Doctoral Dissertation

Social and Economic Impacts of Elimination of Energy Price Distortion in Indonesia

Graduate School of International Social Sciences
Yokohama National University

AHMADI MURJANI

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1. Introduction

1.1. International Perspective on the Energy Subsidy

Global warming has been progressing as a consequence of increasing GHG (greenhouse gas) emission as well as the excessive use of fossil fuels in the world. Burniaux et al. (1992) stated that such an excessive use of fuels results from a distortion in the energy market which appears in the form of energy subsidies.[1] The government of any country could also distort the energy price by imposing a tax instead of providing for energy subsidies. A subsidy can be translated into a benefit for the people or producers in such a manner that the consumers pay a lower price for energy consumption while the producers could set a higher price for selling their energy products (Hutchinson at al., 2017). Organization for Economic Co-Operation and Development (OECD) (2006, p.7) defines a subsidy as follows: "a subsidy is a measure that keeps prices for consumers below market levels, or keeps prices for producers above market levels or that reduces costs for both producers and consumers by giving direct or indirect support".

Despite some benefits such as easier access for the poor people to energies (Saunders and Schneider, 2000), consumer and producer surplus (Beers and Bergh, 2001), and enhanced productivity in the industrial sectors (Razack et al., 2009), many governments all over the world pay more attention to the adverse impacts caused by the energy subsidy. Besides global warming as one of the environmental consequences, a high fiscal burden, discouraged investment in energy-related activities, and miss targeting recipient of the subsidy are some of the unwanted impacts of the energy subsidy (Shang et al., 2015).

[1] Although the incident of the Climate Gate in 2009 reflected how difficult and complex to evidently prove the climate change (Ryghaug & Skjølsvold, 2010), this dissertation follows the majority consensus from around 11,602 peer-reviewed papers published in 2019 and analysed by Powell (2019) showing that the global warming is happening.

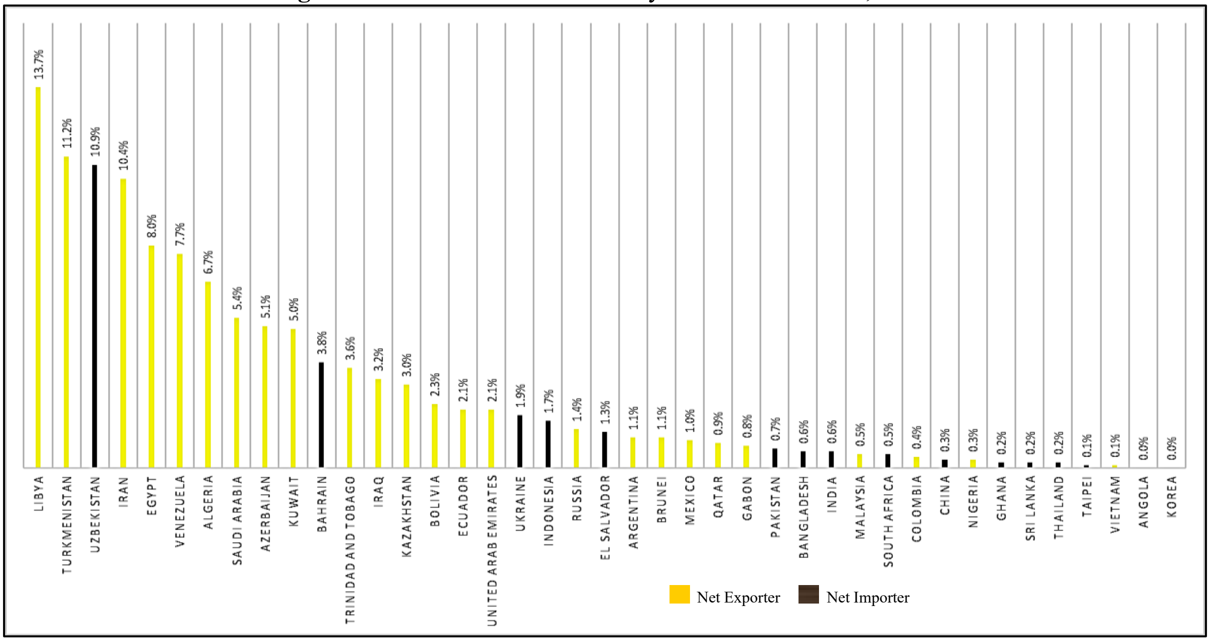
While the adverse impacts and beneficial aspects of the energy subsidy were discussed in the existing research, the reasons for the existence of the energy subsidy in the developing countries are not highlighted to a sufficient degree. First, in most developing countries, the government directly controls the domestic energy prices. When the government is reluctant to pass the impact of the change (increase) of the world energy prices onto domestic prices, the energy subsidy is utilized as a policy tool to stabilize prices. While the domestic energy prices are stabilized under the subsidization, the national budget is forced to absorb the fiscal instability (or expansion) caused by such a subsidy expenditure (Coady & Shang, 2015). Reform of this policy (or termination of the subsidy) needs a political will of the government.

Second, the energy subsidy policy is indeed related to political aspects: government budget and social welfare. Furthermore, the energy subsidy reform faces some political costs and risks, which makes this policy unpopular among political leaders (Inchauste & Victor, 2017). An open room exists for further study about how to quantify the political risks and consequences of the energy subsidy reform.

To date, many countries still maintain their energy subsidy in various magnitudes. According to OECD (2018), regarding the fossil fuel subsidies in 2017, oil subsidy dominates the proportion by exhibiting 45% of the total, followed by electricity (35%), natural gas (19%), and coal (1%). Figure 1.1 depicts the fossil fuel subsidy as a share of GDP from selected countries in the world.

Figure 1.1 clearly demonstrates that many countries were providing the energy subsidy regardless of their status as a net oil exporter or a net oil importer, but the majority of large-scale subsidization of fossil fuels is undertaken by the net oil-exporting countries. The net oil exporters in Figure 1.1 are Libya, Turkmenistan, Iran, Egypt, Venezuela, Algeria, Saudi Arabia, Azerbaijan, Kuwait, Trinidad and Tobago, Iraq, Kazakhstan, Bolivia, Ecuador, United Arab Emirates, Russia, Argentina, Brunei, Mexico, Qatar, Gabon, Malaysia, Colombia, Nigeria, Vietnam, and Angola. The list[2] of net oil-importing countries comprises of Uzbekistan, Bahrain, Ukraine, Indonesia, El Salvador, Pakistan, Bangladesh, India, South Africa, China, Ghana, Sri Lanka, Thailand, Taipei, and South Korea.

Figure 1.1. The Fossil Fuel Subsidy as a Share of GDP, 2017



Source: Author's processing from OECD (2018).

The current situation from selected countries about fiscal commitment in the form of government debt as a percentage of GDP can be examined in Table 1.1.[3] Coady et al. (2019) regarded the net government debt as a problem related to the energy subsidy besides climate change and air pollution. Table 1.1 shows that both groups of countries demonstrate an average of net government debt of more than 20% of GDP, although some net oil-exporting countries demonstrate a negative value of net debt as a percentage to GDP (financial assets exceed the gross national debt). In comparison, net oil importing countries exhibit an average higher debt. The situation of having oil imports exceeding exports adds additional strain with higher level of debt. Of course, a fiscal commitment is only one of the concerns to take into consideration to reform the energy subsidy, but the evidence from the debt cannot be ignored. The net oil-

[2] The classification of net oil exporter and importer are processed from The World Fact Book provided by Central Intelligence Agency of the United States of America.

[3] Unavailable countries' data from the World Economic Outlook Database 2018 causes some countries will not be shown.

importing countries that are burdened by high debt should naturally be motivated to apply for the energy subsidy reform (Vagliasindi, 2013).

Table 1.1. Net Government Debt from Selected Countries, 2017

Country	Net Government Debt (percentage to GDP)	Net Oil Exporter/Importer Classification
Algeria	20.49	1
Bolivia	35.37	1
Colombia	41.27	1
Egypt	94.01	1
Ghana	65.27	2
Indonesia	24.80	2
Islamic Republic of Iran	29.74	1
Kazakhstan	-11.78	1
Korea	6.61	2
Mexico	46.12	1
Nigeria	19.61	1
Pakistan	61.61	2
Saudi Arabia	-7.72	1
South Africa	47.90	2
Taiwan	33.29	2
Trinidad and Tobago	-10.97	1
Average Net Govt. Debt Net Exporters	25.61	
Average Net Govt. Debt Net Importers	39.91	

Source: Author's calculation based on the World Economic Outlook Database 2018 (International Monetary Fund, 2018).
Notes: Classification 1 = net oil-exporting country, 2 = net oil-importing country.

Energy subsidy reform mentioned in this dissertation refers to the actions taken by the government to adjust its energy subsidy expenditure in form of either partial or full elimination of the subsidy. In a short term, Inchauste & Victor (2017) defined the reform as a policy that alters the magnitude and allocation of a subsidy. The successful reform is identified as a permanent and continual reduction of subsidies. On the other hand, a reform that is not sustained for a long time (for at least one year) can be defined as a partially successful reform. A failed reform means a case when the reform attempts are followed by an immediate return to the original position (Clements et al., 2013).

The countries were encouraged to reform their energy subsidy policy, as formulated in the G-20 Summit held in Pittsburgh in 2009, by reducing the fossil fuel subsidies gradually (Vagliasindi, 2013). Sequentially, the Paris Agreement of 2015 adopted during COP 21 aimed to fight the climate change by enriching the actions and investments to achieve a sustainable low carbon society in the future (United Nations, 2015). The international framework set by this Agreement is intended for the years after 2020. These consensuses were supported by the current level of world oil prices that are relatively lower than before. As a result, a plan to implement the energy subsidy reform became politically more feasible.

A study conducted by Vagliasindi (2013) classified the countries in the world according to national income and trade balance of energy products. As to low- and lower-middle-income countries, energy net importers are Ghana, Armenia, Moldova, Morocco, Jordan, India, and Pakistan and net exporters are Nigeria, Indonesia, Azerbaijan, Egypt, Iran, and Yemen. As to upper-middle and high-income groups, energy net importers are Turkey, Chile, Dominican Republic, and Peru and net exporters are Malaysia, Argentina, and Mexico. Some samples included in the study were identified as exhibiting a budget deficit higher than 4% of GDP or exhibiting public debt more than 40% of GDP.[4] A more complete cross-country study was conducted by Kojima (2013), which covers 65 developing countries. A more recent study about the progress of the energy subsidy reform was conducted by Inchauste & Victor (2017). Samples countries of this study were selected based on the criteria of (1) significance of the role of the subsidy, (2) attempts of reform, and (3) variation in the energy reform cases. The countries in the study are The Dominican Republic, Ghana, Indonesia, and Jordan. Lastly, Verme (2017) compiled the reform attempts made by the governments in the Middle East and North Africa (the selected countries are Iran, Yemen, Jordan, Egypt, Morocco, and Tunisia).

Appendix A.1.1. examines 68 countries with their respected net oil-exporting/importing status. Some pieces of evidence emerged as primary findings concerning the attempts at the reform of energy subsidy policy. First, regardless of the net oil-exporting/importing status, the

[4] The energy net exporter or importer classification might be different from Table 1.1 due to the difference of year of the study and the dynamics of countries' export and import.

energy subsidy policy was widely adopted by the government since some time ago with various results. Second, world oil prices put a significant impact. Third, protests and public reactions were likely to happen. Lastly, some countries provided some mitigation programs and stabilization funds. These studies of the energy subsidy reform from selected countries offer insightful knowledge and some lessons regarding the attempts at the subsidy reform. However, learning from experiences in the past seems incomplete without planning the policy in the future by conducting a simulation of some possible scenarios.

1.2. Energy Subsidy Policy in Indonesia

Indonesia is a net oil-importing country today, but it was a member of the Organization of the Petroleum Exporting Countries (OPEC) before. After having been a member of OPEC for 46 years, Indonesia suspended its membership in 2008 (OPEC, 2015). Despite the reactivation of the OPEC membership in early 2016, Indonesia decided to suspend its membership again and announced the decision during the 71st Meeting of the OPEC Conference in November 2016 (OPEC, n.d.). The withdrawal of Indonesia from OPEC was highly related to the export structure of oil in Indonesia, as in 2004, Indonesia became a net oil-importing country.

In 2020, Indonesia has a population of around 271 million according to the Indonesian Central Bureau of Statistics' projection. The World Bank classifies Indonesia as a lower-middle-income country with GDP per capita of US$ 3,893.6 (current US$) in 2018 (World Bank, 2019, 2020). The average economic growth in Indonesia in the period from 2011 to 2019 was relatively stable at around 5.33% per year. Interest rates were set at 6.13% for deposit and 10.54% for lending in 2018. The trade balance in Indonesia highly fluctuated especially in the period from 2011 to 2018. Negative trade balances occurred from 2012 to 2014 and in 2018. The current account balances in Indonesia were always at a negative value starting from 2012, and the value was -2.98% of GDP in 2018 (World Bank, 2019).

According to the International Energy Agency (IEA), Indonesia is at the fifth ranking of the fossil-fuel consumption subsidies in the world after Iran, Saudi Arabia, China, and Russia (IEA, 2020). This means that Indonesia ranks the highest in the Southeast Asian region. In 2020, the fuel subsidy has a proportion of around 60% of the total energy subsidy in Indonesia. According to the Ministry of Finance's data, the fuel subsidy does not always dominate the share of energy subsidy in Indonesia. In the period from 2005 to 2010, the electricity subsidy exceeded the share of the fuel subsidy in 2009, 2016, and 2017. After a period of high burdens and fluctuations of the energy subsidization especially after the Asian Financial Crisis in 1997, Indonesia managed to relax the fiscal strain in the period when the world oil prices declined after 2012. In 2018, the proportion of the energy subsidy expenditure on the total expenditure of the central government was around 6.50% which was significantly lower than in 2008 (32.16%) and 2012 (30.33%).[5] LPG dominated the share of subsidy among the subsidized energy goods by 37.87% followed by electricity (36.81%), solar fuel (23.12%), and kerosene (2.20%) (Indonesian Ministry of Finance, 2019).

1.2.1. Subsidized Energy Products and Reform Attempts

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 the 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. Gasoline, Kerosene, and ADO are the oldest subsidized energy products in Indonesia, which given since the 1960s and acknowledged by the official data in the fiscal year 1977/1978 (Inchauste & Victor, 2017). Electricity began to be subsidized in 1998, joining gasoline, kerosene, ADO[6], industrial diesel oil, and fuel oil. In 2005, the line-up of subsidized fuel goods

[5] The world oil prices peaked up in 2008 and 2012.
[6] Also called solar fuel.

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[7]. The reform of electricity subsidies seems promising as the government successfully implemented pricing adjustments gradually in the period from 2013 to 2017. By 2017, out of five voltage groups, the subsidies for the three highest voltage groups were fully removed.[8]

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 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 the users of government vehicles to buy

[7] Tariffs are differentiated into some categories such as households, industries, businesses, public institutions, and governments and road lightings (IISD, 2014).
[8] Including a partial tariff adjustment for the households configured at 900 Volt Ampere (Indonesian Ministry of Energy and Mineral Resources, 2017).

fuels from Pertamina stations. This was in effect as of June 2013, and the price of gasoline and ADO increased by 44% and 22%, respectively. As a final touch to the reform, particularly for gasoline, the government fully eliminated 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, 2019). 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). However, some problems emerge in subsidizing the 3 kg cylinder of LPG. The LPG subsidy tends to be absorbed by wealthier households because it is provided universally to households. This mechanism is not in harmony with its general purpose, which is to expand the LPG access for lower-income households (Toft et al., 2016).

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 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*).

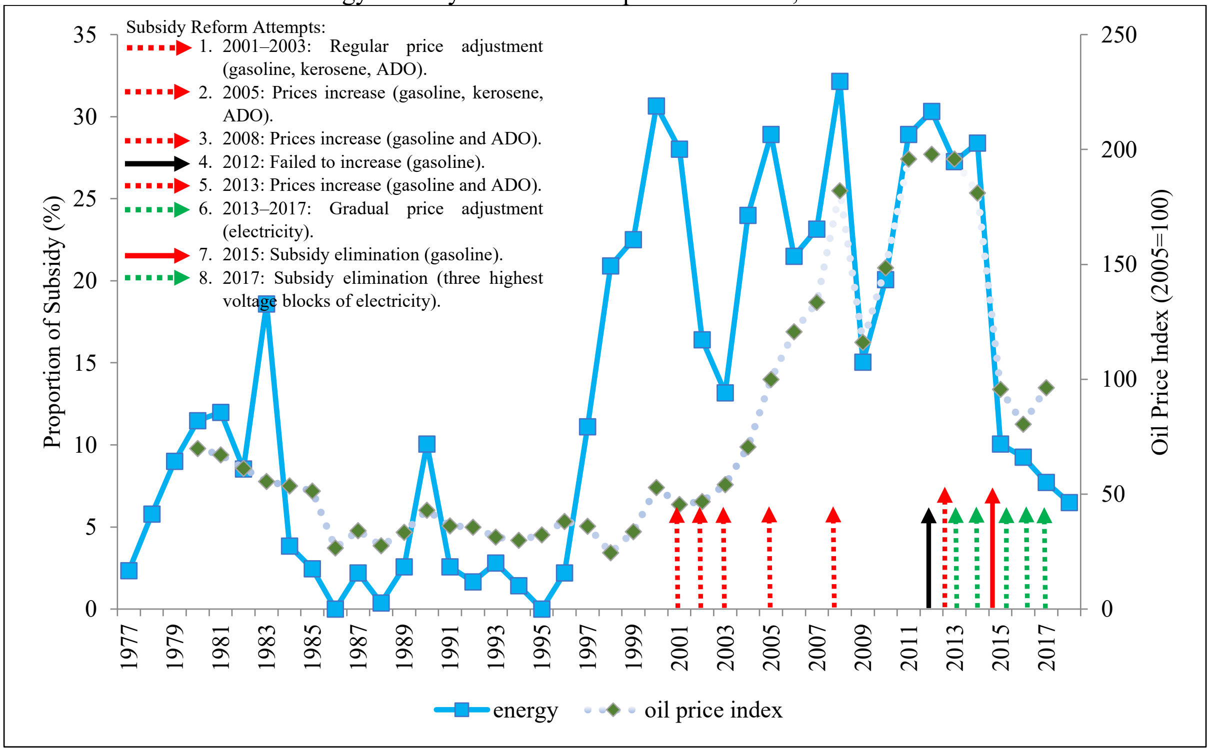
The world oil prices reached a higher level in 2008, as a result, the fiscal pressure due to the energy subsidy became more significant. The government of Indonesia responded by increasing the prices of gasoline and ADO. Along with the reform in 2008, the government deployed mitigation programs such 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[9] (*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 timeline of the reform attempts is illustrated in Figure 1.2.

