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Indonesian Export Analysis: Autoregressive Distributed Lag (ARDL) Model Approach

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A R T I C L E I N F O

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A B S T R A C T

There are some factors predicted tohave an effect on the countries' economic devlopment. This study aimed to analyze the long-term and short-term effects of Inflation, Exchange Rate, and Foreign Economic Growth (the destination of the United States, China, and Japan) on the Indonesian Export. The Auto-Regressive Distributed Lag (ARDL) Model is used in this analysis from 1968 through 2017. The results of the analysis show that in the long-term, the inflation and the economic growth in China as well in Japan has a positive sign and significant effect on Indonesian exports. In addition, in the short-term, the US exchange rate and economic growth have a positive significant effect on Indonesian exports.

A B S T R A K

Ada beberapa faktor yang diprediksi dapat berpengaruh pada perkembangan ekonomi negara. Penelitian ini bertujuan untuk menganalisis efek jangka panjang dan jangka pendek dari inflasi, kurs dan pertumbuhan ekonomi negara asing (negara tujuan ekspor Indonesia yaitu USA, Cina dan Jepang). Model Auto Regressive Distributed Lag (ARDL) digunakan untuk analisis ini selama periode data 1968-2017. Hasil analisis menunjukkan bahwa dalam jangka panjang, inflasi dan pertumbuhan ekonomi Cina dan Jepang memiliki tanda yang positif dan signifikan pada ekspor Indonesia. Di samping itu, dalam jangka pendek, kurs dan pertumbuhan ekonomi USA berdampak positif pada ekspor Indonesia.

1. INTRODUCTION

The countries' economic development is intended to increase national income or the rate of economic growth. One of the indicators that can provide a realistic description of the nation's economic development is the productivity level (Lequiller & Blades, 2014). In addition, the developing countries economic development tends to focus on exports in increasing domestic revenues. This makes exports have an important role in economic development (Acs, et al., 2008). Indonesia is one of the lucky developing countries with abundant natural resources. It can provide advantages through international trade (Ploeg, 2010).

Many economists believe that international trade can trigers the development. It can create beneficiaries in economic empowerment (Shafi et al., 2015), without the cooperation and trading with other countries either goods, services, or technology and capital. A country, then, will not be able to generate the economy development, In this condition, international trade is one of the factors to promote the Gross Domestic Product (GDP) of a country. Indonesia has made good inter-state trade with neighbour countries, ASEAN, even with European countries (Kurniasih, 2019; Oktaviani & Ruehe, 2010).

During the period 1969-2017, international trade (exports) reached about 14.38 percent of the average growth of the exports. For the period as well, the Indonesian economy has grown about average of 5.61 percent a year. It indicated that the Indonesian economic growth was also supported by export capabilities. Increased exports will encourage economic growth. However, the tendency of export evolution almost be not followed by the trend of GDP growth (Figure 1).

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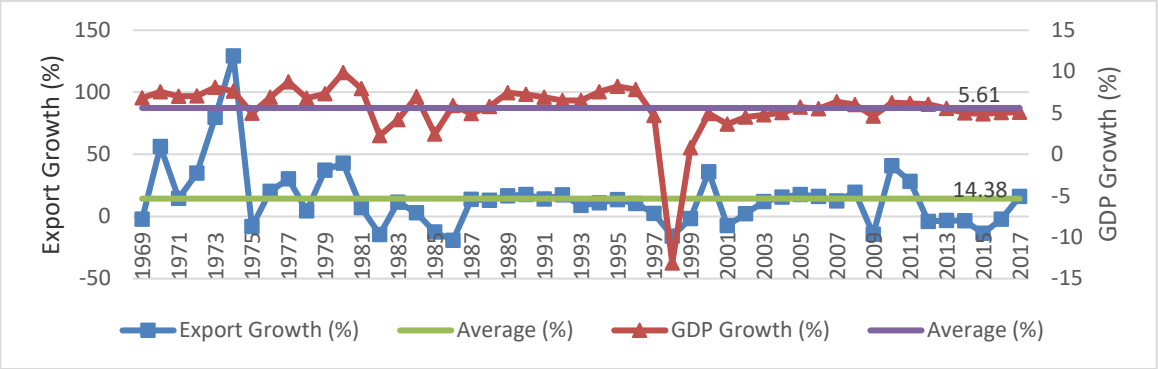

Figure 1. Indonesian Export and GDP Growth, 1969-2017

During the Five-Year Development Plan (REPELITA), period I to III, the Indonesian main exports are oil and gas. Instead, since Repelita IV and after, non-oil and gas are the main export commodities, especially natural resources of non-oil and gas and textiles. The dependency on exports and imports makes the Indonesian economy is categorized as an open economy. Domestic economic environment will also affect export performances. The high inflation rates have adverse impacts on the economy. Thuy and Thuy (2019) explained the depreciation of the domestic currency has also negative effects. The policies of trade among countries as well, affect the domestic economy.

