

## The Impact of Ethylene Price Change on Polyethylene Industry, Industrial Resin Synthetic Materials and Price of World Crude Oil at Indonesian for 2007-2017

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**Abstract:** The objective of the research is to recommend the model on Price of Ethylene in terms of Supply Resins Synthetic Material, Demand Plastic Industry, Indirect Cost Polyethylene, Labour Cost Polyethylene, Demand Manufacturing Industry, Polyethylene and Oil Price in 2007-2017 period. The results will be published in reputable journals. The objectives of the research are 1) To analyze the effect of the Supply Resins Synthetic Material, Demand Plastic Industry, Indirect Cost Polyethylene, Labour Cost Polyethylene, Demand Manufacturing Industry, Polyethylene and Oil Price to Price of Ethylene in 2007 - 2017, 2); Analyzing the most powerful factors affect Price of Ethylene on Supply Resins Synthetic Material, Demand Plastic Industry, Indirect Cost Polyethylene, Labour Cost Polyethylene, Demand Manufacturing Industry, Polyethylene and Oil Price in the period 2007-2017. Some of the analytical tools used are Multiple Regression Equations with through the Multicollinearity Test, Heterokedastisitas Test, Autocorrelation Test because if there is a deviation then the t test and F test done previously become invalid. The research stages are literature study and retrieve data from several media Outline of research in the form of international journal publications. The results of the study indicate that the Indirect Cost Polyethylene, Labour Cost Polyethylene, Supply Resins Synthetic Material, Polyethylene and Oil Price have a significant influence on Price of Ethylene. The Supply Resins Synthetic Material, Indirect Cost Polyethylene and Polyethylene Pricee have a positive impact while the Labour Cost Polyethylene and Oil Price have a negative impact on Ethylene Price in Indonesia.

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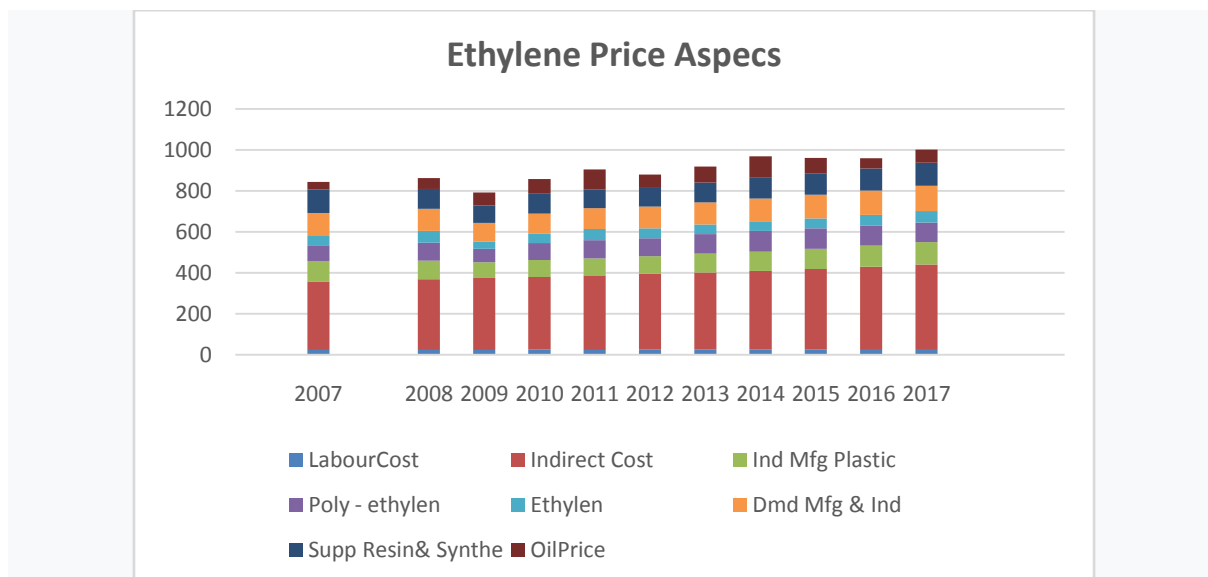
### I. Introduction

The current petrochemical industry derived from petroleum whose industries are still mostly in the upstream sector include olefin, aromatic, ethylene, propylene, butadiene, benzene, toluene and xylene. So many derivatives are directly in the form of plastics, synthesis materials, chemicals, pesticides and others. Some derivatives of ethylene and propylene products have already been produced in Indonesia and some have not yet been developed. Furthermore, the derivatives of ethylene and propylene products in the downstream sector are used for plastic manufacturing (Syamsu, 2015).