Figure 1.2. Proportion of Energy Subsidy to The Central Government Expenditure, World Oil Price Index, and Energy Subsidy Reform Attempts in Indonesia, 1977-2018



Source: Indonesian Ministry of Finance, International Monetary Fund Commodity Prices, and Inchauste & Victor (2017).

[9] The expansion of the unconditional cash transfer program.

1.3. Research Gaps

Some research of the energy subsidy reform impact on welfare can be observed in some countries such as Madagascar (Andriamihaja and Vecchi, 2007), Mali (Kpodar, 2006), and Bolivia, Ghana, Mali, Jordan, and Sri Lanka (Gillingham et al., 2006). Furthermore, Verme & Araar (2017) provided the case studies of selected countries from the Middle East and North Africa region (Morocco, Tunisia, Libya, Egypt, Jordan, Yemen, Djibouti, and Iran). Some studies also employed Indonesian cases such as Ikhsan et al. (2005), Yusuf and Resosudarmo (2008), Olivia & Gibson (2008), Dartanto (2013), and Renner et al. (2019). Previous research exhibits some limitations that will be covered in this dissertation. Those research gaps are articulated as follows:

(1) Some studies discussed the impact of the energy subsidy reform on welfare, but:
  a. Only one examined the impact on the prices (inflation). This dissertation found some limitations in this research topic (modeling and structural break issues).
  b. Previous studies on the inflation threshold are very limited in Indonesia, and the threshold was indicated at various rates.

(2) Some studies calculated the price elasticity of demand for energy goods, but:
  a. None utilized complete subsidized energy goods.
  b. Those utilized a specific model that has an issue (i.e., endogeneity).

(3) Some studies conducted simulation analyses, but:
  a. Those studies did not account for time reference (high or low world oil prices).
  b. In the case of studies in Indonesia, those employed outdated data.

1.4. Research Objectives

From previous research limitations combined with Indonesia's case study, this dissertation aims to provide a comprehensive study and simulation on the energy subsidy reform in Indonesia. This dissertation tries to answer the following research questions:

(1) Does the energy subsidy reform deliver the inflationary impact significantly in the short and the long run?

(2) Does inflation affect the growth in the short and the long run? How much is the threshold level of inflation?

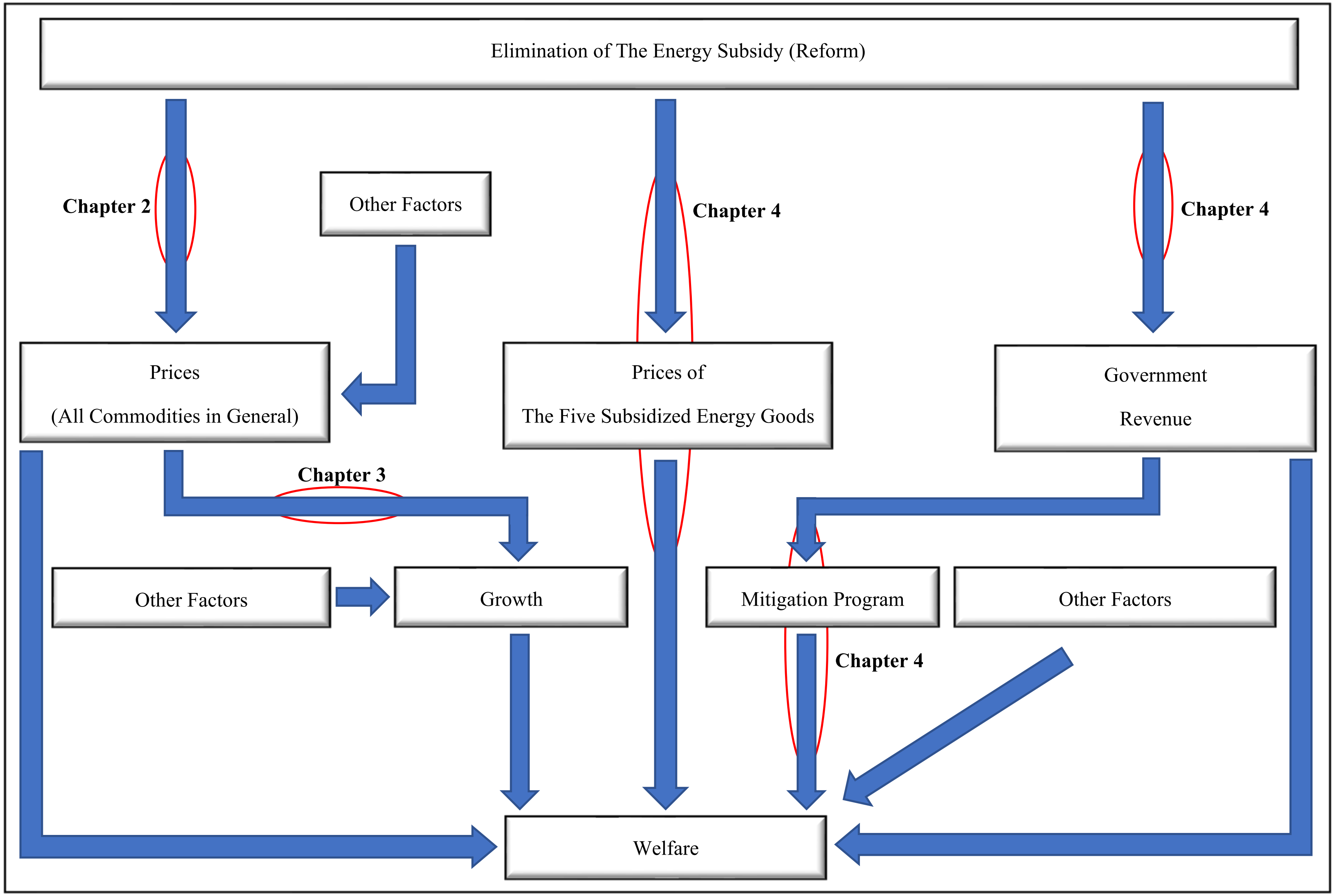
(3) What is the impact of the energy subsidy reform on the welfare and the government saving in the period of low oil prices and high oil prices?

By answering those research questions, this dissertation aims to provide for new insights into planning and simulating the energy subsidy reform. Moreover, the possibility to expand the study into other subsidized goods is widely opened by learning from this research. Four chapters follow after this introductory chapter. Chapter 2 discusses the short-run and long-run impacts of the energy subsidy on inflation. Chapter 3 focuses on the examination of the short-run and long-run impacts of inflation on the economic growth and on the task of measuring the level of inflation threshold. Chapter 4 investigates the elasticity of demand of subsidized energy goods and simulates the energy subsidy elimination. Chapter 5 provides conclusions.

1.5. Dissertation Framework

This dissertation targets Indonesia as a study case. Indonesia is an extraordinary country in terms of energy subsidy reform with its various attempts and mitigation programs toward the various subsidized energy goods. The reform in Indonesia was analyzed exclusively by the World Bank (in Vagliasindi (2013), Inchauste & Victor (2017)), the IMF (in Coady et al. (2019)), and other institutions such as *Institut du Développement Durable et des Relations Internationales* (in Savatic (2016)). To better understand this study's flow, Figure 1.3 depicts the framework of the energy subsidy reform in this dissertation. Three chapters (Chapter 2 through Chapter 4) complement each other to explain the energy subsidy reform in Indonesia.

Figure 1.3. Energy Subsidy Reform Framework



After the introduction in Chapter 1, Chapter 2 examines the short-run and long-run relationship between the energy subsidy and inflation in Indonesia. This chapter utilizes the Autoregressive Distributed Lag (ARDL) model that demonstrates an advantage in tackling a short period of data. The model in this chapter corrects the previous study by including the trend issue and some possible structural breaks in this particular topic. To avoid omitted variable bias, this chapter also includes the oil price index and broad money supply as regressors. According to the result, the energy subsidy exhibits a negative and significant relationship in the short run and long run on the consumer price index, which means that a reduction in the energy subsidy would immediately bring an inflationary impact. Moreover, the world oil price index and broad money supply positively and significantly affect the consumer price index. This chapter suggests that the energy subsidy reform should be applied gradually.

In Chapter 3, by employing the ARDL model, the nexus between inflation and economic growth in the short and long run is investigated. To date, the ARDL model was not utilized in the previous inflation-growth study, especially for Indonesia's case. The model also incorporates some regressors that also affect economic growth theoretically. This dissertation found that inflation demonstrates a negative and significant impact on economic growth, both in the short run and the long run. The examination is continued to measure the optimum level of inflation that possibly affects economic growth positively. To measure the threshold inflation level in Indonesia, Chapter 3 utilizes two methods such as Threshold Regression (Khan & Senhadji, 2001) and Quadratic Regression (Chowdhury & Siregar, 2004). By utilizing these methods, the two optimum inflation thresholds are found. Both Threshold Regression and Quadratic Regression perform very well bypassing the required error diagnostic checks. Threshold Regression indicates that the threshold level of inflation is at 7%, while Threshold Regression proves 14.31% is the optimum level of inflation that positively affects the economic growth in Indonesia. In general, this chapter suggests that the optimum level of inflation in Indonesia is at around 7% to 14.31%.

Chapter 4 aims to conduct a simulation of energy subsidy removal and measure its impact on welfare and government saving. Chapter 4 employs two large-scale datasets of the Indonesian National Socioeconomic Survey (SUSENAS) of 1999 and 2012.[10] According to Indonesia's previous reform attempts, a very high fiscal burden would lead to a reform attempt, especially after the Asian financial crisis. This dissertation selects 1999 and 2012 as the periods of simulation because both years represent two cases of distinctive high fiscal pressures under two different environment of world oil prices (low and high). Therefore, this study intends to produce a robust conclusion about the reform under the conditions of either high world oil prices or low prices. It also provides a simulation using the SUBSIM tool developed by Araar & Verme (2015). The application of this tool to the Indonesian case is the first attempt. As inputs to this simulation tool, the unit subsidy and the price elasticity of demand from subsidized energy goods are also calculated. Chapter 4 uses the new method in calculating the elasticity of demand of subsidized energy goods, which is the Almost-Ideal Demand System Iterated Linear Least-Square (AIDS-ILLS) method developed by Lecocq & Robin (2015) that overcomes the endogeneity issue of the common AIDS method. Furthermore, after conducting simulations on two different years, this dissertation found that the negative welfare impact of the 1999 reform is smaller than that of the 2012 reform. It is also reasonable knowing that Indonesia was as a net oil exporter in 1999 and vice versa in 2012. However, this dissertation also found that government saving in 2012 is greater than in 1999. Chapter 4 suggests other important keys in the reform, which are the current level of welfare when the simulation is

[10] SUSENAS is a large-scale and multi-use survey conducted by the Indonesian Central Bureau of Statistics covering household information, health, education, employment, expenditure, etc. SUSENAS was firstly introduced in 1963 and until now is conducted once or twice a year (RAND, n.d.).

conducted and the database of mitigation program recipient. In addition, Chapter 4 briefly discusses about mitigation programs and welfare state in Indonesia.

The findings from Chapters 2 through 4 suggest that in Indonesia's case, the inflationary consequence is inevitable when implementing the energy subsidy reform. Hence, knowing the level of inflation threshold is essential prior to the reform. The preparedness of the reform is important to avoid a greater impact on the welfare; also, the current level of welfare (i.e., poverty rate) and the preciseness of mitigation program would determine the amount of financial gain for the government. Ultimately, the reform should also intensively be communicated to the public effectively to secure the transparency of the government as much as possible.

1.6. Research Limitation

The following points are some of the research limitations of this dissertation. This dissertation focuses on direct social and economic impacts based on some reform scenarios. Social impacts consist of many areas. Centre for Social Impact divides the impacts into the following issues: health, children and young people, aging, disability, housing, financial inclusion, population mobility and diversity, education, and employment. United Nations (2020) narrowed down the analyses of social impacts into poverty, inequality, discrimination, unemployment, elderly people, disabilities, young people, and social groups. World Bank (2015) combined the analyses of social impacts and poverty, emphasizing the study on poverty and inequality, education, human development, environment, and natural resources. This dissertation does not cover those wide angles of analyses; poverty and inequality issues are the chosen areas in this study. Similar to social impacts, this dissertation limits the analyses of its economic impacts to the impacts on inflation, growth, and government savings because those variables are affected directly by the reform. Further studies of the impacts on other economic variables are still opened in this particular energy subsidy reform topic.

Chapter 2. Energy Subsidy and Price Dynamics in Indonesia

2.1. 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.[11] 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 and Schneider, 2000). Razack et al. (2009) reported that the energy subsidy in industrial sectors can enhance productivity through the 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 and 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

[11] 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.

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 and 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.[12] As to methodology, this chapter utilizes the Autoregressive Distributed Lag (ARDL) method developed by Pesaran & 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 frameworks[13]. 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 chapter 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 chapter 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

[12] Indonesia has become a net-oil importing country since 2004.
[13] The data series in this chapter for energy subsidy in Indonesia are presented from 1980 to 2017 which is sufficient to perform ARDL approach.

model. Different from the previous researches, this chapter 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 chapter consists of the following sections: literature review, data and methodology, result and discussion, some concluding remarks and policy implications.

2.2. Literature Review

2.2.1. Theoretical Background

This chapter 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 & 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 & Khraief (2019) and Sharma (2019), among others.

2.2.2. 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.

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 and 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 chapter 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 chapter.

2.3. 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 chapter 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[14] component and restricts it in the model. The basic equation adopted from Husaini et al. (2019) with modifications for the Indonesia case in this chapter can be expressed as the following econometrics model:

$$CPI_t = \alpha_0 + \alpha_1 D_{it} + \beta_1 Trend + \beta_2 ES_t + \beta_3 OIL_t + \beta_4 M2_t + \varepsilon_t \qquad (2.1)$$

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[15] 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 (BPS) [16]; 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. The period of observations expands from 1980 to 2017.

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[14] Since the variables in this model exhibit trends, this chapter incorporates it. The basic ARDL model for accounting deterministic trend can be found in Pesaran et al. (2001, p.296). In addition, IHSEViews (2017) stated in their EViews manual blog for ARDL model that any model that shows trends in its variables is better fit when a trend term is included in the model.

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

[16] CPI data of Indonesia are available in monthly and yearly. Also, the CPI are calculated for 27 cities (until 1997), 44 cities (starting from 1997), 45 cities (starting from 2004), 82 cities (starting from 2014), and 90 cities (starting from 2020). This dissertation uses yearly aggregate CPI/inflation from all cities in Indonesia. The cities refer to the capital cities of provinces and some selected capital of regencies.

Some of the variables in Equation (2.1) were transformed into natural logarithm producing Equation (2.2) as follows:

$$LCPI_t = \alpha_0 + \alpha_1 D_{it} + \beta_1 Trend + \beta_2 LES_t + \beta_3 LOIL_t + \beta_4 LM2_t + \varepsilon_t \quad (2.2)$$

Where L is the expression of natural logarithms[17].

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 and Phillips, 1988). Sequentially, the ARDL bounds test (Pesaran et al., 2001) is conducted to check the existence of cointegration. The ARDL bounds testing approach, derived from Equation (2.2), can be expressed as the following final model[18]:

$$\Delta LCPI_t = \alpha_0 + \alpha_1 D_{it} + \beta_1 Trend + \beta_2 LCPI_{t-1} + \beta_3 LES_{t-1} + \beta_4 LOIL_{t-1} + \beta_5 LM2_{t-1} + \sum_{i=1}^{p} \delta_{1i} \Delta LCPI_{t-i} + \sum_{j=0}^{q} \delta_{2j} \Delta LES_{t-j} + \sum_{k=0}^{r} \delta_{3k} \Delta LOIL_{t-k} + \sum_{l=0}^{s} \delta_{4l} \Delta LM2_{t-l} + \varepsilon_t \quad (2.3)$$

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

[17] 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 chapter 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).

