ENERGY SUBSIDY AND PRICE DYNAMICS IN INDONESIA

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ABSTRACT

The downward trend of the world oil prices in recent years has put profound consideration among countries to reform the energy subsidy policies. Examination of the inflationary impact of the reform has become essential due to possible welfare consequences. This study aims to reveal the impact of energy subsidy on the prices in Indonesia by utilizing the autoregressive distributed lag (ARDL) method to capture short-run dynamics and long-run cointegration between dependent and independent variables in the period 1980-2017. The finding of this research indicated that the impact of the energy subsidy is significant for the short-run and the long-run periods. Regarding the result, the government of Indonesia is advised to reform carefully by applying energy subsidy policy gradually and protecting vulnerable poor households.

***Keywords*:** Energy subsidy; Price; ARDL; Subsidy reform; Indonesia.

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1. INTRODUCTION

Energy subsidy has been intensively utilized by governments to minimize the adverse impacts both of the increasing world oil prices and of the government's reluctance to adjust the domestic energy prices (Cottarelli et al., 2013). Indonesia is no exception. Since 2004 when Indonesia became the oil net-importer, the government has been suffering the fiscal strain of energy subsidy; the strain was enhanced partly by the rupiah's depreciation over time. Based on the data from the Indonesian Ministry of Finance, in the period between the 1997 global financial crisis and 2015, the magnitude of the energy subsidy steadily accounted for more than 10% of the total annual expenditure of the central government; since 2016, the size has been in single-digit.[2] When the world oil prices started to decline in 2012, many countries faced the challenge of embarking on the energy subsidy reform. In most of the nations, the considerations of the possible impacts of the energy subsidy reform received extensive national attention.

There are some observable benefits from energy subsidies. They provide poor households with greater access to energy products with lower prices (Saunders & Schneider, 2000). Razack et al. (2009) reported that the energy subsidy in industrial sectors can enhance productivity through the

[1] In the period of 1998 to 2017, the average proportion of energy subsidy to the total expenditure of central government and total expenditure of Indonesia are 21.92 and 15.68% respectively.

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low cost of the energy for production, which ultimately leads to higher output, more employment, favourable wage rate, and better consumption of overall households. The subsidy also gives benefits in the form of producer and consumer surplus in a general context (Beers & Bergh, 2001). In contrast, the potential adverse impacts of the energy subsidy include the following five issues. First, there will be environmental damage, notably the air pollution and greenhouse effect partly due to the excessive use of gasoline motor vehicles. Second, energy subsidy exerts additional urgent public spending and creates a fiscal burden. Third, the need for investment in energy-related sectors can be discouraged because of the unpredictable nature of energy subsidy due to its dependency on the volatilities of world energy prices. Fourth, most of the benefits from energy subsidy is absorbed by wealthier households, while the poor households, the main target of the policy, receive the least (Shang et al., 2015). Fifth, the energy subsidy distorts the price mechanism in the energy market (Morgan, 2007; Fattouh & El-Katiri, 2013).

Indonesia has a long timeline of energy subsidy completed with its energy subsidy policy dynamics. Some previous studies that investigated the nexus between energy subsidy and welfare in Indonesia, which utilized *Computable General Equilibrium* (CGE) and *Social Accounting Matrix* (SAM), covered only a limited period of time. Indonesia is also an excellent study case of a net oil-exporting country shifting to a net oil-importing country.[3] As to methodology, this paper utilizes the Autoregressive Distributed Lag (ARDL) method developed by Pesaran and Shin (1999) and Pesaran et al. (2001) that can perform very well in tackling short time series, as well as comprehensively distinguish the analyses in short-run and long-run framework.[4] The policymakers in energy subsidy coverage benefit from the ARDL technique, since the outcomes of the study affect the sustainability consideration of the energy subsidy policy.

This paper has two aims: (1) To investigate the relationship between inflation and energy subsidy in Indonesia during the period from 1980 to 2017; and (2) To examine the short-run dynamics and long-run cointegration between inflation and the explanatory variables (energy subsidy, oil prices, and money supply).

This paper contributes to the existing literature on the energy subsidy reform topic as an initial case study of Indonesia that employs the time series analysis, particularly the ARDL model. Different from the previous researches, this paper utilizes the aggregated oil price index from the three major oil prices, such as Dated Brent, the Dubai Fateh, and West Texas Intermediate. The utilization of the oil price index is effective, because it not only represents all significant oil prices but is also defined in unit free (robust from inflationary impact). Another advantage of utilizing the oil price index is that it can easily be adjusted with a different base year. The rest of this paper consists of the following sections: literature review, data and methodology, result and discussion, some concluding remarks and policy implications.

[3] Indonesia has become a net-oil importing country since 2004.

[4] The data series in this paper for energy subsidy in Indonesia are presented from 1980 to 2017 which is sufficient to perform ARDL approach.

