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# World Oil Price Shocks in Macroeconomic ASEAN +3 Countries: Measurement of Risk Management and Decision-making a Linear Dynamic Panel Approach

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**ABSTRACT**

The increase in oil prices in the 1970s has had a quite significant impact over the decades since the rise in inflation has had an impact on hyperinflation, recession, lowered productivity and economic growth. The World Bank (2021) forecasts that oil prices will exceed US$44 per barrel in 2021 and US$50 per barrel in 2022, while several factors affect the World Bank's projections, including the persistence of economic issues in the coming years. The purpose of this paper was to empirically assess the impact of oil prices on ASEAN+3 inflation and economic growth. The framework that can be applied to linear dynamic panel data to achieve this goal is the First Difference-Generalized Moment Method (FD-GMM) estimator method. This study used panel data representing ASEAN+3 countries and annual data over the period 2011-2020. The findings of the study indicated that, over the period, increasing oil prices were associated with higher inflation, and higher economic growth in ASEAN+3. Another result was that higher inflation is related to lower economic growth. Lower and higher economic growth was related to decreased inflation. High inflation creates high costs of economic development and social prosperity, therefore that policymakers are expected to adopt policies that are not only good for the short term, but also good for the long term to establish long-term prosperity and long-term price stability. In addition, a variety of non-economic variables that affect global market price volatility should also be considered to reduce potential market risks.

**Keywords:** Oil Price Shock, Inflation, Production Growth, Economic Development, Econometrics
**JEL Classifications:** E31, E42, E63, F43, F62

## 1. INTRODUCTION

Energy plays an important and strategic role since it is an essential part of the circulation of the world's economy. Petroleum, as one of the world's energy sources, has been the energy with the highest level of consumption for the production process relative to other sources. The impact of rising world oil prices on inflation and economic growth at the beginning of the 1970s differed from those of the 2000s. In the 1970's, rising oil prices lead to high inflation, depression, low productivity and low or negative growth rates. The increase in oil prices in the early 2000s led to an increase in inflation, but was relatively much smaller than in the 1970s, and global economic growth remained strong (Unalmis et al., 2010; Blanchard and Riggi, 2013; Baffes et al., 2015). Study findings from (Du et al., 2010; Basher et al., 2012; Mohaddes and Pesaran, 2016) concluded that the increase in oil prices is related positively to output and inflation in China and Indonesia.

The contribution of oil demand in ASEAN countries to total world is quite large, that is 32% in 2018, while the contribution of production to global production is quite low, and that is 7.4% (Pratiwi et al., 2020). During 2011-2020, the average growth in oil consumption in ASEAN countries has been 5.3% per year, while the average growth in oil production (supply) was only 0.5% per

year (https://www.cnbcindonesia.com/news/ 20180710180246-16-22880/Largest-oil-importer-country-in-Southeast Asia, retrieved 12/11/2020). It means that there is a discrepancy of 2% per year between demand and oil production. Increasing oil consumption without sufficient oil supplies would increase the reliance of ASEAN countries on oil, especially ASEAN 3+ (Indonesia, Malaysia, and Singapore). The excessive dependence of ASEAN+3 countries on oil products would be detrimental to the countries in the region, particularly if there is a high enough increase in oil prices. This also contributes to the financial condition of the ASEAN + 3 regions, which is still emerging and which, of course, requires a lot of resources. In addition, the existence of ASEAN+3 economic integration, such as the ASEAN Economic Community (ASEAN Economic Community) in 2015, has triggered economic shocks in a country that may have an effect on other countries in the region (Figure 1).

The objective of this study is to examine the impact of global oil price shocks on inflation and economic growth in ASEAN+3 countries and the impact of inflation on economic growth and the impact of economic growth on inflation in ASEAN+3 countries; inflation in the previous year in ASEAN+3 countries and the impact of economic growth in the previous year on economic growth in ASEAN+3 countries.

## 2. LITERATURE REVIEW

Research conducted by Aisen and Veiga (2007); Nyangarika and Tang (2018); Bala and Chin (2018) have shown that the annual change in oil prices has a positive and statistically significant impact on inflation. In addition, foreign trade, which is a percentage of GDP, has a positive coefficient indicating that the greater the rate of openness to trade causes higher inflation. As far as economic performance is concerned, the results are as expected: real GDP growth, the real effective exchange rate has a negative effect. This is consistent with the intuition that inflation is associated with low growth and undervalued currency values. Real currency devaluation reduces inflation. The marginal effect of real GDP growth per capita and U.S. Treasury Bill rates is higher. Inflation increases when Treasury bill rate increases by 1% (Mishkin, 2004).