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

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.[19]

2.4. Result and Discussion

2.4.1. Brief History of Subsidy in Indonesia

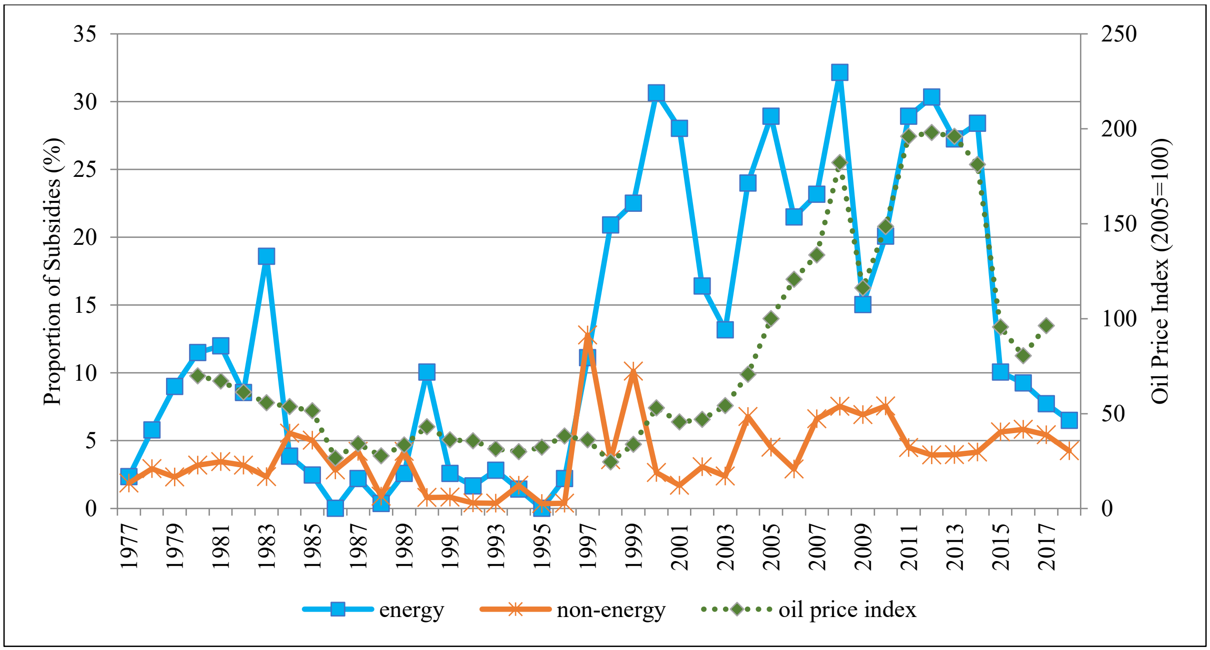
Indonesia has been applying the energy subsidy policy since long ago. The energy subsidy was initiated in the fiscal year of 1977 in the form of a fuel subsidy. In its timeline, Indonesia suspended the fuel subsidy in 1986 and 1995 thanks to the net profit of Indonesia's fuel trade. Fuel subsidy, in 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, in 2018, the structure of non-energy subsidy items covered fertilizer, PSO, SME, and tax (foods and seeds stopped being subsidized in 2017). The trend of energy

[19] 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).

and non-energy subsidies' proportion relative to the total central government expenditure in the period 1977 to 2018 can be examined in Figure 2.1.

Figure 2.1. The Proportion of Energy and Non-energy Subsidies to The Central Government Expenditure, 1977-2018



Source: Indonesian Ministry of Finance and the International Monetary Fund Commodity Prices.

From Figure 2.1, 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.

2.4.2. 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 chapter 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 2.1. It shows that no variable was integrated at order 2 for both conventional unit root tests and unit root tests with a breakpoint.

Table 2.1. Results of Unit Root Test

Variable	1st Differences (PP Test)		1st Differences (Breakpoint)	
	Intercept	Intercept + Trend	Intercept	Intercept + Trend
LCPI	-6.1575***	-6.1679***	-6.3804***	-7.0859***
LES	-6.7040***	-6.6253***	-7.5575***	-7.2484***
LOIL	-5.8646***	-5.8394***	-6.5420***	-6.6425***
LM2	-3.9217***	-4.9472***	-8.7406***	-6.3783***

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

This chapter 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.[20] This chapter employs the Multiple Breakpoint Test by assuming that the break date is unknown. The result of the breakpoint test is provided in Table 2.2.

Table 2.2. Results of Breakpoint Test

Break Test	F-statistic	Break Dates
0 vs. 1	20.9246*	1998
1 vs. 2	8.5961*	1998, 2009
2 vs. 3	7.2635*	1989, 1998, 2009
3 vs. 4	1.1317	-

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

[20] 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.

Before entering the ARDL estimation stage, defining the lags that will be employed in the model is essential. This chapter 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 2.3, 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 2.3 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.

Table 2.3. 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	-	-4.8089	-4.0979	-4.5635
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	-	-4.8089	-4.0979	-4.5635
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*	-	-4.9105	-4.1551	-4.6497
3	3	3,2,2,2*	-	-4.9105	-4.1551	-4.6497
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*	-	-4.9105	-4.1551	-4.6497
4	3	3,2,2,2*	-	-4.9105	-4.1551	-4.6497
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 2.4. 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 2.4. Results of Cointegration Tests

Panel 1. Bounds Testing		
Indicators	Value	
Optimum lag	(3,2,2,2)	
F-statistic of Bounds Test	24.7795***)	
EC_{t-1}	-0.7628***	
Panel 2. Narayan (2005) Critical Values		
α	I(0)	I(1)
1%	5.654	6.926
5%	3.936	4.918
10%	3.29	4.176

Notes: *** denotes the significance at 1% level. ***) denotes the significance at 1% 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 2.5. Moreover, diagnostic checks are also established. Table 2.5 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.

2.4.3. Short-run Dynamics

The short-run dynamics among variables can be drawn from Table 2.5. 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 2.5. Long-run and Short-run Analyses

Panel 1. Long-run Coefficient	
LES	-0.0358** (-2.1405)
LOIL	0.1659*** (5.8154)
LM2	0.2464*** (4.9946)
@TREND	0.0272*** (3.4121)
Panel 2. Short-run[21] Coefficient	
ΔLES	-0.0153*** (-3.3795)
ΔLOIL	0.0452** (2.5396)
ΔLM2	0.2781*** (4.4463)
EC_{t-1}	-0.7628*** (-12.3057)
Panel 3. Diagnostic checks	
LM	0.6550 [0.5328]
Jarque-Bera	0.0270 [0.9866]
Breusch-Pagan-Godfrey	0.5626 [0.8734]
RESET	2.2679 [0.1504]

Notes: *** and ** denote the significance at 1% and 5% 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 0.0153%; 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 0.0452% (significant at the 5% significance level). The last variable is the money supply. Increasing the money supply by 1% would lead to 0.2781% 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 76.28%. In this chapter that utilizes annual

[21] Short-run model in Panel 2 only provides first lag since the main focus usually at the direct impact of the explanatory variables.

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 2.2. The long-run cointegration 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 2.5, 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 2.3 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 2.2. LCPI and Long-run Cointegration Graphs

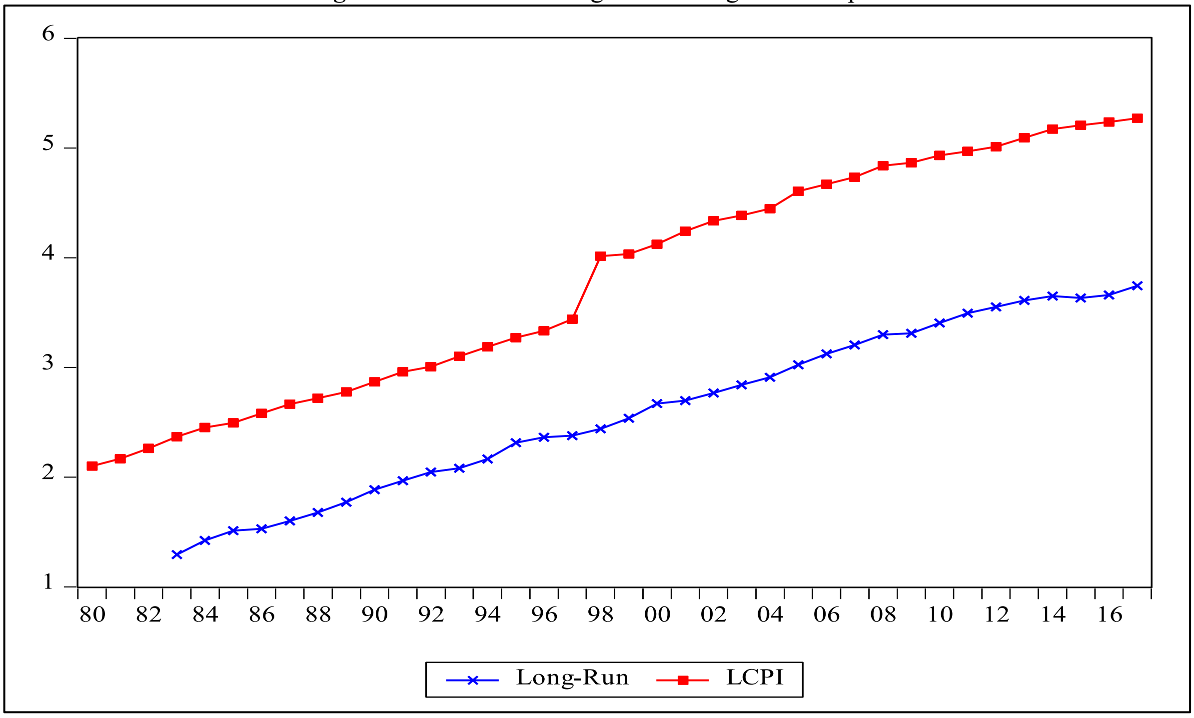
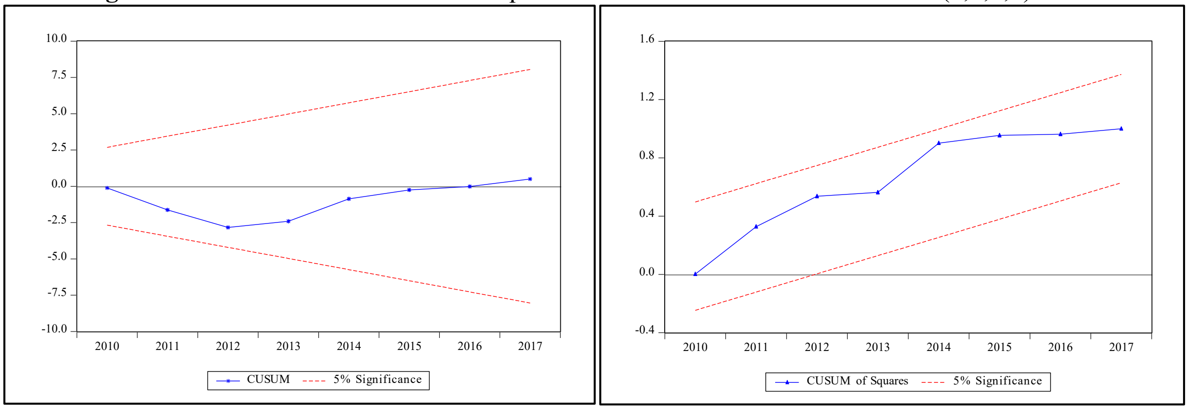


Figure 2.3. CUSUM and CUSUM of Squares of Recursive Residuals for ARDL(3,2,2,2) Model



2.4.4. 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 0.0358% (having inflation by 0.0358%), 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 0.1659%, 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 0.2464%, 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 chapter 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 76.28% 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.

2.5. 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 chapter 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 chapter 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.

Chapter 3. Inflation and Growth in Indonesia: The Nexus and Threshold

3.1. Introduction

Inflation, a macroeconomic indicator that reflects the overall increase of price level, is commonly disliked by people (Shiller, 1997). Inflation is addressed as a fall of the real wage as well as the purchasing power of the people. On the other hand, economists see inflation in broader perspectives. Mankiw (2009) elaborated on the costs of inflation within two different impacts, the cost of expected inflation and the cost of unexpected inflation. He theorized that the costs of inflation drag the policymakers to situate zero inflation. He also discussed a favorable impact of inflation. Low inflation can be a good thing when it could provide a better labor market. Low inflation simply pulls the real wage back to the equilibrium level in which the unemployment rate yielded is lower.

The nexus between inflation and economic growth has been a popular topic to study among economists. The impact of inflation on economic growth could be positive or negative mostly depending on the time of observation, measurement method, and the specific conditions of the national economy. In Indonesia, suggested inflation thresholds (the boundary when inflation is considered beneficial for economic growth) by many researchers were heterogeneous. Therefore, this chapter aims to provide a comprehensive approach and consideration to suggest a better inflation threshold for Indonesia.

3.2. Literature Review of Inflation and Growth: Theoretical Background and Empirical Evidence

The nexus between inflation and economic growth (hereafter growth) can be inferred from distinguished theories. *The Classical Growth Theory* suggested that higher inflation could lead to an increase in the nominal wage. Consequently, the higher cost-burdened by the firms to pay higher wages could deaccelerate the process of production; thus, the growth drops. Here, the impact of inflation is implicitly negative on growth. The *Keynesian Theory* divided the impact of inflation on the growth based on the short-run and the long-run interaction of Aggregate Demand (AD) and Aggregate Supply (AS). In the short run, the impact is positive, whilst in the long run, the impact is negative. The third theory that explained the inflation-growth nexus was *Monetarism Theory*. This theory implied in the long run, inflation is affected by the money's growth rate but with no effect on the growth (neutral).

Another theory was *Neo-Classical Growth Theory,* which puts more analyses on the variables such as capital, money growth, and consumption behavior of people. Tobin (1965) explained that inflation is positively related to growth. The higher inflation would put the real value of money down; thus, people would spend the money on capital. The increase of capital formation as an impact of higher inflation would stimulate growth. The impact of money growth on inflation would not put any impact on the growth was justified by Sidrauski (1967). He supported the theory of the super-neutrality of money from *Monetarism*; hence, the impact of inflation on growth is neutral. The consumption behavior of people was investigated by Stockman (1981) regarding the study of inflation and growth relationship. When inflation occurs, people will decrease their consumption both in goods and capital because of the shortage of purchasing power. Therefore, consequently, capital formation would decline and push the growth down. The other theory, as a comparable theory, is the *Endogenous Growth Theory*. This theory highlights not only the physical capital but also the human capital. The rate of return of such capitals could impede the growth as it relates to inflation. The higher inflation puts the rate of return of capital down; therefore, the growth declines (Gokal & Hanif, 2004).

The empirical evidences regarding the impact of inflation on growth are available from previous studies conducted in many countries. If the impact of inflation can be differentiated into groups, there were three groups of relationships between inflation and growth; positive, negative, and mixed (threshold theory). Thirlwall & Barton (1971) conducted cross-country research in order to clarify the relationship between inflation and growth. They found the inflation is benefiting in the industrial countries (positive effect) and unfavorable in seven developing countries (negative effect). They also suggested that when the yearly inflation exceeds 10%, the impact becomes adverse on the growth. Fischer (1983) utilized the data from 53 countries comprising of 22 advanced countries and 31 developing countries. By using a bivariate approach, he found that inflation has a negative relationship with growth. Ghosh & Phillips (1998) used panel data from IMF member countries; they found low inflation positively affects the growth; oppositely, high inflation brings an adverse impact on the growth.

Khan & Senhadji (2001) employed the threshold approach to identify the appropriate level of inflation when inflation turns unfavorable. They suggested for the industrial countries, the thresholds for inflation range from 1% to 3%, whereas for developing countries, the possible thresholds are 7% to 11%. Mubarik (2005) adopted the model developed by Khan and Senhadji (2001) to investigate the threshold level of inflation in Pakistan based on the yearly data range from 1973 to 2000, and he found the threshold of inflation in Pakistan is around 9%. Frimpong & Oteng-Abayie (2010) focused their research on inflation's threshold in Ghana. They found that inflation's threshold in the period from 1960 to 2008 is at 11%. In their research, the *Two-Stage Least Squared* (hereafter TSLS) was utilized as an additional method not only to accompany the threshold regression but also to prove the robustness of the model. Rutayisire (2015) used a quadratic regression and found the value of inflation's threshold in Rwanda, which is 12.7%. More recent evidence can be found in some research conducted by Aydın et al. in 2016 (inflation threshold is 7.97% for Turkish Republics), Jiranyakul in 2017 (inflation threshold is 3% in Thailand), Behera & Mishra in 2017 (suggesting 4% is the threshold level of inflation in India), Tran in 2018 (inflation threshold in Vietnam ranges from 3% to 4%), and Omay et al. in 2018 (the values of multiple-regime inflation threshold in 10 Southern-African-Development-Community countries are 12% and 32%).

