THE IMPACT OF DEPRECIATION OF EXCHANGE RATE TOWARD TRADE BALANCE IN INDONESIA: TIME SERIES ANALYSIS

By

PUTRI, Kusuma Hani

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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Professor Kim, Dongseok, Supervisor _____

Professor Kim, Hyeon-Wook _____

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ABSTRACT

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By

PUTRI, Kusuma Hani

Currently, the recovering US economy and the raising of protectionism have triggered external shock in several countries including Indonesia. Hence, this study aims to analyze the causality between the exchange rate and the trade balance in Indonesia, to measure and forecast the impact of the depreciation of the exchange rate and trade balance in Indonesia, and to identify the impact of depreciation of exchange rate toward Indonesia's export performance of manufactured, agricultural, and mining commodities. In accordance to achieve the objective of the study, this study use time series analysis. The findings show that the relationship between trade balance and exchange rate in Indonesia is one-way; only the exchange rate affects the trade balance in Indonesia. Furthermore, if there is a shock from the exchange rate, it will lead to a decrease in trade balance by about 0.45 percent in 6 months. In the commodity level, agricultural commodity gets higher deterioration compared to manufactured, mining commodity will increase if there is depreciation of the exchange rate. Moreover, J-curve does not exist either at the aggregate level or commodity level in Indonesia.

Keywords: Exchange Rate, Trade Balance, Time Series, Agriculture, Manufacture, Mining.

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All praise be to ALLAH almighty, Who always gives me health and blessing everyday. Therefore I can write and submit this thesis timely.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

I.1 THE IMPORTANCE OF STUDY

Globalization and open economy provide broader access to a market for every country. In contrast, the open economy also creates external challenges that can affect the sustainability of the world economy.

Recently, The Fed decided to increase the interest rate in order to recover The US' economy. Based on Federal Reserve (2018), the Fed has increased the rate 3 times since March 2018 (1.50-1.75), June (1.75-2.00) and September (2.00-2.25). This shock triggers a fall in the value of the currency in several countries such as India by (8.2%), China by (6.8%), Philippine by (6.3%), and Indonesia by (5.1%).

Moreover, the raising issue of protectionism creates a new pattern of international trade. According to WTO (2014), world trade has focused on inter-developing country trade. Furthermore, world productivity tends to decrease due to lower investment, then it will impact the fall of capital accumulation and technology innovation. Hence, these challenges will contribute to economic performance, especially trade performance.

Many economists and researchers have shed light on these issues, especially issues on the relation between the depreciation of currency and trade performance (Hook & Boon, 2000; Taylor & Sarno, 1998; Thirlwall & Gibson, 1986). In the case of Malaysia and Thailand, the relationship between exchange rate and trade balance is positive (Onafora, 2003). Furthermore, the effect of exchange rate depreciation and trade balance is different in among countrries. Based on Stucka (2004), every 1 percent depreciation of the domestic currency in Croatia could improve the trade balance between 0.94-1.3 percent in the long-run. In Indonesia, the depreciation of Rupiah had short-run effects (Oskoee & Harvey, 2009). Whereas previous studies have examined the impact of the depreciation of exchange rate and trade

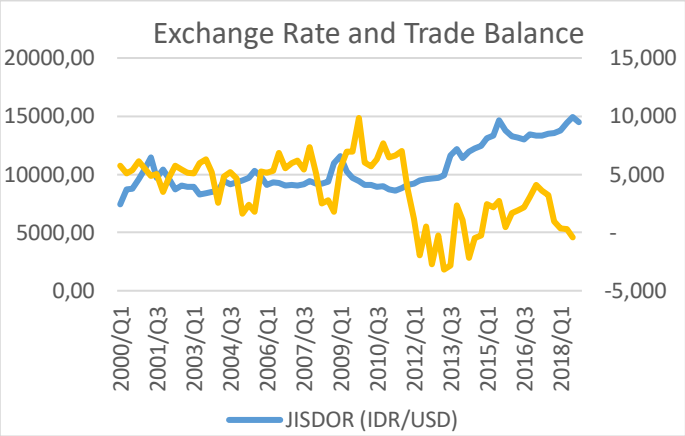
balance at the aggregate level, I intend to examine the impact of the depreciation of exchange rate and trade balance at commodity level (Oskoee & Harvey, 2009; Stucka, 2004; Onafora, 2003). This study will also enhance our understanding of forecasting the depreciation of the exchange rate toward trade balance.

