil imports during rupiah depreciation ushered in severe fiscal consequences in relation to the balance of payment.

Indonesia was able to recover from the 1997 to 1998 Asian Financial Crisis; furthermore, inflation and the local currency were stabilized thanks to the Indonesian government's effective monetary and fiscal policy. However, rising global oil prices in the early 2000s delivered another fiscal commitment regarding the energy subsidy in Indonesia. The share of the energy subsidy in the total budget of the central government began to reach double digits, which had rarely occurred prior to the Asian Financial Crisis. According to the data of Indonesian Ministry of Finance, the average proportion between 1997 and 2018 was around 21.92%. Eventually, the strain on the budget was lessened between 2016 and 2018 thanks to the declining global oil prices as the share of energy subsidies in the central government's expenditure were below 10%.

This paper defines the energy policy reform as pricing reform in the form of reduction or elimination of the subsidy. The consideration to reform the energy subsidy was due to the huge fiscal strain exerted on the government annually; further, the recent downturn of global oil prices has presented an ideal situation for the implementation of this reform. Although some studies on the energy subsidy's implementation have been conducted in other countries, only a few are available in relation to the energy subsidy reform in Indonesia, including Ikhsan et al. (2005), Yusuf and Resosudarmo (2008), Dartanto (2013), Olivia and Gibson (2008), and Renner et al. (2019). These studies focused on the impact of the energy subsidy reduction on welfare or poverty. The first three studies utilized the computable general equilibrium (CGE) method, whereas the last two employed the deaton unit value (DUV) approach and quadratic almost-ideal demand system (QUAIDS) to measure elasticities of energy goods to further calculate the welfare[1] impact.

Indonesia has been a favorite case study for energy subsidy policy, and it has been examined for its key reform (price reform, institutional reform, and non-subsidy policies) and the mitigation actions taken (Inchauste and Victor, 2017). In addition, countries can obtain more insights in dealing with energy subsidy reform by learning from Indonesia's case study (Savatic, 2016). Therefore, this paper firmly focuses on the Indonesian case with the following considerations. First, there are limited studies[2] available for energy subsidy reform simulation in Indonesia. Second, this paper provides a comprehensive analysis of the impact of the reform on welfare/poverty and on the government's revenues. Third, the pricing reforms in this paper cover five subsidized energy goods in Indonesia, namely, electricity, liquified petroleum gas (LPG), kerosene, gasoline, and automotive diesel oil (ADO). Finally, the examinations are conducted for two different years, 1999 and 2012.[3]

This paper sets three aims: First, to measure the income and price elasticity of demand for subsidized energy goods in Indonesia; second, to simulate the subsidy elimination and examine the impacts on welfare or poverty as well as on government revenues; and third, to study the reform results based on two different years (1999 and 2012) so that the subsidy reform could be more precisely formulated. To achieve the goals of this paper, two large datasets of the Indonesian National Socioeconomic Survey (SUSENAS) of 1999 and 2012 are employed. This paper contributes to the existing literature in the following ways: (1) This paper utilizes the almost-ideal demand system iterated linear least-square (AIDS-ILLS) method developed by Lecocq and Robin (2015) that addresses the endogeneity issue in the common AIDS and QUAIDS method when estimating the elasticities. To date, this method has not been applied in a particular energy goods demand system. (2) This paper simulates the pricing reforms by utilizing the World Bank's SUBSIM simulation package introduced by Araar and Verme (2015), which is to be the first attempt of application in Indonesia. (3) This paper studies the behavior of the reform in the low-oil-price period (1999) and in the high-oil-price period (2012) to find a robust conclusion about the timing of the reform. The rest of this paper is comprised of literature review, materials and methods, results and discussion, and conclusions and policy implications.

1 Olivia and Gibson examined welfare impact as a marginal social cost, and Renner et al. (2019) measured the welfare impact as Compensating Variation (CV).

2 Mainly relied on CGE method.

3 In 1999, oil prices worldwide were relatively low; whereas, in 2012, oil prices worldwide were greater.

2. LITERATURE REVIEW

2.1. Energy Subsidy in Indonesia

The evidence of the subsidy practice in Indonesia has been acknowledged since Indonesia became independent in 1945. Two significant subsidized goods during the Old Order[4] Era were rice and fuel, provided as a counterbalance to the harmful inflation at that time, particularly in the last period of Sukarno's regime. The subsidization of goods and services were continued by Indonesia's second president, Suharto. As a net oil-exporting country, Indonesia enjoyed enormous profits and rapid economic growth in the 1980s "Oil Boom" period (Beaton and Lontoh, 2010).

Over time, the magnitude of the energy subsidy increased steadily. The fiscal strain became problematic when the Asian Financial Crisis occurred from 1997 to 1998. The rupiah depreciated severely, and high inflation disrupted the Indonesian economy. As a result, the economy's annual growth declined to −13.13% in 1998. Moreover, starting from 1997, the annual proportions of the energy subsidy on the total budget were bigger than before. Some key events related to the energy subsidy in Indonesia are presented in Table 1.

As the energy subsidy was initiated during the New Order administration, the magnitudes of the energy subsidy in Indonesia have fluctuated mainly because the rupiah has appreciated or depreciated. Furthermore, the fiscal strain worsened after Indonesia became a net oil-importing country in 2004. Table 1 shows that the world's oil prices also significantly impacted the energy subsidy in Indonesia with the additional impact of the exchange rate. When global oil prices were relatively low, right after the Asian Financial Crisis, fiscal strains due to the excessive energy subsidy were high because of the depreciation of the rupiah. Conversely, after the rupiah was stabilized, rising global oil prices worsened the budget problem. It is evident that either the exchange rate or global oil prices determine the energy subsidy structures, especially for a net oil-importing country. In the worst-case scenario, severe depreciation followed by rising oil prices would create a significant adverse impact on the government's budget.

Table 1 also shows some of the Indonesian government's efforts when either global oil prices plunged, or the rupiah appreciated against the US dollar. It can be seen that when the rupiah became stronger against the US dollar in 2007, the government of Indonesia deployed the kerosene-to-LPG conversion program that cuts the proportion of the energy subsidy on the central government's budget. Again, in 2013, when global oil prices

4 Old Order Era is the period when Sukarno, the first President of Indonesia, was in power (1945–1965).

Table 1: Key Events of the Energy Subsidy Policy in Indonesia 1956-2017

Year	Event	Exchange rate (Rupiah per 1 US Dollar)	Oil price index[5]	Percentage of Central Government's Total Budget		
				Oil subsidy	Electricity subsidy	Total energy subsidy
1956-1965	Energy subsidy initiated in Sukarno's regime. Indonesia joined OPEC[6] in 1962	n/a	n/a	n/a	n/a	n/a
1997	Asian financial crisis	2,909	36.13	11.11	-	11.11
1998	As a result of the crisis, Indonesia's economic growth fell to −13.13%. Electricity subsidy began	10,014	24.49	18.27	1.32	19.59
2000	Energy subsidy hiked and world oil prices started to soar	8,422	52.91	26.48	2.09	28.57
2003	The rupiah appreciated against the US dollar. In 2002, 1 USD was equal to 9,311 rupiah	8,577	54.14	10.24	1.47	11.71
2004	Indonesia became a net oil-importing country	8,939	70.59	22.43	0.78	23.21
2005	The Indonesian government fixed gasoline, diesel fuel, kerosene, and electricity subsidies	9,705	100.00	26.47	2.45	28.92
2007	The conversion program from kerosene-to-LPG began	9,141	133.53	16.60	6.55	23.15
2008	The rupiah depreciated against the US dollar. This year, the electricity subsidy reached its peak. Global oil prices also peaked before declining the following period. Indonesia decided to withdraw from OPEC	9,699	182.15	20.06	12.10	32.16
2012	Global oil prices peaked	9,387	197.95	20.97	9.36	30.33
2013	The government increased electricity tariffs, diesel fuel, and gasoline prices	10,461	195.91	18.47	8.79	27.26
2014	Electricity tariffs were adjusted monthly	11,865	181.08	19.94	8.46	28.40
2015	World oil prices declined. The subsidy for gasoline was terminated	13,389	95.58	5.13	4.93	10.06
2017	The subsidy for electricity was withdrawn, except for the two lowest voltage groups	13,381	96.30	3.72	4.00	7.72