Regarding the existing studies on the inflation-growth nexus with a focus on Indonesia, Chowdhury (2002) managed to elaborate on the theoretical and empirical evidence of the historical inflation-growth nexus in Indonesia in the period from 1950 to 1997. The study found that there is no statistical evidence of the relationship between inflation and growth in Indonesia. Chowdhury & Siregar (2004) utilized the quadratic regression to find the threshold of inflation in Indonesia. They found inflation of 20.50% is the lower bound for the adverse impact of inflation on the growth. Chowdhury & Ham (2009) found that the inflation thresholds in Indonesia range from 8.50% to 11% by employing a threshold vector autoregression method. A similar method utilizing vector autoregression with an instrumental variable which was conducted by Pratomo & Kalirajan (2011) suggested that the inflation thresholds in Indonesia take an interval from 2% to 7%. Widaryoko (2013) concluded that the threshold of inflation in Indonesia is 9.53% after comparing linear regression and threshold regression. Winarno (2014) employed the dynamic panel threshold regression approach and found that the threshold for inflation in Indonesia is 4.62%. Azis & Nasrudin (2016) utilized the panel regression with a threshold applied for provinces in Indonesia and found that the value of the inflation threshold is 4.64%. Galih & Safuan (2018) found the threshold level of inflation in Indonesia is around 5.26%. The research conducted by Galih and Safuan employed quarterly data in the period from 2000 to 2016 and examined by the threshold vector autoregression method.

Selected previous studies showed that the difference in method, country, control variables as well as the time of observation might produce the heterogeneous level of inflation thresholds. But the studies in Indonesia were consistent with the evidence. This chapter aims to provide the nexus of inflation and growth in terms of comparison of the methods (threshold and quadratic regression), timely coverage (short and the long run), with the additional review from inflation targeting policy from the Indonesian government. We utilize a different preliminary test for the inflation-growth nexus in the short and the long run, which is

Autoregressive Distributed Lag (ARDL) introduced by Pesaran et al. (2001). There are three sections in this chapter: methodology, result and discussion, and conclusion.

3.3. Methodology

Two stages of analysis are employed in this chapter. The first stage observes the relationship between inflation and growth in the short-run and in the long-run time frame using the ARDL method. The second stage deeply compares the calculation of inflation's threshold using the threshold regression of Khan and Senhadji (2001) (similar to Mubarik (2005)) and quadratic regression to obtain the optimum inflation threshold in Indonesia. There will be an additional review to examine the real data of Indonesia's inflation-targeting framework and actual inflation.

This chapter uses secondary data for the first stage of analyses. The data were retrieved from BPS-Statistics Indonesia (BPS) and the World Bank with the utilization of EViews in the processing stage. The ARDL method utilizes the variables such as economic growth (source from BPS), inflation (source from BPS), investment of fixed assets in the form of growth of gross fixed capital formation (source from the World Bank), the growth of the ratio of export to import (source from the World Bank); whereas in the inflation threshold examination, the growth rate of broad money is included as a variable (source from the World Bank). All variables are expressed in percentage and take the period of observations from 1970 to 2016. The ARDL model by Pesaran et al. (2001) for Indonesia is initially specified as:

$$GR_t = \beta_0 + \beta_1 INF_t + \beta_2 INV_t + \beta_3 EXIM_t + \varepsilon_t \quad (3.1)$$

where GR_t is the economic growth at year t, INF_t is inflation at year t, INV_t is the growth rate of gross fixed capital formation at year t, $EXIM_t$ is the growth rate of the ratio of export to import at year t, ε is an error term, and β is the coefficient of regression. INV and EXIM are the control variables in this model.

The procedures in the ARDL approach cover: unit root test (the variables should be integrated at I(0) and/or I(1) but not I(2)), maximum lag selection (comparison for the lowest value of *Akaike Information Criteria* (AIC), *Schwarz's Bayesian Information Criteria* (SBC), and *Hannan-Quinn Criterion* (HQC)), cointegration test using bounds testing, estimation of the long-run equation, estimation of the short-run equation, and model's diagnostics (checking for normality in residuals, serial correlation test, heteroscedasticity test, and model stability using CUSUM plots). The ARDL bounds testing model inferred from Equation (3.1) is:

$$\Delta GR_t = \beta_0 + \beta_1 GR_{t-1} + \beta_2 INF_{t-1} + \beta_3 INV_{t-1} + \beta_4 EXIM_{t-1} + \sum_{i=1}^{p} \delta_{1i} \Delta GR_{t-i} + \sum_{j=0}^{q} \delta_{2j} \Delta INF_{t-j} + \sum_{k=0}^{q} \delta_{3k} \Delta INV_{t-k} + \sum_{m=0}^{q} \delta_{4m} \Delta EXIM_{t-m} + \varepsilon_t \quad (3.2)$$

where β_1, β_2, β_3, β_4 are the long-run coefficients.

If the cointegration exists in the long run; thus, the equation of the ARDL (p,q) can be expressed as:

$$GR_t = \alpha + \beta_1 INF_t + \beta_2 INV_t + \beta_3 EXIM_t + \mu_t \quad (3.3)$$

where p and q are the optimum lags in the ARDL model, and μ is the long-run error term.

Estimating the short-run equation is the next step by using the *Error Correction Model* (ECM) formulated as:

$$\Delta GR_t = \alpha + \sum_{i=1}^{p} \theta_{1i} \Delta GR_{t-i} + \sum_{j=1}^{q} \varphi_{1j} \Delta INF_{t-j} + \sum_{j=1}^{q} \varphi_{2j} \Delta INV_{t-j} + \sum_{j=1}^{q} \varphi_{3j} \Delta EXIM_{t-j} + \gamma ECT_{t-1} + \varepsilon_t \quad (3.4)$$

where θ and φ denoted for short-run coefficients; γ is the speed of adjustment towards equilibrium.

The second stage of this chapter is to investigate the threshold level of inflation. To obtain the appropriate threshold, this stage differentiates the equation into two comparable models. The first model is the *Threshold Regression Model,* which was adopted from Khan and Senhadji (2001) and Mubarik (2005). The first model is expressed as:

$$GR_t = \beta_0 + \beta_1(INF_t) + \beta_2(D)(INF_t - k) + \beta_3 INV_t + \beta_4 M2_t + \beta_5 EXIM_t + \varepsilon_t \quad (3.5)$$

where variables GR, INF, INV, and EXIM are adopted from Equation (3.1). M2 is the growth rate of broad money as utilized by Frimpong and Oteng-Abayie (2010) in their model. D is a dummy variable in which has a value of 1 if the INF_t > threshold (k); otherwise, 0. The value of k is considered optimum when R^2 is maximized, and the coefficient of INF is significant (the model from Equation (3.5) hereafter is called Model 1).

The second model is the quadratic regression model (so-called Model 2 in this chapter), which was previously utilized by Chowdhury and Siregar (2004) in examining the inflation threshold in Indonesia. However, this chapter includes some control variables to the model. The quadratic model that also adopted from Equation (3.1) with modifications can be expressed as:

$$GR_t = \beta_0 + \beta_1 INF_t + \beta_2 INF^2{}_t + \beta_3 INV_t + \beta_4 M2_t + \beta_5 EXIM_t + \varepsilon_t \quad (3.6)$$

where the expected value of β_1 is > 0, and β_2 is < 0; so, the first derivative of the quadratic regression with respect to INF will be yielding the optimum value of INF (denoted by INF*) when the first derivative of the Equation (3.6) is equal to zero.

Equation (3.6) becomes:

$$\frac{\delta GR_t}{\delta INF_t} = \beta_1 + 2\beta_2 INF_t = 0 \quad \text{thus} \quad INF_t{}^* = \frac{-\beta_1}{2\beta_2} \quad (3.7)$$

After all of the models provide the optimum value of k and pass the mandatory diagnostic checks (normality, serial correlation, and heteroskedasticity); sequentially, the value of R-squared, Adjusted R-squared, Sum Square Residuals (SSR), AIC, SC, and HQC from both models will be compared to obtain the better model's estimation. Additionally, there will be a review for the value of k regarding the experience from Indonesia's targeting inflation and the actual inflation in the period from 2001 to 2017.

3.4. Research Limitation

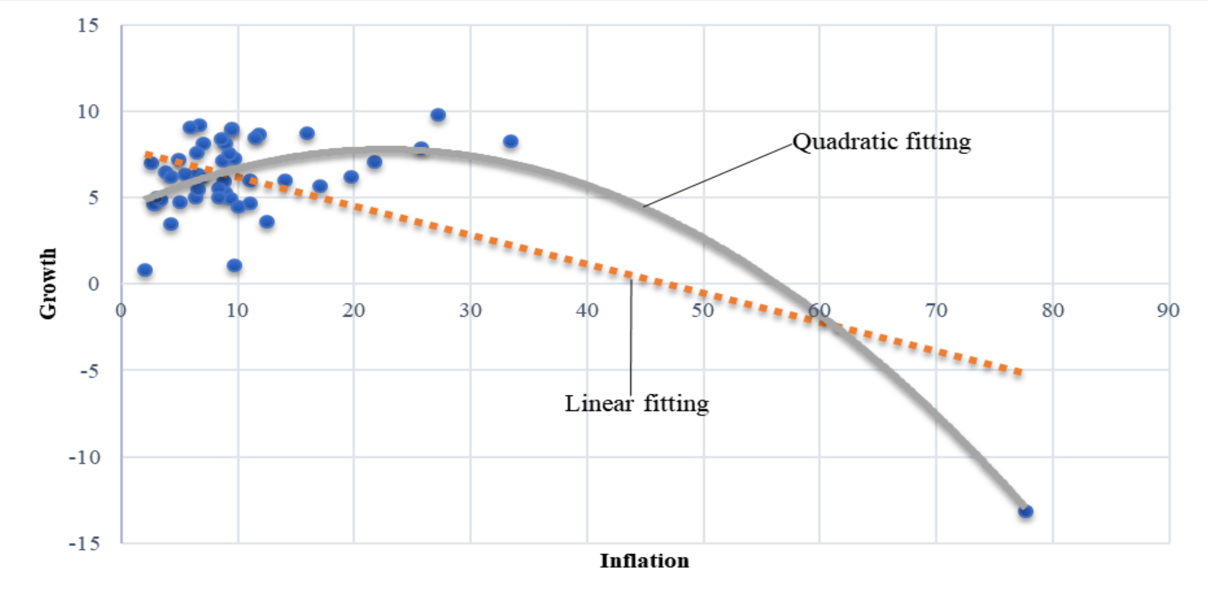
The analyses in this chapter include extreme values that come from economic growth and inflation when the Asian financial crisis hit Indonesia in 1998. With the inclusion of those anomaly values (which can be acknowledged as outliers), the estimation could be affected, especially the scope of the analyses that will be limited to Indonesia. According to Aggarwal (2016), an outlier often provides beneficial information to analyze. Thus, this chapter tries to accommodate the theory that assumes that high inflation would create low economic growth (having a negative relationship) by maintaining high inflation and low growth in 1998. At a later examination, the robustness tests of all models will be performed. This limitation hopefully will be addressed by future research.

3.5. Result and Discussion

Previous studies in Indonesia were focusing on the relationship between inflation and growth as well as calculate the inflation's threshold yielded various thresholds, and this is because of the difference in the method, control variables, and time. Conventionally, the relationship between inflation and growth can be illustrated in a graph using a scatter plot and the technique utilized by Mubarik (2005).

The relationship between inflation and growth, as can be seen in Figure 3.1, is negative when the linear approach is used. On the other hand, the quadratic approach exhibits a turning point (positive to negative slope) when a certain level of inflation is exceeded. From the scatter plot method, the conclusion about the nexus between inflation and growth is somewhat mixed, suggesting that further analyses should be done.

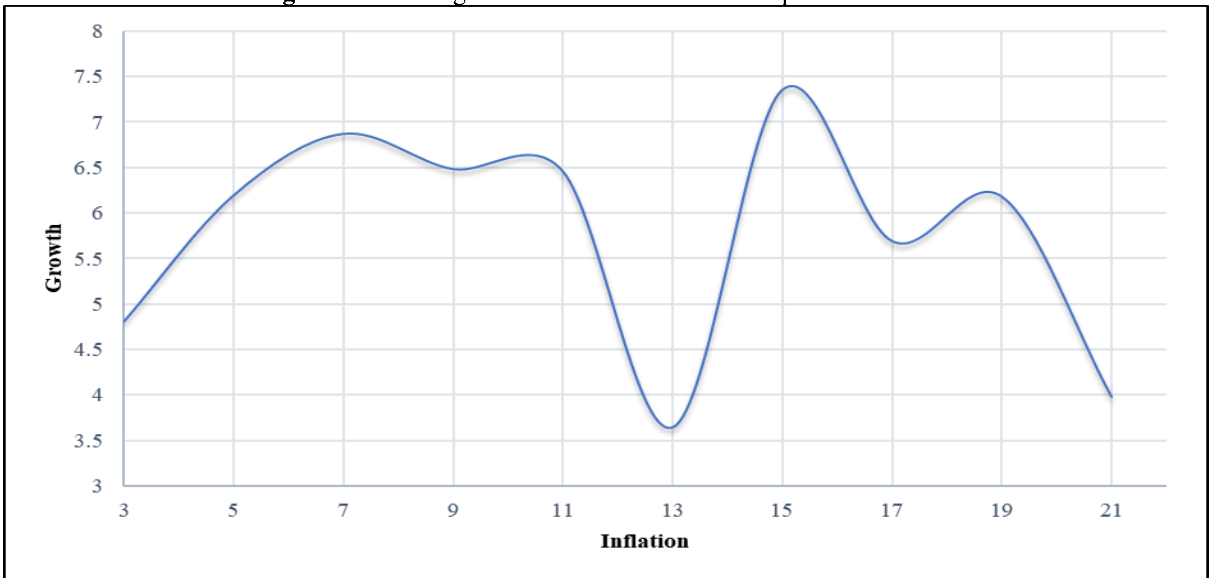
Figure 3.1. Scatter Plot of Inflation and Growth



Source: Author's calculation.

For Mubarik's (2005) method, the procedures are simple by sorting the values of inflation, grouping them into the respected numbers, and calculating the average growth in each group. This chapter provides an example of grouping the inflation into the rate of 3%, 5%, 7%, 9%, 11%, 13%, 15%, 17%, 19%, and 21% (and above). By taking the interval by 2% starting from 3% of inflation, the result can be seen in Figure 3.2.

Figure 3.2. Average Economic Growth with Respect to Inflation



Source: Author's calculation.

Figure 3.2 shows the average growth in relationship with its inflation level in Indonesia from 1970 to 2016. In general, there are four peaks when the relationship between inflation and growth swings from positive to negative, which are around 7%, 10%-11%, 14%-15%, and 18%-19%. Roughly, there are two highest thresholds indicated from this approach are 7% and around 14%-15%. To justify this preliminary observation, the regression test should be conducted.

The further stage of the analysis is the application of the ARDL model. This is to identify the relationship between inflation and growth both in the short run and the long run. Initially, the variables GR, INF, INV, and EXIM (including M2 for the further stage of analysis) are tested using the *Augmented Dickey-Fuller* (ADF) test for their stationarity. The result can be seen in Table 3.1.

The main requirement of the ARDL model is that there should be none of the variables is integrated of order two or I(2). Table 3.1 shows that all the variables are stationary at level or I(0). Since no variables are stationer at I(2), the ARDL can proceed.

Table 3.1. Stationarity Test Result using ADF

Variable	Level		First Difference		Stationer at
	Intercept	Intercept and Trend	Intercept	Intercept and Trend	
GR	-4.6276 (0.0005)	-4.8694 (0.0014)	- -	- -	Level / I(0)
INF	-6.1578 (0.0000)	-6.5007 (0.0000)	- -	- -	Level / I(0)
INV	-4.7087 (0.0004)	-5.2014 (0.0006)	- -	- -	Level / I(0)
EXIM	-4.6739 (0.0004)	-4.9004 (0.0013)	- -	- -	Level / I(0)
M2	-3.5772 (0.0101)	-5.3798 (0.0003)	- -	- -	Level / I(0)

***Notes*:** The value outside the bracket is the t-statistic, and the p-value is in the bracket.
***Source*:** Author's calculation.

The next stage for ARDL is to choose the optimum lag for the model. The process involves comparisons of the values of AIC, SC, and HQC from each lag. After thoroughly trying all possible lags and observing the residuals diagnostic check, the optimum lag is four and providing the model of ARDL (2, 4, 3, 3). In addition, the cointegration among variables should be checked using bounds testing by Pesaran et al. (2001). The variables will be considered having a cointegration relationship if the F-statistic from F-Bounds test > critical value of bounds test.

The F-Statistic from the bounds test is 4.6526 for the total sample size of 43. It is significant at 5% in Narayan (2005) case II (restricted intercept and no trend) for finite sample n = 40 (which is 3.1 for I(0) and 4.088 for I(1)) and n = 45 (which is 3.078 for I(0) and 4.022 for I(1)).[22] Hence, there is a cointegration exists among variables. To justify this result, at the following ECM equation, the coefficient of ECT can be examined and should be negative and significant. As a complement for the bounds testing, the long-run ARDL equation could be obtained, and it is provided in Table 3.2.

Table 3.2. Long-run ARDL Model Estimation

Variable	Coefficient	t-Statistic	Standard Error	Probability
INF	-0.0855	-1.8224	0.0469	0.0795
INV	0.4195	6.2701	0.0669	0.0000
EXIM	0.0964	1.5255	0.0632	0.1388
C	3.5028	4.0673	0.8612	0.0004
GR = 3.5028 - 0.0855INF + 0.4195INV + 0.0964EXIM + ε				

***Source*:** Author's calculation.

Table 3.2 depicts the long-run relationship among variables in the model. Only two variables, INF and INV, have a significant impact on the growth at $\alpha = 10\%$ and 1%, respectively. Here, the impact of inflation on growth is negative and significant, inferring that the inflation in the long-run time frame would bring an adverse impact on growth. For further analysis, Table 3.3 provides the short-run equation of the ARDL model.