The growth of the Ethylene Industry in Indonesia mostly affects the economy that relies on the oil and gas sector. Petroleum is a vital input in the industrial production process, especially for generating electricity, running production machinery and transporting the results of production, the most important of which is petroleum is the driving force of the economy for sustainable economic and social development (Nizar, 2014)

Some statisticians have stated that there is an 80% correlation between petroleum and petrochemical raw materials, which in the downstream sector are the main raw materials in the production of plastic end products. As an illustration of the current petrochemical company in Indonesia that produces raw materials for naphtha and ethylene, PT Chandra Asri Petrochemical Tbk (CAPC) will enjoy benefits when world oil prices fall because companies can buy more raw materials and sell them at a fixed price high. The spread of petroleum prices, naphtha and ethylene is an indicator of the benefits of CAPC as a producer of naphtha and ethylene (Basha, 2014),

Based on Figure 1.0 it can be seen that the lowest Ethylene price occurred in 2009 of \$ 33.94 and the highest price occurred in 2009 of \$ 58.5. Whereas from the most influential microeconomic aspect, Indirect Cost Overhead from Figure 1.0 shows that the lowest Indirect Cost Overhead occurred in 2007 amounting to \$ 334.1 and Indirect Cost Overhead which was the highest in the period 2007-2017 occurred in 2017, namely \$ 412.3 .



Source : PT CAPC and BPS (2018)

**Figure 1.0.** . Data Labor Cost, Indirect Cost, Industry Manufacturing, Supply Material Resins, Demand Manufacturing Industry, Ethylene, Polyethylene, Oil Price in Indonesia 2007 - 2017

## II. Literature Review

Plastic materials gradually began to replace glass, wood and metal. This is because plastic materials have several advantages, namely lightweight, strong and easy to form, anti-rust and resistant to chemicals, have high electrical insulation properties, can be made in color and transparent and cheaper process costs. However, the usefulness of plastic is also limited because of its low strength, heat resistance, easy damage at low temperatures. Diversity of plastic types provides many choices in its use and how to make it (Chatterjee, 2013).

Another macroeconomic factor that is very important and can affect companies that produce petrochemical products is the price of Crude Oil. The price of crude oil has the most basic characteristics and is strongly influenced by changes in the volatility of crude oil prices and reduced crude oil supply in the world market. Volatility of world crude oil prices and reduced supply of crude oil in the world market can be caused by exogenous effects in the form of demand and supply and also strongly influenced by endogenous effects, namely uncertain and volatile political situation in OPEC countries, most of which are countries in Middle East region (Joseph, 2015).

The form of explicit production functions and the equation model approach in the industry of polymers and resins including Polyethylene (LDPE and HDPE) can be done through econometric analysis for price elasticity of supply. This approach is used to estimate the price elasticity of supply using the production function, as described below (Voulgaris, 2014):

$$P_s = f \{P, C, In, M\} (1)$$

Where :

Ps: Price of Ethylene.

C: Overhead and Labor Cost.

M: Material Input (Oil & Ethylene Price).

In: Industry Plastic and Resins.

Q: Price of Group I Polymer and Resin products including Polyethylene.

The petrochemical industry is the main producer of raw materials for other industrial sectors because the end products are mostly still intermediate products or the products are still mostly raw materials for other industries. The increasing use of petrochemical products for industries, according to the needs of industry in Indonesia, can be divided into 8 user industry sectors, namely; fertilizer industry and pesticide industry, synthetic fiber industry, plastic materials industry, adhesive resin industry, paint or coating raw material industry, detergent or washing industry, elastomer industry or synthetic rubber & special chemical industries. (Panjaitan, 2012).

