Asia Pacific Journal of Advanced Business and Social Studies
ISBN (eBook): 978 0 9943656 7 5 | ISSN : 2205-6033
Year: 2020 , Volume: 6, Issue: 2

THE IMPACT OF ELECTRICITY AND LIQUID PETROLEUM GAS (LPG) PRICE CHANGES ON INFLATION: EVIDENCE FROM INDONESIA

Rusiti & Eka Puspitawati
Universitas Pertamina, Indonesia.
Corresponding Email :rusitikalwa@gmail.com

Abstract

Indonesian consumption of energy has been increasing as well as increasing energy prices. Households energy consumption is the most vulnerable to the effects of changes in inflation; while they will be directly affected if there is a rise of electricity and LPG.Using the main of monthly data from January 2009 until December 2017, this study aims to examine the effects of electricity and liquid petroleum gas (LPG) price changes on inflation and vice versa. Augmented Dickey Fuller, Johansen Cointegration, Vector Autoregressive, and Granger Causality model were employed to analyzed the data. The results show that there are no cointegration between electricity price with inflation and LPG price with inflationwhich means there are no long term relationship. Moreover, it is found that electricity price do not cause to the inflation, and inflation does cause to the electricity price.Similar result occursbetween LPG price and inflation. So, it can conclude that both electricity and LPG price does not cause to the inflation, and inflation can give an effect on electricity and LPG price. If the rate of inflation changes, electricity price and LPG price also can change. This finding will contribute to the Indonesian government in making policies to control the inflation in order to avoid an increasing in electricity and LPG price.

Keywords: Causality, Electricity Price, Inflation, LPG Price, Vector Autoregressive.

1. Introduction

Indonesia is the largest energy consumerin Southeast Asia and on the fifth rank in Asia Pacific. The increasing GDP growth, about 6.04% per year in the period of 2017-2050, will generate the rise energy consumption. BPPT (2018)reported that by 2050, the large shares of final energy demand in Indonesia are oil fuels (40.1%), electricity (21,3%), gas (17.7%), coal (11.0%), and the remaining are LPG, biofuels and biomass respectively below 4%.

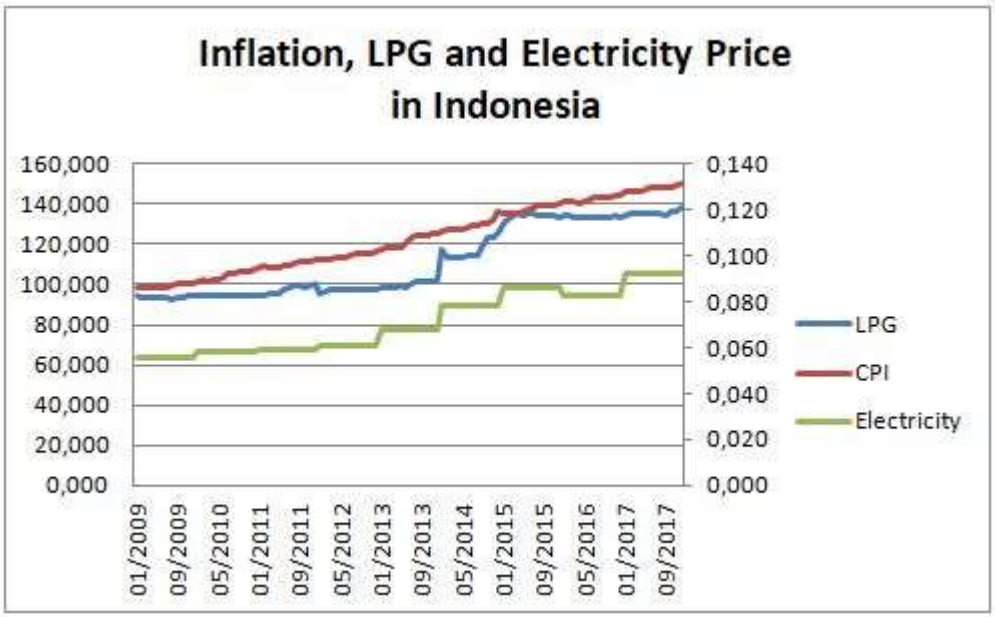
The type of energy used by each sector in Indonesia varies greatly. In 2016, the industrial sector used a lot of gas, coal and electricity(BPPT, 2018), while commercial and household sectors are mostly used electricity. Since theGovernment Regulation No. 79 of 2014 on National Energy Policy (KEN), describing the priorities of Indonesia's energy development, has been implemented, the use of petroleum has been minimalized. The household sectors were encouraged to change karosene into LPG. Hence, the use of electricity and LPG dominates the households energy consumption.