There are some factors that affect exports. Based on some empirical studies such as Kiganda et al. (2017) concluded that inflation influnced the export in Kenya. Obeng (2018) in Ghana, Li et al. (2015) in China, and Aye et al. (2015) also analyzed the exchange rate and the export. Cheng (2017) examined the effect of uncertainty shocks of foreign and domestic economic policies on exports in South Korea. Chisiridis and Panagiotidis (2018) studied the effect of foreign economic activity in Greek export. Therefore, this study aimed to examine and analyze the macroeconomic factors that determine Indonesian exports.

2. THEORETICAL FRAMEWORK AND HYPOTHESES

There are some factors that affect export. According to Krugman (2012), factors which affect the export can be viewed from two sides, namely demand and supply. On the supply side, exports were affected by export price, domestic price, exchange rate, product quality, technology, production capacity, interest rate of capital, labor input price, capital and the policy of deregulation. Based on previous studies, Ekananda (2014) explained the number of deals exports affected by export price, domestic price, nominal exchange rate and time trend (as a proxy of technological progress). Yet, in the demand side that the real exchange rate, the world income, the foreign trade policy and the policy of devaluation in the exporting countries are the determinants of export.

Chaudhary et al. (2016) have explained the relationship between the exchange rate and foreign trade by using the absorption approach. According to this evidence, the excess production by a country than its absorption results in trade surplus and appreciation of its currency. In the BOP theory, a deficit in current account leads to the depreciation of domestic currency whereas a surplus on current account results in appreciation of domestic country in comparison to the foreign currency. Considering its importance, many countries, under the framework of the International Monetary Fund (IMF), devalued their currency to boost exports and discourage imports to correct disequilibrium in their BOPs.

Other determinants of export according to Chisiridis and Panagiotidis (2018), economic theory indicates to three factors that can assign the foreign demand for domestic goods and services: (i) foreign income (ii) prices of domestic export for goods and services and (iii) prices of goods and services that in the global markets challenge. It is important tough to conceive how foreign demand change can affect export growth. The higher growth of GDP in trade-partner may lead to higher demand for exports of goods and services.

The result of research conducted by Obeng (2018) showed that the exchange rate volatility has an asymmetrical relationship with export diversification in Ghana. In their study, they analyzed the relationship of the exchange rate and export in Ghana by using Linear Autoregressive Distributed Lag (ARDL) and Nonlinear Autoregressive Distributed Lag (NARDL) model. Another study by Arize et al. (2017) using the same model, examined the impact of the effective real exchange rate on the eight countries trade balance

(China, Israel, Korea, Malaysia, Pakistan, Philippines, Russia, and Singapore), found that there was a unique relationship and statistically has a long-term relationship between the trade balance and the effective real exchange rate in each country. Beside that, in each case, the real exchange rate has a short-term effect.

Some studies on the effect of macroeconomic variables (inflation, exchange rates, and foreign income) on exports conducted by Sumiyati (2020), Uysal et al. (2018), Anshari et al. (2017), Shrivastava and Panga (2017), Wardhana (2011), and Shafi et al. (2015) showed that the exchange rate has a negative sign but not significant on exports in Pakistan, while the world income has a positive and significant on exports. Meanwhile, the exchange rate variable has a positive effect. However, some studies revealed that there was a negative effect of the exchange rate on exports, among others the studies conducted by Aidi et al. (2018), Rashid and Waqar (2017), Aye et al. (2015), Bagus and Sertiyati (2017), Li and Xu (2015), and Putri et al. (2016).

Besides, some studies such as Cheng (2017) and Chisiridis and Panagiotidis (2018) found a positive relationship between foreign income variable and export. In another case, the inflation variable studied by Barthelemy and Cléaud (2017), and Kiganda et al. (2017) has a strong effect on the exports. However, it was different from Shrivastava and Panga (2017) findings as they revealed inflation has a weak relationship with export. A negative influence of inflation on export was found by Uysal et al. (2018), Aidi et al. (2018), Bagus and Sertiyati (2017), Li et al. (2015), and Rashid and Waqar (2017). However, research conducted by Anshari et al. (2017), Wardhana (2011), Putri et al. (2016), and Shafi et al. (2015) found a positive relationship.