### A. Formulation of Problem

Ethylene prices in Indonesia are fluctuating economic phenomena which are influenced by the Global economy and the macro besides being supported by the ability and quality stability in producing Plastic Seeds (HDPE and LDPE) which indicators are influenced by various things including Polyethylene Prices, Supply

Resins Synthetic Materials, Demand Plastic Industry, Indirect Cost Polyethylene, Labor Cost Polyethylene, Demand Manufactured Industry, Petroleum Prices

On the basis of the above problems, the research question that will be solved in this study is:

- 1). How does the influence of Supply Resins Synthetic Materials, Demand Plastic Industry, Indirect Cost Polyethylene, Labor Cost Polyethylene, Demand Manufacturing Industry, Polyethylene Prices, Petroleum Prices on Ethylene Prices in Indonesia in the period 2007-2017?
- 2). What factors are the most influential on Ethylene Prices in Indonesia in the 2007-2017 period for variables; Price of Polyethylene, Supply Resins Synthetic Materials, Demand Plastic Industry, Indirect Cost Polyethylene, Labor Cost Polyethylene, Demand Manufacturing Industry, Petroleum Prices?

### **B. Research Purposes**

Based on the background and formulation of the problem above, the objectives to be achieved in this study are:

- 1). Analyzing the influence of Polyethylene Prices, Petroleum Prices, Supply Synthetic Material Resins, Plastic Industry Demand, Indirect Cost Polyethylene, Labor Cost Polyethylene, Industry Demand Manufacturing, Ethylene Prices in Indonesia in the period 2007-2017?
- 2). Analyzing the factors that have the most influence on Ethylene Prices in Indonesia in the 2007-2017 period for variables; Price of Polyethylene, Supply Resins Synthetic Materials, Demand Plastic Industry, Indirect Cost Polyethylene, Labor Cost Polyethylene, Demand Manufactured Industry, Petroleum Prices

### **III. Methods**

The research method used in this study is a causal method that aims to test the effect of Ethylene Prices in Indonesia in the period 2007 - 2017 against Labor Cost, Indirect Cost Polyethylene, Supply Resins Synthetic Materials, Demand Plastic Industry, Petroleum Prices, Polyethylene Prices. The technique used to get a representative sample is purposive sampling. The data used in this study is secondary data. Secondary data obtained from the Central Statistics Agency, PT CAPC (Chandra Asri Petrochemical Center), Tbk and KOMPAS Daily

The analytical method in this study uses the method of multiple regression analysis and deviation test against classic assumptions which include multicollinearity test, autocorrelation test, and heteroscedasticity test. In analyzing the factors that influence Ethylene Prices in Indonesia in the period 2007-2017, models are used:

$$\text{LgE} = \alpha + \beta_1 \text{LgPE} + \beta_2 \text{LgSRM} + \beta_3 \text{LgDMI} + \beta_4 \text{LgOP} + \beta_5 \text{LgICP} + \beta_6 \text{LgLCP} + \beta_7 \text{LgDPI} \quad (2)$$

Where :

DPI = Demand Plastic Industry

PE = Polyethylene price

E = Ethylene price

DMI = Demand Manufacturing Industry

SRM = Synthetic Material Supply Resins

OP = Petroleum Price

ICP = Indirect Cost Polyethylene

LCP = Labor Cost Polyethylene

$\alpha$  = constant

Lg = Logarithmic Function

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ : Coefficient - Coefficient

Polyethylene Prices, Supply Synthetic Material Resins, Plastic Industry Demands, Indirect Cost Polyethylene, Labor Cost Polyethylene, Industry Demand Manufacturing, Oil Prices are used as independent variables that are partially or jointly thought to affect Indonesian Ethylene Prices in the period 2007 - 2017.