Data from the author's calculation are based on the data from Indonesian Ministry of Finance, International Institute for Sustainable Development (hereafter, IISD), Indonesian Ministry of Energy and Mineral Resources, World Development Indicators of the World Bank, and the International Monetary Fund Commodity Prices

declined, electricity pricing was reformed. As the oil prices kept falling, the reform of the electricity tariff continued in 2014 and 2017[7]. Ultimately, the subsidy for gasoline was terminated in 2015 as a result of a huge relief in fiscal strain due to declining global oil prices.

2.2. Subsidized Energy Products in Indonesia

The energy subsidy was initially noted in 1977 in the form of a fuel subsidy. The Indonesian government did not subsidize fuel in 1986 and 1995 because of better net profit of Indonesia's fuel trade as well as the stabilization of global oil prices (Indonesian Ministry of Finance, n.d.). The energy subsidy in Indonesia consists of fuel and electricity subsidies. Electricity began to be subsidized in 1998, joining gasoline, kerosene, ADO[8], industrial diesel oil, and fuel oil. In 2005, the line-up of subsidized fuel goods comprised of gasoline, kerosene, and ADO (Dartanto, 2013). The fuel subsidy was then expanded to cover LPG in 2007 as a part of the Indonesian kerosene-to-LPG conversion program (IISD, 2012). Eventually, gasoline was excluded from the subsidized list in 2015.

Electricity is a significant energy source for lighting in addition to other utilizations (e.g., for cooking). The Indonesian Central Bureau of Statistics (BPS) noted that in 2017, 98.14% of households in Indonesia utilized electricity as a source for lighting and 95.99% was generated by the National Electricity Company (PLN). PLN, as the only state-owned electricity company in Indonesia, plays a significant role in electricity generation and is subsidized by the government annually in the form of the difference of average unit cost to produce electricity (per kWh) and government-set tariffs[9]. The reform of electricity subsidies seems promising as the government successfully implemented gradual pricing gradually in 2013, 2014, and 2017.

Gasoline and ADO were two subsidized energy goods in the transportation sector. To date, only ADO is still subsidized by the government. However, important lessons could be learned from the story of gasoline's reform. Fuels for transportation in Indonesia are mainly supplied by Pertamina, an Indonesian state-owned company. Pertamina, like PLN, receives a subsidy in its fuel's production. The subsidy received by Pertamina is in the form of the difference between the retail price set by the government and the economic price of the respective fuel product. The determination of the price depends on the Mid Oil Platt Singapore, transportation cost, distribution and storage, taxes, and profit margin for retailers (Dartanto, 2013). Some policy actions have also been taken regarding the reform in the transportation sector. In January 2013, the government prohibited government vehicles to buy fuels from Pertamina stations. This was in effect as

5 Simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh.

6 Organization of Petroleum Exporting Countries.

7 Rupiah slightly appreciated against US dollar while the world's oil prices inclined insignificantly.

8 Also called solar fuel.

9 Tariffs are differentiated into some categories such as households, industries, businesses, public institutions, and governments and road lightings (IISD, 2014).

of June 2013, and the price of gasoline and ADO increased by 44% and 22%, respectively. Along with the reform attempts in 2013, some compensation programs were deployed such as conditional cash transfers, infrastructure improvements, financial aid for schools, and rice for the poor (IISD, 2014). As a final touch to the reform, particularly for gasoline, the government fully removed the subsidy in 2015.

Kerosene and LPG are the subsidized energy goods managed by Pertamina that are mainly utilized for cooking in Indonesia. Since the conversion program in 2007, the government's expenditure for the kerosene subsidy has been declining. The conversion program successfully reduced around 80% of kerosene usage, from 8.4 million kiloliters in 2007 to 1.6 million kiloliters in 2011. Moreover, from 2007 to 2011, the conversion program provided savings to the government of around 45.3 trillion rupiah (Indonesian Ministry of Energy and Mineral Resources in IISD (2012)). During the period from 2013 to 2018, the proportion of kerosene subsidy to the total energy subsidy has been stable at around 2%; conversely, the LPG subsidy's shares increased from 9.99% in 2013 to 37.87% in 2018. These significant increases are highly related to LPG's price hikes as well as increments in the distribution's quantities (Indonesian Ministry of Finance). In fact, the government of Indonesia kept pushing the domestic consumption of LPG as a continuation of the kerosene-to-LPG conversion program by expanding the distribution of the subsidized LPG cylinder in the eastern region of Indonesia (IISD, 2015).

2.3. Empirical Evidence

Energy subsidy reform is not a new thought among countries. The G20 Summit in Pittsburgh in 2009 declared the commitment to apply a gradual reduction in fossil fuel subsidies. Some countries, indeed, have already applied reductions and others planned to do so (Vagliasindi, 2013). Furthermore, the declining trend of global oil prices lately has attracted more countries to seize it by applying pricing reform on energy goods. To execute a well-planned reform, some studies have been conducted to investigate the possible impact of the reform on welfare as well as on government revenues.

One of the possible assessments prior to the energy subsidy reform is the estimation of income and price elasticity of demand. The elasticities of demand for energy goods are measured by econometric techniques. Among others, the Almost-Ideal Demand System (AIDS) approach is a commonly employed method. Gundimeda and Köhlin (2008) tried to investigate the demand system of energy goods in India by using the AIDS method on around 100,000 households. Yii et al. (2017) also employed this technique when estimating the elasticities of four energy goods (petrol, diesel, electricity, and LPG) in Sabah, Malaysia. They found that petrol and diesel fuels are price elastic while LPG and electricity are inelastic. The AIDS method was also used in the research conducted by Bazzazan et al. (2017) when measuring the elasticity of electricity among other goods in Iran. Eventually, they found that electricity was price inelastic during the period of study.