The positive impact of the global oil price shocks in Indonesia (Apriani, 2007) on output inflation, real exchange rates, and

**Figure 1:** World Consumption and Oil production by Region 2018



Source: EIA, 2020 retrieved from https://www.eia.gov/international/data/world/petroleum-and-other-liquids/annual-petroleum-and-other-liquids-production?

money supply also occurred in the ASEAN countries (Basnet and Upadhyaya, 2015: Dahalan et al. 2015; Kisswani, 2016) using the VAR approach, as well as the positive impact of the increase in oil prices due to the asymmetrical effect. Projections by Dahalan et al. (2015) also indicate that GDP responds adversely to increasing oil prices in the long run without having substantial short-term growth. While Malaysia and Indonesia are developing and exporting oil, while Singapore has a fast-growing oil refining industry, their contribution to the economy is relatively small, this means that the windfall revenues from the oil sector that Indonesia and Malaysia are earning will not be adequate to support the economic slowdown experienced by their neighbors and major trading partners.

Olomola et al. (2006); Iwayemi and Fowowe (2011) conducted researches on the effect of world oil price shocks on inflation, output, real exchange rates, and the money supply in Nigeria using the vector auto-regression (VAR) method. The research used quarterly data from 1970 to 2003. The findings suggested that global oil price shocks have a major influence on the actual exchange rate, but do not affect Nigeria's production and inflation. In contrast, it has been observed that the increase in world oil prices has strengthened people's welfare (Zaouali, 2007). This is due to the appreciation of the real exchange rate in Nigeria, which has an impact on the trade sector.

Using longer time periods and different countries, Salman et al. (2008) examined the short-term effect of changes in oil prices on the business cycle of the G-7 countries just using the co-integration test and the Granger Causality test. The data used was quarterly data for the period 1970: 1–2006: 4. Several facts have been established in this study: there is a short-term neutrality of real GDP as a consequence of shifts in oil prices in Italy, Japan and the United Kingdom. However, oil has had a real impact on economies of other G7 countries, particularly Germany and France. On the other hand, adjustments in government policies have played an important role in reducing the impact of high oil prices in Japan, Italy and France. In addition, the characteristics of the economies of the United States, the United Kingdom, Germany and Canada have influenced the role of oil impact in their business cycle. These differences suggest that fluctuations in oil prices have a time effect on the business cycle in several G-7 economies (Salman et al. 2008; Cologni and Manera, 2009; Engemann et al., 2010; Lee et al. 2012; Baffes et al. 2015; Sato et al. 2011; Dungey and Vehbi, 2015; Mohaddes and Pesaran, 2016; Jan van de Ven and Fouquet (2016) found that global oil price shocks are increasingly important to the stability of real market growth in a number of countries. It reflects an increase in reliance on world oil supplies associated with industrialization in these countries. Even the findings of Sato et al. (2011); found that the variance decomposition of suggests that global oil price shocks are a major cause of price volatility in most economies, followed by a shock to the United States. China's impact on domestic price levels is constant and is largely recorded in Hong Kong, reflecting the high degree of economic convergence between the two economies.

Ftiti et al. (2016) found that oil price shocks in periods of volatility in the global business cycle and/or financial turmoil have had an influence on the association between oil and economic
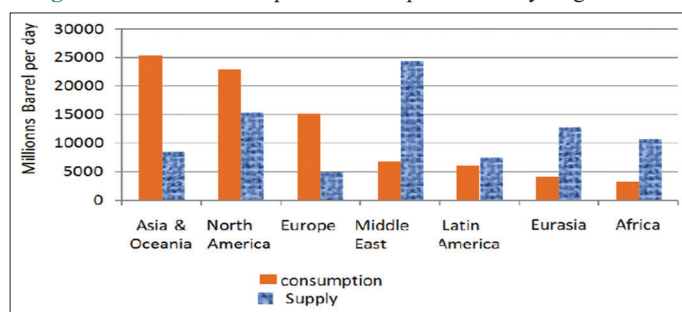
development in OPEC countries. Kurihara (2015) discussed the relationship between the price of oil and economic growth. Their research examined the impact on the economy differed for oil-importing countries. Meanwhile, the oil price shocks of Berument et al. (2010) do not appear to have a statistically significant impact on the production of Bahrain, Djibouti, Egypt, Israel, Jordan, Morocco and Tunisia. In accordance with this, Ahmed (2016) found in his study not all countries would have a positive impact of oil prices on growth and development. In his research in Middle East and North African (MENA) countries, the MENA region is vulnerable to shifts in oil prices only because certain member countries are the major producers and exporters most likely to be impacted by the decline in oil prices because most of their income comes from oil exports. Meanwhile, other Member Countries are oil importers which may benefit from lower oil prices as substitutes for the production of some products but may have a negative impact in the form of reduced remittances, foreign aid, and foreign direct investment as a result of lower revenues from oil exporting countries due to lower prices Lardic and Mignon (2006); Mehrara (2008); Mendoza and Vera (2010); Çatik and Önder (2013); Serletis and Istiak (2013); Moshiri (2015); Charfeddine and Barkat (2020); Jibril et al. (2020) have demonstrated that oil price shocks are asymmetrical in that positive and negative shocks to oil prices of the same size may have different consequences on the country's economic development.