Meanwhile the households energy consumption is the most vulnerable to the effects of changes in inflation. Theoritically, a rise of energy price generates an increase of the production costs. Consequently, aggregate supply shifts to the left, implying that productions fall. Most of the

studies found out that a hike in energy price caused inflation, decrease in output, higher unemployment rate and others. When the world experienced an increase in energy price, it actually eased the burden of many people especially poor household.

Electricity and LPG price from 2009 to 2017 in Indonesia have a positive growth. As shown at Picture 1, this is parrallel with inflation trend.

Picture 1. Electricity Price, LPG Price and Inflation in Indonesia



Source: CEIC Data (2019)

The impact of the electricity price increase has drawn great attention recently, and many research studies are being conducted abroad. The price of goods and services are sensitive to energy sector price shock. Inflation can be caused by a higher energy price. The impact of the change in energy price on inflation can be seen through the increase in consumer price index (CPI). The energy price drives consumer price index to increase. As a result, inflation occurs. Nguyen (2008)examined the impacts of increase in the electricity tariff in the long run on prices of other products in Vietnam. It concluded that such an increase would drive up the prices of all other products. Some authors highlighted the inflationary impacts of domestic energy price depend heavily on many country-specific factors such asinternational trade pattern, tax system, and government expenditure (Cuñado and Pérez de Gracia, 2005; He *et al.*, 2010; Ajmera et al., 2012; Jin Guo, Xinye Zheng, Zhan-Ming Chen, 2016).

Moreover, the effect of the gas price changes on inflation has also drawn by some authors. Ott & Tatom (1982)initially found out that natural gas of the US affected the price level, but any impact on inflation was temporary. Thoresen (1983)investigated that gas price controlled inflation through the energy imports.

Some research found out conversely correlation between electricity price and CPI. He *et al.*(2009) showed the impact of electricity price in China. It increased on sectoral price, the change in CPI and end-use product price index. An adjustment would not have much adverse impact on the economy and residents' lifestyles; therefore, the impact of electricity price adjustments on each sector is different, and it is necessary to consider each sector's capacity for acceptance when a new price policy is made.

2. Research Problem

Those studies above show that it is important to understand the relationship between electricity and gas price changes and the macro-economy variables, particularly inflation. The objective of this paper is to examine the effects of electricity and liquid petroleum gas (LPG) price changes on inflation in Indonesia and vice versa. We also see the response of the variables as a result of other variable's shock, and the contribution of variable to a change in other variable.

3. Literature Review

The price of goods and services are sensitive to energy price shock. Inflation can be caused by a higher energy price. Some researchers have investigated correlations between energy prices and inflation. Most of them uses oil price as the main focus of study. Oil price seems to be inextricably connected to inflation. Arinze (2011)used simple regression analysis and found out that whenever petrol price increases, it caused inflation rate to increase as well. Blanchard & Gali (2007)found out the contribution of oil shocks to CPI inflation. LeBlanc & Chinn (2004)estimated the effects of oil price changes on inflation for the United States, United Kingdom, France, Germany, and Japan by employing Augmented Philips Curve Parameter Estimates and Associated Statistics. It was found that current oil price increases gave a modest effect on inflation in the U.S, Japan, and Europe. The oil price in Europe had a larger effect on inflation compared to the U.S.

The Global oil price has played a main role to determine inflation in one country. Chou & Tseng (2011)examined the short-term and long-term pass-through effects of oil prices on inflation in Taiwan from 1982M1-2010M12 byapplying ARDL model with the Augmented Philips Curve. The result showed that global oil prices had a significant effect on inflation in long term, but in short term the result proved that the effect is not significant.Besides, the oil price also can affect food inflation. Ali, et al (2012) examines the effect of highspeed oil prices on food sector prices in Pakistan by using simple regression. They found out that there was a positive effect of oil price on food inflation such as wheat price, maize price, rice price, cooking oil price andchicken price. However, there was a past study which indicated that an increase in oil prices did not really affect inflation. Olomola & Adejumo (2006)used the VAR method to analyze the data and they ascertained that the oil price shocks did not give substantial effects on output and inflation rate in Nigeria from 1970 to 2003.