In the case of Indonesia, Olivia and Gibson (2008) measured the elasticities of electricity, LPG, kerosene, gasoline, and oil by utilizing SUSENAS 1999 dataset. Although SUSENAS covers all provinces in Indonesia, their study only focused on 28,964 households in Java. In slight contrast from other research in the energy demand system, the DUV method was employed. Among all the goods examined, only electricity was found to be price elastic. However, if the estimation is broken down into rural Java, with the exception of oil, the goods had price elasticities of demand by more than unity. The chosen locus to be analyzed was also picked by Bhakti (2011) by incorporating pooled SUSENAS data covering the period from 2007 to 2010. The AIDS method was involved when she measured the elasticity of demand for food, electricity, LPG group[10], kerosene, gasoline group[11], and other non-food item groups. She eventually found that all energy goods have the price elasticity of demand by more than one (price elastic). Another attempt to investigate the elasticity for subsidized energy goods[12] was taken by Murjani (2017) by utilizing SUSENAS 2016 data in the regency level of estimation. Slightly different from previous research in the energy demand system, he distinguished the method into AIDS- and QUAIDS-based on the assumption that different income groups would have a different form of Engel curve. He found that electricity, gasoline, and LPG have price elasticities of demand of less than one (price inelastic). A recent study in energy demand system in Indonesia was conducted by Renner et al. (2019). The QUAIDS method was applied to examine the elasticities of energy goods in Indonesia such as electricity, LPG, kerosene, and gasoline. By collecting some series of annual SUSENAS data into a pooled[13] dataset, they found that, for the lowest decile of income group, only gasoline had price elasticity more than unity among others. In contrast, the highest decile possessed a price elasticity of demand of more than one only for LPG whereas the elasticity of the midrange[14] income group seemed to be a mixture of the lowest and highest of deciles.

The study that related to the energy goods reform simulation and the welfare impact in Indonesia mainly relied on the CGE and Input-Output analysis method as can be seen from the studies of Ikhsan et al. (2005), Yusuf and Resosudarmo (2008), and Dartanto (2013). Other simulations accompanied by a prior calculation of energy goods' elasticities were done by Olivia and Gibson (2008) and Renner et al. (2019). Instead, of CGE, Olivia and Gibson (2008) utilized the marginal social cost approach adopted from Ahmad and Stern (1984) to measure welfare impact of possible energy subsidy reform while Renner et al. (2019) addressed the simulation of the reform by applying the first- and second-order welfare impacts to justify the declines in welfare when some scenarios of the reform were applied.

It is obvious that based on the previous simulation on the energy subsidy reform, welfare would be adversely affected regardless of the choice of its measurements. However, the difference in methods for calculating elasticities yielded varied results.

10 LPG group consisted of LPG, city gas, and coal bricked.
11 Gasoline was grouped with ADO.
12 Murjani (2017) limited his estimated goods into the demand system due to insignificant consumption for kerosene and ADO in the regency he examined. In the final estimation, he included only electricity, LPG, and gasoline into the demand system.
13 The pooled dataset covered years 2009–2013.
14 5^{th} decile.

Furthermore, the heterogeneity[15] of the chosen energy goods in the previous demand system studies made the application in the simulation seem incomplete. Besides the unavailability of the up-to-date *Social Accounting Matrix* utilized in the previous CGE simulation, the timing of simulation reform, as well as the government's revenue aspect, have not been deeply examined. This paper, therefore, addresses all those issues. Initially, this paper calculates the elasticities (income and price) of the subsidized energy goods such as electricity, LPG, kerosene, gasoline, and ADO in Indonesia for two chosen years, 1999 and 2012. The AIDS-ILLS introduced by Lecocq and Robin (2015) will be employed to overcome the endogeneity issue in the common AIDS method. Second, this paper engages with the World Bank's SUBSIM simulation package introduced by Araar and Verme (2015) to provide a comprehensive simulation of the energy subsidy reform. Moreover, this paper not only examines the welfare impacts but also measures the government's gain from the reform. Finally, some scenarios of the reform will be also set up to formulate well-measured policy.

3. MATERIALS AND METHODS

To handle the identification of elasticity of demand for subsidized energy goods as well as to simulate the energy subsidy reform in Indonesia, this paper generally prepares two methods that consist of AIDS-ILLS and SUBSIM simulations. The data utilized in this paper are two SUSENAS datasets (the core and consumption modules) for the years 1999 and 2012.[16] Furthermore, it is necessary to conduct the examination for those years when the world oil prices were relatively low (in 1999) in comparison to the opposite situation (in 2012). However, for both years, Indonesia experienced a similar situation in budget pressures[17]. For the calculation of unit subsidy for subsidized energy goods, the annual report from the Indonesian Ministry of Finance, Indonesian Ministry of Energy and Mineral Resources, and PLN are used. The details of each method are explained as follows.

3.1. AIDS

First, the AIDS model by Deaton and Muellbauer (1980) is specified for the estimation of the five chosen energy goods, namely, electricity, LPG[18], kerosene, gasoline, and ADO. The AIDS model is defined in Equation (1).

$$w_i^h = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} lnp_j^h + \beta_i ln\left[\frac{M^h}{a(P^h)}\right] + \varepsilon_i^h \quad (1)$$

15 Although study conducted by Yii et al. (2017) in Malaysia included solar fuel, none of the studies in Indonesia treated it as single good in the demand system.

16 For 1999, the number of households in the dataset is 62,210. For 2012, the number of households in the dataset is 286,113.

17 In 1999, Indonesia suffered severe depreciation that led to higher burden for oil imports. In 2012, the cause of the fiscal strain was the rising prices of oil worldwide.

18 Due to the absence of subsidy for LPG in 1999, this paper excludes it in 1999 estimation.

Where,

w_i^h : Budget share of the i^{th} energy goods obtained from the expenditure of the i^{th} energy goods divided by total energy goods expenditures (of total n goods). $\sum_{j=1}^{n} w_i = 1,$ for household h.

α_i, β_i, γ_{ij}: Parameters in the demand system.

p_j^h : Price of the j^{th} energy goods faced by household h.

M^h: Total expenditure of energy goods of household h in the demand system.

P^h: Price index defined as

$$Ln\, a(P^h) = \alpha_0 + \sum_{i=1}^{n} ln\, p_i^h + 0.5\sum_i \sum_j \gamma_{ij} lnp_i^h lnp_j^h$$

ε_i^h : Error term.

In the AIDS model, some restrictions are imposed for Equation (1) such as:

Adding up: $\sum_{i=1}^{n} \alpha_i = 1, \quad \sum_{i=1}^{n} \beta_i = 0, \quad \sum_{i=1}^{n} \gamma_{ij} = 0$

Homogeneity: $\sum_{j=1}^{n} \gamma_{ij} = 0$

Symmetry: $\gamma_{ij} = \gamma_{ji}$

Another property of the AIDS model enables some demographic variables to be injected into the model as additional regressors through α_i so that:

$$\alpha_i = \alpha_i^* + \sum_{k=1}^{m} \alpha_{ik}^* d_k \quad (2)$$

Where,

α_i^* : The intercept of the i^{th} energy goods.

α_{ik}^* : The coefficient of the i^{th} energy goods for k^{th} demographic variable.

d_k: The value of k^{th} demographic variable.

Some demographic variables are included in the Equation (2) such as household size, dummy location (urban or rural), dummy income groups (top 60% or bottom 40%), age of household's head, dummy education of household's head (holding a college degree or otherwise), and dummy gender of household's head (male or female).

From derivations of Equation (1), the Marshallian (uncompensated) income elasticity of demand can be defined as:

$$e_i = 1 + \frac{1}{w_i}\left[\beta_i\right] \quad (3)$$

and the price elasticity of demand as:

$$e_{ij} = \frac{1}{w_i}\left[\gamma_{ij} - \beta_i\right] - \delta_{ij} \quad (4)$$

where δ_{ij} is Kronecker delta that is equal to one if $i=j$ and equal to zero if $i \neq j$.

