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The Relationship Between Exchange Rate and Trade Balances: An Empirical Study on Indonesia

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ABSTRACT
The aim of the study is to analyze the relationship between exchange rate and trade balance in Indonesia from 1986 to 2018 (33 years) using the Vector Autoregression (VAR) Model. Also, the study examining the possibility of the J-Curve effect in Indonesia's trade balance. The main findings of this study are: in Indonesia, from 1986 to 2018, the value of net trade last year brings a small effect on the value of the exchange rate. However, it significantly reacts to the shock on the exchange rate, although it is not depicted as the J-Curve effect.
Keywords-Exchange rate, Trade balance, Indonesia, VAR, J-Curve

1. INTRODUCTION

In Indonesia, the trade balance is a big concern of the government. In early 2019, Indonesia faced a deficit in net trade. Looking years back, this is not the first time that trade balance was fluctuating. Some economists argue that the depreciation of Rupiah causes it, so exports decline and import rise. In the account of this case, this paper attempt to identify the relationship between exchange rate and trade balance.
The trade balance and exchange rate examined here is the data of the period 1986-2018. We attempt to know whether the depreciation of the exchange rate could strengthen the trade balance or not. Moreover, in 1998 Indonesia experienced a great monetary crisis followed by the significant depreciation of Rupiah vis-a-vis US$, which improve our curiosity on studying this topic. Rupiah tried to reach its stability after the great depreciation, but there are many constraints, although, on the other hand, the depreciation on Rupiah may affect other aspects of Indonesia's economy.
This paper organized in this order: section-2 elaborates the review of some previous studies, section-3 elaborates the methodology used; and section-4 elaborates the results. The last is the conclusions.

2. LITERATURE REVIEW

Marshall-Lerner conditions, as introduced by the British economist Alfred Marshall (1842-1924) and Romanian economist Abba P. Lerner (1905-1985), concerning trade stated that the existence of currency devaluation could lead to an increase in payments. However, this will only happen if there is more than one elasticity of demand for exports and imports. The real effect of currency devaluation can be shown by the more expensive imported goods and vice versa, the cheaper export goods.
The concept of currency devaluation, as explained in the Marshall-Lerner Condition, provides a new understanding of the J-Curve effect. In the short term, the J-Curve effect is a condition of exchange rate depreciation, which results in a decrease in the current account. This condition occurs as a result of inelastic demand. Conversely, an elastic demand condition, in the long run, will result in a better current account. Generally, the current account measures the net value of exports and imports of goods, services, and investment income.
Research related to the application of Marshall-Lerner conditions has been widely carried out. In Indonesia, Adiningsih, Siregar and Hasanah (2013) examined the effect of the real exchange rate on Indonesia's bilateral trade balance for the period 1996-2011. The study was conducted on three major Indonesian trading partners, namely the US, China, and Japan, using the Vector Error Correction Model (VECM). The results concluded that the trade balance between Indonesia-China and Indonesia-Japan showed the occurrence of the Marshall-Lerner Condition and the J-Curve Curve Phenomenon, while in the US Indonesia bilateral trade, it had not yet been seen.
In the previous period, Husman (2007) learned about similar topics that might occur in Indonesia from 1993-2004. It came with findings that the overall sample showed that Marshall-Lerner conditions were satisfied. This resulted in dissatisfaction with the case of Singapore and the UK because export demand was not elastic as

Indonesia's exports to both countries were mostly consumer goods. In the case of Japan, South Korea, and Germany, a J-curve phenomenon was discovered. It indicates that the depreciation of the Rupiah can cause an increase in exports of Indonesian goods. Estimates of elasticity show that a 1% depreciation of Rupiah only increases Indonesia's export-import ratio by 0.37%. This small number strongly indicates that the real exchange rate only plays a small role in Indonesia's export performance.

Research on exchange rates and trade balance was also carried out by Edwards and Garlick (2008) for research samples in South Africa. The study found that the movement of the real exchange rate had a sensitive influence on trade volume. Whereas depreciation of the nominal exchange rate in the long run only has a limited impact on the trade balance. This is due to the influence of domestic inflation. Furthermore, Thorbecke (2010) produces findings that changes in exchange rates can affect trade. This indicated by a decline in exports as a result of exchange rate depreciation in Indonesia, Malaysia, and Thailand.

A similar finding was also shown by Edwards & Lawrence (2006) for the trade balance case for 44 manufacturing industries in the period 1990-2002. Using the Panel Data Method, it is found that depreciation in the real exchange rate can increase the trade balance for non-commodity manufactured products. The panel estimation results show that a one percent depreciation is expected to increase the value of exports relative to imports by around 0.7 percent.