### **IV. Result**

#### **A. Simultaneous Test (F) [Conformity Model]**

Based on the ANOVA table or F test, the calculated F value is 15,177 with a probability of 0.024. Because the probability is smaller than 0.05, it can be concluded that the regression coefficient Supply Synthetic Material Resins (SRM), Plastic Industry Demand (DPI), Indirect Cost Polyethylene (ICP), Labor Cost Polyethylene (LCP), Demand Manufacturing Industry (DMI), Petroleum Price (OP), Price of Polyethylene (PE). or the seven independent or independent variables simultaneously influence Ethylene Prices in Indonesia in the period 2007 - 2017. This also means the coefficient of determination R<sup>2</sup> is not equal to zero or significant. For more details, see Table 1.0 below:

**Table 1.0** Simultaneous Signification Test (ANOVA)

Model	F	Sig.
	92,356	0,002 <sup>a</sup>

a. Predictors: (Constant), PE, LCP, ICP, OP.SRM, DPI, DMI

b. Dependent Variable: E

Source: Processed Data (2019)

**B. Coefficient of Determination**

The outer appearance of the SPSS summary model shows the amount of Square R<sup>2</sup> of 0.973. This means Ethnicity Prices in Indonesia in the 2007 - 2017. period is 97.3% can be explained by variations of seven independent or free variables; Supply Synthetic Material Resins (SRM), Plastic Industry Demand (DPI), Indirect Cost Polyethylene (ICP), Labor Cost Polyethylene (LCP), Demand Manufacturing Industry (DMI), Petroleum Price (OP), Polyethylene (PE) Prices.

While the rest (100% - 97.3% = 2.7%) is explained by reasons other than the model, the Standard Error of Estimate [SEE] is 0.01897, the smaller the SEE value will make the regression model more precise in predict dependent or dependent variables, for more details can be seen in Table 2.0 below:

**Table 2.0.** Coefficient of Determination.

Model	R	R Square	Durbin-Watson
	0,986 <sup>a</sup>	0,973	2,514

Predictors: (Constant), PE, LCP, ICP, OP.SRM, DPI, DMI

b. Dependent Variable: E

Source: Processed Data (2019)

**C. Multiple Regression Equations**

To interpret the parameter coefficients of independent variables can use unstandardized coefficients or standardized coefficients. Of the seven independent or independent variables included in the model, there were five (5) variables, namely Petroleum Prices (OP), Indirect Cost Polyethylene (ICP), Labor Cost Polyethylene (LCP), Supply Synthetic Material Resins (SRM) and Polyethylene (PE), which is significant at  $\alpha < 5\%$ , this can be seen from the probability of both far below 0.05 [PE = 0.021 < 0.05 & ICP = 0.023 < 0.05 & LCP = 0.013 < 0.05 & SRM = 0.044 < 0.05 & OP = 0.046 < 0.05]. The remaining two (2) independent variables; Demand Plastic Industry (DPI), Demand Manufacturing Industry (DMI), which is influential and insignificant because of  $\alpha > 5\%$ , where DPI = 0.405 > 0.05; DMI = 0.164 > 0.05. For more details, see Table 3 below:

**Table 3.0** Partial Significance Test (t Test).

Model	Unstandardized Coefficients		t	Sig.	Level	Sign
	B				$\alpha \leq 5\%$	No
(Constant)	-8,254		-4,086	0,026	< 5 %	Significant
PE	1,615		4,454	0,021	< 5 %	Significant
DPI	1,545		0,967	0,405	> 5 %	No
ICP	7,697		4,336	0,023	< 5 %	Significant
LCP	-7,149		-5,256	0,013	< 5 %	Significant
SRM	1,839		3,361	0,044	< 5 %	Significant
OP	-0,378		-3,307	0,046	< 5 %	Significant
DMI	-4,389		-1,387	0,164	> 5 %	No

Dependent Variabel : Ethylene(E)

The constant coefficient is negative and significant states that by assuming the absence of variables, Supply Synthetic Material Resins (SRM), Plastic Industry Demand (DPI), Indirect Cost Polyethylene (ICP), Labor Cost Polyethylene (LCP), Demand Manufacturing Industry (DMI), Petroleum Price (OP), Price of Polyethylene (PE). then Ethylene Prices in Indonesia in the 2007-2017 period experienced a decrease of 8,254 units.

