

## MODELLING INDONESIAN OIL AND GAS EXPORT

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### Abstract

This study investigates factors affecting Indonesian oil and gas export to six main importing countries. A simultaneous equation model containing demand and supply equation is used to analyze the problem. A two-stage least squares method is employed to estimate the model. The results show that exchange rate does not statistically influence Indonesian oil and gas export demanded. It also finds that the Gross Domestic Product (GDP) of importing countries and Indonesian oil and gas price statistically affect the demand. From the supply model analysis, price statistically affects Indonesian oil and gas export supplied. In addition, Indonesian oil and gas production influences the supply.

**Keywords:** Oil and gas export, simultaneous equation model, exchange rate, GDP

**JEL classification number:** F40, Q41

### Abstrak

Studi ini menyelidiki faktor-faktor yang mempengaruhi ekspor minyak dan gas Indonesia ke enam negara importir utama. Model permintaan dan penawaran digunakan untuk menganalisis ekspor migas Indonesia dalam bentuk persamaan simultan. Metode Two-Stage Least Squares (2SLS) dipakai untuk mengestimasi persamaan simultan tersebut. Hasil studi menunjukkan bahwa kurs tidak berpengaruh terhadap permintaan ekspor migas Indonesia. Studi ini juga menemukan bahwa Produk Domestik Bruto (PDB) negara pengimpor dan harga migas Indonesia berpengaruh terhadap permintaan ekspor migas Indonesia. Dari hasil analisis model penawaran didapatkan bahwa harga dan produksi migas Indonesia mempengaruhi penawaran ekspor migas Indonesia.

**Kata Kunci:** Ekspor minyak dan gas, model persamaan simultan, kurs, PDB

**JEL classification numbers:** F40, Q41

### INTRODUCTION

Indonesia as a developing country has conducted international trade for a long time. In most countries, international trade has a significant share on Gross Domestic Product (GDP). As Ibrahim (2002) shows in his finding, international trade contributed significantly on economic growth and productivity. International trade is the exchange in goods and services between different countries. Export and import are the parts of international trade activity. Exports and im-

ports of Indonesia are about 22% of its GDP in 2010. It means that international trade has a significant role in Indonesian GDP as it can also increase Indonesian international reserves (Anoraga, 2004). Hence, the government gives more attention on export in its nation development program (so called an export-led growth). Export-led growth or export promotion means that export becomes the growth engine for increasing economic growth (Ali-man and Purnomo, 2001).

Indonesian export account can be divided in two parts, namely oil and gas export and non-oil and gas export. Up to 1986, oil and gas export still dominated Indonesian export, though its portion has been falling since then. Therefore, since 1987, Indonesian export has been mainly dominated by non-oil and gas export. Nevertheless, since 2003 Indonesia has become a net oil importer country because of continuously declining crude oil production, increased consumption, and disappointing exploration efforts. Consequently, Indonesia pulled out of OPEC in the early 2009 (Djumena, 2008).

Net oil importer means that on one hand Indonesia still exports crude oil, but on the other hand it also imports refinery products which their prices are relatively higher than crude oil. Refinery product is derivatives of crude oil, such as gasoline, diesel fuel, asphalt base, heating oil, kerosene, and liquefied petroleum gas (LPG). The fluctuations of crude oil production which steadily declines since year 2000 are one of several factors causing Indonesian oil and gas export to decline. When Indonesia was hit by monetary crisis in 1998, Indonesian exchange rate on USD suffered from great depreciation up to Rp14,900. In the same year, oil and gas export values also declined to USD 7,872.3 million. This phenomenon may indicate that there probably exists a relationship between exchange rate and oil and gas export.

The purpose of this study is to test whether there are evidence that importer's income, oil and gas price, exchange rate, and Indonesian oil and gas production influence Indonesia oil and gas export using data for 6 countries for the period of 2003q1 to 2010q4; utilizing the two-stage least squares (2SLS) technique.

There are some international trade theories developed by noted economists. However only described two theories that possibly best explain our purpose, namely Heckscher-Ohlin (H-O) theory and vent for

surplus theory. At first, H-O theory or Factor Proportions theory was developed as an alternative to comparative advantage theory. Eli Heckscher (1879-1952) and Bertil Ohlin (1899-1979) developed an international trade theory called factor proportions theory, also known as H-O theory. This theory stresses that the relative differences in factor endowments and factor of production prices are the most important determinants of trade (with the assumption that technology and taste is not change among countries at a time). This theory contends that countries should produce and export the goods which require abundant resources (factors) and import the goods which are scarce and expensive factor. For instance, Indonesia exports mostly labor intensive products (yet unskilled workers) or domestically abundant-raw materials such as crude oil, coal, agriculture outputs, etc. (Savitri, 2007).