Another factor that affected inflation is the electricity price. Research by Ling-yun & Yan (2009) examined the relationship between electricity price and inflation using State Space Models (SSMs). In that study, Ling-yun & Yan using three primary variable that is coal, electricity, and oil price, and other variable that is output and price level in China. The result shows that there are cointegration of output and price level with coal, electricity and oil price in the long run. Besides, they also found out that coal, electricity, and oil price can impact on economy, and the effect on price level is prior to output. Study about electricity price also analyzed by Khobai, et al (2017). In this study, researchers explore the relationship between electricity price and economic growth in South Africa. To determine the long run relationship among the variables, autoregressive distributed lag (ARDL) bound test is applied. The result is there is a long run relationship between electricity price and economic growth, and electricity prices negatively affect the economic growth.

Ajmera et al, (2012) researched the impact of commodity price movements on CPI inflation. In this study, researchers analyzing the price movements of four commodities, that is crops, animal slaughter and processing, dairy, and oil and gas on CPI inflation. The oil and gas in this study was calculated by aggregating indexes for natural gas, crude petroleum (domestic production), and liquefied petroleum gas. Input-output data is the model that applied in this analysis, and a Leontif model is utilized to calculate input shares. The result is only oil and gas prices had a

considerable impact on CPI inflation. In contrast to three other commodities, rising oil and gas prices had a large impact on overall consumer price inflation.

Research by He et al, (2010) analyze the influence of coal price adjustment on the electric power industry, and the influence of electricity price adjustment on the macroeconomy in China. The study applied general equilibrium models. The results showed that the increasing in coal price causes a rise in the cost of the electric power industry and reasonable to adjust electricity prices. Besides, there is an adverse influence on the total output, Gross Domestic Product (GDP), and the Consumer Price Index (CPI) when there is an increase in electricity price, such as will lead to the deterioration and decline of social welfare.

Binder (2018) examined the relationship between inflation expectation and gas prices in the U.S. using regression model. This research using panel microdata from the Michigan Survey of Consumers on gas price expectations and inflation expectations to study the dynamics of consumers' gas price and inflation expectations. The result in the study is that there is positive correlation between gas prices and inflation expectation. The impact of gas prices on inflation expectations fades quickly with forecast horizon.

4. Methodology

This study analyzed using Eviews 9 and focus on three chosen variables. Those variables are Consumer Price Index (shows inflation, based index value of 100 in year 2012), Average Total Price of Electricity (shows electricity price, IDR/kWh), and Average Urban Consumer Price : Liquid Petroleum Gas (shows LPG price, in IDR/12kg). Time series data from January 2009 (2009:1) to December 2017 (2017:12) are used for all variables in Indonesian country. All of the data are in ln (natural logarithm) to get the best result. The following equation is a VAR equation(Nasri 2017).

$$z_t = \alpha_o + \sum_{n=1}^{p} \phi_n z_{t-n} + \varepsilon_t \qquad (1)$$

where,

z_t : vector z in periode t
α_o : constanta
ϕ : n^{th} parameter value of z, with n = 1, 2, 3, ..., p
ε_t : error in t

The test will be used in this study are unit root test, Johansen Cointegration Test, Vector Autoregressive (VAR), and Granger Causality Test. For unit root test, we employed Augmented Dickey Fuller Test and we used Hannan Quinn Criteria to determine the optimum lag. According to Trung & Vinh (2011), variable series is stationary or does not has a unit root if the stationary test is significant, so the null hypothesis will be rejected and alternative hypothesis will be accepted. But, if the stationary test is not significant, it can be concluded that variable series is non-stationary or has a unit root.If the findings is non-stationary variables, we have to run the next unit root test, that is in first difference, to get stationary variable series. The hypothesis in the unit root test is:

$H_o : \delta = 0$ (has a unit root/non stationary)
$H_1 : \delta \neq 0$ (has no unit root/stationary)

If the value of t-statistic (in absolute form) greater than ADF test statistic (in absolute form), the null hypothesis is not rejected and it means there is a unit root (non stationary) in the data. But if the value of t-statistic (in absolute form) less than ADF test statistic (in absolute form), the null hypothesis is rejected and it means there is not a unit root (non stationary). In this study, we found that in level, variables were not stationary, and in first difference, there are nounit root (stationary).