2. LITERATURE REVIEW

2.1. Theoretical Background

This paper first focuses on the inflationary impact of the energy subsidy policy in Indonesia. Examining the inflationary effect of the energy subsidy becomes essential for the policymaker, since inflation delivers an adverse consequence on people, especially the poor. According to Cardoso (1992) and Easterly and Fischer (2013), inflation affects the poor; the higher the prices, the worse-off the poor. This will be due to lower purchasing power and lower real income, especially for households of the bottom quintile. The rationale of inflationary consequence due to an absence of energy subsidy can be inferred from Nicholson and Snyder (2010). They wrote that the producers (including households) would determine the price level of goods and services equal to the marginal cost. The marginal cost itself is calculated from the total cost, which contains fuel or transportation cost. The higher costs incurred by the producers, the higher the price level they will set. In aggregate, this situation leads to the so-called cost-push inflation. Ikhsan et al. (2005) found that the transportation sectors in Indonesia are affected the most from the energy subsidy reform. Other studies on the impact of energy subsidy upon the inflation include those conducted by Hossein (2013), Abdelrahim (2014), and Husaini et al. (2019). A study conducted by Murjani (2019) captured the existence of short-run and long-run nexus between inflation and poverty in Indonesia.

It is widely understood that world oil prices also deliver an inflationary impact on domestic prices. Some studies revealed the positive relationship between world oil prices and domestic inflation. Crude oil plays a vital role in industrial production, particularly as a factor of production. When the oils are imported, from the producers' side, increasing the world's oil prices would squeeze the profit rate since the marginal cost of production also rises. Thus, the impact would be passed to the consumers in the form of higher prices of goods (Bala & Chin, 2018; Mulyadi, 2012).

The quantity theory of money formulates that the velocity of money is the ratio of nominal GDP (price multiplied by GDP) to the quantity of money (M). The speed of money in such a theory is assumed to be constant; hence, the percentage change in the amount of money affects the percentage change of price (by holding percentage change in GDP as exogenous). As a result, the growth rate of the money supply positively affects the rate of inflation (Mankiw, 2009). Also, the utilization of money growth to examine the price fluctuation was performed in some research conducted by Cooray and Khraief (2019) and Sharma (2019), among others.

2.2. Empirical Motivation

When the consideration to adopt the energy subsidy reform emerged as the consequence of the recent downward trend of world oil prices, some studies were conducted to examine the possible impacts of the reform, especially on the vulnerable groups and the potential gain. Shang et al. (2015) measured the benefits of energy subsidy removal in the world coverage. With the energy subsidy elimination, the financial gain was around \$3 trillion or 4% of the global GDP in 2013, whereas in 2015, it accounted for approximately \$2.9 trillion or about 3.6% of global GDP. For the environment, the reduction of CO_2 emission in 2013 regarding the reform was more than 20% significantly. Moreover, the welfare gain produced by the reform was estimated at \$1.4 trillion or about 2% of the world GDP in 2013 and kept climbing to \$1.8 trillion (2.2% of world GDP) in 2015. Shang et al. (2015) also showed the possible adverse impacts of the reform. The reform could create a winner and loser for urban-rural populations, affecting poor households and energy-intensive companies. Auspicious implications of the energy subsidy reform have also been shown in the joined paper reported in 2010 of the International Energy Agency (IEA), Organization of the Petroleum Exporting Countries (OPEC), Organization for Economic Co-Operation and Development (OECD) and the World Bank, not only enhancing the real income of the countries but also highlighted better environmental conditions. From the market point of view, the phasing out of energy subsidy would lead to a better energy prices mechanism, hence, a better energy market (IEA, OECD, & World Bank, 2010).

The energy subsidy reform comes with some consequences. One concern of the adverse impacts is related to the nexus between the energy subsidy and welfare. The reform could hurt the poor with a higher rate of energy products' prices. In Indonesia, Ikhsan et al. (2005), Yusuf and Resosudarmo (2008), and Dartanto (2013) examined the impacts of increasing prices of energy products on poverty. Without any compensation, the higher prices of energy products eventually hurt the poor, sequentially pushing the poverty rate into a higher rate. Similarly, Renner et al. (2019) also found that the reduction of the energy subsidy would harm low-income households regardless of different scenarios of energy price changes. Other supporting evidence can be obtained from Madagascar (Andriamihaja & Vecchi, 2007), Mali (Kpodar, 2006), and Ghana, Bolivia, Mali, Jordan, Sri Lanka (Gillingham et al., 2006). Such discussions show that the poor are vulnerable and will be harmed by the energy subsidy reform, and most of the research suggested protecting the poor by a direct mitigation program.

While the aspiration to apply energy subsidy reform faces the poverty-impact consideration and the need for social mitigation program (which can lead to other potential fiscal commitment), a study conducted by Plante (2014) suggested that the fuel subsidies worsen the aggregate welfare in the long run as a result of exertion in non-oil consumption, worsening labor allocation, and additional distortion on the other macroeconomic variables. He also reported that the welfare losses, in the long run, are applied for both oil-importing and oil-exporting countries. This research also implicitly shows the nexus between the energy subsidy and welfare in the long run; energy subsidy worsens welfare. Sequentially, an attempt utilizing time-series analysis to measure the impact of energy subsidy on welfare through prices' responses was held by Husaini et al. (2019). The research found that the energy subsidy reform could trigger higher prices both for the short and the long run in Malaysia.