3. RESEARCH METHOD

Data Source

The study used secondary data from the Annual Data Series. It has some variables such as inflation, exchange rates, foreign economic growth, and Indonesian exports during the period from 1968 to 2017. Overall data were obtained from the International Monetary Fund and the World Bank. The total value of Indonesian exports is expressed in the form of billions of USD. The inflation rate is Indonesia's inflation rate that expressed in percent. The exchange rate is the Indonesian exchange rate per USD (IDR / USD). Also, the foreign economic growth is measured by the economic growth of each Gross Domestic Product of Export Destination Countries (China, the United States, and Japan) measured in billions USD.

The Asymmetric ARDL Model

Based on the stationary test by Philips-Perron statistic test, in Table 1, there are some variables that are stationary at the level, and others are at first-difference. Due to the different level of stationary, the Auto Regressive Distributed Lag (ARDL) model is used in this analysis.

Table 1. Stationary Test Using Philips-Perron

Variables	*at Level*	*First-Difference*	Result
	Prob.*	**Prob.***	
Lnx	0.0319	0.0000	I(I)
INF	0.0000	0.0001	I(0)
LnER	0.8212	0.0000	I(I)
LnGDP_US	0.0000	0.0534	I(0)
LnGDP_China	0.9976	0.0000	I(I)
LnGDP_Japan	0.0001	0.0016	I(0)

Source: Results of research, 2021.

The next stages of the Autoregressive Distributed Lag (ARDL) model are the optimal lag test, co integration test, diagnostic testing, and the stability test of the model. The basic model of export estimation can be written as:

$$X_t = \beta_0 + \beta_1 INF_t + \beta_2 ER_t + \beta_3 GDP\_US_t + \beta_4 GDP\_China_t + \beta_5 GDP\_Japan_t + \varepsilon_t \quad (1)$$

Where:

X	= Indonesian Export
INF	= Indonesian Inflation rate
ER	= Exchange Rate (IDR/USD)
GDP_US	= US Economic Growth
GDP_China	= Economic Growth in China
GDP_Japan	= Economic Growth in Japan
β_1, β_2, β_3, β_4, and β_5	= Estimation Coefficient
β_0	= Constant
ε_t	= Error Term

From the estimation equation above, the long-term equation (2) and short-term equation (3) in this study can be written as follows (Obeng, 2018):

$$LnX_t = \beta_0 + \beta_1 LnX_{t-i} + \beta_2 INF_{t-i} + \beta_3 LnER_{t-i} + \beta_4 LnGDP\_US_{t-i} + \beta_5 LnGDP\_China_{t-i} + \beta_6 LnGDP\_Japan_{t-i} + \varepsilon_t \quad (2)$$

While the short-term effect is written as:

$$\Delta LnX_t = \beta_0 + \sum_{i=0}^{\rho} \theta_{1i} \Delta LnX_{t-i} + \sum_{i=0}^{\rho} \theta_{2i} \Delta INF_{t-i} + \sum_{i=0}^{\rho} \theta_{3i} \Delta LnER_{t-i} + \sum_{i=0}^{\rho} \theta_{4i} \Delta LnGDP\_US_{t-I} + \sum_{i=0}^{\rho} \theta_{5i} \Delta LnGDP\_China_{t-i} + \sum_{i=0}^{\rho} \theta_{6i} \Delta LnGDP\_Japan_{t-i} + \delta ECT_{t-i} + \varepsilon_t \quad (3)$$

The optimal lag selection is based on the criteria of AIC, SBC, and HQC; Δ indicates a change; and i = 0, 1, 2, ... etc. As well, δ is the Error Correction Term (ECT) coefficient which describes the speed of adjustment from short-term toward long-term equilibrium. The disequilibrium due to shocks in the previous periods will be corrected and adjusted towards the long-term equilibrium. Gonzalo and Pitarakis, suggested the Error Correction Model/ECM) must be a valid model of the co integrated variables, so it must have a negative coefficient and statistically significant.

4. DATA ANALYSIS AND DISCUSSION

The result of optimal lag from ARDL model estimation is presented in Table 2.