Cointegration test that employed in this study is Johansen Cointegration Test. By this cointegration test, we can decide which model we will use in this study, VAR model or VECM model. If the variable has no cointegration, it will analyzed used VAR model, but if the variable has a cointegration, it will analyzed used VECM model. From the VAR/VECM model, we can see impulse response that shows variable's response as a result of other variable's shock, and variance decomposition that shows the variable's contribution to changes in other variable and variable itself. Equation (1) above shows VAR equation model and VECM equation is as following(Johansen 1991).

$$\Delta y_t = \mu + \sum_{i-1}^{k-1} \Gamma_i \Delta x_{t-i} + \alpha\beta Y_{t-k} + \varepsilon_t \qquad (2)$$

where,

Δ : first difference notation
y_t : p x 1 cointegration vector at orde 1
μ : p x 1 vector constanta
k : lag
ε_t : p x 1 gaussian white noise residual vector
Γ_i : adjustment matrix in short term among variables in lag i
α : p x r spread of adjustment
β : p x r cointegration vector

After doing cointegration test and deciding on the model that will be used, we also applied the Granger Causality Test to determine the causality relationship between the variables. This analysis will involve the process of examining the stationarity of the time series and verifying the order of cointegration by using the Engle-Granger test (Altintas & Kum 2013). This test used to see a reaction between the variables. For example, if variable A is granger cause to B, and B also granger cause to A, it means that the value after A can help to expected value for the next period of B and also the value after B can help to expected value for the next period of A(Sørensen 2005). According to Diebold (2014) in Altintas & Kum (2013), granger causality does not imply "X causes Y", but it means "X contains useful information for predicting Y".

5. Data Analysis

Table 1 shows the result of the Augmented Dickey Fuller (ADF) test in unit root test. The result below shows that all variables are non stationary in level, but significant in five percent in first difference test. It means that in first difference, the null hypothesis is rejected and all variables are stationary.

Table 1. Unit Root Test

	Level		First Difference	
	ADF Statistic	t-statistic (5%)	ADF Statistic	t-statistic (5%)
Inflation	-0.532291	-2.889200	-9.106407	-2.889200 (**)
LPG Price	0.017296	-2.888669	-10.80240	-2.888932 (**)
Electricity Price	-0.396094	-2.888669	-10.63902	-2.888932 (**)

Note : ** indicates the rejection of null hypothesis at 5% significance level

The optimum lag between electricity price and inflation based on VAR Lag Order Selection Criteria is 2, also between LPG price and inflation. This lag is selected by Hannan Quinn Criteria. As stated before, this study will examine whether there is an effect of electricity price

and LPG price on inflation, and vice versa. For this reason, we used cointegrating test to see the cointegration or relationship among those variables.

Table 2 presents the result for cointegrating test. The result shows that both maximum-Eigen statistic and trace statistic are not presence in Indonesian economy at 5% level among the variables. It means that there is no long run relationship between electricity price with inflation, and between LPG price with inflation. Between electricity price and inflation, and LPG price and inflation, at null hypothesis, the trace statistic value is less than critical value test (trace) at 5% significant level, both in hypothesized no. of CE(s) that is none and at most 1. This condition also happen in maximum-Eigen statistic. These conditions mean that there is no cointegration at the 0.05 level.

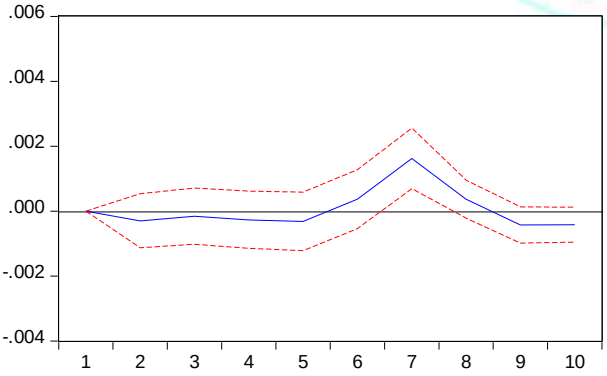
Table 2. Cointegration Test

	Hyphotesized No. Of CE(s)	Max-Eigen Statistic	CriticalValue (Eigen) at 5%	Trace Statistic	Critical Value (Trace) at 5%
Electricity price and Inflation	None	8.270780	19.38704	14.04837	25.87211
	At most 1	5.777591	12.51798	5.777591	12.51798
LPG price and Inflation	None	11.82971	17.14769	14.26226	18.39771
	At most 1	2.432559	3.841466	2.432559	3.841466