[22] Since the intercept is restricted (Case II), intercept is available in the long-run model (not in the ECM).

Table 3.3. Short-run ARDL Model Estimation (ECM)

Variable	Coefficient	t-Statistic	Standard Error	Probability
ΔGR_{t-1}	0.2108	1.4958	0.1409	0.1463
ΔINF	-0.1479	-5.6562	0.0262	0.0000
ΔINF_{t-1}	0.0025	0.0679	0.0367	0.9464
ΔINF_{t-2}	-0.0735	-2.1746	0.0338	0.0386
ΔINF_{t-3}	-0.0679	-3.0789	0.0221	0.0047
ΔINV	0.1923	4.5332	0.0424	0.0001
ΔINV_{t-1}	-0.1246	-1.7741	0.0702	0.0873
ΔINV_{t-2}	-0.1903	-4.1785	0.0455	0.0003
$\Delta EXIM$	0.0257	0.9999	0.0257	0.3262
$\Delta EXIM_{t-1}$	-0.0581	-1.8381	0.0316	0.0771
$\Delta EXIM_{t-2}$	-0.0699	-2.6391	0.0265	0.0136
ECT_{t-1}	-0.9453	-5.1681	0.1829	0.0000
Adjusted R-squared = 0.8740, Standard Error of Regression = 1.4552				

Source: Author's calculation.

The result from Table 3.3 justifies the existence of long-run cointegration of variables since the coefficient of the Error Correction Term (ECT) is -0.9453 and significant at α = 1%. The speed of adjustment of the ECM into the equilibrium is 94.53%. The advantage of the ARDL model is the availability of the short-run coefficients to examine the dynamics of independent variables in the lags provided. Here, the focus is on the coefficients of INF and its lags. The values of INF coefficients are negative at lag 0, 2, 3, and positive at lag 1. Interestingly, there are only negative coefficients that possess significances at α = 1% and 5% level. This result implies that, in the short run, the negative impact of inflation on growth is more dominant and significant.

The last stage for the ARDL model is the diagnostics check. The summary of the checks is available in Table 3.4. From Table 3.4, the ARDL (2, 4, 3, 3) model is proven to pass the checks (probability values of respective tests are > 5%, and CUSUM checks are stable). Thus, the model produces reliable estimations.[23]

[23] Endogeneity issue is also addressed in the ARDL model, see Nkoro & Uko (2016) and Pesaran & Shin (1999).

Table 3.4. Diagnostics Checks Result

Test	Value	Probability
Residuals Normality	Jarque-Bera = 2.3444	0.3097
Breusch-Godfrey Serial Correlation LM Test	Obs.R-squared = 1.9184	0.3832
Heteroskedasticity Test: Breusch-Pagan-Godfrey	Obs.R-squared = 14.0750	0.5198
CUSUM Stability Check	The line does not cross the boundaries	-
CUSUM of Squares Stability Check	The line does not cross the boundaries	-

***Source*:** Author's calculation.

After the ARDL model robustly provided the result of the inflation-growth nexus, the further analysis is to obtain the threshold of inflation. As mentioned in the previous section, this stage compares Model 1 and Model 2. Despite the difference in models, initially, the aim of Model 1 and Model 2 is to get the highest R-square of regression. Furthermore, the comparison in this stage also utilizes indicators such as Adjusted R-squared, Sum Square Residuals, AIC, SC, and HQC.

The first implemented model is the threshold model from Equation (3.5). After the initial calculation, the value of inflation's threshold appeared from k = 4. For the completeness of the analysis, the maximum value of k is set on the value of 15. Table 3.5 presents the result of threshold regression for the value of k from 4% to 15% of Model 1.

Table 3.5 shows some findings; the first one is based on the values of R-squared. The values of R-squared increase from the value of k = 4 to k = 7 and decline starting from k = 8 to k = 9. From the values of k = 10 and above, the values of R-squared incline significantly and no signs of decreasing. It is obvious that the higher the k, the bigger the R-squared. However, when the values of significance from the variables INF and D*(INF-k) are considered, the reasonable range of k only from k = 4 to k = 8, where both variables are significant. Hence, the threshold effect disappears when k exceeds 8%. Eventually, the value of k = 7 is the optimum value for inflation's threshold. When inflation is less than or equal to 7%, increasing inflation by 1% makes an increase in growth by 0.42%. Conversely, when inflation exceeds 7%, increasing inflation by 1% produces a decrease in growth by 0.23% (the value comes from -0.647751+0.419454).

Table 3.5. Threshold Regression Result of Model 1

k (%)	Variable	Coefficient	Standard Error	t-statistic	Probability	R-squared
4	C	-1.542210	3.025714	-0.509701	0.6130	0.729747
	INF	1.451646	0.783675	1.852357	0.0712	
	D4*(INF-4)	-1.656226	0.802413	-2.064056	0.0454	
	INV	0.140761	0.043231	3.256024	0.0023	
	M2	0.090138	0.034304	2.627599	0.0120	
	EXIM	0.002099	0.031599	0.066431	0.9474	
5	C	-0.223862	2.041077	-0.109679	0.9132	0.740125
	INF	0.888545	0.428978	2.071308	0.0447	
	D5*(INF-5)	-1.101916	0.447333	-2.463302	0.0181	
	INV	0.134578	0.042406	3.173546	0.0029	
	M2	0.092075	0.033464	2.751481	0.0088	
	EXIM	0.000236	0.030842	0.007644	0.9939	
6	C	0.623359	1.623801	0.383889	0.7030	0.744566
	INF	0.587035	0.288704	2.033346	0.0485	
	D6*(INF-6)	-0.807361	0.307667	-2.624141	0.0121	
	INV	0.130447	0.042318	3.082537	0.0037	
	M2	0.093314	0.033175	2.812791	0.0075	
	EXIM	0.002413	0.030645	0.078743	0.9376	
7*)	C	1.095914	1.396698	0.784646	0.4372	0.748510
	INF	0.419454	0.214476	1.955720	0.0573	
	D7*(INF-7)	-0.647751	0.234393	-2.763524	0.0085	
	INV	0.128093	0.042033	3.047468	0.0040	
	M2	0.096074	0.033090	2.903434	0.0059	
	EXIM	0.005450	0.030526	0.178551	0.8592	
8	C	1.648455	1.230330	1.339848	0.1877	0.747690
	INF	0.285455	0.168656	1.692526	0.0981	
	D8*(INF-8)	-0.517029	0.189057	-2.734780	0.0092	
	INV	0.127534	0.042253	3.018374	0.0044	
	M2	0.095443	0.033102	2.883309	0.0062	
	EXIM	0.003187	0.030476	0.104582	0.9172	
9	C	2.124325	1.113528	1.907743	0.0634	0.744817
	INF	0.186582	0.138496	1.347196	0.1853	
	D9*(INF-9)	-0.418546	0.158955	-2.633115	0.0119	
	INV	0.128111	0.042652	3.003664	0.0045	
	M2	0.093738	0.033195	2.823833	0.0073	
	EXIM	0.001603	0.030597	0.052381	0.9585	
10	C	2.218061	1.047235	2.118017	0.0403	0.748505
	INF	0.155710	0.121741	1.279024	0.2081	
	D10*(INF-10)	-0.396985	0.143660	-2.763369	0.0085	
	INV	0.125574	0.042422	2.960117	0.0051	
	M2	0.095541	0.033035	2.892112	0.0061	
	EXIM	0.004686	0.030489	0.153701	0.8786	
11	C	2.294819	0.980331	2.340862	0.0242	0.753810
	INF	0.139276	0.109537	1.271498	0.2107	
	D11*(INF-11)	-0.390137	0.132390	-2.946876	0.0053	
	INV	0.122147	0.042064	2.903872	0.0059	
	M2	0.095593	0.032556	2.936258	0.0054	
	EXIM	0.006488	0.030221	0.214691	0.8311	

k (%)	Variable	Coefficient	Standard Error	t-statistic	Probability	R-squared
12	C	2.347648	0.922749	2.544189	0.0148	0.760027
	INF	0.130463	0.100342	1.300187	0.2008	
	D12*(INF-12)	-0.392000	0.124139	-3.157751	0.0030	
	INV	0.118085	0.041656	2.834761	0.0071	
	M2	0.095450	0.032006	2.982267	0.0048	
	EXIM	0.008183	0.029882	0.273840	0.7856	
13	C	2.443075	0.875785	2.789584	0.0080	0.764131
	INF	0.119783	0.093632	1.279302	0.2080	
	D13*(INF-13)	-0.389624	0.118241	-3.295173	0.0020	
	INV	0.115897	0.041321	2.804797	0.0077	
	M2	0.093851	0.031547	2.974956	0.0049	
	EXIM	0.009840	0.029682	0.331509	0.7419	
14	C	2.560850	0.829301	3.087962	0.0036	0.768184
	INF	0.108515	0.087407	1.241493	0.2215	
	D14*(INF-14)	-0.385303	0.112333	-3.430009	0.0014	
	INV	0.114279	0.040923	2.792571	0.0079	
	M2	0.091395	0.031070	2.941605	0.0053	
	EXIM	0.011200	0.029467	0.380092	0.7058	
15	C	2.648316	0.790763	3.349065	0.0017	0.772854
	INF	0.100940	0.082244	1.227321	0.2267	
	D15*(INF-15)	-0.386722	0.107883	-3.584648	0.0009	
	INV	0.111449	0.040593	2.745506	0.0089	
	M2	0.089914	0.030635	2.935029	0.0054	
	EXIM	0.013245	0.029241	0.452963	0.6530	

Notes: *) denotes the optimum value of K, where R-squared is maximized, and the threshold effect appears.
Source: Author's calculation.

The threshold model at k equal to 7 has an R-squared around 0.748510 (Adjusted R-squared is 0.717840). This model passes the diagnostics checks for Normality (probability of Jarque-Bera is 0.186995), Serial Correlation (Obs. R-squared in Breusch-Godfrey test has probability around 0.2741), and Heteroskedasticity (Obs. R-squared in Breusch-Pagan-Godfrey test has probability around 0.1518). Thus, this model fulfilled the residuals' diagnostics checks.

The comparator of the threshold regression of Model 1 is the quadratic regression model in the form of Model 2. The purpose of this model is to find the maximum value of INF by taking the first differential of the quadratic regression model. The result of Model 2 can be seen in Table 3.6.

Table 3.6. Quadratic Regression Result of Model 2

Panel 1				
Variable	Coefficient	Standard Error	t-statistic	Probability
C	2.935610	0.598230	4.907156	0.0000
INF	0.145662	0.066364	2.194891	0.0339
INF^2	-0.005091	0.000957	-5.317669	0.0000
INV	0.073575	0.037409	1.966762	0.0560
M2	0.087057	0.026748	3.254766	0.0023
EXIM	0.019998	0.025806	0.774914	0.4428

Panel 2	
Indicators	Value
INF*	14.30583
R-squared	0.823439
Adj. R-squared	0.801907
Prob. of Jarque-Bera	0.129571
Prob. of Breusch-Godfrey	0.6400
Prob. of Breusch-Pagan-Godfrey	0.3356
Prob. of Ramsey RESET Test	0.1471

Source: Author's calculation.

Table 3.6 Panel 2 indicates that the inflation threshold for the quadratic regression model is around 14.31% (calculated from Equation (3.7) utilizing coefficients from INF and INF^2 from Table 3.6 Panel 1). This result is double the threshold provided by Model 1. However, this result is still below the threshold suggested by Chowdhury and Siregar (2004) that employed a similar method in Indonesia, which was 20.50%. In terms of diagnostic checking, Model 2 could satisfy the tests for Normality, Serial Correlation, Heteroskedasticity, and Ramsey RESET test, as indicated in Table 3.6 Panel 2 (all of the probability values are > 5%).

If both models are compared, the value of R-squared from Table 3.6 at INF* = 14.31% is bigger than the result from Table 3.5 at k = 7% (0.823439 > 0.748510). For a complete comparison of Adjusted R-squared, Sum Square Residuals, AIC, SC, and HQC, the results are depicted in Table 3.7. It is clear that Model 2 could provide a better model as all indicators from Model 2 are better (bigger R-squared as well as adjusted R-squared, and smaller Sum Square Residuals, AIC, SC, and HQC).

Table 3.7. Post-estimation Statistics Comparison

k	Model	R-squared	Adj. R-squared	SSR	AIC	SC	HQC
7	Model 1	0.748510	0.717840	138.4802	4.173776	4.409965	4.262655
14.31	Model 2	0.823439*	0.801907*	97.22145*	3.820040*	4.056229*	3.908920*

Notes: * indicates the better indicator.
Source: Author's calculation.

The other resource for thresholds comparison is by observing the *Inflation Targeting Framework* (ITF) tabulation from the Central Bank of Indonesia (BI). Table 3.8 elaborates the ITF spans from 2001 to 2017 with the actual inflation and growth in the respected year.

Table 3.8. Inflation Targeting in Indonesia, 2001 – 2017

Year	Inflation Targeting (%)	Actual Inflation (%)	Growth (%)
2001	4 - 6	12.55	3.64
2002	9 - 10	10.03	4.50
2003	9±1	5.06	4.78
2004	5.5±1	6.40	5.03
2005	6±1	17.11	5.69
2006	8±1	6.60	5.50
2007	6±1	6.59	6.35
2008	5±1	11.06	6.01
2009	4.5±1	2.78	4.63
2010	5±1	6.96	6.22
2011	5±1	3.79	6.49
2012	4.5±1	4.30	6.23
2013	4.5±1	8.38	5.56
2014	4.5±1	8.36	5.01
2015	4±1	3.35	4.88
2016	4±1	3.02	5.02
2017	4±1	3.61	3.64
Average	5.53*	7.31	4.50
Median	5*	6.60	4.78
Mode	5*	7**	5.03

Notes: * indicates the values without deviation. ** indicates rounded to zero digits of the decimal.
Source: Central Bank of Indonesia, data processed.

The first impression regarding the ITF in Indonesia is that the inflation targeting values are mostly set at a level below 10% (from 4% to 10%). The nexus of inflation's threshold analysis and the ITF policy are not empirically analyzed in this chapter (the analysis of ITF in Indonesia has gone beyond this chapter's coverage); however, in a wider point of view, the purpose of both tools is to provide a good economic climate in Indonesia. The inputs from Table 3.8 are implicitly in line with the conclusion that the value of the threshold of inflation in Indonesia is around 7% (from the average, median, and mode of actual inflation). Table 3.8 also suggests that the tight monetary policy framework applied by BI to reach the low ITF's target in recent years.

Around 27 countries have adopted the application of ITF, according to Hammond (2012). Among those 27 countries, some studies of the threshold inflation have been conducted in nine countries. As a result, the comparison between the ITF and the suggested threshold can be examined further. The comparison can be seen in Table 3.9.

Table 3.9. Inflation Targeting in Some Countries

No.	Country	Inflation Target (%)	Threshold (%)	Author	Comparison
1	Armenia	4±1.5	4.5	Sargsyan (2005)	About the same
2	Ghana	8.7±2	11	Frimpong & Oteng-Abayie (2010)	Target<Threshold
3	Indonesia	4.5±1	7-14.31	Murjani (2019)	Target<Threshold
4	Mexico	3±1	9	Risso & Carrera (2009)	Target<Threshold
5	Philippines	4±1	10-15	Yap (1996)	Target<Threshold
6	South Africa	3-6	4	Leshoro (2012)	About the same
7	Sweden	2	3	Jismark & Jonason (2019)	Target<Threshold
8	Thailand	3±1.5	3	Jiranyakul (2017)	About the same
9	Turkey	5±2	7.97	Aydın et al. (2016)	Target<Threshold

***Source*:** Author's compilation. Inflation targets are sourced from Hammond (2012).

Among the countries listed in Table 3.9, most of the studies indicated that the countries set a lower inflation target compared to the suggested threshold of inflation. This finding suggests that the less tight monetary policy not only could be applied in Indonesia but also in other countries that employ the ITF.

3.6. Conclusion

The discussion in regard to the nexus between inflation and growth has expanded into various perspectives. The studies conducted in countries around the world from different economic backgrounds have provided us with diverse conclusions. Moreover, the theory of the existence of an inflation threshold (where the impact of inflation on the growth swings from positive to negative) invited more methods to be applied in order to investigate the threshold. Relevant studies of inflation's threshold conducted in Indonesia yielded heterogeneous numbers. This chapter aims to add another test to investigate the nexus between such variables in the short- and long-run time frame as well as to find the threshold.

By utilizing the ARDL method, the nexus of inflation and growth in Indonesia has been examined. It is evident that the relationship between inflation and growth, in the long run, is negative and significant. With a help from the analysis of ECM, the short-run dynamics between inflation and growth could be seen. Likewise, inflation could have an adverse influence on growth in the short run. Thus, identifying the threshold of inflation becomes essential.

Initial observation using the graph showed that the threshold exists at around 7% of inflation. This finding is then supported by the threshold regression's result. The threshold regression method produced the optimum R-squared at the significant probability value of the threshold at k equal to 7%. Sequentially, the threshold regression was compared with the quadratic regression model to find a better model. It is evident that the value of inflation is optimum at around 14.31%, as the quadratic regression provided a better comparison for the models' post-estimation statistics. Both models have proven robust estimations; therefore, this chapter suggests that the inflation threshold in Indonesia is at around 7% to 14.31%. In the very end, the ITF in Indonesia has been added as supplementary input for the decision. The ITF seemingly supported the result of the threshold regression by the evidence that the ITF practiced the inflation's targeting from 4% to 10% in the last decade; the result from quadratic regression also revealed the possibility of less tight monetary policy in Indonesia. Similarly, a lower ITF could also be found in other countries such as Ghana, Mexico, The Philippines, Sweden, and Turkey.

