Widarjono, Agus; Hakim, Abdul

Article

Asymmetric oil price pass-through to disaggregate consumer prices in emerging market : evidence from Indonesia

IJEEP
INTERNATIONAL JOURNAL OF ENERGY ECONOMICS AND POLICY

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2019, 9(6), 310-317.

EconJournals

Asymmetric Oil Price Pass-through to Disaggregate Consumer Prices in Emerging Market: Evidence from Indonesia

Agus Widarjono*, Abdul Hakim

Department of Economics, Universitas Islam Indonesia, Yogyakarta, Indonesia. *Email: agus.widarjono@uii.ac.id

Received: 23 June 2018 **Accepted:** 10 September 2019 **DOI:** https://doi.org/10.32479/ijeep.8287

ABSTRACT

This paper investigates the inflationary asymmetric effect of oil prices to disaggregate consumer prices for Indonesia using Non-linear Autoregressive Distributed Lag model. Our study affirms that the long-run relationship exists between oil prices and the Consumer price index (CPI) as aggregate consumer price and its all sub-components. With the exception of the education price index, our results report the asymmetric impact of oil price pass-through (OPPT)) on all sub-components of CPI. Incomplete degree of OPPT is found but varied among sub-components of CPI and is attributed to energy-related goods and services. The highest degree of OPPT is foodstuffs price index, followed by the transportation price index. We also find the positive degree of OPPT is greater than the negative degree of oil price oil pass-through to disaggregate consumer price.

Keywords: Oil Price, Disaggregate Consumer Prices, Non-Linear Autoregressive Distributed Lag, Indonesia
JEL Classifications: C22; E31

1. INTRODUCTION

The prices of world crude oil have been steadily rising since 2000. It reached its highest level of US$ 100.01 per barrel in 2008. Because of the world economic crisis in 2009, the prices of world crude oil sharply dropped in that year to be US$ 58 per barrel. However, the prices of world crude oil rose and were US$ 88, 95 and US$ 92.41 per barrel in 2012 and 2013 respectively. The rise in world oil prices has affected not only oil-importing countries but also net oil-importing countries. Indonesia, which is the net oil-importing countries, financially suffers from the high world crude oil price.

Consumption of domestic fuel in Indonesia consists of subsidized fuel and non-subsidized fuel. Due to the high world oil price, it leads to fiscal pressure because government spending on energy subsidies is 28% of the total budget and most of this energy subsidy (80%) is allocated for fuel subsidies. The government cut fuel subsidies by raising the price of domestic fuel several times during world oil price crisis. The latest subsidized and non-subsidized fuel price adjustment by the Indonesian government was June 2013 and November 2014 by 44% and 33.5% respectively. However, fuel price both subsidized and non-subsidized fuel has been cutting since January 2015 because of decreasing world oil price. The fuel price adjustment, then, was for only non-subsidized fuel.

The Rising fuel price in June 2013 leads to rising inflation quite significantly. The Inflation rate was 3.29 % in July 2013 while annual inflation was 8.38%. Thus, the fuel price hike was able to contribute to inflation close to 40% in 2013. The increase in domestic fuel price, however, has a different inflationary effect to domestic consumer prices. The rates of inflation in July 2013 for transport, communication and financial services; foodstuffs; housing, water, electricity, gas and fuel; education, recreation and sports; health; clothing; prepared food, beverages, cigarettes and tobacco are 9.6%; 5.46%; 0.44%; 0.69%; 0.4%; -0.09% and 1.55% respectively. The highest direct impact of oil price shock in June 2013 is for transportation, communication, and financial services because price shock affects directly to transportation cost. Moreover, the biggest indirect effect of a hike in oil price is for foodstuffs (FDS). Figure 1 exhibits the trend of Consumer price index (CPI), all sub-component of CPI, and world crude oil prices. The figure indicates clearly a strong positive relationship between CPI and its sub-components and the price of world crude oil in Indonesia.

The inflationary effect of a hike in the world crude oil price on consumer price then draws pay attention of researchers to investigate the inflationary impact of oil price in emerging markets such as Indonesia (Cunado and de Gracia, 2005; Cunado et al, 2015; and Abdlaziz et al. 2016). This present paper investigates the asymmetric effect of oil price to Indonesian disaggregate consumer prices. There are some reasons for using disaggregate consumer price in estimating the inflationary effect of oil price. First of all, our study complements the existing empirical studies on the oil price pass-through (OPPT) at the aggregate price level (CPI) for the emerging market such as Cunado and de Gracia (2005), Chen (2009), Cunado et al (2015), Choi et al. (2018). The second, using aggregate data may obscure results which is similar results to a number of related contexts such as industrial production (Herrera et al, 2011) and consumer expenditures (Edelstein and Kilian, 2009). Finally, the impact of oil price on consumer price components has a different channel so they have a different OPPT to inflation such as Ibrahim and Chancharoenchai (2014), Gao et al (2014).