Based on the previous studies, there are some gaps that should be filled to better understand the nexus between energy subsidy and welfare, along with the need for implementation of the energy subsidy reform. Firstly, the welfare impact (through prices) should be differentiated between the short run and the long run to accommodate the market's response due to price distortion. Secondly, the time series analysis could be utilized (rather than previously used methods such as *Computable General Equilibrium* (CGE), *Social Accounting Matrix* (SAM), and Input-Output Analysis) to investigate the issue from another perspective. As far as observed, there was only one research from Husaini et al. (2019) utilizing time series analysis in this particular issue in Malaysia. Thirdly, this paper accounts for the existence of trend issues as well as possible structural breaks in the ARDL model that were not included in the existing literature. All those gaps are addressed in this paper.

3. DATA AND METHODOLOGY

The econometrics model in this study employs the consumer price index (CPI) as the dependent variable and energy subsidy (ES) as an independent variable. To broaden the analysis and overcome omitted variable bias, this paper also includes variables such as oil price index (OIL), broad money supply (M2), and dummy variables to tackle possible structural break in the model (a similar technique to overcome the structural break problem in ARDL analysis can also be found in Badeeb and Lean (2016)). This model also accounts for the trend component and restricts it in the model. The basic equation adopted from Husaini et al. (2019) with modifications for the Indonesia case in this paper can be expressed as the following econometrics model:

$$CPI_t = \alpha_0 + \alpha_1 D_{it} + \beta_1 Trend + \beta_2 ES_t + \beta_3 OIL_t + \beta_4 M2_t + \varepsilon_t \quad (1)$$

where,
CPI_t : consumer price index in year t,
D_{it} : fixed regressor; the dummy variables in break date i in year t (D=0 before break dates and D=1 from the break dates and beyond),
$Trend$: trend component in the model,
ES_t : energy subsidy expenditure (trillions of rupiah) in year t after deflating using 2005 as the base year,
OIL_t : crude oil price index[5] in year t using 2005 base year,
$M2_t$: money supply (trillions of rupiah) in year t,
ε_t : error term,

variable CPI_t was obtained from Statistics Indonesia (2018); variable ES_t was extracted from the Indonesian Ministry of Finance (MOF); variable OIL_t was gained from the International Monetary Fund (IMF); $M2_t$ was retrieved from World Development Indicators of the World Bank (2019). The period of observations expands from 1980 to 2017.

Some of the variables in Equation (1) were transformed into natural logarithm producing Equation (2) as follows:

$$LCPI_t = \alpha_0 + \alpha_1 D_{it} + \beta_1 Trend + \beta_2 LES_t + \beta_3 LOIL_t + \beta_4 LM2_t + \varepsilon_t \quad (2)$$

Where L is the expression of natural logarithms[6].

Further development of the model is conducted to transform into the ARDL model. Initially, the series of variables are tested for their stationarity by using the Phillips and Perron unit root test (Perron & Phillips, 1988). Sequentially, the ARDL bounds test (Pesaran et al., 2001) is conducted

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

[6] The log-log regression model exhibits the elasticity between dependent and independent variables; the percentage increase of *CPI* is translated as inflation, the percentage increase of *M2* is simply the growth of money supply, and the percentage increase of *OIL* will be interpreted as oil price inflation. This paper applies the strategy to overcome two zero values of energy subsidy expenditure in 1986 and 1995 by taking natural log of ES_t as: $LES_t = Ln(ES_t + 1)$. As the number of zero occurrences are few, the coefficient will be interpreted same as the common log-log model (Wooldridge, 2013, p.193).

to check the existence of cointegration. The ARDL bounds testing approach, derived from Equation (2), can be expressed as the following final model[7]:

$$\begin{aligned}\Delta LCPI_t = {} & \alpha_0 + \alpha_1 D_{it} + \beta_1 Trend + \beta_2 LCPI_{t-1} + \beta_3 LES_{t-1} + \beta_4 LOIL_{t-1} + \\ & \beta_5 LM2_{t-1} + \sum_{i=1}^{p} \delta_{1i} \Delta LCPI_{t-i} + \sum_{j=0}^{q} \delta_{2j} \Delta LES_{t-j} + \sum_{k=0}^{r} \delta_{3k} \Delta LOIL_{t-k} + \\ & \sum_{l=0}^{s} \delta_{4l} \Delta LM2_{t-l} + \varepsilon_t \end{aligned} \quad (3)$$

Where β_1, β_2, β_3, β_4, and β_5 are the long-run coefficients. To be having a cointegration in the long run, utilizing the F test and critical value from Pesaran et al. (2001) or Narayan (2005), the model should reject the null hypothesis defined as follows:

H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$
H_1: At least one $\beta \neq 0$

Three rules are set as the base for taking the decision of hypothesis testing. Firstly, the null hypothesis is rejected if F-statistic is bigger than the upper critical value. Secondly, the null hypothesis cannot be rejected if F-statistic is smaller than the lower critical value. Thirdly, if the F-statistic is in between the upper and lower bounds, the decision is inconclusive. In order to satisfy the model robustness, CUSUM and CUSUM of Squares graphs are examined (Brown et al., 1975). Further, some diagnostic checks are also performed to justify the goodness of fit of the model.[8]

