

Conference Paper

Analysis of Investment and Export of Economic Growth Using Neural Network Computing ANFIS

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Abstract

This research is an application to realize a system that is capable of providing data and information between levels of economic growth and Indonesian export between 2010 and 2015. Data from the system that was created dug deeper to find out the prediction of drug distribution in the future. The system to be built is the system that is able to predict the level of export needs that will happen in time (month/year) that you want based on the data of the time (month/year) using ANFIS system. The ANFIS system will search the best function to predict the export needs in the year 2010. Furthermore, the output is used as the data in 2010. The data is output as the prediction will be matched with actual data, whether the resulting function of ANFIS system has a small error. If so, then the function obtained is optimal.

Keywords: time series prediction, neural network, ANFIS

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1. Introduction

Economic Growth is a long-term economic problems and a gauge to see how much the level of economic development in the country. Economic growth rate achieved by a country is measured by the growth of the real national income [1].

Most economists consider that the establishment of an investment is the most important factor responsible for the growth and development of the economy of a country. The establishment of investment can be done if people do not use all the income earned in the consumption, but there are some who are saved. Saving is necessary for the establishment of investment. For example, investment construction, roads, bridges, education or investment in school or university.

In a country will grow dynamically if investment is much greater than the depreciation factors of production. The state has a smaller investment than depreciation factor of production will tend to experience economic stagnation (economy rate of growth

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is very slow and can even zero). This condition can cause unemployment in relatively large amounts.

In developing countries or underdeveloped with the large population, generally have a ratio of investment to total population is relatively small. As the country often invite foreign investment in the country. Foreign investment does not always give the advantage to the country, especially in the long term. In macroeconomic theory, investment is one of the components of the national income. As the influence of the investment on the economy of a country can be reviewed on the national income of the country.

Generally it is said, when the GDP increased investment also rose. Or vice versa, if the investments go down the GDP also fell. GDP is calculated on the basis of production consists of four main components: consumption (C), investment (I), government purchases (G), exports (X) and imports (M). Mathematical form of the GDP can be written as $Y = C + I + G + (X - M)$ $Y = \text{GDP}$ equation can be seen that investment is positively correlated with GDP.

International trade is one of the factors that contribute directly or indirectly to increase economic growth. Through international trade will create relationships that could influence each other between one country to another with regard the needs of each country and also to target the benefits to be gained from cooperation. Trading is done is often said to be a process of exchange of goods and services by one country to another to meet the needs of the state or are just looking for profit. This process is appropriately referred to as the Export-Import. For example, the export of Indonesia in 2011.

Judging from the development of Indonesia's exports can be ascertained that Indonesia's economic growth experienced significant progress, as well as economic growth has established the possibility to increase exports of more promising and there will be opportunities to build synergy Indonesian economy. Indonesia's economic growth target is achieved thanks to the exports, consumption and investment. Since 2010, the export volume of Indonesia exceeded US \$ 200 billion in agriculture, industry, mining and oil and gas.

According to data from the Central Bureau of Statistics, in October 2011, for the first time Indonesia had a surplus in trade with China. In our country, there are ten main export the Indonesian textile and textile products (TPT), forest products, electronic products, rubber and rubber products, oil and oil products, automotive, footwear, shrimp, cocoa, and coffee. But in the international market more competitive for up to ten main export Indonesian diversified. In macroeconomic theory, the relationship

between exports and economic growth is a common identities for export as part of the national income. But in the theory of economic development of the relationship between the two variables is not focused on issues of identity itself, but more focused on the issue of whether the export of a country will produce prosperity or even bring misery to the country.

According to Jens J. Krüger said that economic growth in the country is a variable size can be controlled, while exports are variables that cannot be controlled (Internally Generated Export hypothesis). As suggested by this: First, the strategy of export policy in Indonesia. Second, strengthen the bases of the national economy with a comprehensive empirical study.

2. Literature Review

2.1. Economic growth

Economic growth in a country's economy is a problem in the long term. In addition, the economic growth of a country can also be used as a measuring tool to see or measure or analyze how high or low levels of economic development in the country. Economic growth in a country can be caused by many factors. For developed countries, they rely on the production of their goods and services, but does not rule out the possibility that the loan they are doing as well as their investment in their country. But for developing countries is not easy if you have to rely on the production of goods and services. Flow classical economists place more emphasis on the provision of labor, capital stock and technological changes in the economic growth process. This approach is based on the assumption that the market can allocate the available resources efficiently, while the flow of Keynesian emphasis on aggregate demand factors. Keynesian approach put the central issue in the export as a driver of economic growth. At this time there are many economists who are interested in doing a study on the economic growth. Some empirical studies have been carried out, both in developed countries and in developing countries such as Indonesia is Pietro Peretto (2017). These studies suggested the importance of increasing exports and investment as a driver of economic growth.