Study results by Fischer et al. (2002); Haider et al (2012); Hourcade et al.(2014) reported that: higher inflation tends to be more volatile; in high inflation countries, there is a strong relationship between fiscal balance and seigniorage in both the short and long term; inflation inertia is decreasing with increasing average inflation; and high inflation is related to weak macroeconomic efficiency. Meanwhile Jha and Dang (2012), Barro (2014), Mohseni and Jouzaryan (2016) concluded that high inflation had a negative and significant impact on economic growth.

The results of a study by Gylfason and Herbertsson ( 2001), Arai et al. (2004), Gokal and Hanif (2004), Baharumshah et al. (2016), Ben S. Bernanke, Thomas Laubach, Frederic S. Mishkin (2018) show that there is no evidence to support the view that inflation is generally injurious to GDP growth. On the other hand, there is a negative correlation between intra-country inflation and development over the period under study due to the positive oil price shock of Kim and Hammoudeh (2013). Meanwhile, Aisen and Veiga (2013), Nguyen et al. (2015) analyzed the role of political instability on economic growth using the System-GMM estimator for dynamic data panel models. The findings indicate that high inflation has a negative and statistically significant impact on growth.

## 3. RESEARCH METHOD

The type of research used in this study is exploratory. The data obtained is panel data, which is a combination of annual time series data for the period 2009-2018 and cross-section data from ASEAN+3 countries. ASEAN+3 countries included in the study include Indonesia, Malaysia, the Philippines, Singapore, Thailand, China, Japan and South Korea. This study uses a dynamic

panel analysis method, called the First Differences-Generalized Moments Method (FD-GMM) (Table 1).

The advantage of the use of annual data is as continues to follow: (1) information on the variation of the period used for the estimation; (2) It is important to measure the consistency of the predicted parameters over time (3) the dynamic structure of the problem can be analyzed using the lag variable. The reasons for selecting ASEAN+3 countries are partially due to the fact that the economic conditions of these countries were diverse and divided into developed and developing countries. It is expected that the impact of global oil price shocks will be observed across countries with different per capita incomes (Zaouali, 2007; Kurihara, 2015). Moreover, the reason for selecting these countries though is that OPEC supplies Asia to the most oil compared to other regions of the world (Ftiti et al., 2016). Asia is expected to see the fastest increase in oil demand in the world. From OPEC's forecast of world oil demand, this rising need is mainly in developing countries, two-thirds of which are Asian countries

Based on previous research, the specification of the dynamic panel model to be used in this study refers to the model (Aisen and Veiga, 2008; 2013), i.e.:

$$ln\ Y_{i,t} = \beta\ ln\ Y_{i,t-1} + \lambda\ X_{i,t} + \nu_i + \varepsilon_{i,t} \qquad (1)$$

$$D.ln\ Y_{i,t} = \beta\ D.ln\ Y_{i,t-1} + \lambda\ D.X_{i,t} + D\varepsilon_{i,t} \qquad (2)$$

And for inflation model (Eq. 1), the dependent variable is the consumer price index (CPI) as well as the vector X is the variable that affects inflation. For the economic growth model (Eq. 2), the dependent variable is GDP and the vector X is the variable that influences economic growth.

Based on the considerations of several previous studies, the model specifications in this analysis can be seen in the following two equations:

1. The inflation model; the influence of global oil prices on inflation applies to the modified Aisen and Veiga (2008) models:

$$D.CPIit = \beta1D.CPIi, t-1 + \beta2D.OPIit + \beta3D.GDPit + \beta4D.RIRit + \beta5D.Tit + D.eit \qquad (3)$$

This model uses a variable instrument for the contribution of the agricultural sector to GDP and industry variables for the contribution of the sector to GDP.

**Table 1: Data and data sources used in research**

| Variables | Units | Sources |
|---|---|---|
| World oil prices (OPI) | US $ per barel | IFS |
| Consumer Price Indeces (CPI) | 2012=100 | WDI |
| Real GDP (GDP) | International $ (PPP 2012=100) | WDI |
| Real interest rates (RIR) | Percentage | WDI |
| Trade openess (*T*) | Percetage | WDI |
| Middle school enrollment (EDU) | Percentage | WDI |

Sources: International Financial Statistics (2018), World Development Index (2019)

2. Global Economic growth Model; the impact of world oil prices on economic growth refers to the modified model of Aisen and Veiga (2013)

$$D.GDPit = \beta 1 D.GDPi, t\text{-}1 + \beta 2 D.OPIit + \beta 3 D.CPIit + \beta 4 D.EDUit + D.eit \quad (4)$$

The model uses the foreign direct investment instrument (FDI) and the contribution of the industrial sector to GDP.