Second, vent for surplus theory was developed by Hla Myint into development economics study. It stated that a country will export its products if there exists excess supply in domestic market. The premise is its domestic economy is too small to absorb all the output of its market, then generating a surplus (Oiconita, 2006). Excess supply can be due to the declining of domestic consumption, namely decreasing household consumption, people do not interested in the goods anymore, or government's strictly prohibition for medical reasons (such as cigarette causes cancer); whereas its productions are not change.

In general, the importance of international trade especially for developing countries as Indonesia is namely; (1) it allows countries to export goods whose production makes relatively heavy use of resources that are locally abundant while importing goods whose production makes heavy use of resources that are locally scarce, (2) it allows countries to specialize in producing narrower ranges of goods, giving them greater efficiencies of large-scale

production, and (3) it is not limited to trade in tangible goods. International migration and international borrowing and lending are also form of mutually beneficial trade-the first a trade of labor for goods and services, the second a trade of current goods to the promise of future goods.

In line with previous theories, Hendro (1997) concludes that Rupiah real exchange rate has a significant effect on exports, evidenced by the high response of the fluctuations of Rupiah value on total export. When depreciations occur, exports will tend to rise. Smith (2004) found that the real TWI<sup>1</sup> (Trade Weighted Index) exchange rate has sizeable effect on export volumes; the low measured elasticity of export volumes needs to be considered in the sense of the large cyclical movements in the TWI exchange rate. He also found that export sectors respond differently to the same exchange rate movement, with exports of services volumes (which include tourism) have more exchange rate sensitivity than export volumes from the agricultural sector.

Kusumawati (2000) uses simultaneous equation model to estimate Indonesian export of manufacture to the United States. From export price side, she concludes that foreign price, country partner income, and manufacture export demanded have significant effects on export price of manufactures. Foreign price and country partner income have positive effects, while export quantity has negative effect on export price. In addition, if it is observed from export quantity, the domestic demand and exchange rate volatility have no significant effects on export quantity. Yet, relative price and domestic production capacity have significant effects. Relative price has a negative effect, while production capacity has a positive effect.

Komaludin et al. (2005) studied the relationship among several macro economic variables, namely Gross Domestic Product (GDP), SBI rate, Customer Price Index (CPI), and Exchange Rate on the oil export and non-oil and gas export demand in Indonesia for period 1994-2005. The finding shows that the exchange rate and CPI has no significant effect on both oil and Indonesian non-oil and gas export. However, SBI rate has negative significant effect and GDP has positive significant effect.

Using data for 1971-2008, Dargay and Gately (2010) estimated the changes in price and income on world oil demand, disaggregated by product for six groups of countries. They concluded that world oil demand is now dominated by transport and other oil, which are less price-responsive and more income-responsive than residual and heating oil. Similarly, the regional shift of world demand away from the OECD and FSU<sup>2</sup> has the same effect toward regions whose income growth and income-elasticities of demand are higher, and whose price-elasticities are lower, than for the OECD and FSU". Or in other words, world oil demand has shifted toward products and regions which are faster growing and less price-responsive.

Based on the previous theories and studies, this study investigates both demand and supply sides of Indonesian oil and gas export to selected countries, namely Japan, Australia, People's Republic of China, the United States of America, South Korea, and Singapore. Demand side analysis for Indonesian oil and gas export to foreign countries involves some variables real GDP of foreign countries, Indonesian crude oil prices sold to foreign countries, Indonesian real exchange rate against foreign countries and supply side analysis for Indonesian oil and gas export values supplied by Indonesia includes some variables such as Indone-

<sup>1</sup> TWI is a measure of movements in the New Zealand dollar against the currencies of New Zealand's major trading partners. The currencies comprise the US dollar, the Australian dollar, the Japanese yen, the euro and the UK pound.

<sup>2</sup> OECD stands for Organization for Economic Cooperation and Development, while FSU stands for Former Soviet Union.

sian crude oil prices and Indonesian oil and gas production.