2.2. Investment growth

Investment or investment is the purchase of capital goods and equipment to increase production capacity to produce goods and services that are needed in the economy.

There are some experts who say that economists exports and investment is the 'engine of growth' or referred to as an engine of growth. Therefore, the level of high economic growth and sustainable generally supported by an increase in exports and investment. Economic growth is the increase in the per capita output in the long run. This understanding contains three main points, namely: process, output per capita, and the long term.

The process of the development of the economy over time that is dynamic, output per capita output associate aspect ratio and total population, while the long-term trend shows that economic changes within a certain period, driven by changes in the internal economy. Economic growth is also defined as an increase in the total output in the long term regardless of whether the increase was greater or less than the population growth and if followed by changes in the structure of the economy or not.

According [1], the investment enables a society to continuously improve economic activity and employment, and increase national income and improve the welfare of people. This role comes from the three essential functions of investment activity, namely:

1. Investment is one of the components of aggregate expenditure, so that the increase in investment can increase aggregate demand, national income, and employment.
2. Investments to improve the increase in capital goods production up to capacity increases.
3. Investment is always followed by the development of technology. The flow of capital or foreign investment from abroad by both government and private sector foreign trade is complementary to solving the vicious circle of poverty. Foreign investment in the sector of mobile exploration of natural resources such as mining, forestry, fisheries, and also in the manufacturing sector. Private foreign investment generally make a large multinational company.

2.3. Export

Export or commonly referred to a number of international trade is trade/purchase between buyers and sellers (from one country to another system running export-import) in a market, in order to achieve maximum benefit for both sides party. According to the flow of mercantilism, exporting is something beneficial (win), while import is a detrimental thing (lose). So the state should pursue exports and avoid imports.

But since the beginning of the 19th century, economists market thought otherwise. They say that international trade is a transaction that is mutually beneficial, for the following reasons:

1. International trade involves two transactions when the two countries are export and import of mutual benefit.
2. International trade provides a diversity of goods and services. We can imagine if Indonesia does not have trade relations with other nations in the world. The diversity of goods and services traded in the Indonesian domestic market will be very limited.
3. International trade can bring efficiency. A country that is trying to meet all the needs of goods and services alone will not achieve efficiency in the economy.

Only with international trade, the efficiency can be generated and the two countries will mutually benefit. Salvatore said that trade can be an engine for growth (trade as an engine of growth, [1]). If the activity of international trade is the export and import, then one of the components, or both, can be a driving force for growth.

Pietro Peretto stated at the beginning of the 1980s developing country set policy in the form of export promotion. Thus, the policy makes exports as the driving force for growth. For a nation or state, the attainment of economic growth as planned or expected, the success of reducing unemployment and creating inflation stabilization is a measure of the success of the policy in the country's economy. Therefore it is, then the countries are trying to achieve an economic growth rate that is optimal by various policies in the economy. In order to achieve the desired economic growth would be the sectors that will be the engine for economic growth.

2.4. Investment and exports

Investment is needed as a driving force of development in order to achieve economic growth that is expected. Based on empirical findings using multiple linear regression

model can be seen that investment and exports have a significant impact on economic growth in Indonesia. Investment and exports are positively related to economic growth. The positive effects of these two variables also indicate the importance of the role of business to increase investment and exports are carried out by the government in the economy in order to achieve economic growth in Indonesia. The positive effects of the investment and exports show that Indonesia is able to benefit from their international trade and investment by both government and private. Exports and investments play an important role in the economy of a country. Exports will generate income that can be used to finance the import of raw materials and capital goods needed in the production process that will create value added. Aggregate value added generated by the production of the entire economy in the value of the Gross Domestic Product (GDP).