Note:
CPI = Log Consumer Price Index (2005 = 100)
D = First difference operator EDU = Education level (percentage)
GDP = Log real GDP (international 2005 PPP $ = 100)
OPI = Log Average world price of crude oil (US $ per barrel) RIR = Real interest rate (percentage)
T = Trade (percentage of GDP) e = Error
it = country i, year t.

## 4. RESULTS AND DISCUSSIONS

Based on the results of the dynamic panel estimation with FD-GMM, the first lag of the dependent variable (previous year inflation) has a positive but not statistically significant coefficient. This indicates that there is no persistent inflation (Arellano and Bover, 1995; Aisen and Veiga, 2013). The insignificant dependent lag also means that current inflation is not affected by previous inflation (backward-looking) but is influenced by inflation expectations (forward looking). This also shows the progress of the monetary authorities in the ASEAN + 3 region in resolving the inflation crisis.

Meanwhile, economic growth has a negative and significant inflation coefficient. Each 1% increase in economic growth would result in a 1.32% decline in inflation, ceteris paribus. According to Fischer et al. (2002), and Hourcade et al. (2014) high inflation is also characterized by a reduction of GDP levels where high inflation is correlated with low macroeconomic results.

Changes in the world price index of crude oil have a positive and significant effect on inflation. Every 1% increase in the rate of change in oil prices would result in an inflation increase of 0.0553%, ceteris paribus. That because the increase in oil prices has led to an increase in manufacturing costs and prices (cost push inflation). An increase in the price of oil can lead to an increase in the prices of other goods. When there is an increase in the price of oil, not only will the price of fuel increase, but the price of goods and services related to fuel oil will also increase (Jha and Dang, 2012; Barro, 2014; Mohseni and Jouzaryan, 2016). As a result, inflationary pressures may be intensified if the rise in fuel prices increased or the price of other goods, such as food and housing, increased (Olomola et al., 2006).

The high price of oil in recent years has also encouraged the development of biofuel production as an alternative energy source (Singagerda et al., 2018). It led to a shift in the use of a large number of commodities that were initially used only as food to become raw materials for the biofuel industry (such as palm oil, corn, wheat, soybeans) which, in turn, caused price increases (Farida and Santi Singagerda, 2021). The condition is consistent with the implementation of policies and targets for aggressive conversion of resources to biofuels by various countries.

The increase in energy prices has contributed to an increase in the fiscal deficit. One of the determinants of inflation is the consequence of fiscal imbalances where the fiscal deficit is the amount of seigniorage and borrowing (Fischer et al., 2002 ; Haider et al., 2012); Hourcade et al. (2014). Therefore, the relationship between deficit and inflation derives from the relationship between seigniorage and inflation. According to Fischer et al. (2002); Haider et al. (2012); Mohaddes and Pesaran (2017) in high inflation countries, there is a strong relationship between fiscal stability and seigniorage in both the short and long term. Luis Catão (2001); (Mishkin, 2004); Fakher (2016), found that there is a strong positive relationship between fiscal deficits and inflation among high inflation groups in developing countries, but not in developed countries with low inflation.

Estimates suggest that changes in real interest rates have a negative but insignificant impact on inflation. Each 1% increase in the rate of change in real interest rates will affect prices to decline by 0.0032%, ceteris paribus. Higher interest rates would reduce investment, shifting the aggregate demand curve to the left and, in turn, lower interest rates, and vice versa (Table 2).

Changes in trade openness have a negative however insignificant effect on inflation. Every 1% increase in the rate of change in trade openness would affect prices to decline of 0.0002%, ceteris paribus. The implication is that countries that are open to international trade are more likely to raise funds through import duties and are less dependent on seigniorage income and furthermore reduce inflation (Aisen and Veiga, 2008; Özşahin and Üçler, 2017; Alam et al., 2019).

Based on the estimation of the results in Table 3 of the FD-GMM dynamic panels, the first lag of the predictor variables (previous year's economic growth) has a positive but not significant coefficient. It shows that the economic growth of ASEAN+3 is not influenced by the economic growth of the previous year.

**Table 2: Estimation of inflation model coefficient**

| Variables[1] | Twostep | Twostep-robust[2] |
|---|---|---|
| Δln_cpi L1 | 0.6252 | 0.6252 |
| | (0.4203) | (0,3847) |
| Δln_gdp | −1.3241*** | −1,3241*** |
| | (0.5140) | (0.5067) |
| Δln_opi | 0.0553*** | 0.0553*** |
| | (0.0134) | (0.0148) |
| Δrir | −0.0032* | −0.0032 |
| | (0.0019) | (0.0020) |
| Δopenness | −0.0002** | −0.0002 |
| | (0,0001) | (0.0004) |
| Wald test | 31.45 [0.0000] | 40.16 [0.0000] |
| Arelano-Bond m₁ | −2.4853 [0.0129] | −2.6582 [0.0079] |
| Arelano-Bond m₂ | −1.4107 [0,1583] | −1.3815 [0.1671] |
| Sargan test | 1.4940 [1,0000] | |