## METHODS

This study considers the six largest importer countries that import oil and gas commodity from Indonesia. Those countries are Japan (33.12%), South Korea (20.35%), Singapore (14.82%), Australia (6.71%), China (5.75%), and the United States (3.35%) in 2010. The data are gathered from various institutions such as Statistics Indonesia/BADAN PUSAT STATISTIK, Pertamina, International Monetary Fund (IMF), Asian Development Bank (ADB), US Energy Information Agency (EIA), OPEC, Ministry of Energy and Mineral Resources Republic of Indonesia, ESRI (Economic and Social Research Institute), and others that related to this study.

In this study, we use two models to explain the behavior of Indonesian oil and gas export, namely demand model and supply model. These models used in my research were adopted from models developed by Kusumawati (2000) with some modifications, specifically the exchange rate variable she used was put in supply model, whereas mine is in demand model. The reason is that Indonesia is one of oil and gas exporters in the world. That's why, the fluctuation of real exchange rate is not a fundamental variable in affecting Indonesian oil and gas export to other countries. This was proved by the previous studies, such as Kusumawati (2000) and Komaludin et al. (2005).

The general demand function is as follows:

$$X^D = f(GDP, P, ER) \quad (1)$$

Where  $X^D$  is demand for Indonesian oil and gas export to foreign countries,  $GDP$  is the real GDP of foreign countries,  $P$  is Indonesian (Minas) crude oil prices sold to foreign countries, and  $ER$  is Indonesian real exchange rate against foreign countries.

The general supply function is as follows

$$X^S = f(P, PRODD) \quad (2)$$

where  $X^S$  is Indonesian oil and gas export values supplied by Indonesia, and  $P$  is Indonesian (Minas) crude oil prices, and  $PRODD$  is Indonesian oil and gas production.

Some researchers use log-linear model rather than linear model in estimating their model. The choosing between the two functional forms is crucial because functional form influences the measurement of independent's variable on dependent variable. Misspecification of functional form will cause the misspecification of the error term, thus this will violate the classical assumptions. In the end, the estimates will be biased. In choosing the functional form between linear model and log-linear model, we use MWD test which proposed by J. MacKinnon, H. White, and R. Davidson.

This study estimates each country's case in separate estimation. Therefore, there are six demand-supply model; each model for each country. In other words, this research does not treat the data as a pooled-data. Hence, the above function is expressed as follows:

Demand Model:

$$X_{tk}^D = \alpha_0 + \alpha_1 GDP_{tk} + \alpha_2 P_{tk} + \alpha_3 ER_{tk} + u_{tk} \quad (3)$$

It is expected:  $\alpha_1 > 0$ ,  $\alpha_2 < 0$ , and  $\alpha_3 < 0$ <sup>3</sup>

Supply Model:

$$X_{tk}^S = \alpha_4 + \alpha_5 P_{tk} + \alpha_6 PRODD_{tk} + v_{tk} \quad (4)$$

It is expected:  $\alpha_5 > 0$  and  $\alpha_6 > 0$

Subscript  $t$  stands for time series data (namely for period 2003:1–2010:4) and  $k$  stands for each country involved in this study such as Japan, South Korea, Singapore, Australia, People's Republic of China, and the United States. Finally, in

equilibrium condition, quantity of demand will equal to supply quantity ( $X^D = X^S$ ).

The data used in this study is quarterly time series data of Indonesian oil and gas export values, foreign GDP, prices of oil and gas, exchange rate, and domestic oil and gas production during period 2003:1-2010:4. Sources of data are from various institutions such as Central Bureau Statistics of Indonesia (BADAN PUSAT STATISTIK), Pertamina, International Monetary Fund (IMF), Asian Development Bank (ADB), US Energy Information (EIA), OPEC, ESDM Ministry, ESRI (Economic and Social Research Institute), and other related sources.

Furthermore, to avoid any ambiguities in relation to the variables and measurements used in this study, the study defines (1) Indonesian oil and gas export values constitute the quarterly values of Indonesian oil and gas export in million US Dollar. These values are indirectly obtained by subtracting non oil and gas export from total export. In other words, oil and gas export is equal to total export – non oil and gas export. The values are then adjusted to Indonesian Consumer Price Index (CPI) to change them real values, (2) GDP is the quarterly data of the 6 country's GDP converted to US Dollar currency in billion unit. These nominal GDP are then adjusted to GDP deflator to transform real GDP, (3) Real Exchange Rate is in constant terms after taking inflation into account. CPI is utilized as a proxy for inflation which is expressed in Rp/US\$ for US, Rp/Yen for Japan, and so forth, (4) Indonesian oil and gas prices utilizes the spot price of Indonesian (Minas) crude oil prices sold to foreign countries as its proxy. Then, prices are adjusted to CPI of each foreign country (the real prices) in US Dollar per barrel, and Indonesian oil and gas production is the Minas crude oil production as a proxy excluding Indonesian gas production. The data are in 1000 barrels and obtained from ESDM Ministry and EIA.