2.5. ANFIS (Adaptive Neuro Fuzzy Inference System)

Neural network is a network structure in which the overall behavior of the input-output is determined by a set of parameters to be modified. One of the neural network is a multilayer perceptron (MLP). This type of network is a special type of feed forward. MLP has been applied to practice using the back propagation algorithm of fault or error propagation (EBP)

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2.5.1. Learning ANFIS

According to Chang (1997: 340) in his ANFIS learning algorithm using a hybrid method that combines the Least-Squares Estimator (LSE) and Error Back-propagation (EBP). In the structure of the ANFIS method EBP done in layers to-1, while the LSE made to layer to layer 4. In the 1st parameter is a parameter of the membership function of fuzzy sets are nonlinear with respect to the output system. The learning process in this parameter using EBP to renew the arguments. While on the 4th, the parameters are parameters of the linear output system, which constitutes the basic rules of fuzzy.

The learning process for updating parameters in this layer using the LSE. According to Chang (1997: 340) as a whole learning process on ANFIS can be seen in the

TABLE 1: ANFIS learning process.

	Directions Forward	Directions Back
The premises	Fixed	EBP
The consequent	Least Square Estimator	Fixed
Signal	Output node	Signal Error

2.5.2. Structural forecasting system with ANFIS

The process of forecasting time series forecasting needs medication as this study used ANFIS architecture 1 input and 1 output. In forecasting the ANFIS method is divided into 3 processes namely: initialization process beginning, the process of learning (learning), and forecasting process. Determining the input and the training is done at the beginning of initialization where every period of input pattern or pattern different. The data used for the learning process (Training) consisting of data input, ANFIS parameters, and test data are in a period of training ANFIS. Training with ANFIS learning algorithm using a hybrid, where the merger method Least-squares estimator (LSE) in the groove and forward error back propagation (EBP) in the backward flow. The learning algorithm is the premise parameters will remain as advanced workflow, but rather the consequent will be updated when the groove forward. The flow chart can be seen in the Figure 1.

2.5.3. ANFIS flow forward

The process flow of an advanced system ANFIS consists of several layers. At the first layer of input data in each period will be fuzzification process. This process is mapped to input data into the fuzzy set in accordance with the classification selected (in this study only uses two types of fuzzy sets, namely: high and low)

In the process of this input will be calculated fuzzy membership function to transform the input set classic (crisp) to a certain degree. Membership function used is the type of Bell where the membership function, there are two parameters, namely the mean and variance parameters in the ANFIS method is referred to as the premise. In the second and third layer process inference engine (fuzzy inference system) is determined for the fuzzy rule calculation process further. In this process because the system ANFIS is 1 input, then there is no counting. Loop output layer is equal to the output node of