In regards to the statement above, the deprecation of exchange rate could be an opportunity for boosting the trading activity for the country in the future. Meanwhile, we should identify the relationship between exchange rate and trade balance because every country has different characteristic and monetary and trade policy. Therefore, further studies on forecasting the impact on depreciation exchange rate are needed in order to measure and formulate prominent policy in the future.

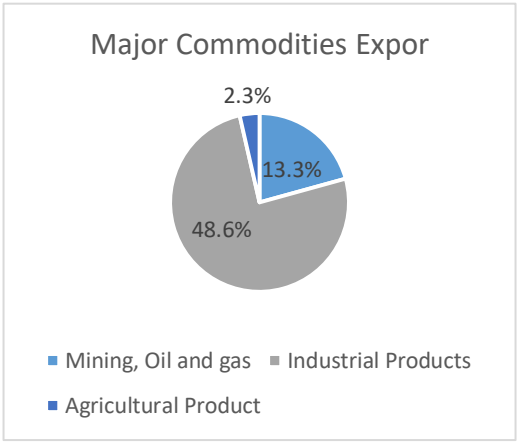
I.2 THE SCOPE OF THE STUDY

As a member of G-20, Indonesia has played an important role in the world trade, thus this study will contribute to identifying the impact of the depreciation of the Rupiah toward trade balance in Indonesia. I want to focus on these two variables because these external economic shocks make a big impact on trade and exchange rate in Indonesia. In regards to trade activity, Bank Indonesia (2018) forecasts Indonesia's trade activity in Indonesia still has an obstacle with the limitation of capability and capacity of industry in the mid-term. In regard to macroeconomic performance, Bank Indonesia (2018) states that the exchange rate is stable during 2017 and has lower volatility among other peer countries by (8.4%). In contrast, the World Bank (2018) states that the growth of Rupiah is more volatile compared to the previous year and has a tendency to make greater move compared to other currencies in Asia.

Figure 1: Dynamic of Exchange Rate, Trade Balance, and Major Commodities Export



Sources: Bank Indonesia, 2018



Source: Ministry of Finance, 2013

Moreover, exports of Indonesia still depends on primary commodity and natural resource-based manufactured goods. According to UNCTAD (2018), 53 percent of Indonesia's export based on commodity products. In addition, the Ministry of Finance of Indonesia (2014) claims major commodities export are dominated by Industrial product by (48.6%), mining and gas by (13.3%), and agricultural commodities by (2.3%), respectively. Thus, the analysis of the commodity level is necessary to identify.

In accordance with this situation, further study to analyze relation and forecasting trade performance and monetary indicator in Indonesia is needed. The exchange rate as the main monetary indicator determines the trade performance. Hence, shock in the exchange rate could impact not only trade performance at the aggregate level but also at commodity level.

The remainder of this paper is organized as follows: section one will explain the background of the impact of depreciation of exchange rate toward trade balance in Indonesia, section two will identify the definition of variable and economic theory among variables, section three will describe the method of this study, section five will discuss result and discussion, and section six is the conclusion. In the following section, I will present a

literature review and theory on the topic of the relationship between exchange rate and trade balance.

I.3 THE OBJECTIVES OF STUDY

According to the background and the importance of this study above, the objectives of this study are as follows:

1. Analyzing the causality relation between the exchange rate and the trade balance in Indonesia.
2. Measuring and forecasting the impact of the depreciation of the exchange rate and trade balance in Indonesia.
3. Identifying the impact of depreciation of exchange rate toward export performance on the manufacture, agriculture, and mining commodity in Indonesia.

I.4 THE RESEARCH QUESTIONS AND HYPOTHESIS

This study will undertake to answer the following research questions:

1. How is the relation between exchange rate and trade balance ?
2. How large is the magnitude of the impact of the depreciation of the Rupiah towards trade balance in Indonesia?
3. How long will the depreciating of the exchange rate impact to trade balance?
4. Which export commodity will get a higher impact from the depreciation of Rupiah?