### Simultaneous Equation and Two-Stage Least Squares (2SLS) Method

The model used above is a simultaneous equation since there is more than one equation specified above. Moreover, Ordinary Least Squares (OLS) method may not be used to estimate the coefficient for its calculation will be inconsistent. Two-Stage Least Squares (2SLS) method firstly developed by Henry Theil will overcome the bias problem above. The idea behind 2SLS method is to the stochastic endogenous regressor (which is correlated with the error term and causes the bias) with one that is non-stochastic. The non-stochastic variable is independent of the error term. This requires 2 stages:

“Stage 1: Regress each endogenous variable which is a regressor as well, on all of the exogenous and lagged endogenous variables in the entire system by using simple OLS (that is equivalent to estimating the reduced form equations) and obtain the fitted values of the endogenous variables of these regressions ( $\hat{y}$ ). Stage 2: Use the fitted values from Stage 1 as proxies or instruments for the endogenous regressors in the original (structural form) equations.”

Those three equations (for Japan) can be summarized as follows:

Demand:

$$X^D = \alpha_0 + \alpha_1 GDP + \alpha_2 P + \alpha_3 ER + u \quad (5)$$

Supply:

$$X^S = \alpha_4 + \alpha_5 P + \alpha_6 PRODD + v \quad (6)$$

$$\text{Equilibrium: } X^D = X^S \quad (7)$$

where the endogenous variables are  $X^D, X^S$  and  $P$ , and the exogenous variables are  $GDP, PRODD$ , and  $ER$ .

Those equations (1), (2), and (3) are called structural (or behavioral) equations. From the structural equations, we can derive reduced-form equations as follows:

$$X = \Pi_0 + \Pi_1 GDP + \Pi_2 ER + \Pi_3 PRODD + \varepsilon_1 \quad (8)$$

$$P = \Pi_4 + \Pi_5 GDP + \Pi_6 ER + \Pi_7 PRODD + \varepsilon_2 \quad (9)$$

To apply 2SLS method, we proceed as follows:

STAGE 1: Regress the Eq. 19 above. Thus:

$$\hat{P} = \hat{\Pi}_4 + \hat{\Pi}_5 GDP + \hat{\Pi}_6 ER + \hat{\Pi}_7 PRODD + \varepsilon_2$$

$$P = \hat{P} + \hat{\varepsilon}_1 \Leftrightarrow \hat{P} = P - \hat{\varepsilon}_1$$

STAGE 2: Finally, substitute  $\hat{P}$  into Eq. 15 and 16, yields:

$$\text{Demand: } X = \alpha_0 + \alpha_1 GDP + \alpha_2 \hat{P} + \alpha_3 ER + u^*$$

$$\text{Supply: } X = \beta_0 + \beta_1 \hat{P} + \beta_2 PRODD + v^*$$

Before estimating the 2SLS method, each equation needs to be “identified”. If the result shows that each equation is just-identified and/or over-identified, 2SLS method can be used to estimate the coefficients. The model identification procedure shows that the demand equation is *just-identified* and supply equation is *over-identified*. If we use two-stage least squares (2SLS) method on simultaneous equation, it will yield estimators of variables which consistent and efficient. Yet, when 2SLS is applied on non-simultaneous equation (i.e

single equation), the estimators are consistent but not efficient. Single equation is best estimated by ordinary least squares (OLS) since it yields consistent and efficient estimators. Therefore, a test of simultaneity is needed to find out whether the estimated equation is a simultaneous equation or a single equation. Hausman specification test can be used to test the simultaneity. The simultaneity test shows that the simultaneity problem exists in each model (consists of 6 countries), so the demand-supply model is a simultaneous equation.

## RESULTS

In estimating simultaneous equation, Two Stage Least Squares Method (2SLS) is applied. The values of the parameters of variables can be shown in Tables 1 and Table 2. To describe the relationship sign/direction of each variable, this study formulates the results in the form of equations.