- Regression coefficient of positive and significant value of Polyethylene (PE), stated that the price of Polyethylene (E) by assuming the absence of other independent variables, then if there is an increase, then Ethylene Prices in Indonesia in the period 2007-2017 increased 1,615 units.
  - Demand Plastic Industry (DPI) regression coefficient is positive and insignificant, assuming the absence of other independent variables, so if Demand Plastic Industry (DPI) increases, Ethylene Prices in Indonesia in the 2007-2017 period have increased by 1.54 Units.
  - Indirect Cost Polyethylene (ICP) regression coefficient, is positive and significant, that assuming the absence of other independent variables, then if Indirect Cost Polyethylene (ICP) increases, then Ethylene Prices in Indonesia in the period 2007 - 2017 has increased by 7,697 Units.
  - The Labor Cost Polyethylene (LCP) regression coefficient is negative and significant, stating that assuming the absence of other independent variables, then if Labor Cost Polyethylene (LCP) increases then Ethylene Prices in Indonesia in the period 2007 - 2017 decreased by 7,149 Units.
  - Regression coefficient of Synthetic Material Supply (SRM), is positive and not significant, stating that by assuming none of the other independent variables, then if Synthetic Material Supply SRS increases, then Ethylene Prices in Indonesia in the period 2007 - 2017 increase amounting to 1,839 units.
  - The Petroleum Price (OP) regression coefficient is negative and has a significant effect, stating that by assuming the absence of other independent variables, if the Petroleum Price (OP) increases, then Ethylene Prices in Indonesia in the period 2007 - 2017 decreased by 0.378 Units .
  - The Demand Manufactured Industry (DMI) regression coefficient is negative and not significantly influential, stating that by assuming the absence of other independent variables, then if the Demand Manufacturing Industry (DMI) has increased, then Ethylene Prices in Indonesia in the period 2007 - 2017 decreased by 4,389 Unit.
- So So it can be concluded that the Ethylene Price variable in Indonesia in the period 2007 - 2017 is influenced by Petroleum Prices (OP), Indirect Cost Polyethylene (ICP), Labor Cost Polyethylene (LCP), Supply Synthetic Material Resins (SRM) and Polyethylene (PE) Prices , so that the multiple regression equation becomes as follows:

$$\text{LogE} = (-8,254) + 1,615\text{LogPE} + 7,697\text{LogICP} - 7,149\text{LogLCP} + 1,839\text{LogSRM} - 0,378\text{LogOP} \quad (3)$$

#### D. Test Multicollinearity

Multicollinearity test aims to test whether the regression model found a high or perfect correlation between independent variables. If there is perfect multicollinearity between independent variables, then the independent variable regression coefficient cannot be determined and the standard error value becomes infinite. If multicollinearity between independent variables is high, the regression coefficient of the independent variable can be determined but having a high standard error value means that the regression coefficient cannot be estimated correctly.

a). Guided by table 4.0, it can be seen. Then other variables have CI values above 30 which show strong multicollinearity, namely PE, DPI, ICP, LCP, SRM, OP and DMI.

b). Guided by table 4.0, it appears that only the OP has a Tolerance value above 0.10. Can be taken

Complications there is no multicollinearity, while for Tolerance below 0.10, namely PE, DPI, ICP, LCP, SRM and DMI. Can be taken Complications have mild multicollinearity. Whereas for VIF; Independent variables are only OP under 10 So that VIF can be taken. There is no multicollinearity. while for VIF above 10, namely PE, DPI, ICP, LCP, SRM and DMI. Can be taken Complications have mild multicollinearity.

**Table 4.0** Tolerance, VIF and CI Independent Variables

Model	Collinearity Statistics		Condition Index
	Tolerance	VIF	
(Constant)			1,000
PE	0,082	12,236	43,317
DPI	0,006	155,769	137,024
ICP	0,014	71,472	211,044
LCP	0,020	50,514	297,620
SRM	0,080	12,503	620,604
OP	0,172	5,798	1832,297
DMI	0,005	213,896	3417,921

Processed (2019)

### E. Autocorrelation Test

Autocorrelation test aims to test whether in a linear regression model there is a correlation between residual errors in period  $t$  with errors in period  $t - 1$  (before). If there is a correlation, then there is a problem with autocorrelation. Autocorrelation arises because sequential observations over time are related to each other (Ghozali, 2014).