The utilization of more advanced methods (especially that accounts for extreme values of inflation), a wider period of observation, as well as more entities (country or province), would be a better way to improve the suggested threshold. Also, there is still a need to include additional input from various sources to strengthen the decision to pick the value of the optimum threshold of inflation. So, the model produces a robust result from the methodological perspective as well as the policymakers' sight. The study of the threshold inflation in other ITF countries can also be conducted to complete the literature.

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Chapter 4. Assessing the Energy Subsidy Reform in Indonesia through Different Scenarios

4.1. Introduction

The energy subsidy in Indonesia has been poured since the 1960s (Beaton & Lontoh, 2010; Vagliasindi, 2013). 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. Indeed, Indonesia not only exported 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 international balance of payment.

Indonesia was able to recover from the 1997–1998 Asian Financial Crisis; inflation and the local currency were stabilized thanks to the Indonesian government's effective monetary and fiscal countermeasures. 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%. 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 chapter 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 gained momentum due to the huge fiscal strain exerted on the government annually; 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[24] impact.

Indonesia has been a favorite study case for energy subsidy policy for many economists around the world, and it has been examined for its key reforms (price reform, institutional reform, and non-subsidy policies) and the mitigation actions taken (Inchauste & Victor, 2017). In addition, many countries can obtain some insights in dealing with energy subsidy reform by learning from Indonesia's case study (Savatic, 2016). Therefore, this chapter firmly focuses on the Indonesian case with the following considerations. First, there are limited studies[25] available for energy subsidy reform simulation in Indonesia. Second, this chapter 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 chapter 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.[26]

This chapter sets three aims: the main aim is to simulate the energy subsidy elimination (increasing prices of subsidized energy goods) and examine the impacts on welfare or poverty as well as on government revenues; the second aim is to measure the income and price elasticity

[24] Olivia and Gibson examined welfare impact as a marginal social cost, and Renner et al. (2019) measured the welfare impact as Compensating Variation (CV).
[25] Mainly relied on CGE method.
[26] In 1999, oil prices worldwide were relatively low; whereas, in 2012, oil prices worldwide were greater.

of demand for subsidized energy goods in Indonesia; and the third aim is to study the results from the reforms in two different years (1999 and 2012) and to extract lessons so that the subsidy reform in the near future could be more precisely formulated. To achieve the goals of this chapter, two large datasets of the Indonesian National Socioeconomic Survey (SUSENAS) of 1999 and 2012 are employed.

This chapter contributes to the existing literature in the following ways:

(1) This chapter 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.

(2) This chapter 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.

(3) This chapter 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 period of the reform.

The rest of this chapter is comprised of literature review, materials and methods, results and discussion, and conclusion and policy implications.

4.2. Literature Review

4.2.1. 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[27] 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

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

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 & Lontoh, 2010).

Over time, the scale 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 4.1.

Table 4.1. Key Events of the Energy Subsidy Policy in Indonesia, 1956–2017

Year	Event	Exchange Rate (Rupiah per 1 US Dollar)	Oil Price Index[28]	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[29] 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

[28] Simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh.
[29] Organization of Petroleum Exporting Countries.

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

Notes: 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.

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 4.1 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 4.1 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 launched 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 declined, electricity pricing was reformed. As the oil prices kept falling, the reform of the electricity tariff continued in 2014 and 2017[30]. Finally, the subsidy for gasoline was terminated in 2015 as a result of a huge relief in fiscal strain due to declining global oil prices.

4.2.2. Indonesia As a Welfare State

4.2.2.1. National Social Security System

According to the Britannica Online Encyclopedia (2015), "the welfare state is a concept of government in which the state or a well-established network of social institutions plays a key role in the protection and promotion of the economic and social well-being of citizens. It is based on the principles of equality of opportunity, equitable distribution of wealth, and public responsibility for those unable to avail themselves of the minimal provisions for a good life". Indonesia is one of the world's welfare states with the provision of the National Social Security System (hereafter SJSN or *Sistem Jaminan Sosial Nasional*). SJSN was established by Law Number 40 of 2004 for the National Social Security System. SJSN covers five items, such as health security, work accident security, old-age security, pension security, and death security, under the regulation of The National Social Security Council (hereafter DJSN or *Dewan Jaminan Sosial Nasional*). In addition, Law Number 40 of 2004 formulated an organizing social security agency so-called *Badan Penyelenggara Jaminan Sosial* (hereafter BPJS). BPJS works are financed by a contributary and mandatory saving from its members. Under Law

[30] Rupiah slightly appreciated against US dollar while the world's oil prices inclined insignificantly. The subsidy for electricity was maintained for two lowest blocks whilst the subsidy for other blocks were withdrawn (adjusted) by the government (Indonesian Ministry of Energy and Mineral Resources, 2017).

Number 24 of 2011, BPJS established Health Social Security Organizing Agency (BPJS *Kesehatan*) and Employment Social Security Organizing Agency (BPJS *Ketenagakerjaan*). In addition to the SJSN, Indonesian social assistance is a non-contributory provision for the targeted poor and vulnerable society (Martabat, 2011).

4.2.2.2. Indonesian Social Security

Indonesian social security is a contributory insurance and compulsory saving aims for civil servants, military forces personnel, police personnel, and formal sectors' workers. Four institutions run the social security program in Indonesia, such as the following:

a. PT ASABRI is a state-owned institution that manages saving and pension services for military and police personnel, including civil servants in both institutions.
b. PT TASPEN is a state-owned institution that manages saving and pension for civil servants.
c. BPJS *Kesehatan* is a state-owned institution that runs maternity and healthcare benefits for government employees and pensioners, including veterans.[31]
d. BPJS *Ketenagakerjaan is* a state-owned institution that administers death benefits, old-age benefits, healthcare benefits, maternity benefits, and accident benefits at the workplace for private workers.[32]

4.2.2.3. Indonesian Social Assistance

Indonesian social assistance comprises income support and social service. Income support covers social welfare programs administered by the Ministry of Social Affairs and local governments (i.e., income support to the neglected elderly, poor-disabled person, and neglected children) and cash transfer programs (i.e., cash transfers provided in 2005, 2008, and 2013). The social service in Indonesia can be divided into some programs such as healthcare for the

[31] BPJS *Kesehatan* was formerly PT ASKES.
[32] BPJS *Ketenagakerjaan* was formerly PT JAMSOSTEK. BPJS *Ketenagakerjaan* also voluntarily provides aids for informal sectors' workers.

poor, maternity benefit for uninsured women, aid for school (including a student scholarship), and social welfare insurance program (covering the poor and near-poor who work in informal jobs). The social service programs are run by Ministry of Health, Ministry of Social Affairs, registered Non-governmental organizations (NGOs), and local governments.

4.2.2.4. Welfare State, National Social Security System, and Subsidy

As a welfare state, Indonesia utilizes subsidies to enhance the prosperity of its citizens. Besides the energy subsidy, Indonesia also provided non-energy subsidies, such as rice, fertilizer, seeds, wheat, sugar, and many more. Although those subsidies function outside of the National Social Security System, they are the integral parts of Indonesia's welfare state mechanism. The subsidy reform attempts in Indonesia could harm welfare; the Indonesian government always mitigated the negative impact by either enhancing the existing social assistance or introducing a new program. OECD (2019) reported that the social security system in Indonesia has a bright future, but it needs a higher effort, especially in funding. Therefore, the energy subsidy reform could be a way to loosen the fiscal strain and improve or develop the social security system in Indonesia.

4.2.3. Empirical Evidence

Energy subsidy reform is not a new thought in the international community. The G20 Summit in Pittsburgh in 2009 declared the commitment to introduce a gradual reduction in fossil fuel subsidies. Some countries have already applied reductions and others are planning to do so (Vagliasindi, 2013). Furthermore, the declining trend of global oil prices lately has attracted more countries to seize the moment 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. 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[33], kerosene, gasoline group[34], 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[35] was taken by Murjani (2017) by utilizing SUSENAS 2016 data in the regency level of estimation.

[33] LPG group consisted of LPG, city gas, and coal bricked.
[34] Gasoline was grouped with ADO.
[35] 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.

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[36] 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[37] income group seemed to be a mixture of the lowest and highest of deciles.

The studies 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. But the difference in methods for calculating elasticities yielded varied results. The

[36] The pooled dataset covered years 2009–2013.
[37] 5th decile.

heterogeneity[38] 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 period of simulation reform, as well as the government's revenue aspect, have not been deeply examined. This chapter, therefore, addresses all those issues. Initially, this chapter 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 chapter 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 chapter 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.

4.3. 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 chapter introduces two methods that consist of AIDS-ILLS and SUBSIM simulations. The data utilized in this chapter are two SUSENAS datasets (the core and consumption modules) for the years 1999 and 2012.[39] 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[40]. For the

[38] 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.

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

[40] 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.

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.

4.3.1. AIDS

First, the AIDS model by Deaton and Muellbauer (1980) is specified for the estimation of the five chosen energy goods, namely, electricity, LPG[41], kerosene, gasoline, and ADO. The AIDS model is defined in Equation (4.1).

$$w_i^h = \alpha_i + \sum_{j=1}^{n} \gamma_{ij}\, ln\, p_j^h + \beta_i ln\left[\frac{M^h}{a(P^h)}\right] + \varepsilon_i^h \qquad (4.1)$$

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.

$\alpha_i, \beta_i, \gamma_{ij}$: 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 that defined as $Ln\, a(P^h) = \alpha_0 + \sum_{i=1}^{n} ln\, p_i^h + 0.5 \sum_i \sum_j \gamma_{ij}\, ln\, p_i^h\, ln\, p_j^h$

ε_i^h : Error term.

In the AIDS model, some restrictions are imposed for Equation (4.1) such as:

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

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

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

[41] Due to the absence of subsidy for LPG in 1999, this chapter excludes it in 1999 estimation.

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

$$\alpha_i = \alpha_i^* + \sum_{k=1}^{m} \alpha_{ik}^* d_k \tag{4.2}$$

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 (4.2) 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 (4.1), the Marshallian (uncompensated) income elasticity of demand can be defined as:

$$e_i = 1 + \frac{1}{w_i}[\beta_i] \tag{4.3}$$

and the price elasticity of demand as:

$$e_{ij} = \frac{1}{w_i}\left[\gamma_{ij} - \beta_i\right] - \delta_{ij} \tag{4.4}$$

where δ_{ij} is Kronecker delta that equal to one if $i = j$ and equal to zero if $i \neq j$.[42]

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[43] value, if the

[42] Lecocq and Robin (2015) employed QUAIDS formula in their paper. If the QUAIDS formula is adjusted to AIDS, e_i and e_{ij} will be adjusted accordingly.

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

value of e_{ii} is less than one (for example, 0.5) the elasticity is said to be price inelastic.[44] 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 chapter is no exception. This chapter 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.[45]

4.3.2. 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.

[44] e_{ii} is the own price elasticity. When $i = j$, e_{ij} can be denoted by e_{ii}.
[45] This assumption is later proven in the income elasticity estimation result.

Lecocq & Robin (2015) augmented ε_i in Equation (4.1) with the residual vector $\hat{v}$ so that:

$$\varepsilon_i^h = \rho_i \hat{v}^h + u_i^h \quad (4.5)$$

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 follow:

$$lnM^h = \alpha + \beta lnExp^h + \sum_{i=1}^{n} \gamma_i \ln p_i^h + \sum_{k=1}^{m} \delta_k d_k^h + \hat{v}^h \quad (4.6)$$

Where,

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

$\alpha, \beta, \gamma_i, \delta_k$: 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 (4.1) as a new variable. Therefore, Equation (4.1) can be expressed as:

$$w_i^h = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j^h + \beta_i ln\left[\frac{M^h}{a(P)}\right] + \rho_i \hat{v}^h + u_i^h \quad (4.7)$$

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

4.3.3. 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 chapter 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 chapter 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 chapter slightly advances[46] 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 (4.7), 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 chapter sidesteps the censoring issue based on some considerations. First, the SUSENAS datasets employed in this chapter already minimize the possibility of zero expenditure by extending the period of the consumption asked in the questionnaires[47]. 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.

[46] This chapter incorporates the core data of SUSENAS especially for the electricity block and LPG cylinder variables.

[47] 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.

4.3.4. Subsidy Reform Simulation

This chapter adopted the simulation method designed for subsidy reform introduced by Araar and Verme (2012), called SUBSIM[48]. The model has been developed further since its initial release, and the current version available is from 2015[49]. 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:

$$\Delta w_h = -\sum_{g=1}^{G} e_{g,h} \left(\frac{\Delta p_g}{p_g}\right) \tag{4.8}$$

Where Δw_h is the welfare change for household h, $e_{g,h}$ is the initial of the total expenditure per capita 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 (4.8) tends to be overestimated in measuring the welfare changes when the price changes significantly, the Cobb-Douglas approach is recommended by Araar and Verme (2015). The formula is defined as follows.

$$\Delta w_h = e_h \left(\frac{1}{\prod_{g=1}^{G} \varphi_{g,h}^{\alpha_{g,h}}} - 1\right) \tag{4.9}$$

Where e_h is the initial of total expenditure per capita of household h, $\varphi_{g,h}$ is the weighted post-reform prices[50] 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 total expenditure per capita where

[48] SUBSIM stands for Subsidy Simulation.
[49] The version that included a comprehensive STATA module (Araar & Verme, 2015).
[50] According to Araar & Verme (2016), this is the ratio of the post-reform prices to the pre-reform prices.

the post-reform total expenditure per capita is the summation of initial total expenditure per capita and the welfare change. [51]

Let's denote the post-reform total expenditure per capita is e'_h; thus, some welfare measurements can be compared (before and after the reform) such as poverty rate (headcount ratio or P_0), poverty gap (P_1), and inequality (Gini index). The formulas for each measurement can be defined as follows:

$$P_\alpha = \frac{1}{N}\sum_{e_h<z}\left(\frac{z-e_h}{z}\right)^\alpha \tag{4.10}$$

Where P_0 is poverty headcount ratio or poverty rate (P_α when α=0), P_1 is poverty gap (P_α when α=1), N is sample size, e_h is the initial of total expenditure per capita of household h, and z is poverty line. The new P_α due to the reform can be obtained by replacing e_h with e'_h.[52]

$$GINI = \frac{1}{\mu N(N-1)}\sum_{i>j}\quad\sum_j\left|e_i - e_j\right| \tag{4.11}$$

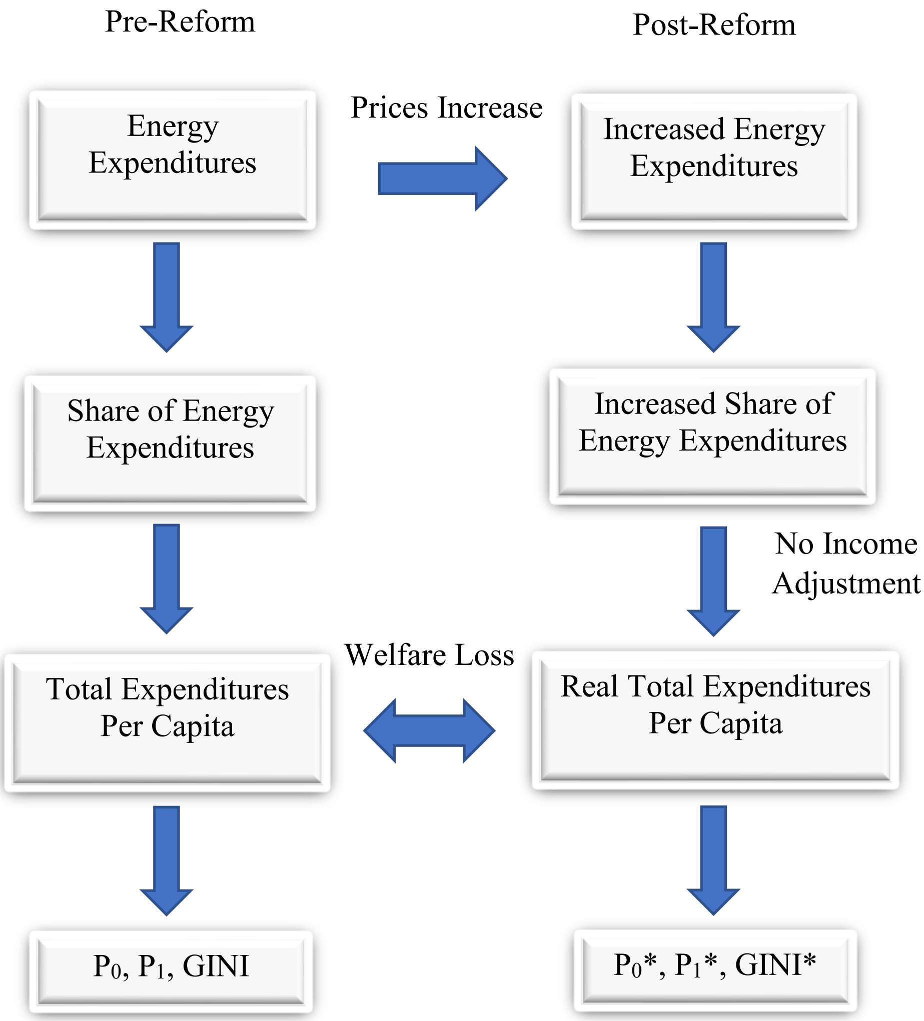
Where GINI is Gini index explaining inequality, μ is the mean of e_h, N is sample size, e_i and e_j are e_h at i^{th} and j^{th} households. The new GINI after the reform can be calculated by replacing e_h with e'_h.[53]

The mechanism of the direct welfare impact of the energy subsidy reform is presented in Figure 4.1. The welfare impact is translated as a loss of purchasing power in the form of a decline in real expenditures per capita. The estimation is based on the change of the share of energy goods' expenditures as a result of the increasing prices of those subsidized energy goods (Olivier & Laderchi, 2018). Therefore, when there is no increase in income, the increasing shares of energy goods consumed should be counterbalanced by other goods' expenditures to maintain the same utility level. The affected total expenditures per capita are used to calculate

[51] Since the welfare change due to price increases is negative, it is simply a subtraction.
[52] The formula to calculate P_α is also known as FGT indices that refers to its founders such as James Foster, Joel Greer, and Eric Thorbecke (Foster et al., 1984).
[53] The Gini index formula utilized in this chapter is adapted from (Vinod et al., 2001).

the post-reform welfare measurements, such as poverty rate (P_0*), poverty gap (P_1*), and inequality (GINI*).