We expect that this present study contributes and enhances to the empirical literature of OPPT to disaggregate consumer price level in the emerging market. Moreover, Indonesia as a country that adopts the inflation targeting in its monetary policy, the information of the degree of OPPT to disaggregate consumer price is so important in controlling inflation. Therefore, we also expect that this study can contribute to curbing inflation through monitoring sub-components of CPI whenever oil price shock hits in Indonesia.

The remaining of our paper is planned as follow. The previous empirical studies of OPPT to domestic price are highlighted in section 2. Next Section discusses data and method to investigate the asymmetric effect of OPPT to disaggregate consumer prices. To address this issue, the Non-linear autoregressive distributed lag (NARDL) model is applied. The results of this study are presented and discussed in section 4. Finally, the last section offers a conclusion.

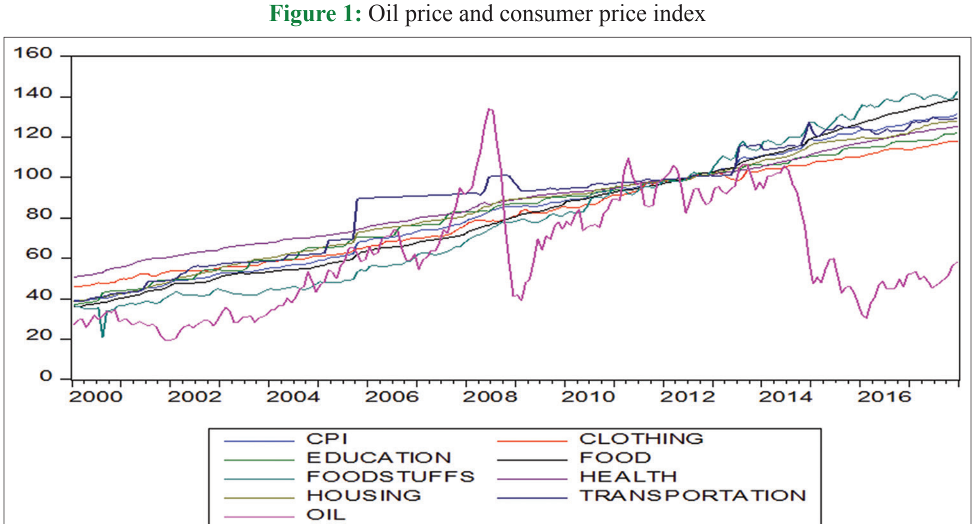
2. LITERATURE REVIEWS

The episodes of rising and volatility the prices of the world crude oil since 2000 have raised concern over its impact on the inflation rate. From a theoretical point of view, a rise in oil price can cause higher inflation through two channels, i.e. first round-round and second-round effects. The price of energy-related goods and services, which are components of the CPI, can directly transfer to a hike in domestic consumer prices as oil price increases. A rise in oil price indirectly influences inflation through higher energy price. A higher energy price leads to higher producer price that is finally translated to higher final consumer prices. The second-round effect of oil price increase on inflation comes from higher wage because of higher consumer price from the first-round effect (Sek, 2017).

Generally speaking, the empirical researches of OPPT to consumer prices are divided into an aggregate price level and a commodity price level. Notable among them for aggregate price level in developed countries are Kilian (2008), Chen (2009), Álvarez et al. (2011), (Gao et al., 2014), Katircioglu et al. (2015), Choi et al. (2018), Lorusso and Pieroni (2018), Evgenidis (2018). Kilian (2008) examined the effects of world oil price on inflation for seven major industrialized economies. His findings show that Inflation responses are varied across the countries. Chen (2009) proves that oil price shocks are incomplete pass-through and a higher level of trade openness are a lower OPPT in 19 industrialized countries. Álvarez et al. (2011) for Spanish report the inflationary effect of oil price is small. Lorusso and Pieroni (2018) for the UK economy also report that a hike in the oil price increases domestic inflation.

The recent empirical studies, however, find that OPPT to domestic price is asymmetric instead of symmetric for developed countries such as Choi et al.(2018), Evgenidis (2018), among the others. Their studies find that the OPPT to domestic price is asymmetric with the positive degree of OPPT having a larger effect than the

Figure 1: Oil price and consumer price index



negative degree of OPPT. Investigating OPPT to inflation with an aggregate price level leads to obscured results (Gao et al., 2014). Using disaggregate U.S. consumer price, they report that oil price through inflation exits only on energy-intensive CPI but with the small pass-through degree. The rise in aggregate consumer price is driven mainly by a substantial rise in prices of energy-related goods and services.

Many previous empirical studies also have examined the impact of world oil price on the domestic price for developing countries and emerging market such as Cunado and de Gracia (2005), Huang and Chao, (2012), Long and Liang (2018), among the others. Cunado and de Gracia (2005) report that oil prices lead to a more inflationary effect on consumer price as oil prices are measured in domestic currencies for some Asian countries. Huang and Chao, (2012) using the multivariate threshold in Taiwan finds that the domestic oil prices do not increase the consumer price indices as the oil price is above the threshold level. World oil price, however, affects the wholesale price index. Long and Liang (2018) document that global oil price asymmetrically affects on PPI and CP but the OPPT to PPI is higher than to CPI in China. Sek (2017) finds that oil price directly affects consumer prices in Malaysia and consumer prices are affected indirectly by oil prices through import prices and production costs channel.