### Export Demand Model

In this model, it is assumed that  $GDP$ ,  $P$ , and  $ER$  affect Indonesian oil and gas export values. The estimation result of Indonesian oil and gas export by using demand model is tabulated in Table 1.

**Table 1:** Estimation Results of Indonesian Oil and gas Export, Demand Model

Variable	Coeff.	t-stat.	p-value	Variable	Coeff.	t-stat.	p-value
Japan				South Korea			
$C$	12941.500	1.0577	0.2992	$C$	-411.0158	-1.3627	0.1838
$GDP$	2.9966	0.5236	0.6047	$GDP$	6.7034	2.4436	0.0211
$P$	-73.7624	-0.7585	0.4545	$P$	-8.8656	-1.7641	0.0886
$ER$	-126.7404	-0.7866	0.4381	$ER$	51.3873	1.0812	0.2888
Singapore				Australia			
$C$	1683.3150	0.1511	0.8810	$C$	-373.5851	-1.1413	0.2634
$GDP$	160.0667	0.2816	0.7803	$GDP$	3.6728	0.8108	0.4243
$P$	-79.7354	-0.2487	0.8054	$P$	-4.7449	-0.4661	0.6448
$ER$	-0.4718	-0.2003	0.8427	$ER$	0.0285	0.7270	0.4733
China				United States of America			
$C$	-187.7558	-0.5769	0.5686	$C$	2375.6950	1.6932	0.1015
$GDP$	-0.2540	-1.7221	0.0961	$GDP$	-0.7872	-1.8242	0.0788
$P$	13.2871	2.9967	0.0057	$P$	3.6289	1.4307	0.1636
$ER$	0.1787	1.1965	0.2415	$ER$	0.0070	0.2628	0.7946

**Table 2:** Estimation Results of Indonesian Oil and gas Export, Supply Model

Variable	Coeff.	t-stat.	p-value	Variable	Coeff.	t-stat.	p-value
Japan				South Korea			
<i>C</i>	-6139.6460	-4.3008	0.0002	<i>C</i>	-4292.4870	-2.1666	0.0386
<i>P</i>	20.7116	4.4017	0.0001	<i>P</i>	19.5623	2.1950	0.0363
<i>PRODD</i>	0.0734	5.7478	0.0000	<i>PRODD</i>	0.0418	2.6509	0.0129
Singapore				Australia			
<i>C</i>	-2743.5140	-1.2155	0.2340	<i>C</i>	-633.6529	-1.0245	0.3141
<i>P</i>	18.8343	2.0815	0.0463	<i>P</i>	6.0629	2.4861	0.0189
<i>PRODD</i>	0.0212	1.1218	0.2712	<i>PRODD</i>	0.0059	1.1495	0.2597
China				United States of America			
<i>C</i>	-164.6673	-0.2960	0.7693	<i>C</i>	-464.3164	-1.5783	0.1253
<i>P</i>	10.8153	3.0065	0.0054	<i>P</i>	0.0941	0.0693	0.9452
<i>PRODD</i>	0.0016	0.3159	0.7543	<i>PRODD</i>	0.0064	2.3220	0.0275

According to Table 1, the Indonesian oil and gas export demand model to each country can be formulated in the form of equation as follows:

Japan:

$$\hat{X}_D = 12941.55 + 2.9966 GDP - 73.7624 P - 126.7404 ER$$

South Korea:

$$\hat{X}_D = -411.158 + 6.7034 GDP - 8.8656 P + 51.3873 ER$$

Singapore:

$$\hat{X}_D = 1683.315 + 160.0667 GDP - 79.7354 P - 0.4718 ER$$

Australia:

$$\hat{X}_D = -373.5851 + 3.6728 GDP - 4.7449 P + 0.0285 ER$$

China:

$$\hat{X}_D = -187.7558 - 0.254 GDP + 13.2871 P + 0.1787ER$$

**Export Supply Model**

In this model, it is assumed that *P* and *PRODD* affect Indonesian oil and gas export values (*X*). The estimation result of the export supply model is tabulated in Table 2 as follows.