Figure 4.1. The Direct Impact of The Energy Subsidy Reform on The Welfares



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

$$\Delta r = \sum_{h=1}^{H} e_{g,h} \left(\frac{\Delta p_g}{p_g}\right)\left(1 - \varepsilon_g\left(u_g - \frac{\Delta p_g}{p_g}\right)\right) \qquad (4.12)$$

Where Δr is the revenue changes due to the subsidy reform, ε_g is the uncompensated[54] price elasticity of demand for good g, and u_g is the unit subsidy for good g. The unit subsidies of

[54] This chapter employs the Marshallian (uncompensated) elasticity of demand instead of Hicksian because it is mostly employed by previous research (Widarjono, 2016).

energy goods are obtained from various sources. To deal with a large price change and to set a boundary on the maximum decrease in quantity, the formula is expressed as follows:

$$\Delta r = \sum_{h=1}^{H} e_{g,h}\left(\frac{\Delta p_g}{p_g}\right) + max(\varepsilon_g e_{g,h}\frac{\Delta p_g}{p_g};\ -e_{g,h})(\frac{\Delta p_g}{p_g} - u_g) \qquad (4.13)$$

In this chapter, 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 chapter are supported by STATA software.

4.4. Result and Discussion

4.4.1. 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 chapter, as mentioned before, different from previous research in terms of providing detail for estimation in 2012 for electricity and LPG. The results can be examined in Table 4.2.

Table 4.2 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.

Table 4.2. 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***	-	-	-

Notes: *** 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.

4.4.2. SUBSIM Simulations

4.4.2.1. Energy Prices and Unit Subsidies

It is obvious that the gradual decrease of the energy subsidy would bring a smaller impact than a radical[55] approach. Therefore, to simulate the worst-case situation, this chapter 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 chapter 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 4.3 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.

[55] Fully elimination on either particular energy good or all energy goods simultaneously.

Table 4.3 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.

Table 4.3. Energy Prices and Unit Subsidies in Indonesia, 1999 and 2012 (Rupiah per Unit)

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

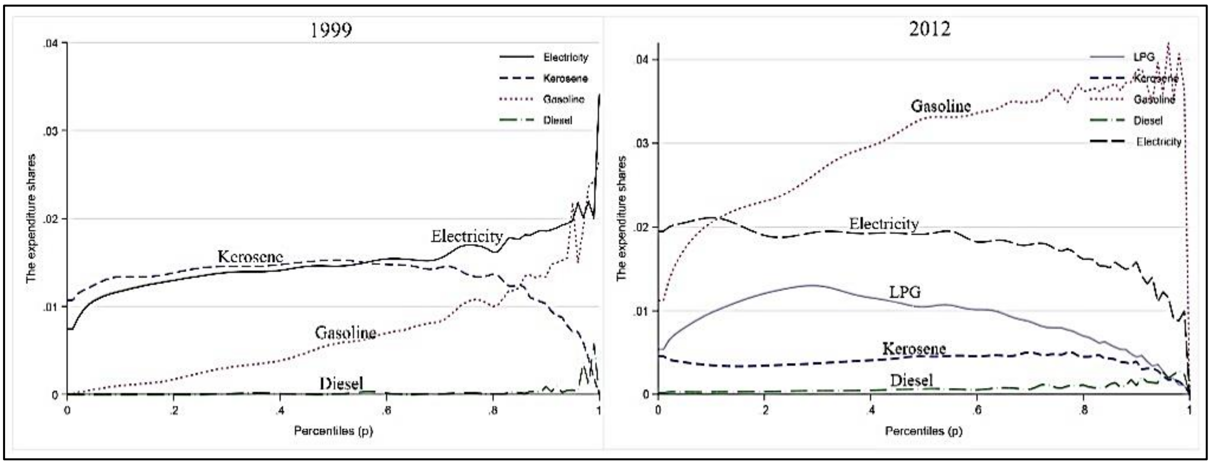
Source: Author's compilation. ***Notes:*** * denotes that the data gained from the median of the unit value of LPG in SUSENAS 1999 data.

4.4.2.2. 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 chapter presents two figures that explain the share of energy goods' expenditures (Figure 4.2) and their distributions of benefits (Figure 4.3).

There are some points that can be extracted from Figure 4.2 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 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 4.2 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.

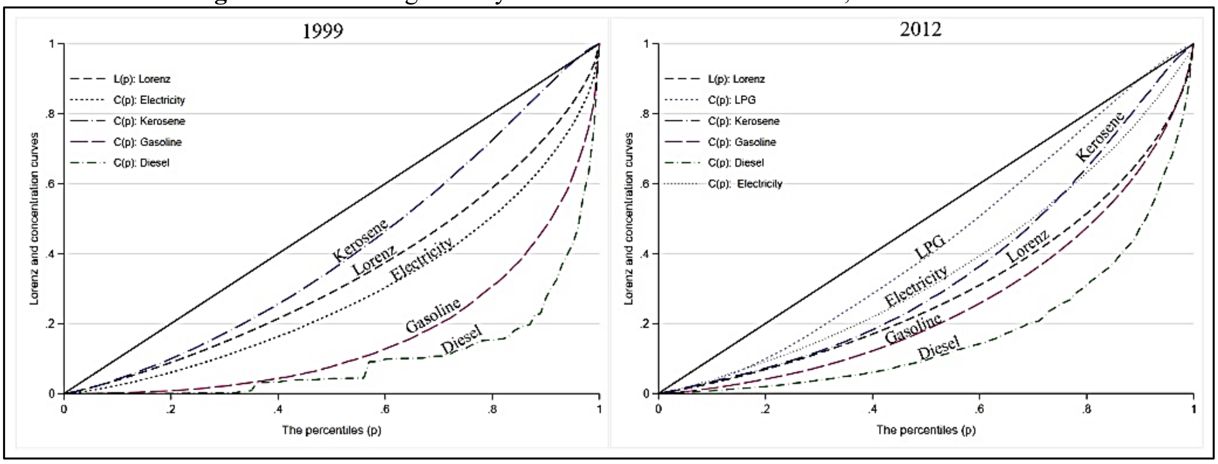
Figure 4.2. Expenditures on The Subsidized Goods Relative to The Total Expenditures (%), 1999 and 2012



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

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[56]), 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 4.2 where the electricity, LPG, and kerosene were classified as normal goods whereas gasoline and ADO were luxury goods.

Figure 4.3. The Progressivity in The Distribution of Benefits, 1999 and 2012



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

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 4.3. 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[57]) since the curves were closer to the 45-degree 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.

[56] 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.

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

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.

4.4.2.3. Energy Subsidy Reform Simulation

This chapter 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 recipients,[58] (2) removing the entire subsidy and mitigating the impact using conditional cash transfers to the targeted households,[59] (3) removing the entire subsidy and providing conditional cash transfers to target households with 5% over-coverage,[60] (4) applying similar treatment with plan number 3 but to households with 5% under-coverage.[61] 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 4.4 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

[58] This scheme is taken if the recipients of the mitigation program are unknown.
[59] This scheme is applied if the recipients are fully identified. This chapter assigns the households as non-poor if the monthly expenditures per capita are equal or more than the poverty line, the households below the poverty line are categorized as poor households.
[60] The error in providing accurate database of poor households is inevitable. This chapter 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 chapter includes the 5% households upper the poverty line as recipients (over-coverage).
[61] Not including 5% households below the poverty line as recipients (under-coverage).

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[62]. The possible reform in 1999 could be implemented 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.

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. A deeper examination into the energy goods reveals that 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. But this chapter 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. 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

[62] 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.

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

Table 4.4. 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. ***Notes:*** 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. [63] This chapter sets the poverty thresholds at Rp. 78,225 and Rp. 240,000 for 1999 and 2012, respectively.

Another examination into 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

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

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.[64] 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 chapter 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.[65] The percentages of government savings based on four different scenarios are provided in Table 4.5.

The evidence shows that the reform in the year of higher oil prices created a more adverse impact on welfare. But in terms of government savings that can be seen from Table 4.5, 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 4.5 is examined from the simulation point of view, Simulation 3 provided more savings followed by Simulation 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

[64] 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.
[65] 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.

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. 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 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 4. 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.

Another important discussion about the reform is about the possibility of doing a reform without a mitigation program, especially when the government's budget is minimal. According to Table 4.4, the poverty rate would increase by 1,76% in 1999 and 2.48% in 2012 without any mitigation program. Indonesia terminated the subsidy for gasoline in 2015 and electricity (three highest voltage groups) in 2017 with different schemes. When eliminating the gasoline's subsidy, the mitigation programs were in the form of enhancement of new programs for the poor such as *Kartu Indonesia Pintar* (Indonesian Smart Card), *Kartu Keluarga Sejahtera*

(Indonesian Prosperous Card), and *Kartu Indonesia Sehat* (Indonesian Health Card). On the other hand, there was no mitigation or compensation program when the electricity subsidy was withdrawn. Those examples show that the mitigation program either can accompany the reform or not depending on the distribution of benefits of the subsidy.[66]

[66] If the subsidy is mainly absorbed by higher income households (still giving benefits for the poor), the subsidy can be eliminated and accompanied by compensation program for the lower income households (gasoline case). If the subsidy is fully absorbed by higher income households, the reform can be applied by removing the subsidy without any compensation program (electricity case).

Table 4.5. 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. ***Notes:*** * The transfer required to offset the change in headcount ratio (poverty rate).

All in all, this chapter found that the energy subsidy reform is not only a matter of 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 chapter 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 secure the transparency of the government.

4.5. 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 chapter 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 chapter 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 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 a greater impact of the simulated reform. This chapter 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 chapter 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 chapter also found that the welfare consequences under both periods could be countered by conditional cash transfers or other well-targeted mitigation programs.[67] 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

[67] The utilization of cash transfer might be effective only in short period. However, the Indonesian government also provided noncash mitigation programs such as Health Insurance for the Poor, School Operational Assistance, The Rural Infrastructure Program, and Hopeful Family Program that designed for a medium to long period.

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 a good reason to be implemented.

Lastly, the energy subsidy reform in Indonesia is far from the finish line. The successful story of elimination of gasoline subsidy in 2015 and electricity subsidy for the three highest blocks in 2017 are examples of the strong commitment from the Indonesian government to reform. On the other hand, the remaining energy subsidy on the LPG, kerosene, and ADO should also carefully be examined to reform. The subsidy for LPG still has its miss targeted problem whilst the effectivity of the subsidy of kerosene and ADO needs further study. The reform requires more effort and willingness to realize other successful stories for other energy goods in Indonesia with all of its political-economic considerations. The energy subsidy reform is a precondition to enhance the welfare system integration in Indonesia with its updated and precisely targeted household database to support the existing national social security system in Indonesia.

Chapter 5. Conclusion

During the recent period of low oil prices and the commitment of the international community to support the reduction in the global CO_2 emission, some studies were conducted to simulate the energy subsidy reform. Among others, this dissertation demonstrates a comprehensive approach to perform a detailed simulation of the energy subsidy reform. Some key advancements of this dissertation compared to previous studies on the same topic are the improved ARDL method, detail examination of the inflation-growth nexus, and the first utilization of the AIDS-ILLS method in the subsidized energy goods along with SUBSIM as a new tool in simulating a subsidy reform. Eventually, by utilizing Indonesia as the study case, this dissertation discovered some findings, as follows.

First, this dissertation found that the energy subsidy significantly affects the consumer price index both in the short and long run. The speed of adjustment from short to long run is fast. The long-run equilibrium is achieved within two years. Next, this evidence should be considered by the government as the policymaker. The energy subsidy reform would bring immediate inflationary impact, and the impact would exist in a longer period. Another finding that should be noted is the significant impact of world oil prices on the consumer price index, suggesting the vulnerability of inflation on the world oil prices fluctuation. Lastly, the significant influence of money supply on the consumer price index creates a possibility for the government to employ a monetary policy to control inflation.

Second, this dissertation studied the inflation-growth nexus in the short and long run and measured the threshold of inflation. In Indonesia's case, inflation demonstrates a significant negative impact on growth for the short and long-run periods. While this evidence agrees with the effort of the government of Indonesia to keep inflation at a low level, another finding of this dissertation for the inflation threshold suggests another perspective. This dissertation suggests that inflation benefits growth between 7% to 14.31%.

Third, after conducting an energy subsidy reform simulation with some scenarios, some significant findings should be noted. Welfare impacts are inevitable when the subsidies are withdrawn, and these welfare impacts are worse when the world oil prices are at a higher level. From a monetary point of view, severe currency depreciation would lead to a higher strain on the subsidy budget despite the status as the net oil-exporting country and low oil prices period shown in this dissertation, suggesting the importance of currency stability during the reform. In addition, when the welfare situations are better, reforming the energy subsidy would bring greater revenue for the government. Although the welfare impacts are higher during reform in the high oil prices period, the well-targeted mitigation programs are cost-effective to counterbalance the welfare impacts. This dissertation emphasizes the significance of the availability and accuracy of the database of the mitigation program recipients because it will determine the size of the saving due to the reform.

From the findings, international community can obtain insightful policy perspectives and lessons to materialize successful energy subsidy reform. First, the governments need to reform the energy subsidy carefully. Most of the countries chose to reform gradually to avoid a significant increase in inflation; but choosing the right subsidized energy goods to eliminate is essential. Indonesia has shown its successful and unsuccessful stories of the energy subsidy reform that could be an excellent example to learn in planning and applying the reform.

Second, the governments should not hesitate to reform in the face of the inflationary and negative welfare impacts. This dissertation found that the level of inflation that positively affects the growth is around 7% to 14.31% in Indonesia, and the threshold is relatively higher than the ITF. Similarly, the inflation threshold is found to be higher than the level of the inflation target for some countries that adopted ITF, such as Ghana, Mexico, The Philippines, Sweden, and Turkey. Further studies for the inflation threshold in other countries that adopted ITF are needed to find a more comprehensive comparison between the inflation threshold and the target of inflation. Furthermore, the welfare impact can be minimized using a precise mitigation program. Indeed, the mitigation programs are well known in some countries that attempted to reform (i.e., Poverty Family Benefit program in Armenia, Targeted Social Assistance in Azerbaijan, Bolsa Familia in Brazil, Nominative Targeted Compensation program in Moldova, and other similar programs in other countries). The mitigation programs should be designed not only for a short period but also for a long time. As a matter of fact, Indonesia has implemented cash transfer mechanisms along with other noncash transfer mitigation programs.

Third, the period of the reform is essential, especially when the world oil prices at a lower level. The reform is feasible and even could produce a bigger gain if the government has prepared certain conditions such as a precise database of targeted recipients for mitigation programs, relatively low level of poverty, stable exchange rate, and communicative government.