4. RESULT AND DISCUSSION

4.1. Brief History of Subsidy in Indonesia

Indonesia has been applying the energy subsidy policy since long ago. The energy subsidy was initiated in the fiscal year of 1977 in the form of a fuel subsidy. In its timeline, Indonesia suspended the fuel subsidy in 1986 and 1995 thanks to the net profit of Indonesia's fuel trade. Fuel subsidy, in general, is the margin of domestic sales of energy with its overall production cost. Therefore, the measure of fuel subsidy is affected by the production cost, including other costs such as crude oil input, processing, and distribution (Indonesian Ministry of Finance, 1999). Electricity, as energy good, has been included in subsidized items since 1998 to cover the loss of State Electricity Company (PLN), the state-own company which generates and distributes electricity in Indonesia (Indonesian Ministry of Finance, 2000).

The non-energy subsidy has a more prolonged time incident. The rice and imported grist have initially started to be subsidized from 1973. Additionally, as noted in Indonesian Ministry of Finance fiscal documentaries, the non-energy subsidy has also been given for fertilizer, seeds, soy, corn, wheat, sugar, the imported raw material for medicine, tax, financing for small-medium enterprises (SME), and public service obligation (PSO) in different time occurrences. Eventually,

[7] Unrestricted constant and restricted trend with dummy variables as fixed regressors (case 4).

[8] In addition to the diagnostic checks, when the errors are not serially correlated, the endogeneity problem is not a problem in the ADRL model (Nkoro & Uko, 2016). The endogeneity issue is also overcome in the ARDL model that has optimum lags selection (Pesaran & Shin, 1999).

in 2018, the structure of non-energy subsidy items covered fertilizer, PSO, SME, and tax (foods and seeds stopped being subsidized in 2017).

The attempts at energy subsidy reform in Indonesia mainly started after the 1997 Asian financial crisis. The government of Indonesia was assisted by the IMF to recover from the financial crisis by adopting the IMF-supported adjustment programs, one of which was the reduction of the energy subsidy (Clements et al., 2013). In the period from 2001 to 2003, Indonesia utilized the monthly pricing formula for gasoline, kerosene, and Automotive Diesel Oil (ADO). The monthly pricing system was abandoned in January 2003 due to widespread protests from the citizens.

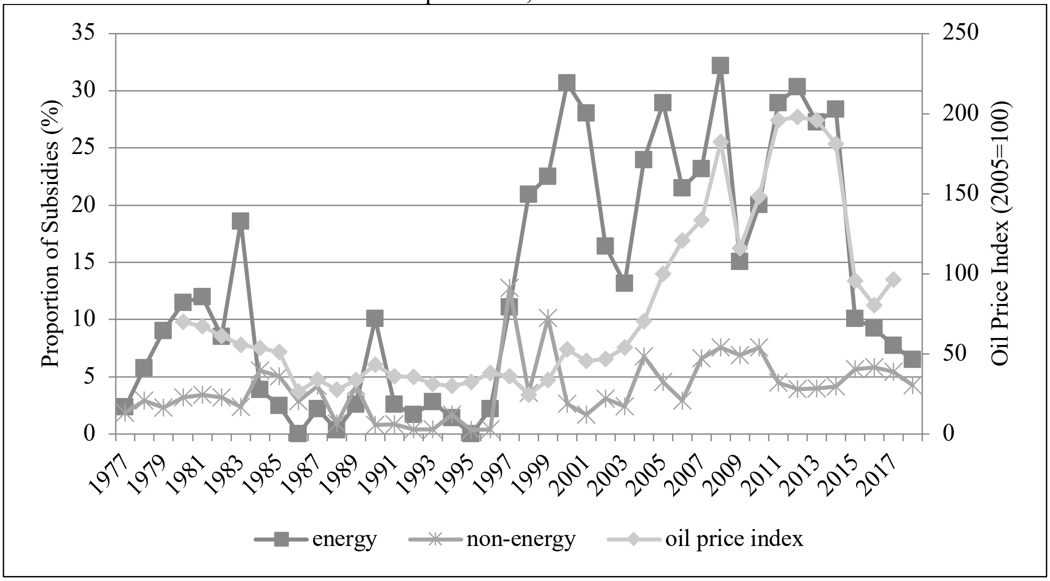
In 2005, under Yudhoyono's regime, the prices of Gasoline, Kerosene, and ADO were increased. The reform in 2005 could reduce the energy subsidy expenditure in 2006 by around a third. In addition, following the 2005 reform, a first short-run mitigation program was introduced. The government of Indonesia deployed an unconditional cash transfer covering 12 months of payments. Furthermore, the government provided other mitigation programs such as Health Insurance for the Poor (*Asuransi Kesehatan Masyarakat Miskin*), School Operational Assistance (*Bantuan Operasional Sekolah*), and The Rural Infrastructure Program (*Infrastruktur Pedesaan*).