This problem arises because the residuals are not free from one observation to another. This is often found in time series data because the disturbance in a person / individual / group tends to affect the disturbance in the same individual / group in the next period.

There are several ways that can be used to detect the presence or absence of autocorrelation. One method commonly used to detect autocorrelation in multiple linear regression is Durbin Watson (DW) Test. The D-W test is one test that is widely used to determine whether there is autocorrelation. Almost all statistical programs have provided facilities to calculate the  $d$  value (which describes the DW coefficient). The value of  $d$  will be in the range 0 to 4, see the following table:

Tables: A-5a (Ghozali, 2014) for  $n = 11$  &  $k = 7$  obtained  $du = 0,0000$

$du < d < 4 - du \rightarrow$  No Autocorelation  $\rightarrow 0,00 < 2,154 < 4,000$

Based on the test results in Table 4.8. The Multiple Regression Analysis Equation, obtained Durbin Watson (DW) Value is = 2.154. It means that  $d$  is between 0,00 and 4,000, so the conclusion that the Price of Ethylene for Multiple Regression Analysis Equation in the period 2000-2017 has no decision or doubtful area  $\rightarrow H_0$ ; means there is no autocorrelation.

### F. Test Heteroscedasticity

There are two ways to detect the presence or absence of Heteroscedasticity, namely by the graph method and the statistical method. The graph method is usually done by looking at the plot graph between the predicted value of the dependent variable and the residual. While statistical methods that can be used to identify the presence or absence of Heteroscedasticity problems, some of these methods are Park Test, Glejser Test, Spearman Test, Goldfeld-Quandt Test, Bruesch-Pagan-Godfrey Test and White Test. But what will be discussed in this section is only the Glejser Test:

Results can be seen in table 6.0. clearly shows the overall variables, Supply Synthetic Material Resins (SRM), Plastic Industry Demand (DPI), Indirect Cost Polyethylene (ICP), Labor Cost Polyethylene (LCP), Demand Manufacturing Industry (DMI), Petroleum Prices (OP), Price Polyethylene (PE). The ratio has a significance value of all of which is above 0.01. It means that there is no Heteroscedasticity in this model, in other words all the independent variables contained in this model have the same or homogeneous variant distribution

**Table. 6.** Glejser Test Tables for Determination There Are No Heteroscedasticity

Model	Sig.
(Constant)	0,110
PE	0,587
DPI	0,131
ICP	0,503
LCP	0,634
SRM	0,524
OP	0,333
DMI	0,179

a. Dependent Variable: AbsUi

Soures : Processes Data (2019)

### V. Discussion

Another macroeconomic factor that is very important and can affect companies that produce petrochemical products is the price of Crude Oil. The price of crude oil has the most basic characteristics and is strongly influenced by changes in the volatility of crude oil prices and reduced crude oil supply in the world market. Volatility of world crude oil prices and reduced supply of crude oil in the world market can be caused by exogenous effects in the form of demand and supply and also strongly influenced by endogenous effects,

namely uncertain and volatile political situation in OPEC countries, most of which are countries in Middle East region (Cowley, 2015) ..

Growth in the plastics industry explains that consumption of plastic raw materials in Indonesia continues to grow every year, the continued growth of the plastic industry, of course, companies producing plastic raw materials will increase production of plastic raw materials in order to meet domestic demand for raw materials regardless of material imports. standard from the outside, by adding production capacity (expansion), namely by seeking attractiveness to invite investors to invest their shares in companies producing plastic raw materials, expansion and continued availability of raw materials will become the motor of growing and developing industries producing plastic raw materials in the country (Titov, 2014).

## VI. Conclusion

Petroleum Prices (OP), Indirect Cost Polyethylene (ICP), Labor Cost Polyethylene (LCP), Synthetic Material Supply (SRM) and Polyethylene (PE) Prices significantly influence Ethylene Prices in Indonesia in the period 2007 – 2017.

Synthetic Material Supply (SRM), Indirect Cost Polyethylene (ICP) and Polyethylene (PE) prices are positive and significant contributions, while Petroleum Prices (OP) and Labor Cost Polyethylene (LCP), contribute negatively and significantly to Ethylene Prices in Indonesia in the period 2007 - 2017.

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