On the contrary, moreover, Hatemi (2005) concluded that Sweden did not meet the conditions of Marshal-Lerner because the Swedish trade balance was influenced by changes in income rather than the real exchange rate. This supported the previous study conducted by Liew, Lim, and Hussain (2003) whose study in ASEAN countries found insensitivity of trade balance in the exchange rate, but only sensitive in real money.

These contradictory arguments are a consideration of how important it is to oversee this topic from year to year to fully understand the economic situation of our country, especially in terms of international balance trade and to anticipate its side effects.

3. METHODOLOGY

Data used in the study is annual data from 1986 to 2018 obtained from World Bank. During this period, Indonesia faced many changes in exchange rates and trade imbalances. The exchange rate is represented as EXCRT, which is around the average rupiah vis-à-vis US$ and the net trade in goods and services is denoted as NTGS (measured in current US$).

From the kinds of literature reviewed before, it is known that both indicators have causality. Their current values depend on their own-value on past times and depend on the other variable's values too. Hence, it is quite difficult to distinguish which one is the dependent variable and which one is the independent variable. So, we attempt to model it either on Vector Autoregression (VAR) or Vector Error Correction Model (VECM), which makes it possible to place both indicators as endogenous variables as explained by Sims (1980).

Furthermore, either VAR or VECM has the following advantages (Gujarati, 2004): [1] This method is simple because there is no separation between exogenous and endogenous variables. [2] Simple estimation by using OLS (Ordinary Least Square) on each equation. [3] Better on forecasting compared to other models using more complex simultaneous equations.

This is step by step on VAR/VECM modeling:

Firstly, testing the stationary assumption using the unit root test, which is based on the Augmented Dickey Fuller (ADF) test, which is widely used in economic data. If data does not pass the unit root test in level, it might be tested again in its first difference or second difference.

Secondly, determining the optimal lag needs using criteria Akaike Information Criterion (AIC), Likelihood Ratio (LR), Schwarz Information Criterion (SC), Final Prediction Error (FPE), and Hannan-Quin Criterion (HC). When several criteria used, then additional information is required, which is Adjusted R-square. Thus, the optimal lag will be selected from the model that generates the highest Adjusted R-square.

Thirdly, based on the stationary testing using the ADF test, if the results conclude that degree of stationarity in the same level, so a co-integration test might be carried out to determine which one is fit, Vector Autoregression (VAR) or Vector Error Correction Model (VECM). In this case, the Johansen Cointegration method will be used.

Being explained by Enders (2015), cointegration usually refers to a linear combination of non-stationary variables. Theoretically, it is quite possible that nonlinear long-run relationships. Though, from Engle and Granger's original definition, cointegration refers to variables that are integrated in the same order. If two or more variables are integrated into different orders, they cannot be cointegrated. After determining the model, further analysis can be done. There are several options, such as Impulse Response Function (IRF) or Variance Decomposition (VD), represented in graphs so that it is easier to understand the empirical conditions observed.

Based on Enders (2015), the forecast error variance decomposition is well-known as another useful aid in uncovering the interrelationships among variables in the system. It tells us the proportion of the movements sequentially due to its shock to the shock of others variable. Nevertheless, impulse analysis and variance decompositions (together called innovation accounting) can be useful tools to examine the relationships among economic variables. If the correlations among various innovations are small, the identification problem is not likely to be especially important. Alternative orders must be generated should yield similar impulse responses and variance decompositions. Of course, the contemporary movements of many economic variables are highly correlated. Plotting the impulse response functions is a practical way to visually represent the behavior of a series of variables in response to various shocks. With such knowledge, it would be possible to trace out the time paths of the effects of shocks.

4. EMPIRICAL ANALYSIS

There are two variables examined here: the exchange rate (represented as EXCRT, which is around the average rupiah vis-à-vis US$) and the net trade in goods and services (denoted as NTGS (measured in current US$)). These variables consist of Indonesia's data from the year 1986 to 2018 obtained from World Bank. First of all, look at the line graph for each variable. Based on the graph (a), the NTGS variable shows fluctuation among periods and, even at some points, shows a deficit in the trade balance of goods and services in Indonesia. From 2010 to 2013 it fell sharply then tried to rise again but experienced a decline again last year.