If the value of e_i is negative, the good is considered an inferior good. Further, if the value of e_i is positive and less than one, the good is considered a normal good. Finally, if the value of e_i is positive and more than one, the good becomes a luxury good. According to the theory of demand, the value of price elasticity of demand should be negative, meaning that the increase in price will be responded by a smaller quantity demanded. In absolute[19] value, if the value of e_{ii} is less than one (for example, 0.5) the elasticity is said to be price inelastic.[20] The elasticity is said to be price elastic if the value of e_{ii} is bigger than one (for example, 1.2). If the value of e_{ii} is equal to one, the elasticity is called unit elastic (Frank, 2008).

Moreover, the Hicksian (compensated) elasticities can be obtained by employing the following formula: $e_{ij}^c = e_{ij} + w_j e_i$, where e_{ij} is the uncompensated price elasticity of energy goods *i* with respect to energy goods *j*, e_i is the uncompensated income elasticity of demand for energy goods *i*, and w_j is the budget share of energy goods *j*.

The choice of either AIDS or QUAIDS in the demand system model is subject to the research design as well as the chosen goods. As mentioned earlier, some research in the energy demand system employed the AIDS among the QUAIDS model. This paper is no exception. This paper specifies the demand system into the AIDS model based on the assumptions that the energy goods are normal and luxury goods instead of inferior, and households will consume more subsidized energy goods when their incomes increase rather than shift to more expensive and non-subsidized energy goods.[21]

3.2. ILLS Estimator

The model of AIDS-ILLS estimation is actually based on AIDS and QUAIDS approaches. Lecocq and Robin (2015) identified the endogeneity problem in both standard AIDS and QUAIDS models. The independent variable that is the total expenditure of the goods in the demand system equation is suspected to be correlated with the error terms that can lead to bias and inconsistent estimations. To overcome this issue, total expenditure (as a proxy of total income) is included as an instrumental variable (IV) in the first-stage regression. In STATA exercise, another benefit from the AIDS-ILLS method is that it is faster in dealing with a large dataset compared to Poi's (2012) approach.

Lecocq and Robin (2015) augmented ε*i* in Equation (1) with the residual vector $\hat{v}$ so that:

$$\varepsilon_i^h = \rho_i \hat{v}^h + u_i^h \tag{5}$$

The residual vector $\hat{v}$ itself is gained from the first-stage IV regression that includes independent variables such as a log of total expenditure, log prices (electricity, LPG, kerosene, gasoline, and ADO), demographic variables, and log of total energy expenditure (*M*) as the dependent variable. The first-stage IV regression can be expressed as follows:

$$lnM^h = \alpha + \beta lnExp^h + \sum_{i=1}^{n} \gamma_i lnp_i^h + \sum_{k=1}^{m} \delta_k d_k^h + \hat{v}^h \tag{6}$$

Where,

M^h: Total expenditure of energy goods in the demand system for household *h*.

α, β, γ_i, δ_k: Parameters in the IV regression.

Exp^h: Total expenditure of the household *h*.

p_i^h : Price of the i^{th} energy goods faced by household *h*.

d_k^h : The value of k^{th} demographic variable for household *h*.

$\hat{v}^h$: Residuals.

From the first regression, residuals, namely, $\hat{v}$ are inserted into the demand model in Equation (1) as a new variable. Therefore, Equation (1) can be expressed as:

$$w_i^h = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} lnp_j^h + \beta_i ln\left[\frac{M^h}{a(P)}\right] + \rho_i \hat{v}^h + u_i^h \tag{7}$$

where ρ_i is the coefficient for $\hat{v}^h$ of i^{th} energy goods, and u_i^h is the error term.

3.3. Estimation Method for Missing Prices

A further issue dealing with household survey data is unavailability of prices, especially for a household that does not consume certain energy goods. Price variables are often calculated from expenditure divided by quantity consumed (or so-called unit value). This paper follows the suggestion from Heien and Wessells (1990) to conduct an estimation for a household that does not consume energy goods by using linear regression on price as a function of dummy region (Java or not Java), total expenditure, household size, and dummy location of household (urban or rural). This paper modifies the price variables into the same value in each census block by utilizing the median value of the respective energy goods. Similar treatment was applied by Renner et al. (2019); however, this paper slightly advances[22] in term of estimating unit value for electricity and LPG for 2012. So, the median of electricity blocks, as well as LPG cylinder sizes, will be treated differently according to their respected groups.

Regarding the household that does not consume the energy goods, there will be zero values for quantity, expenditure, and unit value. As the unit value estimation has been addressed previously, and the quantity consumed is not necessarily utilized in Equation (7), the zero-expenditure part is important in the demand system. Zero expenditure happens because of infrequent consumption, availability of the goods or services in the survey's period, or other factors. As a result, the demand system is called a censored model. Two popular methods when dealing with zero consumption in the demand system are a Heckman-type sample selection correction by Heien and Wessells (1990) and a consistent two-step estimation by Shonkwiler and Yen (1999) approach. However, this paper sidesteps the censoring issue based on some considerations. First, the SUSENAS datasets employed

19 Sometimes, to avoid miss conception, the value of elasticity is addressed in an absolute value.

20 e_{ii} is the own price elasticity. When *i*=*j*, e_{ij} can be denoted by e_{ii}.

21 This assumption is later proven in the income elasticity estimation result.

22 This paper incorporates the core data of SUSENAS especially for the electricity block and LPG cylinder variables.

in this paper already minimize the possibility of zero expenditure by extending the period of the consumption asked in the questionnaires[23]. Second, Dow and Norton (2003) argued that zero expenditure (not a missing value) is not a sample selection problem since the expenditure cannot have a negative value. Third, AIDS-ILLS has not yet accommodated the censoring issue in the demand system estimation.

3.4. Subsidy Reform Simulation

This paper adopted the simulation method designed for subsidy reform introduced by Araar and Verme (2012), called SUBSIM[24]. The model has been developed further since its initial release, and the current version available is from 2015[25]. The advancement of this method emphasizes its simplicity in dealing with minimum amounts of data and the ease of the outputs to be interpreted. Therefore, policy analysts could suggest sufficient policy reform recommendations for the government to take, under limited time restriction (Araar and Verme, 2012).

SUBSIM aims to provide the distributional impact of the subsidy reform on the welfare of the households as well as the government's budget. The formula for measuring changes in welfare in each household for multiple goods can be defined as follows:

$$\Delta w_h = -\sum_{g=1}^{G} e_{g,h}\left(\frac{\Delta p_g}{p_g}\right) \tag{8}$$

Where Δw_h is the welfare change for household h, $e_{g,h}$ is the initial of the total per capita expenditure of household h when the price of goods g changes, and $\left(\frac{\Delta p_g}{p_g}\right)$ is relative price changes of goods g. Since the marginal approach in Equation (8) tends to be overestimated in measuring the welfare changes when the price changes significantly, the Cobb-Douglass approach is recommended by Araar and Verme (2015). The formula is defined as follows.

$$\Delta w_h = e_h\left(\frac{1}{\prod_{g=1}^{G}\varphi_{g,h}^{\alpha_{g,h}}} - 1\right) \tag{9}$$

Where e_h is the initial of total per capita expenditure of household h, $\varphi_{g,h}$ is an average of weighted post-reform prices of goods g for household h, and $\alpha_{g,h}$ is the expenditure share of goods g for household h. Δw_h is employed to calculate the post-reform per capita expenditure where the post-reform per capita expenditure is the summation of initial per capita expenditure and the welfare change[26].