The world oil prices reached a higher level in 2008, as a result, the fiscal pressure due to the energy subsidy became more significant. The government of Indonesia responded by increasing the prices of gasoline and ADO. Along with the reform in 2008, the government deployed mitigation programs such as 7-months payments of unconditional cash transfer, subsidized rice, small business loans, and support for the education of lower-rank civil servants and military families.

In 2012, the world prices peaked up and once again put the government of Indonesia in a difficult financial situation. Thus, the government attempted to increase the price of gasoline because the gasoline price has not changed since 2009 whilst the world oil prices kept increasing. However, the government's plan to increase the gasoline price was rejected by the parliament after a voting session. Furthermore, the failure of the pricing reform was also related to the significant number of public demonstrations against the proposal of the reform (Inchauste & Victor, 2017). Eventually, the pricing reform was materialized in 2013 by increasing prices of gasoline and ADO. This time, the government provided more mitigation programs. The previous unconditional cash transfer was changed to the Temporary Cash Transfer Program (*Bantuan Langsung Sementara Masyarakat*) by utilizing the new Unified Database (*Basis Data Terpadu*). The government also introduced a social identification card used by the targeted recipient for some social assistance programs such as education subsidies, rice subsidies, and Hopeful Family Program (*Program Keluarga Harapan*). Besides, for poor communities, the government also provided a basic infrastructure program covering housing and water infrastructure.

The most recent reforms were those implemented during President Joko Widodo's regime. The subsidy for gasoline was fully terminated in 2015 amidst the declining trend of the world oil prices. The reform was followed by the introduction of three cards program (Indonesian Smart Card, Indonesian Health Card, and Indonesian Prosperous Card) as a set of mitigation measures. Sequentially, the government dismantled the electricity subsidy for the three highest voltage blocks in 2017 thanks to the lower world oil prices. The trend of energy and non-energy subsidies' proportion relative to the total central government expenditure in the period 1977 to 2018 can be examined in Figure 1.

Figure 1: The Proportion of Energy and Non-energy Subsidies to The Central Government Expenditure, 1977-2018



Source: Indonesian Ministry of Finance (n.d.) and the International Monetary Fund (2019).

From Figure 1, it is evident that most of the time, the energy subsidy took a higher magnitude compared to the non-energy subsidy. Moreover, the level of the energy subsidy significantly soared in the period of the Asian Financial Crisis in mid-1997 and beyond. The non-energy subsidy also inclined drastically in the same period due to initial mitigation programs provided by the Indonesian government due to the crisis including the effect of the world oil prices. However, the trends of both subsidies started to decline after 2012 as a response to the decreasing trend of world oil prices.

4.2. Preliminary Checks

As an initial stage in the ARDL analysis, the stationarity of variables should be verified. The ARDL model, although it is suitable for analyzing short time series, has a limitation that could be applied only on the stationary variables that stationer at level (I(0)) or the first difference (I(1)). Therefore, the first step in the ARDL model is to justify that no variable is stationer at the second difference (I(2)) or more (Pesaran & Shin, 1999). However, according to Zivot and Andrews (2002), the conventional stationarity tests (for example, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP)) could produce a non-rejection in the null hypothesis (of a unit root) when the structural break exists. In response to this concern, this paper applies the breakpoint unit root test along with the conventional PP unit root test to prove that no variable is I(2) or more. The results of unit root tests are presented in Table 1. It shows that no variable was integrated at order 2 for both conventional unit root tests and unit root tests with a breakpoint.

Table 1: Results of Unit Root Test

Variable	1st Differences (PP Test)		1st Differences (Breakpoint)	
	Intercept	**Intercept + Trend**	**Intercept**	**Intercept + Trend**
LCPI	-6.158***	-6.168***	-6.380***	-7.086***
LES	-6.704***	-6.625***	-7.558***	-7.248***
LOIL	-5.865***	-5.839***	-6.542***	-6.642***
LM2	-3.922***	-4.947***	-8.741***	-6.378***

Notes: *** denotes the significance at 1 percent. The null hypothesis is the variable has a unit root.

This paper also found that the model has structural breaks in the years 1989, 1998, and 2009; as a result, dummy variables were included as fixed regressors.[9] This paper employs the Multiple Breakpoint Test by assuming that the break date is unknown. The result of the breakpoint test is provided in Table 2.

Table 2: Results of Breakpoint Test

Break Test	F-statistic	Break Dates
0 vs. 1	20.925*	1998
1 vs. 2	8.596*	1998, 2009
2 vs. 3	7.264*	1989, 1998, 2009
3 vs. 4	1.132	-

Source: Author's calculation based on EViews.
Notes: * indicates significance at 5 percent using Bai-Perron critical values.

Before entering the ARDL estimation stage, defining the lags that will be employed in the model is essential. This paper simulates the various combinations of maximum lag on both the dependent variable and the regressors. The strategy is simple; the model that violates the error diagnostic checks will be eliminated; otherwise, the *Akaike Info Criterion* (AIC), *Schwarz Criterion* (SC), and *Hannan-Quinn Criterion* (HQC) from the model will be noted for model comparison. The ultimate model is the model that possesses minimum AIC, SC, and HQC. It should be noted that the more negative a number, the smaller it is considered. The result of the lag-selection process is provided in Table 3, with EViews assisted in the selection process. To avoid being over-parameterized, the boundary of simulated lag is set to 4. All in all, Table 3 depicts that the optimum ARDL model based on the minimum value of AIC, SC, and HQC is ARDL(3,2,2,2). In this ARDL model, the lags assigned for *LCPI*, *LES*, *LOIL*, *LM2* are 3, 2, 2, and 2, respectively.