**Significant at the 1% actual level, **Significant at the 5% actual level, *Significant at 10% of the actual level. (1) Dependent variable: Δln_cpi, (2) Two-step robust results using a robust standard error that is corrected for limited samples (Bun and Windmeijer, 2010). Sources: Arellano and Bover, 1995; Aisen and Veiga, 2013

**Table 3: Estimation coefficient of the economic growth model**

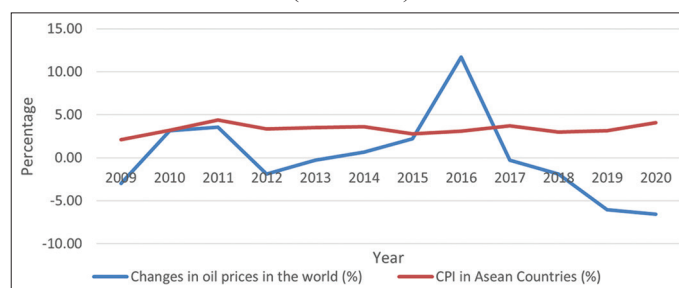| Variable FD-GMM | Dynamic Models |
|---|---|
| $\Delta ln\_gdp$ L1 | 0.0255 |
| | (0.1781) |
| $\Delta ln\_cpi$ | −0.0727*** |
| | (0.1787) |
| $\Delta ln\_opi$ | 0.0686*** |
| | (0.0104) |
| $\Delta edu$ | 0.0006*** |
| | (0.0009) |
| Wald' test | 65.64 [0.0000] |
| Arelano-Bond m1 | −1.9741 [0.0484] |
| Arelano-Bond $m_2$ | 0.40639 [0.6845] |
| Sargan's test | 4.613979 [1,0000] |

***Significant at the 1% actual level, **Significant at the 5% actual level, *Significant at 10% of the actual level. Sources: Arellano and Bover, 1995; Aisen and Veiga, 2013

**Figure 2:** Changes in oil prices and inflation in ASEAN + 3 countries (2009-2020)



Source: IMF[1], EIA[2] (2020)

Inflation is creating a negative and significant impact on economic growth. Each 1% increase in inflation would lead to a 0.7027% decline in economic growth, ceteris paribus. High inflation, as economists recognize, has a negative effect on economic growth and social welfare (Rousseau and Wachtel, 2011; Ftiti et al., 2016). High inflation triggers high social costs to be paid by governments, businessmen and society (Friedman, 2017; Özşahin and Üçler, 2017). The social cost consists of the cost of shoe leather, the cost of the menu, the volatility of relative costs, the distorted tax rates and the inconvenience of living with shifting prices (Mankiw, 2012). An increase in the price level would reduce the stock of real capital, which in turn contributes to a decrease in demand and output. In general, inflation increases the cost of production and transport and reduces people's purchasing power, which has a negative impact on the economy. According to Lardic and Mignon (2006); Mehrara (2008); Mendoza and Vera (2010); Çatik and Önder (2013); Serletis and Istiak (2013); Moshiri (2015); Charfeddine and Barkat (2020); Jibril et al. (2020), which concluded that inflation uncertainty has contributed to a three-month decline in output growth. Inflation may also have a positive impact on output growth. It occurs when inflation tends to be small, around 2 or 3% per year, regardless of inflation, it can allow the labor market work better. Without inflation, real wages would be pushed above the level of equilibrium leading to higher unemployment (Mankiw, 2012).

The rate of change in the oil price index has a positive and significant impact on economic growth. Each 1% increase in the rate of change in oil prices would result in an increase in economic growth of 0.0686%, ceteris paribus (Figuer 2). It is also in line with the studies by Du et al. (2010); Basher et al. (2012); Mohaddes and Pesaran (2016), which concluded that the increase in oil prices is related positively to output and inflation in China and Indonesia. It is related to an improvement in incomes derived from the export of crude oil and its processed products, an increase in revenue of other commodity exporting countries whose prices are followed by an increase in oil prices, a decline in oil intensity, an increase in aggregate demand and the availability of fuel subsidies in several countries. Therefore, Thus, the positive impact of oil prices on economic growth is related to an increase in revenues derived from the export of crude oil and its processed products.

The increase in oil price also led to an increase in income for other commodity exporting countries whose prices followed the increase in oil prices (Figure 3). The growth in exports, in particular, has an effect on the economic growth of the country concerned. The ASEAN region itself is the largest supplier of a number of important world food commodities, including rice and palm oil. Approximately 90% of total of rice is produced in the Asian region and mostly in ASEAN countries. Exports of milled rice in Thailand increased from US$ 2.701 million in 2009 to US$ 6.359 million in 2018, while China increased from US$ 719.58 million in 2009 to US$ 475.768 million in 2018.