Table 2. The Optimal Lag Length

Lag	LR	AIC	SC	HQ
0	NA	10.6016	10.8378	10.6905
1	612.2190	-3.1719	-1.5186*	-2.5498*
2	57.6216*	-3.3348*	-0.2643	-2.1794
3	30.9166	-2.9070	1.5806	-1.2183

Source: Result of research, 2021

The optimal lag selected based on the value of AIC is lag 2. Furthermore, the long-term co-integration test results on the variables to be analyzed, as expressed in Table 3.

Table 3. Co-integration Test Results

F-statistics: 5.501131	*Critical Values*		Conclusion
	Lower Bound I(0)	*Upper Bound* I(1)	
1% significance level	3.67	5.01	
5% significance level	2.69	3.82	Cointegration
10% significance level	2.27	3.29	

Source: Results of research, 2021

According to Pesaran et al. (2001), co-integration test method in this research is Bound Test Co-integration, wherein Table 3 shows the F-statistic is 5.5011. It is greater than the critical value of Bound I(0) and I(1) at the level of significance of one percent. Thus, there is a co-integration relationship between the variables in the tested model. It means the short-term equilibrium will lead to long term equilibrium. Table 4 shows there are some independent variables have a significant effect on Indonesian exports, namely the current exchange rate, the previous exchange rate lag(1) and lag(2), current inflation, the current US GDP and lag(4), and current China GDP. All the variables are significant at 5 percent. As well, the Japanese GDP of lag (3) is significant at 10 percent. It can be explained that the four variables will affect Indonesia export value. This result is reinforced by some results of previous studies, including Arize, et al. (2017), finding that there was a unique relationship and statistically significant between trade and exchange rates in each country in the case study. Obeng (2018) stated that exchange rate volatility has an asymmetrical relationship with exports in Ghana. He revealed that other drivers of exports were income, openness and inflation. Anshari et al. (2017) concludes in his study that the inflation and exchange rate variables simultaneous had a significant effect on the value of exports in ASEAN-5 countries.

Table 4. Results of Estimation Model ARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNX(-1)	0.6048	0.1043	5.8006	0.0000***
LNER	-0.3024	0.1386	-2.1824	0.0373**
LNER(-1)	-0.4039	0.1842	-2.1933	0.0365**
LNER(-2)	0.5557	0.1423	3.9055	0.0005***
INF	0.0092	0.0028	3.3198	0.0024***
LNGDP_US	3.2575	1.1455	2.8438	0.0081***
LNGDP_US(-1)	-2.576	1.7799	-1.4473	0.1585
LNGDP_US(-2)	-0.4946	1.8303	-0.2702	0.7889
LNGDP_US(-3)	2.8420	1.8041	1.5753	0.1260
LNGDP_US(-4)	-2.8805	1.2102	-2.3803	0.0241**
LNGDP_CHINA	0.2649	0.0935	2.8329	0.0083***
LNGDP_JAPAN	0.0283	0.2397	0.1181	0.9068
LNGDP_JAPAN(-1)	0.4731	0.3209	1.4745	0.1511
LNGDP_JAPAN(-2)	0.0106	0.3273	0.0322	0.9745
LNGDP_JAPAN(-3)	-0.5683	0.3295	-1.7246	0.0952*
LNGDP_JAPAN(-4)	0.3782	0.2234	1.6926	0.1012
C	-10.3657	6.0132	-1.7238	0.0954*
R-squared	0.9932		D-W	2.0204
Adjusted R-squared	0.9895		F-stat.	266.0569
			F-prob.	0.0000

Description: ***, **, * significant at the 1%, 5%, 10%.
Source: Results of research, 2021

Cheng (2017) revealed the effect of the shock on foreign economic uncertainty, and found it to be more dominant than domestic economic shocks in influencing Korean output. Furthermore, uncertainty in US policy caused real GDP in Korea to fall 0.2 percent. Also, a decline in US output led to a significant decline in Korean exports, putting more downward pressure on Korean output. This result also shows that uncertainty in economic policies originating from abroad is a significant source of disruption to domestic economics. This is in line with the present findings in the Indonesian case, where a one percent increase in the US GDP increase Indonesian exports by about 3.25 percent and a one

percent increase in the China GDP increase Indonesian exports by about 0.26 percent.