[9] Conflicts of countries in late 1980s and early 1990s along with the Asian Financial Crisis in 1997 to 1998 and the Lehman Shock in 2008 are seemingly captured by the model as structural breaks.

Table 3: Lag-selection Process

Max. Lag Combination		ARDL Model**	Error Diagnostics Violation	Criteria		
Dependent Variable	**Regressors**			**AIC**	**SC**	**HQC**
1	0	1,0,0,0	Serial Correlation, RESET, CUSUM	-	-	-
1	1	1,0,1,1	Serial Correlation, RESET, CUSUM	-	-	-
1	2	1,2,2,2	RESET, CUSUM of Squares	-	-	-
1	3	1,2,2,3	-	-4.809	-4.098	-4.564
1	4	1,4,4,1	Serial Correlation	-	-	-
2	0	1,0,0,0	Serial Correlation, RESET, CUSUM	-	-	-
2	1	1,0,1,1	Serial Correlation, RESET, CUSUM	-	-	-
2	2	1,2,2,2	RESET, CUSUM of Squares	-	-	-
2	3	1,2,2,3	-	-4.809	-4.098	-4.564
2	4	1,4,4,1	Serial Correlation	-	-	-
3	0	3,0,0,0	CUSUM	-	-	-
3	1	3,0,1,1	RESET, CUSUM, CUSUM of Squares	-	-	-
3	2	3,2,2,2*	-	-4.911	-4.155	-4.650
3	3	3,2,2,2*	-	-4.911	-4.155	-4.650
3	4	1,4,4,1	Serial Correlation	-	-	-
4	0	4,0,0,0	CUSUM	-	-	-
4	1	4,0,1,1	CUSUM, CUSUM of Squares	-	-	-
4	2	3,2,2,2*	-	-4.911	-4.155	-4.650
4	3	3,2,2,2*	-	-4.911	-4.155	-4.650
4	4	4,4,4,0	Serial Correlation	-	-	-

Source: Author's calculation based on EViews.
Notes: * denotes the optimum ARDL model. ** denotes automatic calculation from EViews for the optimum lag.

Sequentially, the ARDL model can be established further. The result of the ARDL cointegration test for the long-run relationship can be examined in Panel 1 of Table 4. From the ARDL models in Panel 1, the values of EC_{t-1} were negative and significant at 1%, inferring that the variables are cointegrated. Also, the result from the bounds test shows that the ARDL model has the F-statistic exceeding the upper bounds for both I(0) and I(1) indicated in Panel 2. Thus, it can be concluded that the ARDL(3,2,2,2) model statistically proved that all variables are cointegrated in the long run, and the estimation using ARDL can proceed.

Table 4: Results of Cointegration Tests

Panel 1. Bounds Testing

Indicators	Value
Optimum lag	(3,2,2,2)
F-statistic of Bounds Test	24.780***
EC_{t-1}	-0.763***

Panel 2. Narayan (2005) Critical Values

α	I(0)	I(1)
1%	5.654	6.926
5%	3.936	4.918
10%	3.290	4.176

Notes: *** denotes the significance at 1 percent level. ***) denotes the significance at 1 percent from Narayan (2005) critical values Case 4, n=35, and k=3.

The estimations for the long-run and short-run coefficients are provided in Table 5. Moreover, diagnostic checks are also established. Table 5 informs about the power of the ARDL model to produce robust estimation. In general, in the long run, ARDL(3,2,2,2) satisfied the expected signs of the impact of independent variables on the dependent variable. The variable of energy subsidy was associated with prices in a negative relationship, inferring that the decreasing magnitude of the energy subsidy will affect the increasing level of the overall prices. The world's crude oil prices also affected the domestic price level in Indonesia. The rising prices of the world's crude oils will be responded by inflation in Indonesia. Furthermore, when the money supply increases, the overall price will also elevate, and vice versa.

4.3. Short-run Dynamics

The short-run dynamics among variables can be drawn from Table 5. The table shows the first lag on each regressor; hence, the immediate impact of the independent variables on the dependent variable can be observed. ARDL(3,2,2,2), in a shorter period, provided the coefficients of the relationship between independent and dependent variables.

Table 5: Long-run and Short-run Analysis

Panel 1. Long-run Coefficient	
LES	-0.036** (-2.140)
LOIL	0.166*** (5.815)
LM2	0.246*** (4.995)
@TREND	0.027*** (3.412)
Panel 2. Short-run[10] Coefficient	
ΔLES	-0.015*** (-3.380)
ΔLOIL	0.045** (2.540)
ΔLM2	0.278*** (4.446)
EC_{t-1}	-0.763*** (-12.306)
Panel 3. Diagnostic Checks	
LM	0.655 [0.533]
Jarque-Bera	0.027 [0.987]
Breusch-Pagan-Godfrey	0.563 [0.873]
RESET	2.268 [0.150]

Notes: *** and ** denote the significance at 1 percent and 5 percent respectively. t-statistic is in parenthesis, and the probability value is in the bracket.