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APPENDIX

A.1.1. Energy Policy in Selected Countries

Country	Energy Policy	Net Oil Export-Import Status
Angola	Uniform fuel prices are set across the country. In September 2010, gasoline prices were increased.	Net Exporter
Argentina	In 1989, new deregulation was applied to the energy sector. In July 2012, a new commission was formed to control energy pricing such as restricting LPG in 10-, 12-, and 15-kg cylinders only sold to poor households. Also, diesel fuel prices for public transportation were reformed to be similar to regular retail prices.	Net Exporter
Armenia	In 1994, power sector reforms were initiated by adjusting residential, agricultural, and other customer's electricity tariffs. In 1999, block power tariffs were withdrawn and replaced by a single end-user tariff system. Sequentially, the government deployed the Poverty Family Benefit program to low-income households.	Net Importer
Azerbaijan	In 2005, the Tariff Council was formed that responsible for adjusting prices and tariffs of goods and services including energy products. During 2006 and 2007, the prices of diesel, kerosene, gasoline, and electricity were increased. To counterbalance the reform impact, the government utilized transferring allowance to internally displaced persons (IDP) and other social safety nets programs such as social insurance and targeted social assistance (TSA).	Net Exporter
Bangladesh	In 2011, fuel prices were increased several times whilst no notable change until early 2013. But, in the same month of January 2013, the government elevated the fuel prices by 11%. For the price of 12.5-kg LPG, there are no changes since 2009. The government provided cash subsidies for farmers who utilize diesel fuel for irrigation.	Net Importer
Bolivia	Utilizing uniform fuel prices. In December 2010, the government raised the prices of diesel and gasoline by 83% and 73% respectively. The reform included the increasing fee paid to oil producers. However, due to massive protests, the reform was reversed 5 days after it was announced.	Net Exporter
Brazil	The national oil company, Petrobas, maintained prices for years with increasing losses. In 2012, gasoline and diesel ex-refinery prices were raised and followed by January and February 2013 increases. To stabilize the prices, the government levied a tax on gasoline and diesel that contributing to intervention in the economic domain or CIDE (*Contribuição e Intervenção no Domínio Econômico*). In April 2002, the subsidy for LPG was eliminated and the government provided LPG vouchers for the poor as a part of the Bolsa Familia program.	Net Exporter
Cambodia	The government urged the oil companies to lower the prices on multiple occasions despite the deregulation in fuel prices.	Net Importer

Country	Energy Policy	Net Oil Export-Import Status
Chile	The government provided two stabilizers for fuel prices such as The Fuel Price Stabilization Fund for oil (1991-2005) and The Petroleum Price Stabilization Fund for LPG, LNG, gasoline, diesel, and kerosene (2005-2010). The Fuel Price Stabilization Fund was terminated in 2010 and replaced by SIPCO (*Sistema de Protección ante Variaciones de Precios de Combustibles*). For electricity, since 2009, the government has been subsidizing the off-grid electrification; as a result, the same tariff was applied to all customers.	Net Importer
China	In January 2009, China utilized a 22-day moving average of crude oil prices basket as a base for determining fuel prices. Hence, some price adjustments happened in the period from 2008 to 2012. The government also cut import duties in July 2011 for diesel, jet fuel, gasoline, and fuel oil. Sequentially, in August 2011, a monthly adjustment was starting to be applied for jet fuel prices.	Net Importer
Colombia	At the end of 2008, a fuel stabilization fund was initiated to control the price of gasoline and diesel. In March 2013, the protests emerged for the government's plan to increase the fuel price. Eventually, the government canceled the increase for diesel oil for three months.	Net Exporter
Costa Rica	The government sets uniform fuel prices across the country and adjusts monthly prices based on average international prices. In June 2008, the tax on diesel was removed whereas the gasoline was taxed in order to minimize the impact of increasing world oil prices.	Net Importer
Côte d'Ivoire	The uniform fuel prices were applied in the country for energy goods such as gasoline, kerosene, and diesel. Increasing fuel and food prices in 2008 ignited riots. The government set the prices of LPG to fix in the period from 2008 to January 2013 (other fuels' prices were frozen from April 2010 to January 2013). In January 2013, the gasoline price was raised, and the subsidy for 28-kg LPG was withdrawn.	Net Importer
Dominican Republic	In September 2008, the subsidy for LPG was terminated. The government provided a Bonogas voucher for poor households to buy LPG. In 2009, the government implemented the Bonoluz program which increased consumer tariffs and the mechanism, also improved the electricity subsidy into a more-targeted beneficiary.	Net Importer
Egypt	With the exception of LPG, the government increased the prices of all fuels (including electricity) in July 2014. Further, the government targeted to phase out all the energy subsidy in five years.	Net Exporter
El Salvador	The LPG prices are controlled by the Ministry of Economy by announcing the maximum LPG prices each month. In the second semester of 2011, the gasoline prices were set to lower levels due to a stabilization fund.	Net Importer
Ethiopia	The government terminated the petroleum fuel subsidy in 2008 in order to repay the accumulation of the Oil Stabilization Fund's debt. To lower the gasoline prices, the ethanol concentration in the gasoline was set higher.	n/a

Country	Energy Policy	Net Oil Export-Import Status
Gabon	The government controlled the fuel prices and adjusted them irregularly. In January 2009, the fuel prices were raised.	Net Exporter
Ghana	Since July 2015, the government has removed the subsidy for petroleum products.	Net Importer
Guatemala	The government deregulated fuel prices.	Net Exporter
Guinea-Bissau	The country fully passed the world oil prices through to the domestic prices in 2011. The monthly adjustment is the chosen method applied to domestic prices.	n/a
Honduras	Starting in 2007, the government has been setting the maximum fuel prices weekly. For LPG, only LPG for household usage receives the subsidy.	n/a
India	The government provided oil subsidies only for the state-owned companies. The pricing system was renewed in 2002 except for kerosene and LPG that consumed by household (the change in kerosene price was realized in October 2012). In 2004, the government has applied the price adjustment every two weeks. In 2012, the price of diesel was increased whilst the subsidized LPG was limited to be filled six times per year for each household.	Net Importer
Indonesia	Significant reforms were initiated in early 2001. The government set the prices of gasoline, kerosene, diesel (automotive and industrial), and fuel oil at 50% of the market price. The prices would be gradually increased until reach the market level. In the same year, the monthly pricing system was introduced. The government raised the prices of gasoline and diesel to 75% of the market price sequentially from 2002 to 2003. The monthly pricing system was discontinued in 2003 due to widespread protests. To minimize the adverse impact of the subsidy reform, the government utilized the Energy Subsidy Reduction Impact Mitigation Program to cover education, welfare and health, infrastructure, unemployment, etc. Despite a new program, the mitigation effort was criticized due to the timing and the design. During the increase in world oil prices, the government increased the prices of gasoline, automotive diesel oil, and kerosene in March 2005 (the prices were raised again in October 2005 with the exception of kerosene). Again, in May 2008, the government set higher prices for subsidized gasoline and diesel. For those pricing reforms, the government utilized the cash transfer mechanism to mitigate the adverse impact. In 2012, under the pressure of hiking world oil prices, the government failed to realize the pricing reform after the rejection from the parliament. The government, eventually, increased the prices of gasoline and diesel in June 2013 along with the deployment of a temporary cash transfer program and other social assistance schemes. In 2015, the world oil prices decreased, and the government eliminated the subsidy for gasoline. The subsidy for electricity was cut in 2017 whereas the government maintained the subsidy for the two lowest voltage groups.	Net Importer
Iran	The government of Iran applied the Targeted Subsidy Reform Act as a part of energy subsidy elimination in 2010. The reform itself was designed in five years and in 2012 was generating saving at around US$15 billion. The continuation of the reform did not be realized as planned.	Net Exporter
Iraq	The government adjusted the prices starting from 2005. The subsidy for imported fuels, excluding kerosene, was withdrawn in 2007.	Net Exporter

Country	Energy Policy	Net Oil Export-Import Status
Jamaica	The government through the state-owned company (Petrojam) manages the pricing mechanism of fuel products. In April 2011, the government decreased the tax on fuel and the policy would be reviewed every three months.	Net Importer
Jordan	Significant reform was applied in 2012 by introducing the automatic price adjustment for petroleum products. Further, the government deployed the compensation program for the eligible household.	Net Importer
Kazakhstan	The retail fuel prices are controlled by the government. In 2011, the government started to limit the wholesale prices to around 87% of the upper bound of the retail prices. For farmers, the preferential price was given to farmers and in 2012 the level was around 10% to 15% under the non-agricultural price.	Net Exporter
Kenya	Starting in December 2010, the government set the maximum prices for gasoline, kerosene, and diesel monthly with respect to location. In May 2011, the tax for kerosene was fully removed.	Net Importer
Laos	The gasoline, diesel, and LPG are administered by the government regionally. There were multiple adjustments for fuel pricing such as in 2009 (18 times), 2010 (14 times), 2011 (15 times), and 2012 (14 times until October).	n/a
Liberia	The maximum prices are set by the government for gasoline, kerosene, and diesel. The government removed the custom duties on fuels designated for schools, clinics, and hospitals in 2012.	Net Importer
Madagascar	There were few price adjustments made in Madagascar. Two price adjustments were made in 2011 and the other three adjustments were realized in 2012.	n/a
Malawi	The automatic price adjustment mechanism was fully applied in June 2012. Gasoline, diesel, and kerosene are the fuel products managed by the government for their maximum pricing and set uniformly across the country. Malawi utilizes the price stabilization fund to minimize the significant fluctuations in fuel prices.	n/a
Malaysia	In July 2010, the subsidy for gasoline (97 RON) was eliminated. In June 2011, the additional subsidies for nine vehicles and particular fishing boats were postponed.	Net Exporter
Mexico	Until May 2009, the taxes for gasoline and diesel have been set negative (and set at positive values onward). The increasing prices of domestic fuels, however, could not balance the increasing world prices leaving the fuel subsidy remains. The energy subsidy reform was still in the progress under the 2012 Mexico's climate law.	Net Exporter

Country	Energy Policy	Net Oil Export-Import Status
Moldova	Fossil fuel prices in Moldova, particularly for gasoline and diesel, were elevated to catch the international prices. At the end of 2010, the diesel price was more than the U.S. level. For electricity, the privatization improved the investment in infrastructure. The privatization was then followed by the tariff adjustments. The government applied the mitigation scheme which was the Nominative Targeted Compensation (NTC).	Net Importer
Mongolia	The government utilizes taxes on fuels to stabilize the prices. The prices of gasoline were deregulated in 2012 along with the establishment of the price control council.	Net Exporter
Morocco	In September 2013, the government applied the price indexation system for liquid petroleum goods (including diesel, gasoline, and fuel oil). The system employed a cap on the subsidies per unit. In February 2014, the subsidies for gasoline and industrial fuel oil were removed. The electricity tariffs were increased in August 2014. The subsidy for LPG was maintained until all the liquid petroleum goods were liberalized in November 2015.	Net Importer
Mozambique	The government controls the prices for gasoline, kerosene, LPG, and diesel by using monthly reviewing covering the cities that possess terminals. In March 2010, the fuel prices excluding diesel were raised by more than 70%. Sequentially, the prices for gasoline and diesel were increased in 2011.	Net Exporter
Namibia	Every month, the government informs the prices of gasoline (retail) and diesel (wholesale) for respective locations. The government utilizes the National Energy Fund to subsidize remote areas as well as administered fuel prices.	Net Importer
Nepal	Diesel, LPG, and kerosene are the subsidized energy goods in Nepal. Nepal Oil Corporation (NOC) set a higher price level of diesel for bulk and industry in August 2008. In January 2012, NOC re-applied the dual pricing for diesel. NOC attempted to increase the LPG price in February 2013 but failed due to student unions' protests.	n/a
Nicaragua	Notable reform was in 1999 when the prices of fuels (except LPG) were deregulated. The shortages for LPG in September 2008 forced the president to announce a six-month emergency economic situation. Nicaraguan Institute of Energy was authorized by the government to import and sell LPG as Tropigas demanded a raise at LPG price by 100%.	Net Importer
Niger	Starting from August 2001, the country set the fuel prices uniformly in all regions. When the oil production and refinery started in 2011, the fuel price subsidies were withdrawn in 2012.	n/a
Nigeria	The government sets the prices of gasoline uniformly across the country and removed it in January 2012. However, within two weeks the price was decreased due to the protests. The kerosene is subsidized for lighting and cooking activities of the poor households.	Net Exporter

Country	Energy Policy	Net Oil Export-Import Status
Pakistan	The government has utilized an import-parity formula until June 2011. In 2012, the government announced that the fuel prices were subsidized utilizing the Petroleum Levy adjustments.	Net Importer
Panama	The government manages the maximum prices for diesel and gasoline every two weeks. For LPG, only the 11.4 kg cylinder size receives the subsidy.	n/a
Peru	Diesel, gasoline, LPG, and industrial oil were subsidized. The government issues the reference prices for fuel weekly. In April 2010, a decree was announced, resulting in an adjustment of the price bands every two months.	Net Importer
Philippines	In June 2010, the import duties on petroleum and crude oil were eliminated. The government deployed a Public Transport Assistance Program and smart cards in April 2011.	Net Importer
Russia	The government employs export taxes and other measures on petroleum products to lower domestic prices. In 2012, the government made an agreement with oil companies to maintain the gasoline prices until the presidential election in March 2012.	Net Exporter
Rwanda	The maximum prices of gasoline and diesel are set in Kigali. The government has attempted to stabilize the prices at least in three months period. Furthermore, to maintain the prices lower, the government magnifies stockholding and bulk procurement.	n/a
Senegal	Every month, the National Committee for Hydrocarbon sets the prices based on the import-parity formula. LPG that utilized by household is subsidized. Fuel taxes were reduced in February 2012.	Net Importer
South Africa	Gasoline, kerosene, LPG, and diesel prices are administered by the government each month. The government sets the basic prices for diesel, kerosene, and gasoline whilst the maximum prices for LPG are provided based on the location.	Net Importer
Sri Lanka	The pricing formula was re-used in 2007 for only two months. The base prices are controlled by the government and are made uniform in the country. In February 2012, the prices of diesel, gasoline, fuel oil, and kerosene were raised by the government. The government provided Samurdhi, the national poverty alleviation program, to provide kerosene allowance for households that don't have electricity.	Net Importer
Syria	In 2010, the government targeted 2015 as a year to achieve the market pricing system. The fuel prices were adjusted a few times in the period from 2008 to 2013.	Net Exporter
Tajikistan	Gazpromneft holds the highest oil market share in Tajikistan by around 52%. Despite its monopolistic share, the prices set by Gazpromneft are subject the conformity by the Antimonopoly Agency.	Net Exporter
Tanzania	Starting from 2012, the ceiling prices (wholesale and retail) of gasoline, diesel, and kerosene were announced monthly. In February 2012, the government considered subsidizing LPG to stop deforestation.	n/a
Thailand	Thailand stabilized domestic fuel prices by utilizing the oil fund. A few times, LPG, diesel, and gasoline absorbed the subsidy from the oil fund. The oil fund had been terminated in April 2011 with around 22 billion baht (around US$ 0.7 billion) of deficit estimated in June 2012.	Net Importer

Country	Energy Policy	Net Oil Export-Import Status
Togo	Togo utilizes the automatic pricing system based on the 2002 decree. The prices will be adjusted if the benchmark prices have a margin of around 5%. Despite having such a pricing mechanism, the government did not adjust the fuel prices from 2007 to 2008 when the world oil prices were increasing. Furthermore, the fuel prices had not been raised until June 2011 resulting in larger fuel subsidies. Excluding LPG, the fuel prices were maintained at the same level.	n/a
Tunisia	In September 2012, the prices of diesel, gasoline, and electricity were set higher by around 7%. Further, a similar increase in prices continued in March 2013. In 2014, the government removed the subsidies to cement establishments, adjusted the electricity tariffs, and introduced an automatic pricing system for gasoline.	Net Exporter
Turkey	Turkey applies high tax rates on fuel products. The tax rates were set uniformly on the fuel products at the end of 2008. After canceling to apply uniform tax rates in 2009, the government set the new tax rates differently on each fuel products in 2011.	Net Importer
Uganda	Deregulation on the fuel prices is applied.	n/a
Uruguay	The government sets the upper bound of wholesale prices for kerosene, diesel, and gasoline. The only changes were in 2012.	Net Importer
Venezuela	Since 1996, the fuel prices have been frozen by the government. To prevent smuggling, the fuel at the border are sold more expensive than the domestic prices. In 2011, the fuel buyers in the border area started to register and show identity prior to buying the fuels.	Net Exporter
Vietnam	Vietnam utilizes a price stabilization fund to smooth the fuel price fluctuations. The fuel prices are adjusted irregularly. The price adjustments have been reflecting the market price since 2012 by allowing the wholesalers to determine the prices (subject to government approval). When the price adjustments are more than 7%, the government will use other price stabilization measures such as lowering the import tariff and employing the stabilization fund. In 2013, the government prevented the prices to increase and instructed the fuel companies to use the stabilization fund against the losses.	Net Exporter
Yemen	The energy subsidy reform in Yemen has been started since 2005. In the period from 2005 to 2010, the prices of fuel products had increased by about two folds. The reform continued by increasing the prices of fuel products and LPG from 2010 to 2012. In July 2014, the government attempted to remove the subsidy that ignited significant protests. As a result, the government partially brought back the subsidy in September 2014.	Net Exporter
Zambia	The government initiated to apply the uniform pricing system in September 2010 for diesel, gasoline, and kerosene. Zambia imposes import tariffs for petroleum products.	Net Importer

Source: Author's compilation based on Kojima (2013), Inchauste & Victor (2017), Verme (2017), and Central Intelligence Agency of the United States of America.

LIST OF PUBLICATIONS AND RESEARCH WORKS

Chapter 3

- A part of this chapter has been published in *Journal of Applied Economic Sciences (JAES)*, March 2019.
- Available at *http://cesmaa.org/Docs/JAES-Volume-XIV-1-63-Spring-2019.pdf* and *https://www.ceeol.com/search/article-detail?id=803117*.
- Journal's website is at *http://cesmaa.org/Extras/JAES*.

Chapter 4

- A part of this chapter has been published in *International Journal of Energy Economics and Policy (IJEEP)*, May 2020.
- Available at *https://doi.org/10.32479/ijeep.9223*.
- Journal's website is at *http://www.econjournals.com/index.php/ijeep/index*.

Supplementary Information:

Chapter 2

- A part of this chapter is currently under review at *International Journal of Business and Society (IJBS)*.
- Journal's website is at *http://www.ijbs.unimas.my/index.php*.