According to some literature review, the hypothesis of this study is as follows:

1. The exchange rate has bi-directional toward trade balance.
2. The depreciation of the exchange rate will deteriorate the trade balance in short-run, but it will improve trade balance in long-run .

II. LITERATURE REVIEW

II.1 DEFINITION AND THEORETICAL LITERATURE

Before this study identifies the impact of the depreciation of the exchange rate towards trade balance, it is necessary to clearly define key terminologies referred to in this paper. The key terminologies for this study are exchange rate and trade balance. This process is important because it will determine the interpretation of estimation result in the next chapter. In the definition and economic theoretical section, this study will focus on two greatest macroeconomist's point of views which are Krugman (2012) and Mankiw (2012), because their theories are the most influential toward this study.

a) Definition of Exchange Rate

In defining the exchange rate, Krugman (2012, pp.320-321) defines the exchange rate as " the pricei of one domestic currency in terms of another foreign currency". The exchange rate also can be seen as the asset price and can represent a comparison of the price of goods and services which is produced in different countries (pp.321-324).

However, Mankiw (2012) defines exchange rate in the opposite way, "the exchange rate is the price of one foreign currency in term of domestic currency" (pp.149-150). In accordance with this difference, it can influence the interpretation of raising or falling in the value of the exchange rate. The fluctuations of the exchange rate can be described as depreciation and appreciations.

In regard to this difference, this study will utilize the definition of the exchange rate as " the price of one domestic currency in term of another foreign currency". Furthermore, we can define the depreciation as the rising value of a domestic currency against foreign currency, and appreciation of the exchange rate can be defined as the falling value of a domestic currency against foreign currency. Furthermore, this condition relates to trade, hence

Krugman (2012, p.323) emphasizes " When a country's currency depreciates, the foreign countries find that its exports are cheaper and domestic residents find that imports are more expensive. An appreciation has the opposite effects: Foreigners pay more for the country's products and domestic consumers pay less for foreign products".

b) Definition of Trade Balance

In defining trade balance, this study will use the definition of trade balance from Krugman (2012, pp.300-301) as the difference between the export and import of commodity. This also can be shown in the formulation as follows:

$$CA = EX - IM$$

CA = Current Account

EX= Export

IM= Import

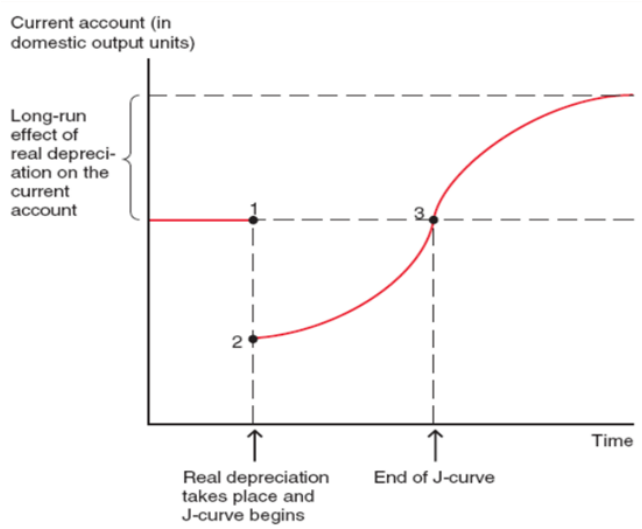
The trade balance surplus shows when exports exceeded imports. This means that the country gained more from export activity rather than spending on imports. On the other hand, when imports exceed exports is called trade balance deficit. It means that the country spends more on imported commodity rather than gaining in export activity.

c) J-Curve Phenomenon

In the previous term, Krugman (2012, p.323) claims " When a country's currency depreciates, the foreign countries find that its exports are cheaper and domestic residents find that imports are more expensive. An appreciation has the opposite effects: Foreigners pay more for the country's products and domestic consumers pay less for foreign products". In reality, the depreciation of the exchange rate does not directly raise the trade balance, and it needs time lag to adjust. J-curve will show the adjustment of depreciation of the exchange rate toward trade balance.