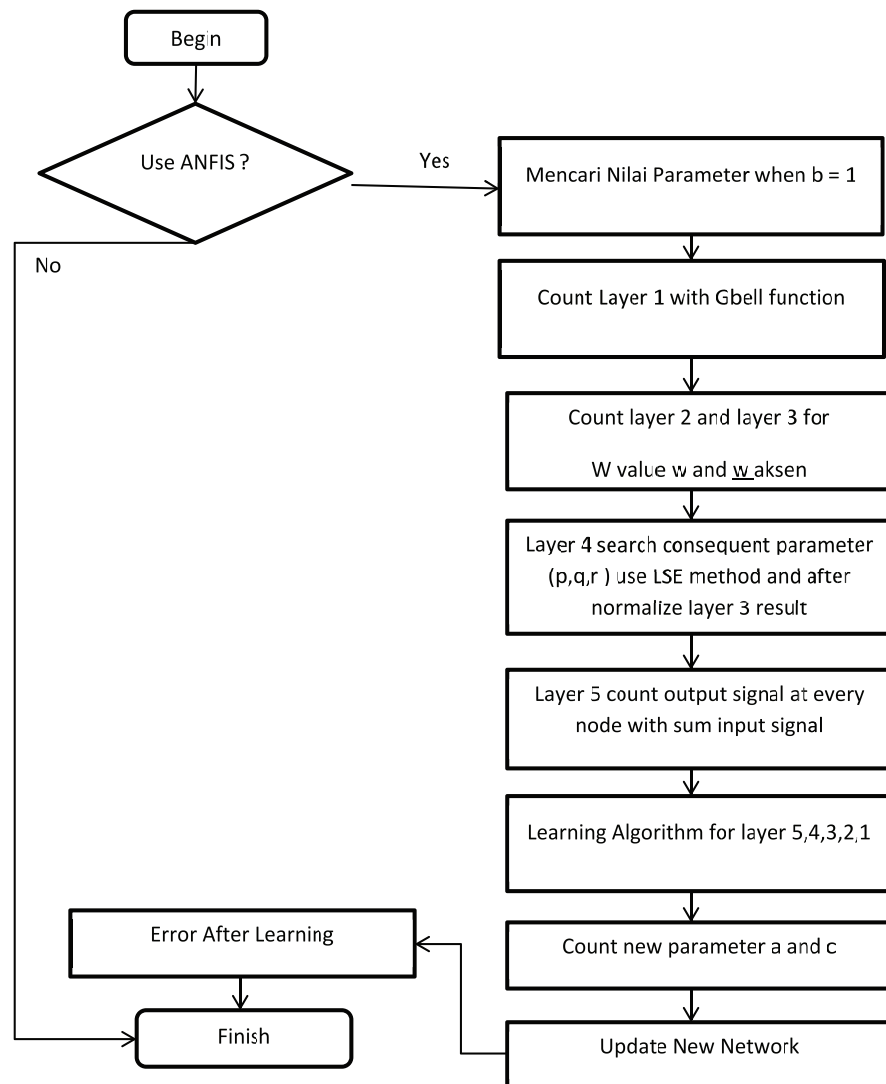


Figure 1: ANFIS flowchart.

layer 1. In layer 3 normalization Each node shows the normalized degree of activation. The layer 4 is made of defuzzification calculation transform the fuzzy output to form a crisp. In this layer is calculated to obtain the LSA parameters consistent. The layer 5 is being carried out summary of two output layer 4. In ANFIS system is fuzzy layer 1,2,3 and 4. The fuzzy system is a determinant of hidden nodes on the system's neural network. Explanation on each layer as follows:

Layer 1

Each node i in this layer is the knot with adaptive function vertex: $N_1A = \text{Bell}(x, a_1, b_1, c_1)$ $N_2A = \text{Bell}(x, a_2, b_2, c_2)$ where x is the input to the node N_1A , and N_2A , while $a_1, b_1, c_1, a_2, b_2, c_2$ is the level of membership of fuzzy set a ($= a_1, a_2, b_1$ or b_2) and determine

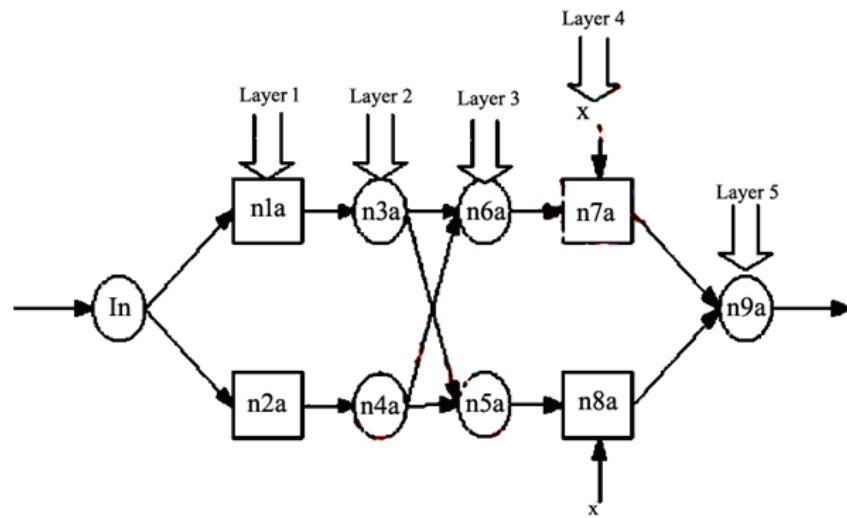


Figure 2: Block diagram for the path forward ANFIS time.

the degree of membership of the input x is given. Membership function parameters of a function can be approximated by the bell:

$$\mu_A(x) = \frac{1}{1 + \left[\frac{x-ci}{2a}\right]^{2bi}}$$

Where $\{a_i, b_i, c_i\}$ is the set of parameters. Parameters in this layer is called the premise parameters.