Based on the ASEAN Trade Database, in 2019, rubber and rubber products were among the top ten ASEAN traded commodity groups with an export value of US$21,844 million, with an import value of US$8,597 million. Indonesia and Malaysia are the largest producers of palm oil in the world, and therefore increase in world oil prices has an effect on the amount in the volume of exports within these countries. Table 4 reveals that Malaysia's palm oil exports increased from US$4,738 million in 2009 to US$14,768 million in 2018, or almost 2.5 times higher. Indonesia's palm oil exports increased from US$2.114 million in 2009 to US$13.576 million in 2018, or 10-fold. Meanwhile, Singapore's palm oil exports improved by 100% from US$ 276 million in 2009 to US$ 361 million in 2018. Indonesia and Thailand reported for both the main exports of rubber/Rubber Nat Dry (Singagerda et al., 2018; Alam et al., 2019).

Developing energy intensity, which is the ratio of energy consumption to GDP in China, is much lower than in previous decades. From 1990 to 2018, China's energy intensity declined sharply by 55.4% from 43,084.41 btu per GDP dollar to 10,457.42 btu per GDP dollar. This increase of energy consumption is due to energy conservation as a result of growing energy prices in the 1970s and1980s, including energy crisis in mid of 2000s (Cabral, 2002; Mirchi et al., 2012). However, China's energy intensity is still higher than other ASEAN+3 countries. It is because China is an industrial country that also needs a lot of energy. During the period 2009-2018, almost all ASEAN+3 countries experienced a decline in intensity, including Indonesia, Malaysia and Thailand, which were classified as Asia's largest palm oil export countries (Desfiandi et al., 2019). As a consequence of sustainable economic and population growth, electrification, industrialization and

1    https://data.imf.org/?sk=388DFA60-1D26-4ADE-B505-A05A558D9A42&sId=1479329334655

2    https://www.eia.gov/petroleum/data.php#prices

urbanization, ASEAN's energy demand will more than triple during 2010-2035, creating tremendous pressure on energy supply and security (Shi, 2015).
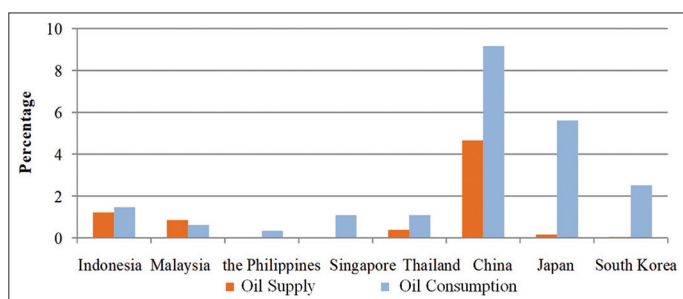
Meanwhile, oil intensity, which is the ratio of oil consumption per dollar of GDP (btu per GDP constant at the 2005 international dollar PPP) has decreased in almost all ASEAN+3 countries over the last 10 years. It indicates that there is public awareness of the consumption of petroleum per unit of output. Singapore has the highest oil intensity, far above other ASEAN+3 countries (Figure 4).

**Table 4: Exports of Crude Oil and Processed Petroleum Products from ASEAN+3 Countries in 2010 and 2018**

| Countries | Crude oil exports products | | Export of processed petroleum | |
|---|---|---|---|---|
| | 2009 | 2017 | 2009 | 2017 |
| Indonesia | 372 | 337 | 16 | 23 |
| Malaysia | 344 | 390 | 46 | 59 |
| The Philippines | 20 | 4.4 | 25 | 24 |
| Singapore | 12 | 27 | 771 | 924 |
| Thailand | 43 | 33 | 24 | 27 |
| China | 102 | 59 | 234 | 285 |
| Japan | 0 | 0 | 87 | 68 |
| South Korea | 0 | 0 | 153 | 152 |

Source: EIA, 2020 retrieved from https://www.eia.gov/international/data/world/petroleum-and-other-liquids/annual-petroleum-and-other-liquids-production?

**Figure 3:** Contribution of the consumption and production of oil of ASEAN+3 countries to the world in 2008



Source: EIA, 2020 retrieved from https://www.eia.gov/international/data/world/petroleum-and-other-liquids/annual-petroleum-and-other-liquids-production?