Finally, the government revenues due to the subsidy reform can be measured as follows.

$$\Delta r = \sum_{h=1}^{H} e_{g,h}\left(\frac{\Delta p_g}{p_g}\right)\left(1-\varepsilon_g\left(u_g - \frac{\Delta p_g}{p_g}\right)\right) \tag{10}$$

Where Δr is the revenue changes due to the subsidy reform, ε_g is the uncompensated[27] price elasticity of demand for good g, and μ_g is the unit subsidy for good g. The unit subsidies of energy goods are obtained from various sources.

Finally, to deal with a large price change and to set a boundary on the maximum decrease in quantity, the formula is expressed as follows:

$$\Delta r = \sum_{h=1}^{H} e_{g,h}\left(\frac{\Delta p_g}{p_g}\right) + max\left(e_g e_{g,h}\frac{\Delta p_g}{p_g}; -e_{g,h}\right)\left(\frac{\Delta p_g}{p_g} - u_g\right) \tag{11}$$

In this paper, the data for calculating the unit subsidies are gained from the annual reports of PLN, related ministries, and some publications. Most of the calculations in this paper are supported by STATA software.

23 For nonfood items, consumption for one-year period is also questioned for 1999 SUSENAS while consumption for maximum three months ago is in SUSENAS 2012 queries.
24 SUBSIM stands for Subsidy Simulation.
25 The version that included a comprehensive STATA module (Araar and Verme, 2015).
26 Since the welfare change due to price increases is negative, it is simply a subtraction.
27 This paper employs the Marshallian (uncompensated) elasticity of demand instead of Hicksian because it is mostly employed by previous research (Widarjono, 2016).

Table 2: AIDS-ILLS estimation results, 1999 and 2012

Panel 1: Uncompensated elasticity of demand, 1999 and 2012					
Items	**Electricity**	**LPG**	**Kerosene**	**Gasoline**	**ADO**
Income					
1999	1.110***	-	0.443***	1.968***	2.576
2012	0.988***	0.902***	0.324***	1.336***	1.836***
Price					
1999	−1.063***	-	−1.072***	−2.484***	−5.054*
2012	−1.165***	−1.119***	−2.277***	−1.568***	−1.498***
Panel 2: Price elasticity of demand for electricity blocks and LPG cylinders, 2012					
Items	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**
Electricity	−1.151***	−1.185***	−1.234***	−1.262***	−1.283***
LPG	−1.099***	−1.099***	-	-	-

*** and *Denote for significance at 1% and 10%, respectively. No information about electricity blocks in 1999 from SUSENAS, and no subsidy was given for LPG in 1999. Electricity Voltage Blocks, 1: 450 watt, 2: 900 watt, 3: 1,300 watt, 4: 2,200 watt, 5: >2,200 watt. LPG Cylinder Sizes, 1: 12 kg, 2: 3 kg

4. RESULTS AND DISCUSSION

4.1. Estimation Results

As the key elements for policy reform simulation, the price elasticities of demand for the chosen energy goods should be obtained prior to executing the SUBSIM. To provide a clear behavior of households' demand toward the energy goods consumed, the income elasticities of demand are also calculated for 1999 and 2012. This paper, as mentioned before, different from previous research in terms of providing detail for estimation in 2012 for electricity and LPG. The results could be examined in Table 2.

Table 2 Panel 1 shows that for both years, kerosene was considered a normal good, whereas gasoline and ADO were considered luxury goods. Further, for electricity, the classification changed from luxury goods in 1999 to normal goods in 2012. All in all, in 1999, only kerosene was considered a normal good while the other energy goods were considered luxury goods. Moreover, in 2012, the energy goods considered normal goods were electricity, LPG, and kerosene, while gasoline and ADO were classified as luxury goods. Being considered as a normal good for LPG in 2012 strongly shows that the LPG-to-Kerosene conversion program deployed by the government of Indonesia in 2007 yielded a significant result thanks to the existence of a subsidized 3 kg cylinder of LPG. For the price elasticities of demand, both years exhibited changes only on the magnitude of the elasticities. All the energy goods had elasticities more than unity (price elastic). Electricity and kerosene experienced an increase in their elasticities; contrastingly, gasoline and solar declined in their elasticities.

4.2. SUBSIM Simulations

4.2.1. Energy prices and unit subsidies

It is obvious that the gradual decrease of the energy subsidy would bring a smaller impact than a radical[28] approach. Therefore, to simulate the worst-case situation, this paper considerably focuses on the energy subsidy elimination, either one-by-one or overall, to study the possible impacts comprehensively. Prior to the simulation, the unit subsidy for subsidized energy goods should be defined. The calculation for the unit subsidy is subtle, despite SUBSIM being able to perform the simulation without the information about it. This paper extensively collected various data and information to provide baseline data including the unit subsidy for all subsidized energy products in both years 1999 and 2012. Table 3 briefly shows the average unit price and unit subsidy for all subsidized energy products. It should be noted that the LPG in 1999 was not subsidized, and the subsidized LPG in 2012 was for the 3 kg cylinder size. Further, the data for electricity blocks as well as their detail subsidy were not available for 1999.

Table 3 depicts the levels of energy subsidy in all subsidized items in the years 1999 and 2012. Indonesia highly subsidized the energy goods in 1999 due to impact of the Asian Financial Crisis, during which the depreciation of the rupiah was amplified. In addition, Indonesia also poured the energy subsidy intensively to counterbalance the impact of rising oil prices in 2012. For both years, the magnitudes of unit subsidy were around 50% or more, with the exception of electricity. Electricity began to be subsidized in 1998 as a response to the adverse impact of the crisis to cover PLN's losses. Over time, the electricity subsidy became well-planned with progressive pricing over households' electricity blocks.

4.2.2. Distributional incident analysis

To better understand the nature of the energy subsidy, whether it is pro-poor or pro-rich, the distributional analysis of the subsidy is an integral step in the SUBSIM simulation. This paper presents two figures that explain the share of energy goods' expenditures (Figure 1) and their distributions of benefits (Figure 2).

There are some points that can be extracted from Figure 1 between 1999 and 2012. For 1999, in term of the shares along with household's expenditure level (expressed in percentiles on the horizontal axis), lower percentile groups emphasize more consumption of kerosene followed by electricity, gasoline, and ADO (diesel fuel). In contrast, higher percentile groups tended to consume electricity and gasoline more than kerosene and ADO. In terms of progressivity of the shares

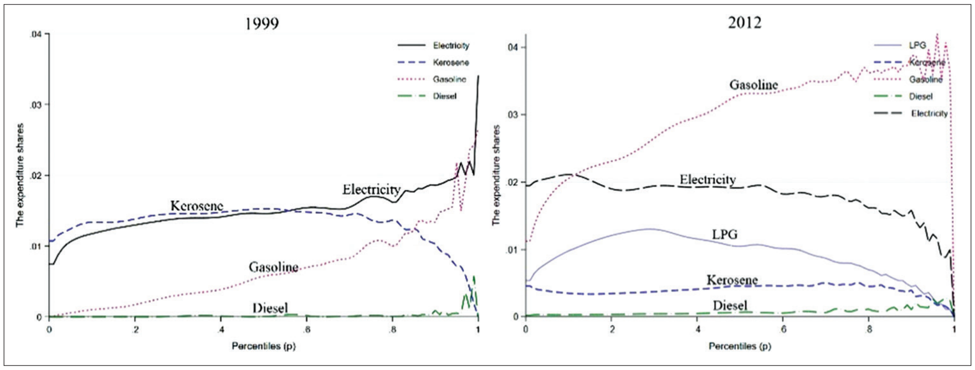
28 Fully elimination on either particular energy good or all energy goods simultaneously.