Some empirical studies also investigated OPPT to consumer prices using disaggregate CPI to get a clear picture of the impact of oil price on consumer prices in emerging markets. Ibrahim and Said (2012) find the oil price largely affects on energy-intensive goods and services (the transportation and communication, the rent, fuel, and power, and food) in the short-run for Malaysia. However, only food price is influenced by oil price in the long-run. Ibrahim and Chancharoenchai (2014) document that oil prices affect significantly on all sub-components of consumer prices for Thailand. An increase in energy price is mainly driven by oil price. Other previous studies have analyzed the impact of oil price on food prices. Prominent among them are Baffes (2007), Chen et al., (2010), Alghalith (2010), Reboredo (2012), Avalos (2014), and document that a high price oil is responsible to high food prices. Abdlaziz et al. (2016) find a rise in oil price is transferred to an increase in food price but not vice versa in Indonesia. Their findings are similar to the study of Ibrahim (2015) for the Malaysian case.

3. DATA AND METHODOLOGY

Our present study employs the monthly data, starting from 2000: M1 to 2017:M12 to examine the impact of oil price on CPI and its sub-components. We use the CPI as an aggregate consumer price level. Because of different degree of OPPT to sub-component of CPI, we disaggregate consumer prices into 7 sub-components consumer prices encompassing of Foodstuffs (FDS); prepared food, beverage, and tobacco products (FD); housing (HS); clothing (CL); health (HTH); education, recreation and sports (HTH); transport, communication, and financial services (TRANS). The CPI and its sub-components are sourced from the Indonesian Central Bureau of Statistics. Industrial production index is from International Financial Statistics. The price of world crude oil is West Texas Crude oil and is sourced from the Federal Reserve Bank of St. Louis, USA.

Our study employs the Phillips curve framework to examine a relationship between oil price and inflation. Originally, the Phillips curve is widely applied to investigate the relationship between inflation and the output gap. However, the Phillips curve is extended to consider world crude oil price in empirical studies such as Cunado and de Gracia (2005); Chen (2009); Chou and Lin (2013); Ibrahim (2015) among the others. This present study investigates the effect of oil price on Indonesian disaggregate consumer price using the augmented Phillips curve.

We begin to formulate the Augmented Phillips curve model as follow:

$$LDCP_t = \beta_0 + \beta_1 LGAP_t + \beta_1 LOIL_t + \varepsilon_t \quad (1)$$

Where $LDCP_t$ is the CPI, $LGAP_t$ is the output gap, and $LOIL_t$ is the world price oil. The output gap is a gap between the actual output (Y_t) and its trend $(\widehat{Y}_t)$. $(Y_t - \widehat{Y}_t)$ is calculated using the Hodrick-Prescott Filtered Trend method. Because of the unavailability of monthly output data which is measured by GDP, the industrial production index is a proxy for GDP. All variables are in logarithm natural.

Many previous studies show that the impact of oil price to the domestic price level is not symmetric but asymmetric such as Chou and Lin (2013), Ibrahim (2015), Long and Liang (2018), Choi et al. (2018), among the others. Therefore, we can specify equation (1) to include the asymmetric effect of oil price on consumer prices as

$$LCPI_t = \beta_0 + \beta_1 LGAP_t + \beta_1 LOIL_t^+ + \beta_1 LOIL_t^- + \varepsilon_t \quad (2)$$

Where $LOIL_t^+$ and $LOIL_t^-$ are positive and negative changes in oil price. Following Shin et al., (2014), $LOIL_t^+$ and $LOIL_t^-$ are computed as:

$$LOIL_t^+ = \sum_{t=1}^{m} \Delta LOIL_{t-1}^+ = \sum_{t=1}^{m} \max(LOIL_t, 0) \quad (3)$$

$$LOIL_t^- = \sum_{t=1}^{m} \Delta LOIL_{t-1}^- = \sum_{t=1}^{m} \min(LOIL_t, 0) \quad (4)$$

To investigate the short-run and long-run asymmetric effects of oil price on consumer price, this study applies NARDL models. The equation (2) can be expressed in a NARDL model as follows (Shin et al., 2014):

$$\Delta LCPI_t = \pi_0 + \pi_1 LCPI_{t-1} + \pi_2 LGAP_{t-1} + \pi_3 LOIL_{t-1}^+ + \pi_4 LOIL_{t-1}^- + \sum_{i=1}^{l} \theta_{1i} \Delta LCPI_{t-1} + \sum_{i=1}^{m} \theta_{2i} \Delta LGAP_{t-1} + \sum_{i=0}^{P} \theta_{3i} \Delta LOIL_{t-1}^+ + \theta_{3i} \Delta LOIL_{t-1}^- + \mu_t \quad (5)$$

Equation (5) can capture the short-run and long-run asymmetric effect of oil price to consumer price. The long-run asymmetric coefficients of the positive and negative oil price were calculated by $\delta_1 = -\frac{\pi_3}{\pi_1}$ and $\delta_2 = -\frac{\pi_4}{\pi_1}$ respectively. The short-run asymmetric coefficients of the positive and negative oil price are $\theta_1 = \sum_{i=0}^{m} \theta_{3i} \Delta LOIL^{+}_{t-1}$ and $\theta_2 = \sum_{i=0}^{m} \theta_{4i} \Delta LOIL^{-}_{t-1}$ respectively.