According to Table 2, the Indonesian oil and gas export supply model to each country can be formulated in the form of equations as follows:

Japan:

$$\hat{X}_S = -6139.646 + 20.7116 P + 0.0734 PRODD$$

South Korea:

$$\hat{X}_S = -4292.487 + 19.5623 P + 0.0418 PRODD$$

Singapore:

$$\hat{X}_S = -2743.514 + 18.8343 P + 0.0212 PRODD$$

Australia:

$$\hat{X}_S = -633.6529 + 6.0629 P + 0.0059 PRODD$$

China:

$$\hat{X}_S = -164.6673 + 10.8153 P + 0.0016 PRODD$$

United States:

$$\hat{X}_S = -464.3164 + 0.0941 P + 0.0064 PRODD$$

**Indonesian Oil and Gas Export to Japan**

Demand Model: All independent variables (*GDP*, *P*, and *ER*) are not statistically significant at 10% level of significance (see Table 1). In addition, the negative sign of *ER* variable is different from hypothesis suggested, whereas coefficients of *GDP* and *P* variables have the same sign with the

hypothesis suggested. Thus, those three variables do not affect Indonesian oil and gas export demanded ( $X_D$ ).

Supply Model: All coefficients of independent variables are statistically significant at 10% significance level and their coefficients' signs have the sign with hypothesis suggested. Indonesian oil and gas price ( $P$ ) positively significantly affects Indonesia oil and gas export demanded ( $X_D$ ) of 20.7116. Meaning, a 1 USD/barrel increase of Indonesian oil and gas price ( $P$ ) will raise Indonesia oil and gas export supplied ( $X_S$ ) of 20.7116 million USD. Meanwhile, variable of Indonesian oil and gas production ( $PRODD$ ) positively significantly affects Indonesian oil and gas export supplied ( $X_S$ ) of 0.0734. Meaning, every increase of 1000 barrel of Indonesian oil and gas production ( $PRODD$ ) will increase Indonesia oil and gas export supplied ( $X_S$ ) of 0.0734 million USD.

#### ***Indonesian Oil and Gas Export to South Korea***

Demand Model: All coefficients of independent variables ( $GDP$ ,  $P$ , and  $ER$ ) have the same sign with hypothesis suggested. Nevertheless, there are only two variables (namely  $GDP$  and  $P$ ) that are significant at 10% significance level, whereas  $ER$  is not significant at such level. The coefficients of  $GDP$  and  $P$  are 6.7034 and  $-8.8656$ , respectively. It means that every increase of 1 billion USD of South Korea's  $GDP$  will increase Indonesian oil and gas export demanded ( $X_D$ ) of 6.7034 million USD. Whereas, every increase of 1 USD/barrel Indonesia oil and gas price ( $P$ ) will decrease Indonesian oil and gas export demanded ( $X_D$ ) of 8.8656 million USD.

Supply Model: Coefficients of  $P$  and  $PRODD$  are found to have positive effects on Indonesian oil and gas export demanded ( $X_D$ ) at 10% significance level and they also have the same sign with hypothesis suggested. Both coefficients are 19.5623 and 0.0418. It means that an increase of 1

USD/barrel Indonesia oil and gas price ( $P$ ) will raise Indonesian oil and gas export supplied ( $X_S$ ) of 19.5623 million USD. Furthermore, every increase of 1000 barrel Indonesia oil and gas production ( $PRODD$ ) will increase Indonesian oil and gas export supplied ( $X_S$ ) of 0.0418 million USD.

#### ***Indonesian Oil and Gas Export to Singapore***

Demand Model: All coefficients of independent variables ( $GDP$ ,  $P$ , and  $ER$ ) are not significant at 10% significance level. The negative sign of variable coefficient  $ER$  is different from the suggested hypothesis, whereas coefficients of  $GDP$  and  $P$  have the same sign with hypothesis. Thus, those three variables do not affect Indonesian oil and gas export demanded ( $X_D$ ).

Supply Model: Coefficient of  $P$  is significant at 10% level of significance and it also has a positive sign which is in line with the suggested hypothesis. Coefficient of  $PRODD$ , however, is not statistically significant at such level, though its sign is positive which is supported by the hypothesis. The coefficient of  $P$  is 18.8343; which means that an increase of 1 USD/barrel Indonesia oil and gas price ( $P$ ) will raise Indonesian oil and gas export supplied ( $X_S$ ) of 18.8343 million USD.

#### ***Indonesian Oil and Gas Export to Australia***

Demand Model: Even though all coefficients of independent variables ( $GDP$ ,  $P$ , dan  $ER$ ) have the same sign with the proposed hypothesis, all of them are not significant at 10% significance level. Thus, those three variables do not affect Indonesian oil and gas export demanded ( $X_D$ ).