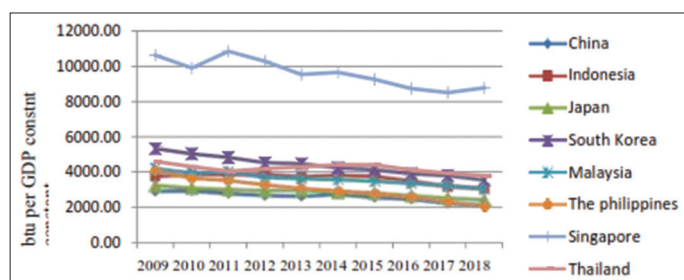**Figure 4:** Development of the crude oil intensity of ASEAN + 3 countries 2009-2018



Source: EIA, 2019 retrieved from https://www.eia.gov/international/data/world/petroleum-and-other-liquids/annual-petroleum-and-other-liquids-production?

One of the factors behind the decline in oil intensity is the effort to reduce oil consumption and the technological changes that play a role in the business so that it is no longer too disrupted by the increase in oil prices, which is actually more service-based (Baumeister and Peersman, 2013; Shi, 2015). In general, the service industry requires less energy to produce than the manufacturing sector. Therefore, even though the price of oil is rising, its impact on the macroeconomics at this time would be smaller.

The use of fuel oil is increasingly widespread in developing countries due to the strengthening of economic growth, expanded use of transport and the development of industrial activities. Increased industrial activity eventually led to increased economic growth. The contribution of ASEAN + 3 countries to GDP in the industrial sector has seen positive average annual growth since 2009 to 2018. Japan experienced an average annual growth rate of 1.2% per year, followed by the Philippines and Indonesia at 4.5% per year. Malaysia, Singapore, Thailand and South Korea had an average growth rate of 5.1%, 5.2%, 6.1% and 6.8% respectively. China is an ASEAN+3 country with the highest annual average growth rate of 10% (EIA, 2019).

The improvement in aggregate demand also plays a role in increasing economic growth, so that the increase in oil prices, which has an effect on inflation, is not accompanied by a decline in economic growth as in the 1970s (Jan van de Ven and Fouquet, 2016). The economic structure of ASEAN+3 countries dominated by consumption is increasing aggregate demand, which in turn would increase economic growth. Almost all ASEAN+3 countries have economic structures driven by consumption (Lescaroux and Mignon, 2008; Dahalan et al., 2015; Pratiwi et al., 2020).

The increase in world oil prices would also trigger an increase in domestic goods prices, as most domestic firms also use oil as raw material for production. The increase in world oil prices would also result to an increase in domestic goods prices, as most domestic companies also use oil as raw material for production (Aisen and Veiga, 2007; Salman et al., 2008; Basher et al., 2012; Baffes et al., 2015; Baharumshah et al., 2016; Jan van de Ven and Fouquet, 2016; Alam et al., 2019). The impact on domestic goods prices would cause the real domestic exchange rate to depreciate against the US dollar. The depreciating domestic exchange rate makes domestic goods more competitive than foreign goods, increasing net exports. This raise in net exports will further improvement domestic production.

Under the free-floating exchange rate regime, the exchange rate is allowed to float according to the market mechanism (Kisswani, 2016). The nominal exchange rate in a country would be largely determined by the supply and demand of domestic exchange rates on the foreign exchange market (Olomola et al., 2006; Iwayemi and Fowowe, 2011; Basher et al., 2012; Kisswani, 2016). The strength of the exchange rate in the forex market is ultimately determined by the scale of the economy of the country. If the economy tends to be a small open economy, exchange-rate

fluctuations tend to be more volatile (Mankiw, 2012). Moreover, whether it is not supported by a strong domestic market structure, high exchange rate volatility seems to depreciate (Olomola et al., 2006; Iwayemi and Fowowe, 2011; Basher et al., 2012; Mohaddes and Pesaran, 2016)

The provision of fuel subsidies in many countries also encourages economic development. According to research conducted by Resosudarmo (2012); Braithwaite et al. (2012); Garnaut (2015); (Deendarlianto et al. (2017); Ramadhan et al. (2019) the policy of subsidizing fuel prices and LNG (increase in subsidies and actual subsidies) has contributed to an increase in Indonesia's real GDP, which has also raised the rate of economic growth. It was based on the fact that the value of government spending has increased significantly relative to the value of consumption, investment and net exports. This policy allows customers to purchase more fuel and LNG since the market sale price of fuel and LNG has decreased (Braithwaite et al., 2012). However, according to Ramadhan et al. (2019) fuel subsidies are a bad creature because Indonesia has a number of other sources of energy. According to him, the issue of fuel subsidies is closely linked to the country's very high reliance on fuel in its national energy usage, so a step out of the fuel subsidy trap is required. Part of the issue of fuel subsidies can be resolved by the implementation of national energy management, which emphasizes the efficiency of fuel consumption and the development of diversification of energy sources, as illustrated by the development of energy installed capacity (Braithwaite et al., 2012; Ramadhan et al., 2019).