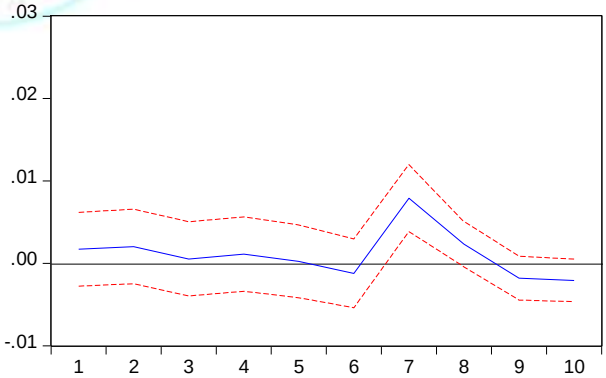
Because there is no cointegration in the data, we used vector autoregressive (VAR) model to analyze the data. Optimal lag has been done before to choose lag, based on Hannan Quinn. VAR model for electricity price and inflation, was declared stablebecause there is no root with modulus greater than one. Same condition also happen in VAR model for LPG price and inflation.

Electricity Price and Inflation

Response of Inflation to Electricity Price



Response of Electricity Price to Inflation



Estimation of impulse response in this VAR model at period 1 shows that there is a positive response of electricity price as a result of inflation shock. This response is tend to decrease in the next period, and in period 6 the response is negative. Electricity price give a high positive response in period 7 as a result of inflation shock, and in the next period, the response is tend to negative. Inflation has a negative response as a result of electricity price shock in period 1 until period 5. A high positive response given by inflation in period 7, but tend to negative in the next period.

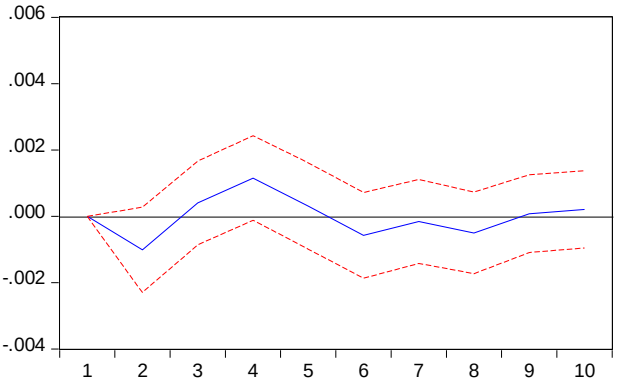
Table 3. Variance Decomposition

Variance Decomposition of Inflation:			
Period	S.E.	Inflation	Electricity Price
1	0.004224	100.0000	0.000000
2	0.004517	99.56064	0.439359
3	0.004591	99.45688	0.543117
4	0.004720	99.15909	0.840906
5	0.004743	98.71504	1.284962
6	0.004793	98.16129	1.838711
7	0.005167	88.54471	11.45529
8	0.005190	88.14628	11.85372
9	0.005223	87.62567	12.37433
10	0.005259	87.15541	12.84459
Variance Decomposition of Electricity Price:			
Period	S.E.	Inflation	Electricity Price
1	0.022533	0.573722	99.42628
2	0.022784	1.353798	98.64620
3	0.022794	1.406081	98.59392
4	0.022833	1.644291	98.35571
5	0.022870	1.649172	98.35083
6	0.023024	1.911087	98.08891
7	0.024434	12.16045	87.83955
8	0.024561	12.93395	87.06605
9	0.024628	13.39936	86.60064
10	0.024718	14.00909	85.99091