J-Curve shows the depreciation of exchange rate will deteriorate trade balance in short-run, but it will improve trade balance in the long-run, and J-curve presents the relation between time and trade balance (in domestic output unit).

Figure 2: J-curve



Source: Krugman, 2012

According to the graph, the trade balance will deteriorate immediately after exchange rate shock, which is shown by bullet 1 and 2, because the rising value of imported that already ordered in term of the domestic product. Then, the trade balance will rise at bullet 3 due to time adjustment on production and consumption. According to Krugman (2012), the time frame of J-Curve in the industrial country is about 6 months to 1 year.

II.2 EMPIRICAL LITERATURE

Several studies on the relationship between the exchange rate and trade balance have been growing interest since the 1930s to 1950s. McKinnon (1990) claims depreciation in a fixed regime exchange rate would reduce trade balance, and it caused the separation exchange rate from monetary policy in the 1930s to 1950s. Moreover, Carniero *et al*. (1998) assert the appreciation of the real exchange rate would reduce trade balance in 1994.

Furthermore, the J-curve phenomenon is a matter of concern among economists and researchers in several countries nowadays (Sezer, 2017; Sanadheera, 2015; Vural, 2015; Shao,2007; Stucka, 2004). In western Asia and Balkan countries, the exchange rate and trade balances showed positive relationships and the J-curve had been found in Croatia and Turkey (Sezer, 2017; Stucka, 2004). In contrast, Yang and Ahmad (2004) claim the relation of the exchange rate and trade balance was positive in the long run and J-curve was not found in China. It also was found that the J-curve phenomenon did not exist in Japan (Shao, 2007). In contrast, Stucka, (2004), Yang and Ahmad (2004), and Sezer (2017) fail to scrutinize the existence of J-curve at commodity level. Therefore, Vural (2015) adds to identify the existence of the J-curve effect in 20 out of 96 commodity groups in Turkey. On another side, Sanadheera (2015) also identifies J-curve did not subsist in 5 main commodities. According to several studies above, the existence of J-Curve diverse cross the countries, because every country has different economic stability, and background, and an also different pattern on social economic. Having had a discussion on the existence of the J-curve in several countries, this study will now focus on the identification of J-curve in Indonesia as a focus country in this research.

The research on the existing J-Curve that focuses on Indonesia's trade partners has been observed by several researchers (Ramadhona, 2016; Oskooe & Harvey, 2009; Onafowara, 2003). Oskoee and Harvey (2009) claim J-curve existed in Indonesia and Indonesia's trade partners such as Canada, Japan, Malaysia, and the United Kingdom. This result was emphasized by the Onafowara (2003) that the J-Curve was found between Indonesia and the United States as a trading partner. In contrast, Ramadhona (2016) claims the J-curve was not found between Indonesia and several trading partners. According to the result, these papers have the same observation to draws attention to the impact of the

depreciation of the exchange rate toward Indonesia's trading partners. However, it is still lacking to recognize the existence of J-curve in commodity level.

II.3 PROPOSED MODEL BETWEEN EXCHANGE RATE AND TRADE BALANCE

According to the definition, theory and several empirical studies above, it can be assumed that the exchange rate and trade balance has a positive relation. Therefore, the proposed model can be constructed according to the data and methodology used, as follows:

$$LN\_TB_t = \alpha_{10} + \beta_{11} LN\_TB_{t-1} + \cdots + \beta_{1p} LN\_TB_{t-p} + \gamma_{11} LN\_REER_{t-1} + \cdots + \gamma_{1p} LN\_REER_{t-p} + \acute{\omega}_{11} LN\_GDP_{t-1} + \cdots + \acute{\omega}_{1p} LN\_GDP_{t-p} + \mu_{1t}$$

$$LN\_REER_t = \alpha_{20} + \beta_{21} LN\_REER_{t-1} + \cdots + \beta_{2p} LN\_REER_{t-p} + \gamma_{21} LN\_TB_{t-1} + \cdots + \gamma_{2p} LN\_TB_{t-p} + \acute{\omega}_{21} LN\_GDP_{t-1} + \cdots + \acute{\omega}_{2p} LN\_GDP_{t-p} + \mu_{2t}$$

$$LN\_GDP_t = \alpha_{30} + \beta_{31} LN\_GDP_{t-1} + \cdots + \beta_{3p} LN\_REER_{t-p} + \gamma_{31} LN\_REER_{t-1} + \cdots + \gamma_{3p} LN\_REER_{t-p} + \acute{\omega}_{31} LN\_TB_{t-1} + \cdots + \acute{\omega}_{3p} LN\_TB_{t-p} + \mu_{3t}$$