This study follows Shin et al. (2014) to estimate NARDL in equation (5). First, we estimate equation (5) using the OLS method. The general-to-specific approach by sequentially trimming of insignificant lag is applied to get the final specification of equation (5). Cointegration which represents the long-run relationship between variables is examined in the second step. Out study employs the bound testing approach following F_{PSS} statistic test. The null hypotheses of no cointegration are $\pi_1 = \pi_2 = \pi_3 = \pi_4 = 0$ and the alternate hypotheses of cointegration are $\pi_1 \neq \pi_2 \neq \pi_3 \neq \pi_4 \neq 0$. The critical F value follows the critical value provided by Pesaran et al. (2001). There is a cointegration if the computed F value exceeds its critical upper bound I (1). By contrast, a cointegration cannot be found as the computed F value is lower than its critical lower bound I (0)., However, if the computed F values are between I (0) and I (1) then it is not a clear decision. If the cointegration presents from the second steps, the asymmetric effect of oil price to consumer price must be checked in the next step. The null hypothesis of the long-run asymmetric effect of oil price to consumer price is $\delta_1 = \delta_2$ against the alternate hypothesis is $\delta_1 \neq \delta_2$. Correspondingly, the null hypothesis of the short-run asymmetric effect of oil price to consumer price is $\theta_1 = \theta_2$ against the alternate hypothesis is $\theta_1 \neq \theta_2$. Both tests follow the Wald F statistics test. If the asymmetric effect occurs, then an increase (a decrease) in oil price affects differently on consumer price for both short-run and long-run.

Table 1: Descriptive statistics

Variable	Mean	Maximum	Minimum	Std. Dev.	Skewness
ΔCPI	0.0056	0.0835	−0.0046	0.0077	5.2516
ΔFDS	0.0063	0.4954	−0.5388	0.0524	−1.4490
ΔFD	0.0063	0.0315	−0.0023	0.0051	2.1718
ΔHS	0.0056	0.0713	−0.0045	0.0064	5.5342
ΔCL	0.0044	0.0301	−0.0271	0.0073	0.3650
ΔHTH	0.0042	0.0246	−0.0133	0.0035	1.6097
ΔEDUC	0.0055	0.0920	−0.0109	0.0109	4.0620
ΔTRANS	0.0057	0.2513	−0.0412	0.0224	6.9948
ΔGAP	0.0012	0.2483	−0.2880	0.0584	−0.9608
ΔOIL	0.0035	0.2139	−0.3320	0.0880	−0.8292

4. RESULTS AND DISCUSSION

The CPI representing the aggregate consumer price level in Indonesia is calculated from the survey of consumer price for 88 cities across the countries. Consumer price in each city covers 225-462 types of goods and services from the cost of living survey that is represented by 1-3 qualities or brand for each commodity. All types of foods and services are grouped into 7 groups as components as discussed before. Table 1 presents descriptive statistics of each component of CPI from the period 2000.M1–2017.M12. Among the seven sub-components of CPI, the FDS indicated the highest rate of growth by 0.635% per months with 0.05% standard deviation. The lowest rate of growth is clothing (CL) with 0.726% standard deviation. Except for FDS, all variables are positively skewed. The oil price grew 0.35% per month with a relatively high standard deviation (i.e 8.8% standard deviation).

Before estimating NARDL, we initially conduct the preliminary analyses of unit root to check the stationary data. We apply the two standard unit root tests both ADF and PP test to determine the order of integration of the variables. The optimal lag order is selected using the schwartz information criterion. Table 2 exhibits the results of the stationary test. Some data are stationary and other data are not stationary at level data. Stationary, however, is found for all variables at the first difference data but none of them are to be integrated into the second difference data. Hence, we can continue to estimate NARDL.

We estimate NARDL by setting maximum lag order of 12. Table 3 reports the final NARDL model for each sub-component of CPI, including CPI as an aggregate consumer price along with the coefficient of determination (R^2). Diagnostic statistic tests including the Jarque-Bera (J-B) for normality test, Langrage Multiplier for autocorrelation, Autocorrelation Conditional Heteroskedasticity (ARCH) for heteroskedasticity and CUSUM statistics for testing structural stability are shown at the bottom of Table 3. Accordingly, this study checks for the existence of cointegration for each sub-component of CPI and oil price following the F_{PSS} test statistics. Based on the bound F-statistics as shown in Table 4, we find that F-statistic of aggregate consumer price (CPI), foodstuffs, prepared food, beverage, and tobacco products, housing; clothing; health exceed the critical upper bound. However, F-statistic of education, recreation and sports, and transport, communication and financial