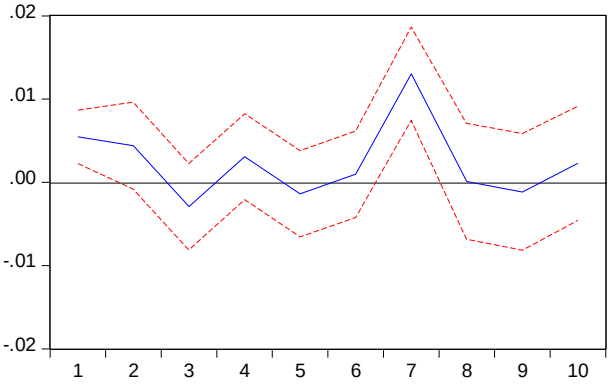
Estimation result of variance decomposition shows that the contribution of electricity prices to changes in inflation is less than the contribution of inflation to changes in electricity prices. In period 1, there is no contribution from electricity price to changes in inflation. Meanwhile, in the same period, there is a contribution from inflation to changes in electricity price, that is 0.57 percent. Based on Granger Causality Test, we find that electricity price does not granger cause to inflation, but inflation does granger cause to electricity price. It means that inflation can affect the changes in electricity price. This may cause the electricity expenditure share of household is not as much as other goods such as food and oil fuel. Besides, electricity price changes by the monopoly company, PLN, consider inflation rate. When inflation rate increase, it can affect the price of raw material of electricity and this condition tend to increase in cost of production of electricity and the last effect is that it can increase the electricity price itself.

LPG Price and Inflation

Response of Inflation to LPG Price



Response of LPG Price to Inflation



Estimation of impulse response in this VAR model seems fluctuative. At period 1 until period 2, it shows that there is a positive response of LPG price as a result of inflation shock. At period 3, the response is negative and the response is positive in period 4. This responseshappen fluctuatively. In period 1, inflation has no response as a result in LPG price shock. Along the graph, seems that the response tend fluctuatively. In period 4, inflation give a high positive response as the result of LPG price shock.

Table 4. Variance Decomposition

Variance Decomposition of Inflation:			
Period	S.E.	Inflation	LPG Price
1	0.004298	100.0000	0.000000
2	0.004597	95.15365	4.846353
3	0.004616	94.43805	5.561952
4	0.004769	88.96779	11.03221
5	0.004800	88.70452	11.29548
6	0.004848	87.49903	12.50097
7	0.004851	87.41150	12.58850
8	0.004914	86.67346	13.32654
9	0.004916	86.66200	13.33800
10	0.004965	86.75202	13.24798
Variance Decomposition of LPG Price:			
Period	S.E.	Inflation	LPG Price
1	0.015144	13.00110	86.99890
2	0.015861	19.52526	80.47474
3	0.016210	21.94008	78.05992
4	0.016503	24.65956	75.34044
5	0.016620	25.01678	74.98322
6	0.016706	25.09698	74.90302
7	0.021198	53.42792	46.57208
8	0.022376	47.95188	52.04812
9	0.022607	47.24583	52.75417
10	0.022889	47.08857	52.91143

Estimation result of variance decomposition shows that in period 10, the contribution of LPG prices to changes in inflationis 13.25 percent, and in the same period, the contribution of inflation to changes in LPG price is 47.09 percent. It seems that the contribution of inflation to the changes in LPG price is higher than the contribution of LPG price to the changes in inflation. Based on Granger Causality test, we find that LPG price does not granger cause to inflation, but inflation does granger cause to LPG price. This seems that the LPG users are still less than 4% of Indonesia's total energy demand. Besides, the oligopoly LPG market structure can cause the price was made unilaterally by the companies where there is an inflation.

6. Conclusion

This study is to find out the relationship and causality between inflation with electricity price, and inflation with LPG price from January 2009 until December 2017. Indonesian LPG price and electricity price has a fluctuation from January 2009 until December 2017. This fluctuation tend to increase. Inflation also tend to increase during this period.

In unit root test, all variables in this study are stationary in first difference at 5 percent significant level. It means that null hypothesis that states "(variable) has a unit root" is rejected.

For cointegrating test, the result shows that there is no cointegration which is mean there is no long term relationship between electricity price with inflation, and LPG price with inflation. Because of this condition, VAR model is employed to analyzed the data. From impulse response function, we find that there is a response that given by electricity price when there is inflation shock (and vice versa), and there is a response that given by LPG price when there is inflation shock (and vice versa). From variance decomposition analysis, we find that there is a contribution from one variable in changes of other variable. For Granger Causality Test, we can conclude that inflation does granger cause to electricity and LPG price, but electricity and LPG price does not granger cause to inflation.