Explanation:

LN_REER_t = Exchange Rate (IDR/USD)

LN_TB_t = Trade Balance (Million Rupiah)

LN_GDP_t = Gross Domestic Product (Million Rupiah)

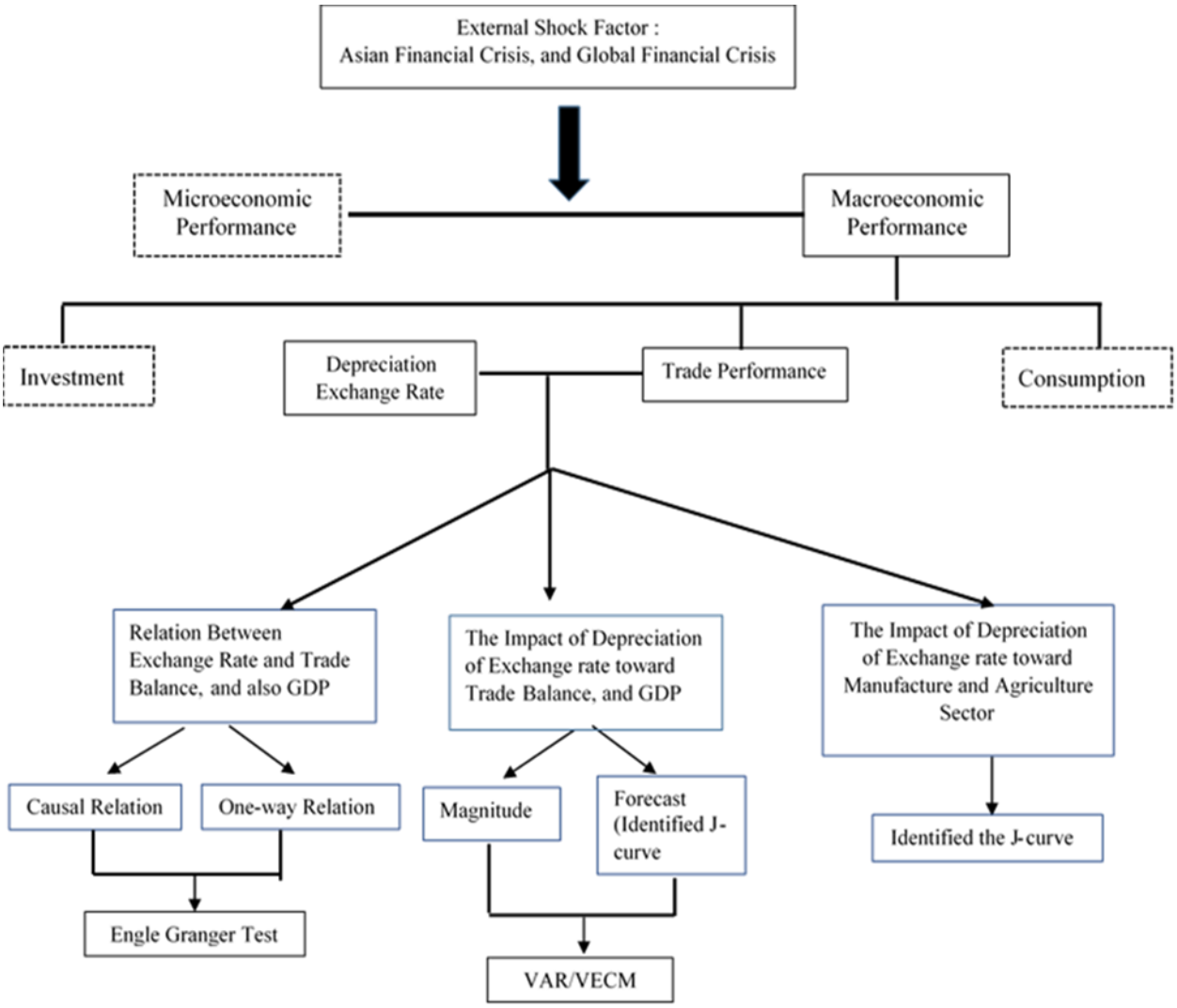
α = Intercept

$\beta, \gamma, \acute{\omega}$ = Coefficient

μ_t = Error Term

II.4 RESEARCH FRAMEWORK

Figure 3: Research Framework



Source : Shao, 2018; Ramadhona, 2016; Stucka, 2004

III. DATA AND METHODOLOGY

III.1 VARIABLE, PERIODE, AND DATA RESOURCES

This study will utilize quarterly time series data with period from 2000 to 2018 for aggregate level data and quarterly data from 2005-2018 for trade balance of commodity-level. This study will use this period because this study will focus on the period after the Asian financial crisis that made Indonesia's exchange regime shift into a floating exchange regime. Further information regarding the data is described as follows:

Table 1: *Variable, Period, and Data Resources*

No	Variable	Period	Unit	Data Resource
1.	Exchange Rate (Real Effective Exchange Rate) Constant 2010 =100	2000q1-2018q4	(Index)	iFederal Reserve Economic Data