Supply Model: Although coefficients of independent  $P$  and  $PRODD$  have the same sign with hypothesis, only  $P$  which is significant at 10% significance level, whereas  $PRODD$  is not significant at such level. The coefficient of  $P$  is 6.0629 which means that an increase of 1



USD/barrel in Indonesia oil and gas price ( $P$ ) will raise Indonesian oil and gas export supplied ( $X_S$ ) of 6.0629 million USD.

#### ***Indonesian Oil and Gas Export to China***

Demand Model: Of three independent variables, two (namely  $GDP$  and  $P$ ) are statistically significant at 10% significance level, yet their signs are different from the suggested hypothesis. In contrast, coefficient of  $ER$  has the same sign with hypothesis but it is not significant at such level. Coefficients of  $GDP$  and  $P$  are  $-0.254$  and  $13.2871$  respectively, which means that for an increase of 1 billion USD China's  $GDP$  will decrease Indonesian oil and gas export demanded ( $X_D$ ) of  $-0.254$  million USD. Furthermore, for an increase of 1 USD/barrel Indonesia oil and gas price ( $P$ ), it will raise Indonesian oil and gas export supplied ( $X_S$ ) of  $13.2871$  million USD.

Supply Model: Coefficient of  $P$  is significant at 10% significance level and it has positive sign which is the same with hypothesis suggested. However, the coefficient of  $PRODD$  is not significant at such level and it is also a positive sign. The coefficient of  $P$  is  $10.8153$ ; which means that for an increase of 1 USD/barrel Indonesian oil and gas price ( $P$ ), it will increase Indonesian oil and gas export supplied ( $X_S$ ) of  $10.8153$  million USD.

#### ***Indonesian Oil and Gas Export to United States of America***

Demand Model: There is only one variable, namely  $GDP$ , which is significant at 10% significance level, yet its negative sign is different from the proposed hypothesis. The other variables ( $P$  and  $ER$ ) are not significant at such level. Coefficient of  $GDP$  is  $-0.7872$  which means that for an increase of 1 billion USD of United States'  $GDP$ , it will reduced Indonesian oil and gas export demanded ( $X_D$ ) of  $0.7872$  million USD.

Supply Model: Coefficient of variable  $PRODD$  is significant at 10% level of

significance and it is also a positive sign which is in line with the suggested hypothesis. On the contrary, coefficient of  $P$  is not significant at such level, yet it has a positive sign which is of similar sign with the proposed hypothesis. The coefficient of  $PRODD$  is  $0.0064$ , which means, an increase of 1000 barrel Indonesian oil and gas production will raise Indonesian oil and gas export supplied ( $X_S$ ) of  $0.0064$  million USD.

#### **Economic Analysis**

Economic analysis considers about direction/sign and magnitude of independent variables' parameters and connects it with economic theories which are classified into two groups, (1) economic analysis of export demand model and (2) economic analysis of export supply model. First, Based on Table 1, the sign/direction of independent variables ( $GDP$ ,  $P$ , and  $ER$ ) coefficients for each country is different one to another. It is also found that those coefficients for each country have different significance level. Some are significance at 10% level, whereas some others are not. Meaning, when the coefficient of one independent variable is significantly different from zero, that independent variable influences dependent variable ( $X$ ).

$GDP$  variable coefficient is significant at 10% level for South Korea, China, and United States.  $P$  variable is significant at 10% level for South Korea and China. Furthermore,  $ER$  variable is not significant at 10% level for all countries. Foreign income  $GDP$  for China and United States is negative though they are significant at 10% significance level. That negative sign is different from hypothesis that should be positive. This might be of Indonesian oil and gas exports to the both countries are smaller (in quantity) or limited than other oil-producer countries exports. Thus, when both countries'  $GDP$  rise rapidly, they need more oil and gas to carry out their economy. While Indonesia cannot fulfill their oil and gas

needs, they then look for (and, later, switch to) other countries (may be Russia) which can probably provide their oil and gas needs. Hence, the higher importers' *GDP*, the lower Indonesian oil and gas exports demanded ( $X_D$ ).