Table 3: Energy prices and unit subsidies in Indonesia, 1999 and 2012 (Rupiah per Unit)

	Subsidized price	Unsubsidized price	Unit subsidy	Parentage of subsidy
1999				
Electricity (kWh)	392	453.88	61.88	13.63
LPG (kg)	1,500	1,500*	0	0.00
Kerosene (L)	280	1,010	730	72.28
Gasoline (L)	1,000	2,530	1,530	60.47
ADO (L)	550	1,375	825	60.00
2012				
Electricity (kWh)				
Block 1 (450 watt)	405.14	1,455.54	1,050.40	72.17
Block 2 (900 watt)	585.39	1,455.54	870.15	59.78
Block 3 (1,300 watt)	801.65	1,455.54	653.89	44.92
Block 4 (2,200 watt)	809.96	1,455.54	645.58	44.35
Block 5 (>2,200 watt)	1,060.08	1,455.54	395.46	27.17
LPG (kg)	3,500	6,700	3,200	47.76
Kerosene (L)	2,500	8,700	6,200	71.26
Gasoline (L)	4,500	8,500	4,000	47.06
ADO (L)	4,500	8,900	4,400	49.44

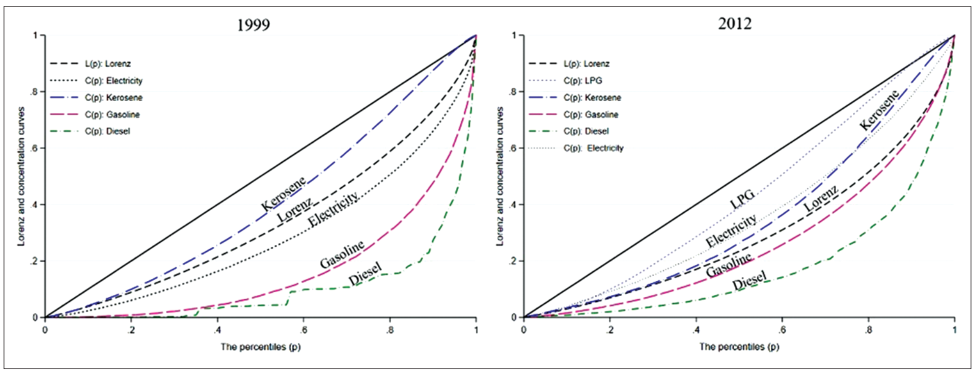
Source: Author's compilation. *Denotes that the data gained from the median of the unit value of LPG in SUSENAS 1999 data

Figure 1: Expenditures on the subsidized goods relative to the total expenditures (%), 1999 and 2012



Source: Author's calculation based on SUSENAS 1999 and 2012 data

Figure 2: Progress in the distribution of benefits, 1999 and 2012



Source: Author's calculation based on SUSENAS 1999 and 2012 data

along with the percentile groups, electricity, gasoline, and diesel showed clear progressive patterns, whereas kerosene exhibited a relatively flat pattern and became regressive for higher percentiles. This evidence also confirms the findings from Table 2 about the income elasticity of demand for kerosene in 1999 that is less than one. When all households consume kerosene in relatively similar shares, kerosene is considered as a normal good. Furthermore, the availability of another source of cooking fuel, unsubsidized LPG, might be attracting the higher percentile households to utilize it more compared to kerosene.

For 2012, households from the lowest percentile (at least in the first ten groups of percentiles) had more shares on electricity than gasoline, LPG, kerosene, and ADO. For higher percentiles, households put more weights on gasoline than electricity, LPG, kerosene, and ADO. It is clear that the main difference was only on whether the households put more weight on electricity than on gasoline and vice versa. Another finding from 2012 is that households put fewer shares of consumptions on kerosene compared to 1999. Moreover, with the existence of subsidized LPG in 2012, households tended to utilize it as the source of cooking fuel. From the progressivity of expenditure shares aspect, electricity, LPG, and kerosene exhibited relatively flat patterns (even more regressive for LPG[29]), while gasoline and ADO showed their progressivity of shares similar to 1999. These patterns also agree with the result of income elasticity of demand from Table 2 where the electricity, LPG, and kerosene were classified as normal goods whereas gasoline and ADO were luxury goods.

According to BPS, Indonesia's poverty rate was 23.43% in 1999 and 11.96% in 2012. The huge difference in the poverty rate is reflected by the distribution of benefits absorbed by the households in Figure 2. When the poverty rate was higher in 1999, the benefits of subsidy in the energy goods were absorbed more unequally, especially for electricity, gasoline, and ADO. In contrast, when the poverty rate was lower in 2012, the benefits were more equally distributed (with the exception for kerosene[30]) since the curves were closer to the 45° line compared to 1999. This evidence indicates that when the poverty rate is higher (more poor people), the benefits of the energy subsidy will be absorbed mostly by the richer households. Conversely, when poverty is lower (fewer poor people) and more people can afford to consume subsidized goods, the benefits will be more equally distributed. Of course, we underline the fact that poor households still received less than wealthier ones for all years in the situation when the universal subsidy is applied. In addition, it is clear that if the targeted subsidy is not an option, the universal subsidy could be applied when the poverty rate is much lower.

4.2.3. Energy subsidy reform simulation

This paper provides some simulations based on four reform strategies: (1) Removing the entire subsidy and counterbalancing the impact on the poverty rate using the universal mitigation

29 The subsidized LPG in 2012 was the 3 kg cylinder size, and this particular LPG item was designated for lower income households. That is why households from lower percentiles tended to consume more than the higher percentiles.

30 With the existence of subsidized LPG that targeted the lower income households in 2012, the consumption of kerosene was affected significantly.