Table 2: Unit root test

Variable	Level				First Difference			
	ADF		PP		ADF		PP	
	Constant	Trend	Constant	Trend	Constant	Trend	Constant	Trend
Lcpi	−2.61*	−1.30	−2.85*	−0.97	−11.56***	−11.94***	−11.44***	−11.74***
LFds	−0.59	−3.48**	−0.42	−7.31***	−15.40***	−15.36***	−37.96***	−38.09***
LFd	−3.06**	−2.30	−3.17**	−1.87	−9.71***	−10.27***	−9.79***	−10.27***
LHs	−5.71***	−2.16	−5.27***	−2.09	−11.91***	−13.29***	−12.56***	−13.34***
LCL	−1.57	−1.45	−2.20	−0.83	−11.11***	−11.23***	−10.71***	−10.87***
LHth	−4.14***	−3.60**	−4.34***	−3.72**	−10.91***	−11.83***	−11.18***	−11.80***
LEduc	−2.88**	−1.47	−6.96***	−2.85	−3.23**	−3.68**	−9.02***	−9.76***
LTrans	−2.39	−1.87	−2.41	−1.90	−13.23***	−13.41***	−13.19***	−13.36***
LGap	−3.83***	−3.79**	−11.66***	−11.71***	−8.39***	−8.40***	−35.51***	−35.26***
LOil	−2.03	−2.06	−1.97	−1.87	−10.98***	−10.97***	−10.95***	−10.94***

***, **,* Indicate statistically significant at α=1%, 5% and 10%

Table 3: Non-linear autoregressive distributed lag estimation

Independent variable	CPI		Foodstuffs		Food		Housing	
	Coeff.	S.E	Coeff.	S.E	Coeff.	S.E	Coeff.	S.E
Constant	0.119**	0.050	0.110*	0.058	0.047	0.041	0.106***	0.033
$lcpi_{t-1}$	−0.030**	0.013	−0.031*	0.017	−0.012	0.011	−0.026***	0.009
$lgap_{t-1}$	0.031**	0.015	0.075***	0.028	0.080***	0.017	−0.016*	0.009
$loil^{+}_{t-1}$	0.006**	0.002	0.008**	0.003	0.002	0.002	0.004**	0.002
$loil^{-}_{t-1}$	0.002*	0.001	0.002	0.002	0.000	0.001	0.001	0.001
$\Delta lcpi_{t-1}$	0.267***	0.066	0.430***	0.061	0.377***	0.065	0.160**	0.068
$\Delta lcpi_{t-2}$	−0.138**	0.067	−0.289***	0.068				
$\Delta lcpi_{t-5}$			0.139***	0.032				
$\Delta lcpi_{t-6}$			0.066**	0.026				
$\Delta lcpi_{t-7}$	0.151**	0.062	0.048**	0.021	0.131**	0.061		
$\Delta lcpi_{t-8}$			0.036**	0.017				
$\Delta lcpi_{t-12}$			0.045***	0.015				
$\Delta lgap_{t-1}$	−0.032**	0.013	−0.068***	0.024	−0.084***	0.015		
$\Delta lgap_{t-2}$	−0.024**	0.011	−0.114***	0.019	−0.059***	0.013		
$\Delta lgap_{t-3}$					−0.044***	0.012		
$\Delta lgap_{t-4}$					−0.050***	0.010		
$\Delta lgap_{t-5}$					−0.035***	0.009		
$\Delta lgap_{t-6}$					−0.022***	0.008		
$\Delta lgap_{t-7}$					−0.016***	0.006		
$\Delta lgap_{t-9}$							−0.014**	0.007
$\Delta lgap_{t-11}$	−0.049***	0.008	−0.096***	0.017	−0.014***	0.005	−0.031***	0.007
$\Delta lgap_{t-12}$			−0.042**	0.018				
$loil'_{t-10}$					−0.012**	0.006		
R^2	0.310		0.519		0.433		0.243	
J−B	12990	0.000	16.448	0.003	194.213	0.000	26389	0.000
LM	0.128	0.720	1.187	0.276	0.159	0.690	0.001	0.977
ARCH	0.018	0.893	0.697	0.404	2.124	0.145	0.004	0.951
CUSUM	Stable		Stable		Stable		Stable	