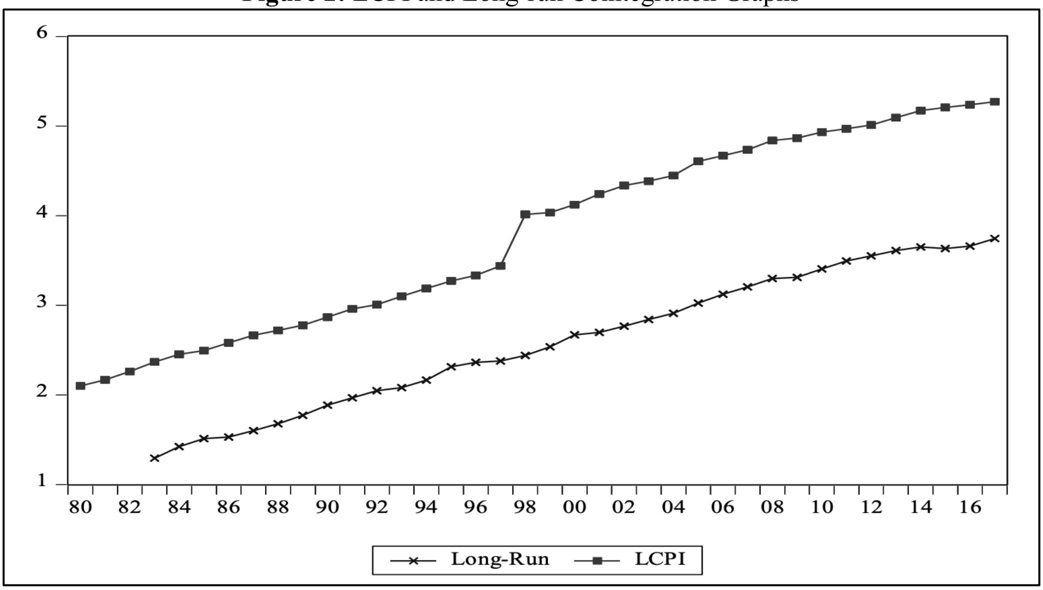
In the short run, decreasing the energy subsidy by 1% would bring inflation by around 0.015%; this figure was significant at the 1% significance level. In fact, for the subsidy, through price controlling policies, the adverse impact on inflation can be minimized (Husaini et al., 2019). The world's crude oil prices also affected inflation in Indonesia. Increasing the oil price index by 1% would bring inflation by 0.045% (significant at the 5% significance level). The last variable is the money supply. Increasing the money supply by 1% would lead to 0.278% of inflation (significant at the 1% significance level). In this model, the independent variables were dynamically connected to the dependent variable from the short run to the long run, with the speed of adjustment around 76.30%. In this paper that utilizes annual observations, the model will reach the long-run equilibrium in the second year, which is significantly fast. It means that the long-run impact of energy subsidy, the world's crude oil prices, and money supply would be experienced in one year after the shock. This fast speed of adjustment can be seen in Figure 2. The long-run cointegration

[10] Short-run model in Table 5 only provides first lag since the main focus usually at the direct impact of the explanatory variables.

graph moved jointly along with the actual LCPI in the same direction since the very beginning of observation.

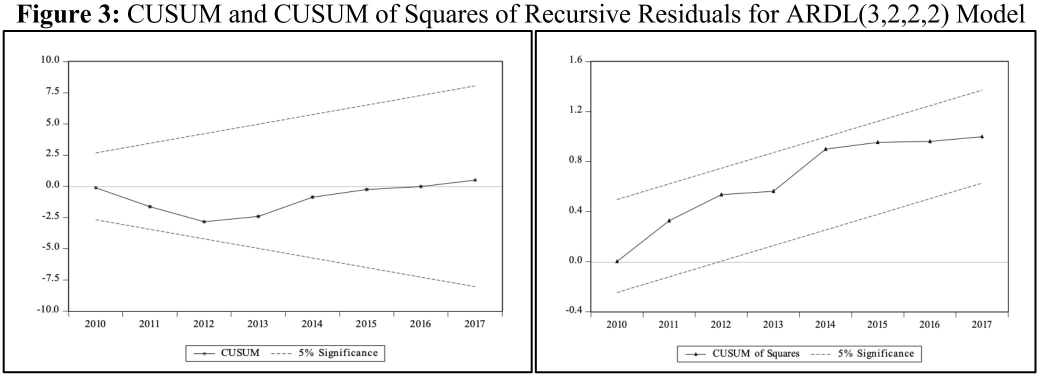
To have a robust and valid estimation, the model should pass the diagnostic checks by not rejecting the null hypothesis in each test. Table 5, in its third panel, reveals the diagnostic checks for the ARDL(3,2,2,2) model. The model satisfied the assumption for no serial correlation (LM test), normality (Jarque-Bera), no heteroskedasticity (Breusch-Pagan-Godfrey), and stability of the model (Ramsey RESET test) in residuals. Moreover, Figure 3 also convinces that the model possessed stability from possible structural breaks since the CUSUM and CUSUM Squares graphs did not cross the 5% boundaries, respectively. In conclusion, the ARDL(3,2,2,2) model can perform a robust estimation.