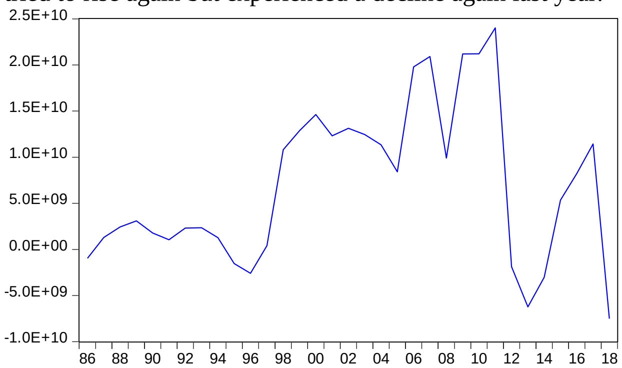

Fig. 1. NTGS 1986-2018

By the figure 2, the EXCRT variable shows significant escalation (high depreciation of Rupiah vis-à-vis US$) in 1998 due to the monetary crisis. Then it fluctuated and tried to reach the stability again, although unfortunately facing depreciation again from 2012 to 2015 and could not come back to its original position yet.
Moreover, the figure 3 shows the essential relation between these two variables. The ratio between NTGS on EXCRT shows the initial reaction of net trade in response to the exchange rate movements. Among the period, there is asymmetric J-Curve happened in Indonesia.

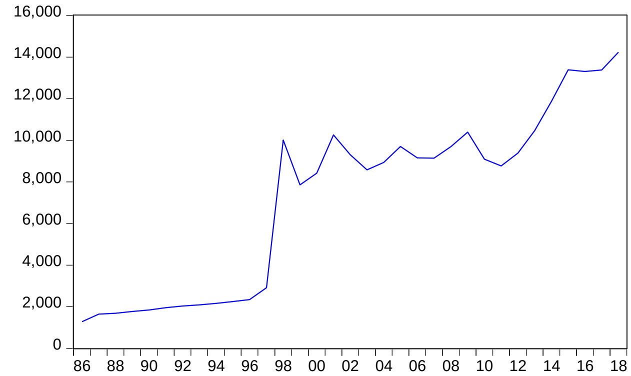

Fig. 2. EXCRT 1986-2018

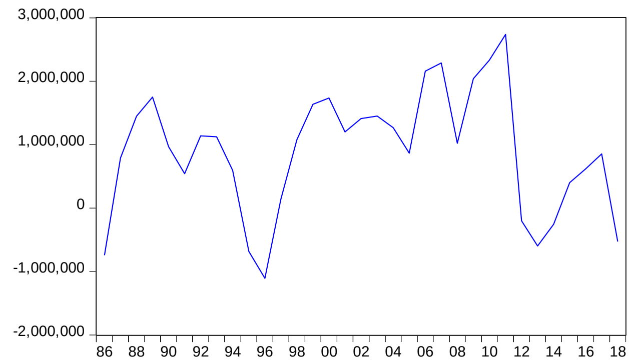

Fig 3. ratio NTGS on EXCRT 1986-2018

Next, attempting to model in VAR or VECM by testing the stationer assumption first. The ADF unit root test conducts it. ADF unit root test results on NTGS indicate that it is non-stationer in level because the probability value (0.1414) is higher than 0.05, but in the first difference, NTGS is stationer with its 0.0003 probability value. ADF test results on EXCRT indicates that it is non-stationer in level because the probability value (0.8157) is higher than 0.05, but in the first difference, EXCRT is stationer with a probability value of 0.0000. So, those two indicators are stationers in the first difference.
The optimal lag length based on the selection of optimal lag is in second lagged. So, we can run the Johansen Co-integration test using this lag. As a result, the Trace Statistics is less than the critical value (6.165209 against 15.49471) and so is the Max-Eigen Statistic (5.821939 against 14.26460). So, this shows that there is no co-integration between them. The relationship between the exchange rate and the trade balance does not last long in the long-run economy.
According to that result, the VAR model is more suitable than VECM, first-different-VAR in particular. At the table (d), values in the squared bracket are the t-statistics of each independent variable. If it is less than 1.96 (standard); thus, the variable is significantly affected. In this case, there is a relationship between two variables.