With the same method, Thuy and Thuy (2019) examined in the case of Vietnam, and found that the exchange rate volatility has a negative effect on real exports. A one percent increase in the volatility reduces Vietnamese exports by about 0.11 percent. This result is in line with our findings in the Indonesian case. A one percent increase in the exchange rate reduces Indonesian exports by about 0.30 percent. However, on the foreign income variable in Vietnamese case, their estimated result suggests different with our found that if real income of the main importing countries from Vietnam goes up by 1 percent the export volume of Vietnam will go down by 1.4 percent. Moreover, this discrepancy may be due to the fact that those studies depended on the condition of a nation with government policies taken by each country will be different from other countries. So that it raises a variety of conclusions and various variables in other economies which often fluctuate and give various conclusions.

Table 5. Effect of Long-Term (Long Run Model)

Dependent Variable: lnx				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LNER	-0.3810	0.2356	-1.6146	0.1172
INF	0.0233	0.0094	2.4627	0.0200***
LNGDP_US	0.3751	0.9756	0.3845	0.7034
LNGDP_CHINA	0.6703	0.2065	3.2465	0.0029***
LNGDP_JAPAN	0.8145	0.4453	1.8290	0.0777*
C	-26.2267	12.025	-2.1810	0.0374**

Description: ***, **, * significant at the 1%, 5%, 10%.
Source: Results of research, 2021

The result of long-term estimation in Table 5 shows that the inflation and China and Japan economic growth have a significant effect on Indonesian export in the confidence level range of one to ten percent. On the contrary, the exchange rate and US economic growth have no significant effect in the long term. But, these two variables can affect in the short term to the long term as shown in Table 6. In this results, the exchange rate was found a negative but not significant effected. This finding is supported by Ahmed et al. (2017) who examined the impact of exchange rate on exports in the case of Pakistan. Where is the exchange rate had a negative effect but was not significant, while world income had a positive and significant effect on exports.

The positive effect of inflation obtained is supported by the opinion of Ball (2005), namely "a country's exports can increase due to capital from debt or loans to produce an increase for goods and services. When inflation increases, it will encourage a loan. It will be repaid with lower value money". Kiganda et al. (2017) who analysis of causality and impulse response also found a significant positive and negative long-term relationship effect between exports and inflation. In the case of ASEAN-5 countries, Anshari et al. (2017) found that the inflation variable had a significantly positive effect on the Philippines. The Pakistan's case which examined by Munir and Kiani (2011) revealed a significant positive long run relationship among inflation and trade openness in Pakistan and coefficient cleared that 1 percent increment in trade openness increases the inflation by 0.026 percent. This result is in line with the present study's findings in the Indonesian case. In the long term, a one percent increase in inflation improves Indonesian exports by about 0.023 percent.

The result of Table 5, China's GDP is more dominantly affect Indonesian exports than Japan's GDP. China's economic growth is positive and significant in the long run. It implies that China is Indonesia's main trading partner. This is supported by Chisiridis and Panagiotidis (2018) on the results of his study in Greece. They revealed that the aggregate elasticity of foreign income from Greek exports is positive and significant, when foreign income is decomposed into the trade of the main partner. The results of this study are supported by other studies, including Heinze (2018), Shrivastava and Panga (2017), Ahmed et al. (2017), Cheng (2017), as well as Barthelemy and Cléaud (2017).

Table 6. Effect of Short-Term (Short Run Model)

Dependent Variable: D (lnx)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LNER)	-0.3024	0.1067	-2.8346	0.0083***
D(LNER(-1))	-0.5557	0.1140	-4.8770	0.0000***
D(LNGDP_US)	3.2575	0.8761	3.7181	0.0009***
D(LNGDP_US(-1))	0.5331	0.9751	0.5467	0.5888
D(LNGDP_US(-2))	0.0385	0.9617	0.0401	0.9683
D(LNGDP_US(-3))	2.8805	0.9143	3.1505	0.0038***
D(LNGDP_JAPAN)	0.0283	0.1641	0.1725	0.8642
D(LNGDP_JAPAN(-1))	0.1795	0.1818	0.9877	0.3315
D(LNGDP_JAPAN(-2))	0.1901	0.1773	1.0722	0.2925
D(LNGDP_JAPAN(-3))	-0.3782	0.1749	-2.1622	0.0390**
CointEq(-1)*	-0.3952	0.0580	-6.8173	0.0000***

Description: ***, **, * significant at the 1%, 5%, 10%.
Source: Results of research, 2021

Table 6 describes the results of a short-term estimation and Error Correction Term (ECT). Based on the estimation results of short-term indicates that the exchange rates variable, the exchange rate of lag(1), US economic growth, US economic growth of lag(3) and Japanese economic growth of lag(3) have a significant effect on Indonesian exports at the level of significance five percent.