2.	National Export (Nominal Value)	2000q1-2018q4	USD million	International Financial Statistic (IFS)-IMF
3.	Export on Agriculture Commodity (Nominal Value)	2005q1-2018q4	USD Thousand	Bank Indonesia
4.	Export on Manufacture Commodity (Nominal Value)	2005q1-2018q4	2005q1-2018q4	Bank Indonesia
5.	Export on Mining Commodity (Nominal Value)	2005q1-2018q4	2005q1-2018q4	Bank Indonesia
6.	Import	2000q1-2018q4	USD million	International Financial Statistic (IFS)-IMF
7.	Import on Agriculture Commodity (Nominal Value)	2005q1-2018q4	USD Thousand	Bank Indonesia
8.	Import on Manufacture Commodity (Nominal Value)	2005q1-2018q4	2005q1-2018q4	Bank Indonesia
9.	Import on Mining Commodity (Nominal Value)	2005q1-2018q4	2005q1-2018q4	Bank Indonesia

10.	Gross Domestic Product	2000q1-2018q4	Rupiah	Bank Indonesia

For further processes, all the variables will be transformed into a natural logarithm. Moreover, export and import will be calculated in order to generate a trade balance in Indonesia. Therefore, this study will convert the trade balance into natural logarithm form, as follows:

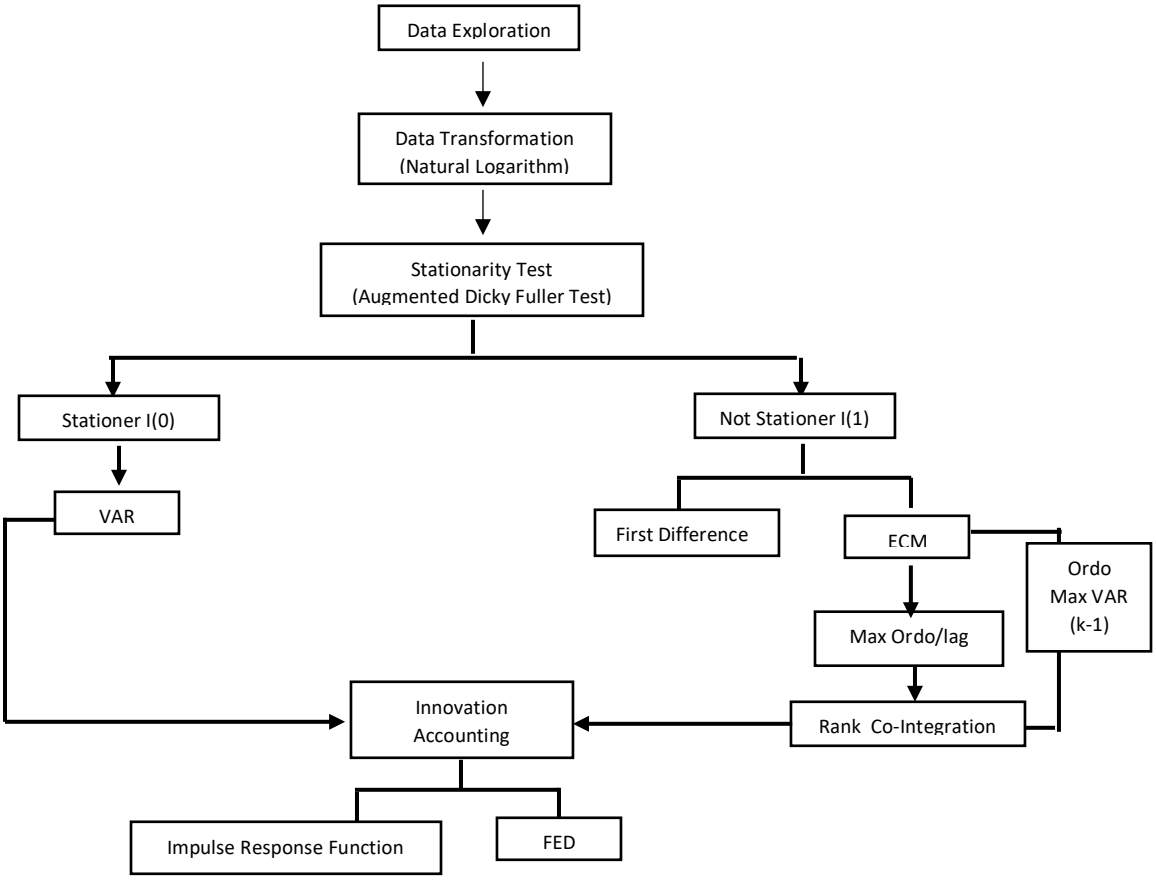
$$\text{Ln\_Export} - \text{Ln\_Import} = \text{Ln}\left(\frac{Export}{Import}\right)$$

III.2 TIME SERIES ANALYSIS

This study will apply time series analysis in order to identify the impact of the depreciation of the exchange rate on trade balance. Therefore, Vector Autoregressive (VAR)/ Vector Error Correction Model (VECM) and Engle-Granger will be utilized in this study, because they can capture the relation between variables and forecast the shock in the future.

In regards to the application of the model, it is necessary to identify the stationary level of the variable. This study will utilize Vector Autoregressive (VAR) if all the variables are stationary in level. In contrast, Vector Error Correction Model (VECM) will be utilized in this study, if all variables are stationary in first different and have a co-integration level. In contrast, if the data is stationary in first difference and there is no co-integration in the variable, the VAR first difference will be applied in this study. For further description regarding two models, it is described as follows:

Figure 4: VAR/VECM Process and Differences



Microsoft Excel 2018 and STATA 13 are applied in this study in order to determine and measure the model.

Overall, these methodologies aim to answer the research question, proving the proposed hypothesis, and creating the conclusion of the study according to theoretical economics, literature review, and empirical studies.

a. Vector Autoregressive (VAR)

Based on Stock and Watson (2014), a vector autoregressive is a time series model which consist of a set of *k* time series regressions and the independent variable are lagged value of all *k* series. For instance, if there are two variables in VAR model that consists of Y_t

and X_t, and the lag in each of the equations is the same and equal to (p), VAR(p), then the equations are as follows:

$$Y_t = \beta_{10} + \beta_{11}Y_{t-1} + \cdots + \beta_{1p}Y_{t-p} + \gamma_{11}X_{t-1} + \cdots + \gamma_{1p}X_{t-p} + \mu_{1t} \ldots\ldots\ldots(1)$$

$$X_t = \beta_{20} + \beta_{21}Y_{t-1} + \cdots + \beta_{2p}Y_{t-p} + \gamma_{21}X_{t-1} + \cdots + \gamma_{2p}X_{t-p} + \mu_{2t} \ldots\ldots\ldots(2)$$

The coefficient of this equation is represented with β and γ, and μ_{1t} and μ_{2t} are the error terms.