Figure 2: LCPI and Long-run Cointegration Graphs



Source: Author’s calculation based on EViews.

Figure 3: CUSUM and CUSUM of Squares of Recursive Residuals for ARDL(3,2,2,2) Model



Source: Author’s calculation based on EViews.

4.4. Long-run Cointegration

As previously explained, the cointegration exists among variables, and the ARDL model successfully fulfilled the expected sign of the coefficients for both the long run and short run. For the long-run association, the nexus between independent variables and the dependent variable can be elaborated as the following findings. 1% decrease in energy subsidy is expected to increase the consumer price index by around 0.036% (having inflation by 0.036%), while other variables are constant. The energy subsidy significantly affects inflation at the 5% significance level. 1% increase in the oil price index is expected to increase the consumer price index by around 0.166%, holding other variables constant. The impact is significant at the 1% significance level. 1% increase in money supply is expected to increase the consumer price index by around 0.246%, while other variables are constant. Money supply significantly affects the prices at the 1% significance level. This finding is similar to Husaini et al. (2019) and Sharma (2019), where the increase in money growth tends to induce higher prices. The trend component was significant at the 1% significance level, showing that this model exhibits a trend throughout observations.

To sum up, the findings of this paper can be articulated as follows. Initially, similar to prior studies, the energy subsidy reduction could ignite higher prices, which could lead to welfare losses. For the Indonesian case, the impacts towards inflation were significant in the short run and the long run. As a matter of fact, a study from Renner et al. (2019) informed about the high level of price elasticity of demand for gasoline and Liquefied Petroleum Gas (LPG), as subsidized energy goods in Indonesia, since the substitution goods such as *Pertalite* (higher octane gasoline with small price difference) and kerosene are available. Higher prices due to the decrease in the energy subsidy could be mitigated if consumers choose substitution goods (the demand for originally subsidized products would plunge this way). Nevertheless, electricity and kerosene should still be in focus in the energy subsidy policy framework because of the inelastic price elasticity of demand in overall households. For electricity, the government of Indonesia has already applied the policy of eliminating the subsidy for seemingly wealthier households.

Secondly, for other explanatory variables, the impacts were also significant for the short run and the long run. The speed of adjustment from disequilibrium until equilibrium will be achieved in the second year by the speed of adjustment of 76.30% each year. The direct adverse impact of reducing the energy subsidy will immediately appear in the short run. The government that applies the energy subsidy reform should be aware of the adverse impact of the subsidy reduction or elimination, particularly on the inflation consequence. The effect of the world's crude oil prices would also pass directly to Indonesia; the impact will be experienced in the short run and the long run.

In this regard, the government of Indonesia should prepare some mitigation programs to minimize the adverse impact. In fact, when the world oil prices increased, the government of Indonesia augmented the amount of energy subsidy to offset the adverse impact of the oil prices' shock.

Lastly, realizing that the growth of the money supply also significantly affected the prices for the short run and the long run, which can be a potential monetary policy for counter-measuring the adverse impact of the world oil prices' fluctuation.

5. CONCLUDING REMARKS AND POLICY IMPLICATIONS

The decreasing trend of oil prices after the period where the prices peaked up has motivated many countries to reform their energy subsidy policies. The consideration emerges for the impact of minimizing, or even eliminating, the energy subsidy on the welfare through inflationary consequences. This paper examined the impact of energy subsidy on the overall prices in Indonesia by employing the ARDL model. The ARDL model is ideal in tackling a short period and in providing both analyses comprehensively in the short run and the long run. From the model's examination, the ARDL model satisfied the diagnostic checks to justify the robustness of the model.

This paper found that there is a cointegration relationship among the variables in the model. In particular, the energy subsidy had a negative association with prices; furthermore, the impacts were significant both in the short run and long run. Reducing the energy subsidy would push the overall prices up immediately, and then the impact would exist until the long run. Furthermore, the influence of world oil prices, as well as the money supply, would appear significantly also for the short run and the long run.

Based on the findings, there are some policy implications regarding energy subsidy reform in Indonesia. For the energy subsidy, the relationship with the prices is negative and significant in the short run and the long run. The adverse impact of the energy subsidy reform on prices will be direct and instant; in response to this, the government of Indonesia is advised to take some short-run relief-measures such as conditional cash transfer or direct subsidy to the poor. Moreover, the government should also update the database of poor households regularly to avoid miss-targeted aids. To avoid long-run fiscal strain as an implication of those social protection programs, the government should carefully design the time frame of the program rather than providing it incidentally. Ultimately, the energy subsidy reform should proceed in a gradual manner while the world oil prices are relatively stable at a lower level. These findings open a further study on the details of energy subsidy reform scenarios, particularly on subsidized energy products. When the oil price shock occurs, the government of Indonesia can effectively utilize the monetary policy to offset the impact on domestic inflation.

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