The finding in this study can be used by Indonesian government as a reference in making policies to control electricity and LPG price. To control those prices, Indonesian government can start from control the inflation rate. This is because when there is a rise in the inflation rate, the prices can rise too. Besides, inflation is not good for the country as it may burden poor people to subsist in high cost of living, and poverty line will escalate when inflation happens, so automatically it will intensify poverty.

References

i. Ajmera, R., Kook, N. & Crilley, J., 2012. Impact of Commodity Price Movements on CPI Inflation. *Monthly Labor Review*, (April).

ii. Ali, S.L. et al., 2012. Impact of Oil Prices on Food Inflation in Pakistan. *Interdisciplinary Journal of Contemporary Research in Business*, vol. 3, pp.123–140.

iii. Altintas, H. & Kum, M., 2013. Multivariate Granger Causality between Electricity Generation, Exports, Prices and Economic Growth in Turkey. *International Journal of Energy Economics and Policy*, vol. 3(Special Issue), pp.41–51.

iv. Anon, 2019. *CEIC Data*. s.n.

v. Anon, 2014. *Peraturan Pemerintah Republik Indonesia Nomor 79 Tahun 2014 Tentang Kebijakan Energi Nasional*,

vi. Arinze, P., 2011. The Impact of Oil Price on the Nigerian Economy. *Journal of Research in National Development*, vol. 9, no. 1.

vii. Badan Pengkajian dan Penerapan Teknologi, 2018. *Outlook Energi Indonesia 2018 : Energi Berkelanjutan untuk Transportasi Darat*,

viii. Binder, C.C., 2018. Inflation Expectations and the Price at the Pump. *Journal of Macroeconomics*. [Online] Available at: https://doi.org/10.1016/j.jmacro.2018.08.006.

ix. Blanchard, O.J. & Gali, J., 2007. *The Macroeconomic Effect of Oil Shocks: Why Are the 2000s So Different From the 1970s*,

x. Chou, K.-W. & Tseng, Y.-H., 2011. Pass-Through of Oil Prices to CPI Inflation in Taiwan. *International Research Journal of Finance and Economics*, vol. 69, no. 69.

xi. He, Y.X. et al., 2010. Economic Analysis of Coal Price – Electricity Price Adjustment in China Based on The CGE Model. *Energy Policy*, vol. 38, pp.6629–6637.

xii. Johansen, S., 1991. Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Journal of The Econometric Society*, vol. 59, no. 6, pp.1551–1580.

xiii. Khobai, H., Mugano, G. & Roux, P. Le, 2017. The Impact of Electricity Price on Economic Growth in South Africa. *International Journal of Energy Economics and Policy*, vol. 7, no. 1, pp.108–116.

xiv. LeBlanc, M. & Chinn, M.D., 2004. Do High Oil Prices Presage Inflation? , vol. 202.

xv. Ling-yun, H. & Yan, L., 2009. Characteristics of China's Coal, Oil and Electricity Price and Its Regulation Effec on Entity Economy. *Procedia Earth and Planetary Science*, vol. 1, no. 1, pp.1627–1634. [Online] Available at: Available at:

http://dx.doi.org/10.1016/j.proeps.2009.09.250.

xvi. Nasri, M., 2017. *An Analysis of the Relationship between Stock Prices and Exchange Rates in Indonesia : Empirical Studies at the Macro and Micro Level*.

xvii. Nguyen, K.Q., 2008. Impacts of a Rise in Electricity Tariff on Prices of Other Products in Vietnam. *Energy Policy*, vol. 36, pp.3145–3149.

xviii. Olomola, P.A. & Adejumo, A. V., 2006. Oil Price Shock and Macroeconomic Activities in Nigeria. *International Research Journal of Finance and Economics*, vol. 3.

xix. Ott, M. & Tatom, J.A., 1982. Are the Adverse Inflation Effects Associated with Natural Gas Decontrol? *Contemporary Economic Policy*.

xx. Sørensen, B.E., 2005. Granger Causality. *Economics 7395*, pp.1–4.

xxi. Thoresen, P.E., 1983. Inflation Controlled by Energy Prices. *Energy Economics*, pp.202–206.

xxii. Trung, L.V. & Vinh, N.T.T., 2011. *The Impact of Oil Prices , Real Effective Exchange Rate and Inflation on Economic Activity : Novel Evidence for Vietnam*,