Table 4: Impact of energy subsidy elimination on welfare in Indonesia, 1999 and 2012

	Headcount index (%)	Change (% points)	Poverty gap (%)	Change (% points)	Gini index	Change (points)
1999						
Pre-reform	23.43	-	4.60	-	31.82	-
Post-reform	25.19	1.76	5.00	0.40	31.65	−0.16
Electricity	23.61	0.18	4.63	0.03	31.79	−0.03
Kerosene	24.85	1.42	4.93	0.34	32.02	0.21
Gasoline	23.60	0.17	4.62	0.02	31.49	−0.33
ADO	23.43	0.00	4.60	0.00	31.80	−0.01
2012						
Pre-reform	11.96	-	2.00	-	40.93	-
Post-reform	14.44	2.48	2.53	0.54	41.29	0.35
Electricity	13.15	1.19	2.26	0.26	41.24	0.31
Block 1	12.92	0.96	2.21	0.22	41.26	0.32
Block 2	12.18	0.22	2.04	0.04	40.97	0.04
Block 3	11.97	0.01	2.00	0.00	40.91	−0.03
Block 4	11.96	0.00	2.00	0.00	40.92	−0.01
Block 5	11.96	0.00	2.00	0.00	40.93	−0.00
LPG	12.27	0.31	2.05	0.06	41.05	0.12
Kerosene	12.16	0.20	2.05	0.05	40.99	0.05
Gasoline	12.59	0.63	2.12	0.12	40.80	−0.13
ADO	11.97	0.01	2.00	0.00	40.92	−0.01

Source: Author's calculations based on SUBSIM. The poverty headcount ratio, poverty gap, and Gini index could be different from the official statistics provided by BPS due to difference in data treatment and the number of samples utilized from SUSENAS.[36] This paper sets the poverty thresholds at Rp. 78,225 and Rp. 240,000 for 1999 and 2012, respectively

recipients,[31] (2) removing the entire subsidy and mitigating the impact using conditional cash transfers to the targeted households,[32] (3) removing the entire subsidy and providing conditional cash transfers to target households with 5% over-coverage,[33] (4) applying similar treatment with plan number 3 but to households with 5% under-coverage.[34] Furthermore, the evaluation of the poverty impact (headcount index, poverty gap, and inequality), as well as the percentages of budget's saving, are also investigated.

Table 4 reveals the welfare impacts of Indonesia's energy subsidy elimination in 1999 and 2012. Overall, the adverse impacts were higher in the period when global oil prices were high (2012). The impacts cover the consequences on the poverty headcount index, poverty gap, and the Gini index (inequality). In 1999, due to the energy subsidy reform, the poverty rate increased by 1.76% points, the poverty gap inclined by 0.40% points, and the Gini index decreased by −0.16 points. The most significant impact came from kerosene. The single impact of kerosene subsidy reform raised the poverty rate by 1.42% points, the poverty gap by 0.34% points, and the Gini index by (positive) 0.21 points. This evidence shows that kerosene in 1999 should be carefully examined for subsidy reform. This is because it not only increases the poverty rate but also puts poor people in a more difficult position to escape poverty and creates wider inequality[35]. The possible reform in 1999 could be executed for gasoline and ADO since the welfare impacts were relatively smaller. Electricity was a bit more complicated because there was no clear information about household consumption based on the voltage blocks; moreover, the subsidy for electricity was only initiated in 1998.[36]

In the period of high oil prices in 2012, the reform delivered a bigger adverse impact on welfare. When the reform was applied to all subsidized energy goods, the poverty rate increased by 2.48% points, the poverty gap increased by 0.54% points, and inequality worsened by 0.35 points. The Gini index was worse than it was in 1999, which should be an alarm call for Indonesian government. The declining poverty rate, ideally, should be followed by less inequality to show that citizens are enjoying the benefits of their country's rapid development more equally. Furthermore, if examined deeply into the energy goods, the most affected good if the reform is applied was electricity. If the subsidy for electricity was eliminated, the poverty rate would increase by 1.19% points, the poverty gap by 0.26% points, and the Gini index by 0.31 points. However, this paper obtained detailed data for electricity blocks, which supported the preciseness of the analysis. From the data based on the electricity blocks, only the two lowest blocks (450 watt and 900 watt) that delivered a significant adverse impact due to the reform. In fact, the impacts from the three higher blocks were insignificant and even improved inequality. This finding supports the elimination of the subsidy for the three highest electricity blocks executed by the government of Indonesia in 2017. Another possible reform that could be applied in 2012 was for ADO. If the impact on the Gini index is highly considered, the reform for gasoline was also a good option. In line with the finding, the subsidy for gasoline was terminated by the

31 This scheme is taken if the recipients of the mitigation program are unknown.

32 This scheme is applied if the recipients are fully identified. This paper assigns the households as non-poor if the monthly per capita expenditures are equal or more than the poverty line, the households below the poverty line are categorized as poor households.

33 The error in providing accurate database of poor households is inevitable. This paper puts 5% as the threshold for the miss classification of the households. Since the error usually happens in categorizing households near the poverty line (almost poor and almost not poor), this paper includes the 5% households upper the poverty line as recipients (over-coverage).

34 Not including 5% households below the poverty line as recipients (under-coverage).

35 Poverty gap describes the distance between poor people from the poverty line. The bigger the poverty gap the farther the poor from the poverty line. In 1999, only reform on kerosene brought inequality wider while other goods created narrower inequality.

36 Since the focus in this study is the changes in welfare, differences from the official statistics do not affect the analysis.

government in 2015. The subsidy reform in Indonesia was more or less consistent with the findings of this paper. However, further actions for other subsidized energy goods should also be taken.

Another examination that can be done regarding the energy subsidy reform is on the government revenue/budget. According to the SUBSIM estimation, in 1999, the monthly energy subsidy absorbed by households was 1.43 trillion rupiah, or approximately 17.16 trillion rupiah annually. This means that the subsidy absorbed annually in 1999 was about 41.94% of the total energy subsidy reported by the Indonesian Ministry of Finance[37]. Conversely, in 2012, the energy subsidy that was received by households was around 45.54% of the total energy subsidy. In the microeconomics theory, the subsidy creates a zone called deadweight loss. The area describes the amount of money, which is absorbed by neither producer nor consumer. This paper indicated the possibility of deadweight loss, at least from SUSENAS data, the subsidies provided by the government of Indonesia are not equal to the amount of subsidy absorbed by the households in the SUSENAS data although other parties in the economy were still able to absorb the subsidy[38]. The percentages of government savings based on four different scenarios are provided in Table 5.

The evidence shows that the reform when oil prices were higher created a more adverse impact on welfare. However, in terms of government savings that can be seen from Table 5, the reform in 2012 provided more savings (except under simulation 1 where the reform in 1999 produced slightly equal savings). This fact cannot be separated from the situation in 2012 when the poverty rate and poverty gap were significantly better than in 1999. The government certainly needs less effort to mitigate the impact of the reform when the welfare indicators are better.

If Table 5 is examined from the simulation point of view, simulation 3 provided more savings followed by simulations 2, 4, and 1. Over-coverage, presented by simulation 3, provided the biggest savings consistently for 1999 and 2012. This makes sense since the inclusion of near-poor households for recipients made the mitigation efforts easier compared to other scenarios. The results also showed that it is most effective if near-poor and poor households are already well-identified. This scenario, however, has two possible side effects. The first is that the amount of the cash transfer received by the poor was less than it should be due to the inclusion of the near-poor households. The second one is the possibility of social friction in society. Sometimes, in a society where the gap between the poor and the wealthier households is so wide, the difference can be seen clearly. This can ignite some protests from the poor when knowing that non-poor households also received the cash transfer.

The second most effective scenario for the government's savings was simulation 2. In this simulation, the mitigation program was to provide conditional cash transfers to perfectly targeted poor households. This is the ideal scenario to minimize social friction as well as to magnify the amount of money received by the recipients. However, to provide a crystal-clear boundary between poor and non-poor households is not an easy task. In fact, it is a challenging work for all the stakeholders and needs continual updates of the poor households' database. In Indonesia, the poor households' database has been updated irregularly. BPS, as the government institution that manages census and survey, conducted some large-scale censuses designated to identify poor households, such as Social Economic Data Collection

37 The annual energy subsidy in 1999 was about 40.92 trillion rupiah, and the annual energy subsidy in 2012 was about 306.48 trillion rupiah.