Furthermore, the ECT as the speed adjustment coefficient in the ARDL model determines the speed of adjustment a short-term equilibrium towards the long term. In Table 6, the ECT has a negative sign and significant at the 1 percent level, with the coefficient value of -0.3952 means that if there is a difference between the desired results and actual disturbance, it will be immediately corrected or adjusted towards long-term equilibrium. The speed of adjustment is about 39.5 percent annually.

Table 7. Diagnostic Test Results

Examination	**Statistical value**	***p-value***
Normality (Jarque-Bera test)	0.0896	0.9561
Autocorrelation (Breusch-Godfrey LM test)	0.5662	0.7534
Heteroskedacity (Breusch Pagan test)	0.9806	0.9737

Source: Results of research, 2021.

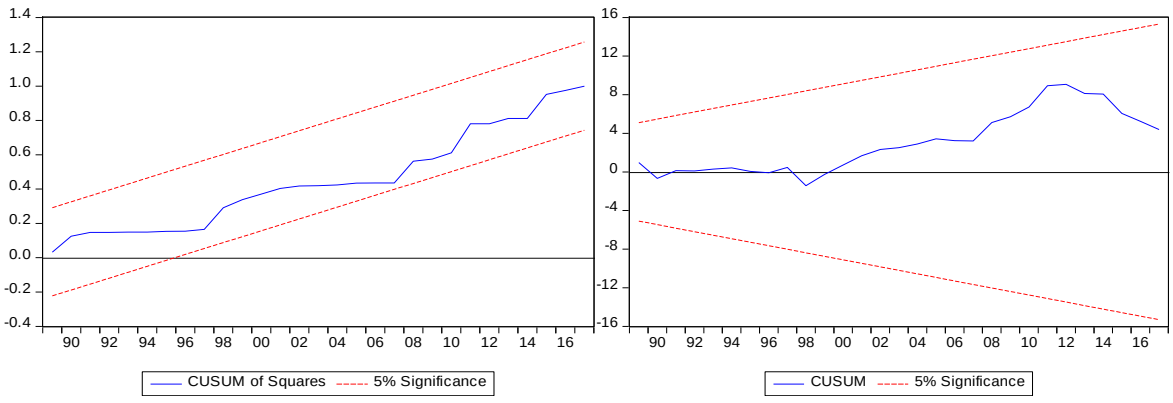

Figure 2. Results Cumulative Sum (CUSUM) of Recursive Residuals and Cumulative Sum of Squares (CUSUMSQ) of Recursive Residuals

In the ARDL method, CUSUM and CUSUMQ test was performed to analyze if the parameter to be estimated is stable or not. Based on Figure 2, the results of CUSUMQ and CUSUM test show that the estimation model in this study has the stable parameters. It can be seen that the CUSUM lines are located between both plotlines with 5 percent significance.

5. CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

This study aims to analyze the effect of macroeconomic variables, namely inflation, exchange rate, and foreign economic growth (which are the United States, China, and Japan). It is against the value of Indonesian exports in the long term and short term. This can assist the government to make fiscal policy and monetary policy in stabilization economics. In the long-term, inflation and China and Japan's economic growth have a significant effect on Indonesian export in the confidence level range of one to ten percent. Yet, the exchange rate and US economic growth have no significant effect in the long term.

Based on the estimation results of short-term, it indicates that the exchange rate such as the exchange rate of lag(1), US economic growth, US economic growth of lag(3) and Japanese economic growth of lag(3) have a significant effect on Indonesian exports at the level of significance five percent. the ECT has a negative sign and significant at the 1 percent level, with the coefficient value of -0.3952, means that if there is a difference between the desired results with actual disturbance, it will be immediately corrected or adjusted towards long-term equilibrium. The speed of adjustment is about 39.5 percent annually.

Based on the result of exposure, the researchers recommend that the significant of economic growth in overseas (the destination of the United States, China and Japan), inf lation, and exchange rates for Indonesian exports, the government and monetary authorities can maintain the stability of inflation and the exchange rate to stabilize the domestic economy. Therefore, they can maintain export destination countries that have good economic growth as well as to maintain a sustainable trade balance. Then, Companies or exporters continue to improve the quality of exports by exploiting natural resources and technology effectively and efficiently, to compensate for export competitiveness in the international market.

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