Layer 2

Each node in this layer labeled N_{3a} and n_{4a} , non-adaptive (parameters) that proceeds from the 1st. Because the system uses a single input, then there is no inference ET. Thus the output layer 2 is: $N_{3a} = N_1A$

$$n_{4a} = N_2A$$

Layer 3

Each node in this layer labeled N_{5A} and N_{6A} , also a non-adaptive. Each node displays the degree of activation with normalized form. $N_{5A} = \frac{N_{3a}}{(N_{3a} + N_{4a})}$ and $N_{6A} = \frac{N_{4a}}{(N_{3a} + N_{4a})}$

Layer 4

Each node in this layer in the form of an adaptive node, and on this layer obtained matrix A, as follows:

Total number of rows Asebanyak data input x. In this layer the parameters sought θ consistent with methods LSE. Equation method LSE stated as follows:

$$A = \begin{bmatrix} (n5a) x(n) & n5a & (n6a) x(n) & n6a \\ (n5a) x(n) & n5a & (n6a) x(n) & n6a \end{bmatrix}$$

With y = output of the desired target

Furthermore, to calculate output in the 4th used the following equation: $N_7A = p_1 * q_1 + x$

$$N_8A = p_2 + q_2 * x$$

Layer 5

Knot on a single layer is labeled N_9A , which counts all the output as the summation of all incoming signals: $N_9A = N_7A + N_8A$

2.5.4. ANFIS flow back

The block diagram of Figure 3 is described systematic backward flow of a system ANFIS. In the process of this algorithm do EBP (Error Backpropagation) where each layer calculation error to update the parameters of ANFIS

The calculation

Layer 1

Calculation error was made

$$\epsilon_1(i, j) = \epsilon_2(i, j) * \mu(n, k), \quad i = 1, 2 \quad n = 2, 1$$

Layer 2

At layer 2, calculation error involving the error and error 5 3 are:

$$\epsilon_2(i) = \delta_3(i) * \frac{\omega(n)}{(\omega_1 * \omega_2^2)} \quad n = 2, 1$$

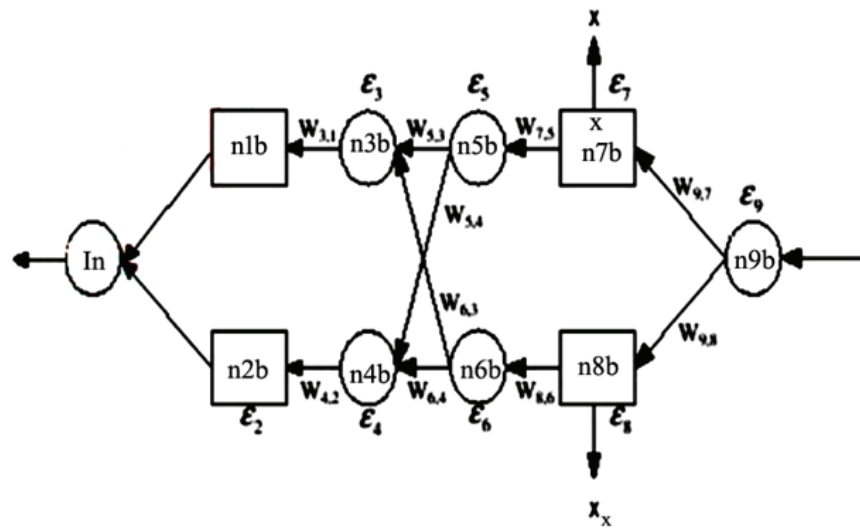


Figure 3: ANFIS flow back.

Layer 3

At layer 3 calculation error as follows:

$$\epsilon_3(i) = \epsilon_5 * \delta_4(i), i = 1, 2$$

Layer 4

The layer 4 is not done the calculation error because the flow of countdown does not happen update the parameters of the consequences on the layer 4.

Layer 5

At Layer 5 calculation error with differential equations of MSE calculation as follows:

$$\epsilon = \vartheta \left[\frac{(yd - y)^2}{2} \right]$$

3. Research Methodology

3.1. Data subject research

The subjects to be studied is the variable that is dependent, is the Time

Research Object The object of research is studied variables are independent, namely:

1. Economic Growth
2. Export Indonesia

The population is the total number of study subjects. While the sample is part of a research subject in the population that will be monitored. Data of this research is secondary data obtained from data that includes data of worldbiz GDP growth, and Exports data from the Ministry of Industry from 2010 to 2015.

3.2. Research method

Data Analysis Methods In this study, using ANFIS model with the following steps:

1. Process Fuzzification (mapping input)
2. Calculation function fuzzy
3. Fuzzy Inference to get fuzzy rule
4. Normalization
5. result

3.3. Data design

Data export and growth Indonesia’s economy in 2010–2015 as an input network. And then in 2016 as a network issue. The actual data of 2016 was used to test the accuracy of the predictions of the neuro-fuzzy system.