Independent variable	Clothing		Health		Education		Transportation	
	Coeff.	S.E	Coeff.	S.E	Coeff.	S.E	Coeff.	S.E
Constant	0.305***	0.073	0.131***	0.040	0.027	0.039	0.224***	0.066
$lcpi_{t-1}$	−0.078***	0.019	−0.032***	0.010	−0.005	0.010	−0.056***	0.017
$lgap_{t-1}$	−0.007	0.014	−0.013***	0.005	0.022***	0.009	0.013	0.034
$loil_{t-9}$	0.012***	0.003	0.003**	0.001	0.000	0.002	0.014***	0.005
$loil_{t-1}$	0.003***	0.001	−0.001	0.001	0.000	0.001	0.009**	0.004
$\Delta lcpi_{t-1}$	0.301***	0.063	0.219***	0.066			0.142**	0.068
$\Delta lcpi_{t-2}$	−0.136**	0.062						
$\Delta lcpi_{t-3}$					−0.140***	0.047		
$\Delta lcpi_{t-7}$			0.119*	0.065	−0.089**	0.038	0.192***	0.067
$\Delta lcpi_{t-8}$	−0.209***	0.059						
$\Delta lcpi_{t-9}$					−0.073*	0.037		
$\Delta lcpi_{t-10}$					−0.098**	0.039		
$\Delta lcpi_{t-11}$					0.500***	0.040		
$\Delta lcpi_{t-12}$					0.139***	0.038		
$\Delta lgap_{t}$	−0.025**	0.010						
$\Delta lgap_{t-1}$	−0.018*	0.010						
$\Delta lgap_{t-9}$					−0.018***	0.006		
$\Delta lgap_{t-11}$	−0.024***	0.007					−0.089***	0.026
$loil^{+}_{t-6}$					−0.017**	0.008		
$loil^{+}_{t-7}$	−0.023**	0.010						
$loil_{t-3}$	−0.033***	0.008						
$loil_{t-8}$	0.022***	0.008						
$loil_{t-9}$	−0.017***	0.008			−0.013**	0.006		
R^2	0.351		0.216		0.739		0.159	
J−B	37.785	0.000	1145.9	0.000	2865	0.000	16441	0.000
LM	0.010	0.920	0.518	0.471	4.460	0.035	0.529	0.768
ARCH	12.222	0.001	0.788	0.375	4.012	0.045	0.054	0.973
CUSUM	Stable		Stable		Stable		Stable	

***,**,* are statistically significant at α=1%, 5% and 10% respectively. J.B,LM and ARCHM stand for tests of normality, autocorrelation and heteroskedasticity services are between lower and upper bound. We can conclude that the long-run movement between CPI, all sub-component of CPI, output gap, and oil price is found. Then, with these results, we can estimate the response of consumer price to the positive and negative oil price as well as the output gap change.

Table 5 presents the short-run and long-run asymmetric test of OPPT to disaggregate consumer prices. We reject the null hypothesis of no long-run asymmetry effect of OPPT to CPI and all sub-components of CPI, except for the education price. Except for the clothing price, we fails to reject the null hypothesis of no short-run asymmetry of OPPT to CPI and all sub-components of CPI. These results imply that CPI components respond asymmetrically to the change in oil price. These results confirm the previous empirical studies for both developed countries (Choi et al., 2018; Evgenidis, 2018) and developing countries (Ibrahim and Chancharoenchai 2014; Sek, 2017; Long and Liang, 2018).

To find the degree of OPPT to disaggregate consumer price in the long-run, our study has to calculate the response of sub-components of CPI to change in output gap as well as oil price. Table 6 exhibits the OPPT of all sub-component of CPI. The long-run coefficients of the output gap are either positive or negative. We reject the null hypothesis for aggregate consumer price (CPI), FDS price, housing price, and health price at α = 10% or lower level. The long-run positive coefficients for CPI as well as FDS price are consistent with economic theory. It suggests that CPI is expected to increase by 1.02% if there is a 1% national output shortage and a 1% a decrease in output leads to an increase in the expected FDS by 2.4%.

We now turn to discuss the asymmetric effect of OPPT to disaggregate consumer price as our main theme. We start with the aggregate consumer price. The long-run positive and negative coefficients of the oil price are statistically significant at α = 10% or lower level for CPI. The impact of a rise in oil price on CPI (0.196) is greater than a decline in oil price on CPI (−0.069). This study also rejects the null hypothesis of no long-run positive relation between oil price and consumer price at 1% for all sub-components of CPI except education price. The positive degree of OPPT ranges from 0.265 for foodstuffs price to 0.152 for housing price. By contrast, the null hypotheses of no long-run negative relation between oil price and consumer price are rejected at α = 10% or lower level for Housing price, clothing price and transportation price. The negative degree of OPPT is from −0.155 for transportation price to −0.042 for clothing price. Our results predict that a 10% increase in oil price is attributed to a rise in FDS by roughly 2.65% but a 10% decrease in price leads to not generate the decrease the FDS. Our finding supports the previous result of Abdlaziz et al. (2016) with the degree of OPPT to food price of 0.642%. However, this result is lower than Malaysia, which is the degree of OPPT to food price of 0.068% (Ibrahim and Said, 2012).