Table 1. Vector Autoregression Estimates

Sample (adjusted): 1988 2018
Included observations: 31 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	EXCRT	NTGS
EXCRT(-1)	0.745264	468810.8
	(0.18967)	(935035.)
	[3.92917]	[0.50138]
EXCRT(-2)	0.284125	-236238.3
	(0.20162)	(993933.)
	[1.40920]	[-0.23768]
NTGS(-1)	-6.06E-08	0.687614
	(4.6E-08)	(0.22872)
	[-1.30650]	[3.00630]
NTGS(-2)	-5.15E-09	-0.143865
	(4.6E-08)	(0.22615)
	[-0.11227]	[-0.63616]
C	809.4642	1.40E+09
	(542.259)	(2.7E+09)
	[1.49276]	[0.52427]
R-squared	0.892439	0.394716
Adj. R-squared	0.875891	0.301595
Sum sq. resids	56015004	1.36E+21
S.E. equation	1467.795	7.24E+09
F-statistic	53.93097	4.238758
Log likelihood	-267.2978	-745.0321
Akaike AIC	17.56760	48.38917
Schwarz SC	17.79889	48.62046
Mean dependent	7625.450	7.42E+09
S.D. dependent	4166.436	8.66E+09

There are two models that are proposed:
EXCRT = C(1)*EXCRT(-1) + C(2)*EXCRT(-2) + C(3)*NTGS(-1) + C(4)*NTGS(-2) + C(5)

NTGS = C(6)*EXCRT(-1) + C(7)*EXCRT(-2) + C(8)*NTGS(-1) + C(9)*NTGS(-2) + C(10)

Furthermore, the 1% percent change in the exchange rate last year affects the value of net trade as big as C(6)%, a significant number. However, the value of R-square is 0.394716 (far from 1). It means that the independent variable is less proper in describing the dependent variable.

Table 2. Model with EXCRT as dependent variable

VAR is not equipped with long-run relationship analysis (co-integration), so it is not appropriate to be used as a confirmatory model for making policies in the future. Interpretation of the VAR model is not the main focus, as it only approaches to the relationship, not influence. A comprehensive analysis might be obtained by focusing on the graphs of Variance Decomposition (VD). But this is a brief explanation about one of the relationships in the VAR model. As the details are shown on table (e) and table (f), the 1% percent change in the net trade last year affects the value of the exchange rate as big as C(3)%, that is only a small number. The value of R-square is 0.892439 (close to 1). It means that the independent variable is good enough to describe the dependent variable in this equation.

Dependent Variable: EXCRT
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 10/11/19 Time: 00:52
Sample (adjusted): 1988 2018
Included observations: 31 after adjustments
EXCRT = C(1)*EXCRT(-1) + C(2)*EXCRT(-2) + C(3)*NTGS(-1) + C(4)
*NTGS(-2) + C(5)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.745264	0.189675	3.929173	0.0006
C(2)	0.284125	0.201622	1.409196	0.1706
C(3)	-6.06E-08	4.64E-08	-1.306498	0.2028
C(4)	-5.15E-09	4.59E-08	-0.112273	0.9115
C(5)	809.4642	542.2587	1.492764	0.1475

R-squared	0.892439	Mean dependent var	7625.450
Adjusted R-squared	0.875891	S.D. dependent var	4166.436
S.E. of regression	1467.795	Akaike info criterion	17.56760
Sum squared resid	56015004	Schwarz criterion	17.79889
Log likelihood	-267.2978	Hannan-Quinn criter.	17.64299
F-statistic	53.93097	Durbin-Watson stat	2.135225
Prob(F-statistic)	0.000000		

Table 3. Model with EXCRT as dependent variable

Dependent Variable: NTGS
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 10/11/19 Time: 01:13
Sample (adjusted): 1988 2018
Included observations: 31 after adjustments
NTGS = C(6)*EXCRT(-1) + C(7)*EXCRT(-2) + C(8)*NTGS(-1) + C(9)*NTGS(
-2) + C(10)

	Coefficient	Std. Error	t-Statistic	Prob.
C(6)	468810.8	935035.0	0.501383	0.6203
C(7)	-236238.3	993933.1	-0.237680	0.8140
C(8)	0.687614	0.228725	3.006298	0.0058
C(9)	-0.143865	0.226146	-0.636158	0.5302
C(10)	1.40E+09	2.67E+09	0.524274	0.6045

R-squared	0.394716	Mean dependent var	7.42E+09
Adjusted R-squared	0.301595	S.D. dependent var	8.66E+09
S.E. of regression	7.24E+09	Akaike info criterion	48.38917
Sum squared resid	1.36E+21	Schwarz criterion	48.62046
Log likelihood	-745.0321	Hannan-Quinn criter.	48.46456
F-statistic	4.238758	Durbin-Watson stat	1.781840
Prob(F-statistic)	0.008975		

The last but the most critical analysis is interpreting from VD graphs. There are four graphs of VD, shown in graph (g). The graph depicts the shock that occurs in the early period on EXCRT significantly affects EXCRT itself in the next period. Later, it still affects, but the impact was getting smaller, indicate by the sloping line.