The implementation of the policy on fuel subsidies has also caused controversy. On the one hand, subsidies may help to reduce people's purchasing power, and on the other hand, subsidies program becomes a burden on the government budget (Resosudarmo, 2012). The distribution of subsidies should take into account precisely those most in need of assistance and their economic impact on society as a whole. Restriction of subsidies will also generate environmental degradation and, if implemented, it would be difficult to eliminate them because they are vulnerable to the development of special interests and dominant rent-seeking behavior (Braithwaite et al., 2012; Tullock, 2013; Kim and Hammoudeh, 2013; Kurihara, 2015; Ramadhan et al., 2019). Fuel price incentives are considered insufficient to deal with the impact of rising oil prices, despite that world oil prices are continuously rising. For that kind of reason, shifting price subsidies to direct subsidies is one of the targets for the energy mix in Indonesia.

Meanwhile, the result also shows that the rate of change in the standard of education has a positive but insignificant impact on economic growth. Every 1% increase in the rate of change in oil prices would lead to an increase in economic growth of 0.0006%, ceteris paribus. The research also indicates that an increase in the level of education suggests an increase in human capital, which in turn generates the productivity of the workforce and subsequently increase economic growth.

## 5. CONCLUSION

Annual average oil prices increased significantly during the years 2009-2018, an increase of 32.47% per year. In the same time,

the average inflation and economic growth in the ASEAN+3 countries show that each growth in 3.31%. In addition, there was a rise in world oil prices, generally followed by an increase in inflation in the respective ASEAN+3 countries, except Indonesia in that periods. This is related to the implementation of very high subsidies for fuel prices in Indonesia.

Meanwhile, so many other countries have introduced a fuel tax in order to match the increase in world oil prices. The objective of implementing subsidies is to reduce the effect of increasing inflation, while introducing fuel taxes would have an impact on inflation. The study results show that the relationship between world oil prices and economic development in many ASEAN+3 countries is generally positive except in Japan, the Philippines and Thailand. It indicates that the huge increase in world oil prices is not always accompanied by negative economic growth. Similarly, there is a positive relationship between world oil prices and economic development in, among others, Indonesia and Malaysia, since both countries are exporters of crude oil and its processed products.

In contrast, the research also found that the significant increase in the rate of change in world oil prices triggers inflation in ASEAN+3 countries. It was related to the reasons that ASEAN+3 countries do not generally subsidize fuel prices. An increase in oil prices may also result in an increase in the prices of other goods, such as the price of fuel oil goods and services, and an increase in the prices of other commodities (rice, rubber, palm oil, coffee, gold, silver, coal, natural gas, and other mining materials). The high price of oil has also promoted the growth of biofuel production as a renewable energy source. The change in the use of a large number of commodities originally used only as food to become raw materials for the biofuel industry (e.g. palm oil, corn, wheat, soybeans) has eventually contributed to price increases. Moreover, the increase in oil prices also contributes to an increase in the fiscal deficit where one of the factors of inflation is the result of a fiscal imbalance. The role of the government in the distribution of targeted incentives (subsidies), the implementation of fuel taxes, and the regulation of the monopoly system in energy sectors.

In this study, it is known that the increase in the rate of change in world oil prices has led significantly to economic growth in ASEAN+3 countries. These are related to an improvement in income earned from the export of crude oil and its processed products, an increase in incomes of other commodity exporting countries whose prices were followed by an increase in oil prices and a decrease in oil intensity. The decline in oil intensity is related to initiatives to reduce oil consumption and technological changes that play a role in the economy so that rising oil prices are no longer too disrupted. Today's economy is more service-based, not manufacturing-based. In particular, the service industry consumes less energy to produce than the industrial sector. The growth in aggregate demand also plays a role in increasing economic growth, so that the increase in oil prices, which has an impact on inflation, is not accompanied by a decline in economic growth as in the 1970s. The increase in aggregate demand was due to the economic structure of ASEAN+3 countries, which was dominated by demand and higher exports due to the depreciating domestic exchange rate, which made domestic

goods more competitive than foreign goods. Economic growth has a negative and significant effect on inflation. High inflation is also characterized by a contraction in GDP where high inflation is associated with poor macroeconomic performance. Besides that, inflation has a disruptive and significant effect on economic growth. High inflation is having a negative impact on economic growth and social security. High inflation induces high social costs to be paid by governments, businessmen and society. An increase in the price level would reduce the stock of real money, which in turn contributes to a decrease in demand and output. In general, inflation increases the cost of produce and transport and decreases people's purchasing power, which has a negative impact on the economy.

Inflation and economic growth have been positively affected by inflation and economic growth in the previous year, but not significantly in ASEAN+3 countries It implies that there is no persistent inflation, the insignificance suggests that current inflation is not influenced by inflation in the previous year (backward-looking), but is influenced by inflation expectations (forward-looking). However, to assess market risk due to world price volatility, multiple proxies, particularly those with current issues other than economic phenomena, for including the global pandemic that attacked most of the world's economic market activities in early 2020 also need to be considered in further study.

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