These results find that the positive degrees of OPPT are related to energy-related goods and services which are supported by the previous results such as Gao et al (2014). Transportation price, which its degree of OPPT is 0.256%, is directly related to the

Table 4: Cointegration test

Price indexes	Test statistic		Critical value	
	F_{PSS}	α	Lower	Upper
CPI	5.054	1%	5.15	6.36
Foodstuffs	4.581	5%	3.79	4.85
Food	8.651	10%	3.17	4.14
Housing	8.322			
Clothing	6.599			
Health	6.504			
Education	3.799			
Transportation	3.542			

The critical values of Bound testing Statistics are from Pesaran et al. (2001)

Table 5: Asymmetric test

Price indexes	W_{LR}	Prob.	W_{SR}	Prob.
CPI	63.548	(0.000)		
Foodstuffs	102.074	(0.000)		
Food	19.958	(0.000)		
Housing	37.194	(0.000)		
Clothing	756.804	(0.000)	6.440	(0.012)
Health	325.756	(0.000)		
Education	0.002	(0.965)	0.223	(0.637)
Transportation	32.573	(0.0000)		

W_{LR} and W_{SR} stand for the Wald test statistics for the long-run and short-run asymmetric effect

oil price. Clothing price (0.158%), Housing price (0.152%) and health price (0.08%), which are lower than transportation price, are also closely related to goods and services which rely on oil in their production. The higher energy-related goods and services are the higher degree of OPPT. These results confirm that because of inelastic demand of energy-related goods and services, consumers reduce their spending for less energy-related goods and services as oil price rise (Edelstein and Kilian, 2009).

Interestingly, FDS price, which is not directly energy-related commodity, is the highest positive degree of OPPT. Moreover, the food price is also relatively high (0.160%). These findings are in line with the Malaysian case (Ibrahim and Said, 2012). The plausible reason for these findings is related as follows. FDS price consists of basic food prices such as cereals, meat, fish, eggs, milk, and their products, Vegetables, and Fruits. Because of rapid economic transformation from an agricultural-based economy to a manufacturing-based economy, Indonesia is a net importer some FDS such as rice as a staple food, corns, meat as a main dish, vegetable, and fruits. Therefore, the high degree of OPPT to the food price mainly stems from the high food price in the world market due to the high oil price. Baffes (2007) finds the overall degree of OPPT to the 35 non-energy commodity index is 0.16 for the 1960-2005 periods. Furthermore, these results find that the negative degrees of OPPT are statistically significant for only transportation price, housing price, and clothing price. These findings predict that a 10% decrease in oil price is attributed to the decrease in transportation price, housing price, and clothing by roughly 1.55%, 0.54%, 0.42% respectively.

Based on the positive and negative degree of OPPT, the effect of oil price on Indonesian disaggregate consumer price is asymmetric. Our findings report that the impact of oil price increase on disaggregate consumer price is greater than the decline in oil price

Table 6: Long run relationship

Variable	CPI	Foodstuffs	Food	Housing	Clothing	Health	Education	Transportation
$lgap_t$	1.023* (0.729)	2.426* (1.732)	6.845 (7.108)	−0.643* (0.403)	−0.091 (0.178)	−0.401** (0.181)	4.309 (8.583)	0.238 (0.612)
$loil^+_t$	0.196*** (0.039)	0.265*** (0.084)	0.160*** (0.060)	0.152*** (0.037)	0.158*** (0.015)	0.080*** (0.016)	0.059 (0.287)	0.256*** (0.064)
$loil^-_t$	−0.069* (0.049)	−0.072 (0.098)	−0.015 (0.083)	−0.054* (0.042)	−0.042** (0.018)	0.019 (0.018)	−0.070 (0.182)	−0.155** (0.073)

***, **,* Indicate statistically significant at α=10%, 5% and 1%. The parentheses indicate standard error

on disaggregate consumer price that confirms a phenomenon as known as rockets and feathers (Bacon, 1991; Tappata, 2009). The speed of adjusting oil prices to changing costs is faster as costs increase than as oil prices decrease. Moreover, the degree of OPPT to Indonesian's disaggregate consumer price is an incomplete degree of OPPT, which is similar to the previous study for Malaysia (Ibrahim and Said, 2012), for Thailand (Ibrahim and Chancharoenchai, 2014), and for the USA (Gao et al., 2014)

5. CONCLUSION

The study investigates the inflationary asymmetric effect of oil price to disaggregate consumer price for Indonesia. Some interesting findings emerge from this study. Our results find strong evidence of the relationship between oil price, output gap, CPI, and its sub-components of CPI. With the exception of education price, the asymmetric effects of oil price to CPI, FDS price, food price, Housing price, clothing price, education price, and Transportation price exist. Furthermore, we affirm evidence that that the positive degrees of OPPT is related to energy-related goods and services to which the highest degree of OPPT is transportations price, followed by clothing price, housing price, health price. FDS price, which is the highest degree of OPPT, and foods price also contribute significantly to inflation. Generally speaking, we document that the CPI and any sub-component of CPI tend to increase faster to the rise in oil price than the decline in oil price.

Understanding the degree of OPPT to disaggregate consumer price, which links between oil price and the inflation rate, is important for Indonesia as a country adopting the inflation targeting in its monetary policy. Therefore, knowledge about the inflationary asymmetric effect of oil price rises on disaggregate consumer price level may help policy-makers to control inflation under the inflation targeting regime. Since there are different degrees of OPPT to consumer prices, the policy-makers have to design appropriate and suitable policies in controlling the inflationary asymmetric effect of oil price mainly to energy-related goods and services. More particularly, the Indonesian government should pay attention more to bearing on high food prices due to oil price increases. The average calorie consumption of 19 provinces of all 34 provinces (55.9%) is below minimum calorie consumption in 2017. Because of foods as the main source of calories and protein, a cash transfers program may be an appropriate economic policy for reducing the inflationary effect of oil price on food prices in solving nutritional deficiencies during the oil price shock.