The sign/direction of coefficient of Indonesian oil and gas prices ( $P$ ) for China is positive and is significant at 10% significance level. That positive sign is also different from research the suggested hypothesis. It means that the higher Indonesian oil and gas prices ( $P$ ), the higher oil and gas exported demanded ( $X_D$ ). This might be the result of this two following reasons. Firstly, in this research, Indonesian oil and gas export is described in terms of value, not volume. Export value is defined as (price  $\times$  quantity). Therefore, the export value increases as the price increases largely and the quantity fixed (or quantity decreases in small amount). Secondly, importer countries worry about the possibly large decreasing of world's oil and gas supply due to political instability and war which is occur in the main oil producer countries, such as Iraq and Nigeria. Hence, the importer countries import more oil and gas to save/increase their domestic oil and gas stock. Consequently, the oil prices keep increasing because of inclining demand and decreasing supply. Though the oil prices are high, those importer countries still import oil and gas because they need it to run their economic activity. In addition, coefficient of  $ER$  for every country is not significant at 10% significance level. It means that  $ER$  does not affect Indonesian oil and gas export demanded ( $X_D$ ).

Second, based on Table 2, the significance of coefficient of  $P$  and  $PRODD$  varies for every country, yet many of them are significant at 10% level of significance. Furthermore, all of them are positive sign for every country, so they are in line with research the suggested hypothesis. The coefficient of Indonesian oil and gas price ( $P$ ) for the United States is not significant at

10% level. It means that  $P$  does not affect Indonesian oil and gas export supplied ( $X_S$ ). The reason is that Indonesia as oil and gas producer cannot increase its supply when oil prices ( $P$ ) go up (to seek more profit) because its oil and gas production is limited.

Moreover, the coefficient of Indonesian oil and gas production ( $PRODD$ ) is not significant at 10% level for Singapore, Australia, and China. It means that  $PRODD$  does not affect Indonesian oil and gas export supplied ( $X_S$ ). The reason is that Indonesia cannot increase its oil and gas production ( $PRODD$ ) anytime because the domestic oil fields are so mature that they have low productivity. Hence,  $P$  and  $PRODD$  do not influence Indonesian oil and gas export supplied.

## CONCLUSION

The data used in the models are estimated by using simultaneous equation, specifically using two-stage least squares (2SLS) method. For the demand model, the coefficient of  $GDP$  significantly influences the demand for Indonesian oil and gas export to South Korea, China, and United States of America.  $P$  has a significant effect on the demand for Indonesian oil and gas export to South Korea and China. Furthermore,  $ER$  does not affect significantly the demand for Indonesian oil and gas export to all countries. Foreign  $GDP$  for China and the United States of America are negative though they are significant. That negative signs are different from the hypothesis. The low Indonesian oil and gas export compared to Middle East's oil and gas export to the six selected countries is possibly the cause of  $GDP$  coefficient being negative. The sign/direction of coefficient of Indonesian oil and gas prices ( $P$ ) for China is positive and is significant. That positive sign is also different from the suggested hypothesis. The possible reason of  $P$  coefficient to be positive is that, Indonesian oil and gas export is described in term of value, not

volume. In this study, export value is defined as (price  $\times$  quantity). Therefore, the export value increases as the price increases largely and the quantity fixed (or quantity decreases in small amount). The positive sign of  $P$  coefficient might be caused by the decrease in oil and gas supply in the main oil and gas exporter countries that suffer from political instability. At the same time, oil and gas importer countries are concern about those conditions and start thinking that the instability will not end in a short period. Hence, they continuously keep importing oil and gas for the safety of their domestic oil and gas stock.

For the supply model, the sign/direction of coefficients of  $P$  and  $PRODD$  are positive for all country, so they are in line with the suggested hypothesis. The coefficient of  $P$  is significant for all countries but the United States of America. Furthermore,  $PRODD$  is significant for Japan, South Korea, and the United States of America. The possible reason of why  $P$  is

not significant is because Indonesia as oil and gas producer cannot increase its supply when oil prices ( $P$ ) is increasing (to seek more profit) because its oil and gas production is limited. The possible reason of why  $P$  not significant is because Indonesia cannot manage to increase its production anytime due to OPEC quota (when Indonesia is still the member of OPEC) and the mature oil fields so that they do not productive anymore (since year 2000).

This study still has some limitations not only in organizing the data but also in applying the model. Therefore, it is looking forward to investigating the phenomena of Indonesian oil and gas export comprehensively whether by using the dynamic model or panel data model. Moreover, it is possible to cover more countries which involve in the further studies. It is expected that further studies are able to show a comprehensive result so that it gives some valuable recommendations for the governments regarding the matters.

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