38 SUSENAS data only reflect the consumption of the household samples in the specific time reference whereas the energy subsidy that mostly in form of universal subsidy could be absorbed not only by the households but also by businesses, industries, and others.

Table 5: Impact of energy subsidy elimination and cash transfer on the government's budget, 1999 and 2012

	Panel 1: Simulation 1 and Simulation 2							
	Simulation 1				Simulation 2			
	Pre-reform	Post-reform	Change	Savings (%)	Pre-reform	Post-reform	Change	Savings (%)
1999								
Subsidies (trillion rupiah)	1.43	0.00	−1.43	-	1.43	0.00	−1.43	-
Transfer (trillion rupiah)*	0.00	0.41	0.41	-	0.00	0.16	0.16	-
Total Budget (trillion rupiah)	1.43	0.41	−1.02	−71.28	1.43	0.16	−1.28	−88.99
2012								
Subsidies (trillion rupiah)	11.63	0.00	−11.63	-	11.63	0.00	−11.63	-
Transfer (trillion rupiah)*	0.00	3.37	3.37	-	0.00	0.66	0.66	-
Total Budget (trillion rupiah)	11.63	3.37	−8.26	−71.03	11.63	0.66	−10.97	−94.29
	Panel 2: Simulation 3 and Simulation 4							
	Simulation 3				Simulation 4			
1999								
Subsidies (trillion rupiah)	1.43	0.00	−1.43	-	1.43	0.00	−1.43	-
Transfer (trillion rupiah)*	0.00	0.10	0.10	-	0.00	0.28	0.28	-
Total Budget (trillion rupiah)	1.43	0.10	−1.33	−92.77	1.43	0.28	−1.15	−80.28
2012								
Subsidies (trillion rupiah)	11.63	0.00	−11.63	-	11.63	0.00	−11.63	-
Transfer (trillion rupiah)*	0.00	0.49	0.49	-	0.00	0.85	0.85	-
Total Budget (trillion rupiah)	11.63	0.49	−11.14	−95.76	11.63	0.85	−10.78	−92.68

Source: Author's calculations based on SUBSIM. *The transfer required to offset the change in headcount ratio (poverty rate)

2005 (Pendataan Sosial Ekonomi 2005), Social Protection Program Data Collection 2008 (Pendataan Program Perlindungan Sosial 2008), Social Protection Program Data Collection 2011 (Pendataan Program Perlindungan Sosial 2011), and Integrated Database Data Collection 2015 (Pendataan Basis Data Terpadu 2015). There is room for error of classification of the households due to rapid changes in the period when the data collection has not been done. It is certainly one weakness of the subsidy reform in Indonesia, as far as the accuracy of the database of households is concerned.

The third most effective way to achieve more saving from the reform is scenario number 3. This is where the mitigation program in the form of cash transfer is given to very poor households. This scenario is called under-coverage because it does not include 5% poor households near the poverty line and only covers the very bottom income groups. This strategy needs more budget compared to the previous two scenarios because it is harder to raise the very poorest households to become not poor where those poor are far below the poverty line. However, accomplishing this scenario may be easier than the previous ways because the very poor households in the real world can be identified easily either from their housing or the physical appearance of the household members. So, the utilization of the large-scale census that absorbs more funds can be replaced by, for example, a snowballing survey until the quota of the households has been achieved.

Finally, the least effective way to mitigate the impact of the reform is to apply Scenario 1. This scenario is simply giving the cash transfer universally to all households. In terms of the amount of money received by recipients, it is the smallest possible amount of money compared to previous ways. Second, in terms of fairness, it is unfair since the wealthier households receive the same amount of cash transfer as the poor households. Although this mitigation strategy does not need a database of targeted recipients, this program is not advised due to its weaknesses as mentioned earlier.

All in all, this paper found that the energy subsidy reform is not only a matter of timing whether the oil price is low or high. It is true that, based on the chosen years of samples, in the lower oil price period the welfare consequences are smaller compared to the higher oil price period. It is also true that as a net oil-exporting country, the welfare impacts are slightly less harmful. However, this paper also showed that the welfare impacts in 2012 are bigger, but with more money saved from the reform. From here, another key element in the reform is discovered that is the pre-reform welfare situation. Whenever the reform will be executed, the government should be well-informed about the current poverty situation as well as the availability of a database of households as future recipients. Another important aspect is the difficulty of quantifying the risk of social conflict after the reform is realized. Regarding this aspect, the government should be ready to communicate with citizens prior to the reform to avoid any unwanted social reactions.

5. CONCLUSION AND POLICY IMPLICATIONS

Dealing with fiscal pressure along with a strong desire to implement the energy subsidy reform is the inspiration behind this study to quantify the possible impacts related to the reform. This paper closely examined Indonesia as a case study in two chosen periods by utilizing two large-scale SUSENAS datasets. Moreover, two new approaches in the energy subsidy reform topic have been employed.

This paper found some significant findings regarding the elasticities of demand for subsidized energy goods in Indonesia. Kerosene used to be the only subsidized energy good classified as a normal good in 1999; however, in 2012, electricity and LPG joined the list while the others were classified as luxury goods. Ultimately, all the energy goods were found to be price elastic in both periods.

The general welfare situation in 1999 was worse than in 2012, which could be due to the post-crisis impact of the Asian Financial Crisis of 1997-1998. The benefits of the energy subsidy were absorbed more unequally compared to 2012. Moreover, despite the status as a net oil exporter in 1999, Indonesia suffered a significant depreciation of the rupiah that led to a higher level of energy goods' subsidization. However, the low level of world oil prices at that time prevented the bigger impact of the simulated reform. This paper underlines that the reform in 1999 was able to take place with a smaller welfare impact thanks to the cheaper oil prices.

By contrast, Indonesia experienced an enormous fiscal strain in 2012 due to skyrocketing global oil prices. It should be noted that Indonesia was also a net oil importer in 2012, which made it more vulnerable to the oil price fluctuation. Indeed, based on the simulation, the welfare impacts were higher than in 1999. The impact could be worse if the welfare (poverty) condition was similar to that in 1999. However, thanks to a rapid decrease in poverty in Indonesia, the benefits of the energy subsidy were absorbed less unequally than 1999 because more people could afford the subsidized energy goods. Furthermore, the possible percentage of savings after the reform was applied in 2012 was bigger than in 1999. This paper emphasizes that the reform in 2012 could have been successfully implemented with a bigger revenue, depending on the better welfare situation as well as the stability of the exchange rate.

This paper also found that the welfare consequences under both periods could be countered by conditional cash transfers or other well-targeted mitigation programs. Based on the simulations, to be more effective, the mitigation program should provide a precise database of the recipients. The database itself should be updated regularly and frequently. If a one-by-one subsidy reform is more preferred, the government should also carefully choose the selected energy good to be reformed to avoid a bigger impact on welfare. The utilization of household survey data such as SUSENAS is sufficient to inform the government of Indonesia about which energy goods can be reformed. Additionally, the government could be more proactive in communicating the policy to citizens to prevent social friction. The energy subsidy reform may be politically unpopular, but it should be executed sooner or later. Indonesia has achieved a remarkable decline in its poverty rate over the past few decades and a more stable exchange rate. With the declining trend of global oil prices and stronger efforts in updating the poor households' database, this unpopular policy has good reason to be implemented.

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