REFERENCES

Abdlaziz, R., Rahim, K., Adamu, P. (2016), Oil and food prices co-integration nexus for Indonesia: A non-linear autoregressive distributed lag analysis. International Journal of Energy Economics and Policy, 6(1), 82-87.

Alghalith, M. (2010), The interaction between food prices and oil prices. Energy Economics, 32(6), 1520-1522.

Álvarez, L.J., Hurtado, S., Sánchez, I., Thomas, C. (2011), The impact of oil price changes on Spanish and euro area consumer price inflation. Economic Modelling, 28(1-2), 422-431.

Avalos, F. (2014), Do oil prices drive food prices? The tale of a structural

break. Journal of International Money and Finance, 42, 253-271.
Bacon, R.W. (1991), Rockets and feathers: The asymmetric speed of adjustment of UK retail gasoline prices to cost changes. Energy Economics, 13(3), 211-218.
Baffes, J. (2007), Oil spills on other commodities. Resources Policy, 32(3), 126-134.
Chen, S. (2009), Oil price pass-through into inflation. Energy Economics, 31(1), 126-133.
Chen, S.T., Kuo, H.I., Chen, C.C. (2010), Modeling the relationship between the oil price and global food prices. Applied Energy, 87(8), 2517-2525.
Choi, S., Furceri, D., Loungani, P., Mishra, S., Poplawski-Ribeiro, M. (2018), Oil prices and inflation dynamics: Evidence from advanced and developing economies. Journal of International Money and Finance, 82, 71-96.
Chou, K.W., Lin, P.C. (2013), Oil price shocks and producer prices in Taiwan: An application of non-linear error-correction models. Journal of Chinese Economic and Business Studies, 11(1), 59-72.
Cunado, J., de Gracia, F.P. (2005), Oil prices, economic activity and inflation: Evidence for some Asian countries. Quarterly Review of Economics and Finance, 45(1), 65-83.
Cunado, J., Jo, S., de Gracia, F.P. (2015), Macroeconomic impacts of oil price shocks in Asian economies. Energy Policy, 86, 867-879.
Edelstein, P., Kilian, L. (2009), How sensitive are consumer expenditures to retail energy prices? Journal of Monetary Economics, 56(6), 766-779.
Evgenidis, A. (2018), Do all oil price shocks have the same impact? Evidence from the euro area. Finance Research Letters, 26, 150-155.
Gao, L., Kim, H., Saba, R. (2014), How do oil price shocks affect consumer prices? Energy Economics, 45, 313-323.
Herrera, A.M., Lagalo, L.G., Wada, T. (2011), Oil price shocks and industrial production: Is the relationship linear? Macroeconomic Dynamics, 15(S3), 472-497.
Huang, W.H., Chao, M.C. (2012), The effects of oil prices on the price indices in Taiwan: International or domestic oil prices matter? Energy Policy, 45, 730-738.
Ibrahim, M.H. (2015), Oil and food prices in Malaysia: A nonlinear ARDL analysis. Agricultural and Food Economics, 3(1), 1-12.
Ibrahim, M.H., Chancharoenchai, K. (2014), How inflationary are oil price hikes? A disaggregated look at Thailand using symmetric and asymmetric cointegration models. Journal of the Asia Pacific Economy, 19(3), 409-422.
Ibrahim, M.H., Said, R. (2012), Disaggregated consumer prices and oil price pass-through: Evidence from Malaysia. China Agricultural Economic Review, 4(4), 514-529.
Kilian, L. (2008), The effects of exogenous oil supply shocks on output and inflation: Evidence from the G7 countries. Journal of the European Economic Association, 6, 78-121.
Long, S., Liang, J. (2018), Asymmetric and nonlinear pass-through of global crude oil price to China's PPI and CPI inflation. Economic Research-Ekonomska Istrazivanja, 31(1), 240-251.
Lorusso, M., Pieroni, L. (2018), Causes and consequences of oil price shocks on the UK economy. Economic Modelling, 72, 223-236.
Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.
Reboredo, J.C. (2012), Do food and oil prices co-move? Energy Policy, 49, 456-467.
Sek, S.K. (2017), Impact of oil price changes on domestic price inflation at disaggregated levels: Evidence from linear and nonlinear ARDL modeling. Energy, 130, 204-217.
Shin, Y., Yu, B., Greenwood-nimmo, M. (2014), Modelling asymmetric cointegration and dynamic multipliers in a Nonlinear ARDL framework. In: Sickels, R., Horrace, W., editors. Festschrift in Honor of Peter Schmidt: Econometric Methods and Applications. New York: Springer. p281-314.
Tappata, M. (2009), Rockets and feathers : Understanding asymmetric pricing. The Rand Journal of Economics, 40(4), 673-687.