TABLE 2: Data export and Indonesia’s economic growth in 2010–2015.

Year	Agriculture	Industry	Mining	Other	Total Non-oil	Economic Growth
2010	5001.9	98010.6	26712.6	9.9	129739.5	6.81
2011	5165.8	122187.7	34652	13	162019.6	6.44
2012	5569.2	116123.3	31329.9	18.7	153043	6.19
2013	5713	113029.7	31159.5	16.3	149918.8	5.56
2014	5770.6	117329.5	22850	10.3	145960.8	5.02
2015	5631	106667	19461	31	131791	4.79

Research has design flow system as follows:

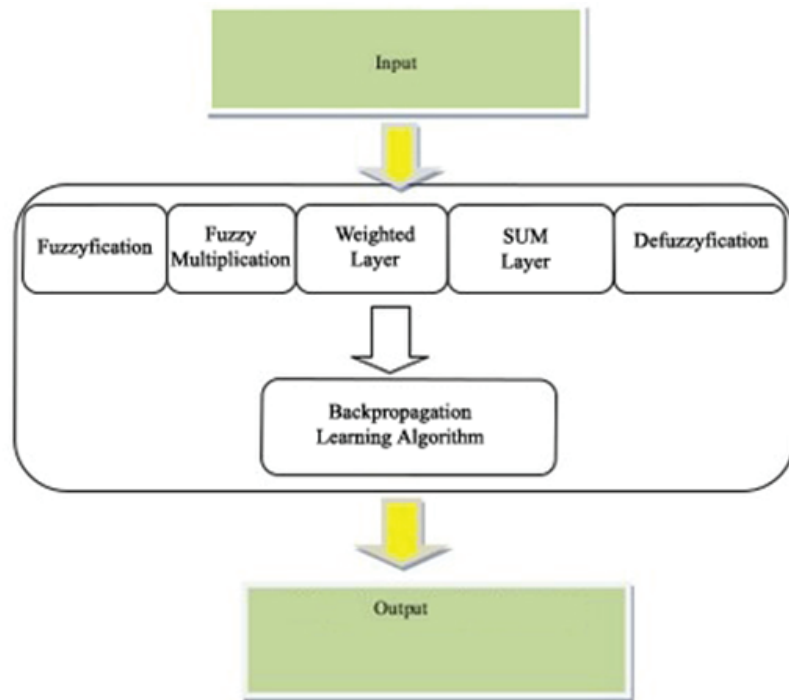


Figure 4: Research design.

4. Data Analysis

A. Regression Analysis Results Dependent Variable: GDP

Dependent Variable: time

Independent Variable: agricultural exports, economic growth

Figure 5: Figure ANFIS learning

MSE = 0.0026% MPE = -0.0000%.

From Table 3 it can be seen that the use of the dependent variable and the independent variable and the export growth rate of the economy has the smallest error, meaning that Indonesia still relies on agriculture in economic growth from year to year.

5. Conclusion

1. Investment and exports are key to economic development. Therefore, investment is needed as a driving force of development in order to achieve economic growth that is expected. Based on empirical findings using multiple linear regression model can be seen that investment and exports have a significant impact on economic growth in Indonesia.

TABLE 3: Research many variables.

Dependent Variable	Independent Variable	Mean Square Error (MSE)	Mean Prediction Error (MPE)
Time	Total non-oil exports, economic growth	07.89%	-0.0013%
Time	Agricultural exports, economic growth	0.0026%	0.0000%
Time	Export industry, economic growth	27.9%	-0.0013%
Time	Mining exports, economic growth	7.58%	-0.0014%
Time	Other export, economic growth	2.6%	-0.0005%
Time	Non-oil exports, economic growth	7.89%	-0.0013%

2. Investment and exports are positively related to economic growth. The positive effects of these two variables also indicate the importance of the role of business to increase investment and exports are carried out by the government in the economy in order to achieve economic growth in Indonesia. The positive effects of the investment and exports show that Indonesia is able to benefit from their international trade and investment by both government and private.
3. Export and investment plays an important role in the economy of a country. Exports will generate income that can be used to finance the import of raw materials and capital goods needed in the production process that will create value added. Aggregate value added generated by the production of the entire economy in the value of the Gross Domestic Product (GDP).

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