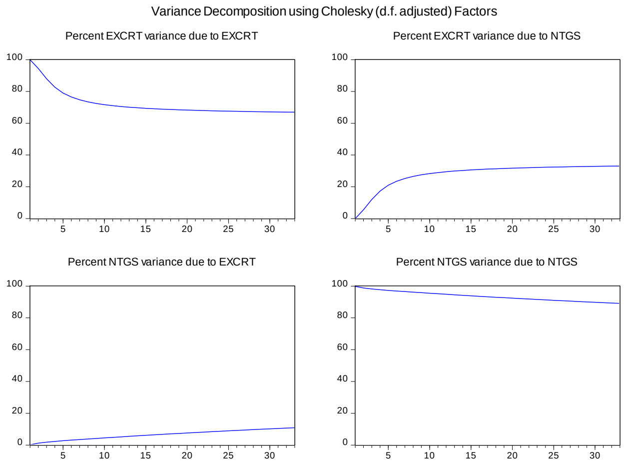

Fig. 4. Variance Decomposition graphs

The impact of NTGS's shock on EXCRT experienced similar. The shock that occurs in the early period on EXCRT significantly affects NTGS in the next period. Later, it still affects, but the impact was getting smaller, indicate by the sloping line.
The shock on EXCRT invariably affects NTGS in a linear line in a positive trend. This linear line also indicates that Indonesia does not experience J-Curve ("J" shaped curve) during periods. However, in contrast, the shock on NTGS invariably affects EXCRT in a linear line in a negative trend.

5. CONCLUSION

In Indonesia, from 1986 to 2018, the value of net trade last year brings a small effect on the value of the exchange rate. However, it significantly reacts to the shock on the exchange rate. The net trade fluctuated among periods and even at some points show deficit. From 2010 to 2013 it fell sharply then tried to rise again but experienced a decline again last year.
The Rupiah's exchange rate experienced high depreciation in 1998 due to the monetary crisis. Then it fluctuated and tried to reach the stability again year by year. Exchange rate movements affect net trade balance, but the impacts depicted as linear. There is no condition that as a result of depreciation, then the trade balance initially gets worse before it gets better-off. So, Indonesia does not experience J-Curve during periods.

REFERENCES

[1] Adiningsih, H., Siregar, H., & Hasanah, H. (2013). Does the J-Curve Phenomenon Exist in The Indonesia ' s Bilateral Trade Balances With Major Trading Countries? *ASEAN Journal of Economics Management and Accounting*, *1*(June), 13–22.

[2] Edwards, L. and, & Garlick. (2008). Trade flows and the exchange rate in South Africa. *Munich Personal RePEc Archive*, (January 2008), 1–23.

[3] Edwards, L., & Lawrence, R. (2006). South African trade policy matters: Trade performance and trade policy. *Economics of Transition*, *16*(4), 585–608. https://doi.org/10.1111/j.1468-0351.2008.00338.x

[4] Enders, W. (2015). Applied Econometric Time Series, 4th edition. In *Journal of the Japan Statistical Society, Japanese Issue* (Fourth, Vol. 45). https://doi.org/10.11329/jjssj.45.215

[5] Gujarati, D. N. (2004). *Basic Econometrics* (Fourth). Singapore: Mc Graw Hill.

[6] Hatemi, A. and I. (2005). Foreign aid and economic growth: evidence from Cambodia. *Journal of Economic Development*, *30*(1), 71–80. https://doi.org/10.1080/09638199.2017.1349167

[7] Husman, J. A. (2007). PENGARUH NILAI TUKAR RIIL TERHADAP NERACA PERDAGANGAN BILATERAL INDONESIA: Kondisi Marshall-Lernerdan Fenomena J-curve. *Buletin Ekonomi Moneter Dan Perbankan*, *8*(3), 1–26. https://doi.org/10.21098/bemp.v8i3.141

[8] Liew, K., Lim, K.-P., & Hussain, H. (2003). Exchange rates and trade balance relationship: the experience of ASEAN countries. *International Trade*, *307003*, 1–11.

[9] Sims, C. A. (1980). Macroeconomics and Reality. *Econometrica*, *48*(1), 1.

[10] Thorbecke, W. and K. (2010). Asian Development Bank Institute. *ADBI Working Paper Series*, (247). https://doi.org/10.1007/978-1-349-67278-3_116