According to Gujarati (2007), the VAR model has several advantages compared to the other model that describes as follows:

1) VAR is a simple model, and it is not necessary to determine whether the variable is dependent or independent. The variable in this model can be a dependent and independent variable.
2) Forecasting of the VAR model is better compared to the other forecasting model.
3) VAR can present better interrelationships between economic variables.
4) This model can overcome spurious regressions, thus this model can overcome the wrong interpretation.

However, this model also has several weaknesses. According to Enders (2004), the VAR model is not based on the theory, is difficult to determine the lag of the model, and is hard to interpret the estimation question.

b. Vector Error Correction Model (VECM)

This model is applied for variables which are non-stationary in the level. According to Stock and Watson (2014), the non-stationary data describes when the regressor variable contains a unit root, and shows the non-normal distribution of unit root. In order to overcome this problem, the regressor needs to be tested in the first difference I(1). Data

which is stationary in first difference could not represent the long-term relationship. Therefore, co-integrated VECM could overcome this problem.

According to Stock J.H and Watson M.W (2014), if two variables are co-integrated (X_t and Y_t), Xt and Yt in first difference can be presented in the VECM model as follows:

$$\Delta Y_t = \beta_{10} + \beta_{11}\Delta Y_{t-1} + \cdots + \beta_{1p}\Delta Y_{t-p} + \gamma_{11}\Delta X_{t-1} + \cdots + \gamma_{1p}\Delta X_{t-p} + \alpha_1(Y_{t-1} - \theta X_{t-1}) + \mu_{1t} \quad (3)$$

$$\Delta X_t = \beta_{20} + \beta_{21}\Delta Y_{t-1} + \cdots + \beta_{2p}\Delta Y_{t-p} + \gamma_{21}\Delta X_{t-1} + \cdots + \gamma_{2p}\Delta X_{t-p} + \alpha_2(Y_{t-1} - \theta X_{t-1}) + \mu_{2t} \quad (4)$$

c. VAR/VECM Model Determination Process

(i) Unit Root/Stationary Testing

In the time series model, there is an important problem of testing regarding unit root (Wooldridge, 2018). This testing is the most important for time series analysis because it can overcome spurious regression. Augmented Dicky Fuller (ADF) is used for testing stationary of data. In this testing, Wooldridge (2015) also asserts that the simple approach to testing unit root begins with an AR (1)i model:

$$Y_t = \alpha + \rho y_{t-1} + e_{t.}\ t = 1,2 \ldots$$

Throughout this section, we let e_t denote the process that has zero mean, given past observed y:

$$E(e_t|y_{t-1}, y_{t-2}, \ldots, y_0) = 0$$

In regards to this model, ρ is the indicator for estimating the white noise which is present whether the variable has a unit root or not. Therefore, the hypothesis according to Woolridge (2018) is as follows:

H_0: $\rho=1$, variable data contains unit root (non-stationary)

H_1: $\rho<1$, variable data does not contain unit root (stationary)

In ADF testing, if the coefficient estimation of ADF statistic is lower than the critical value (1%,5%,10%), we reject Ho. This means that there is no unit root. On the other hand, if the coefficient estimation is higher than the critical value (1%,5%,10%), we accept Ho. This means that the variable data contains unit root or non-stationary. If the data is not stationary in level, the further ADF testing in first difference is needed, and also co-integration test.

This stationary test will determine the model that will be used in this study. If the model is stationary in the level I(0), the model that will be used is VAR. If data is stationary in the first difference I(1) or second difference I(2), co-integration testing is needed in order to capture the short-term and long-term relationship between the variable. If there is any co-integration between variables, thus the Vector Error Correction Model can be used in this study. Moreover, if there is no co-integration in first difference I(1), the model that will be used in this study is VAR first difference.

(ii) Co-Integration Test

Co-Integration test will be tested if the data variable is not stationary in level I(0). According to Engle and Granger (1987), the co-integrated test is variable which consists of two or more than present the common stochastic trend. The co-integration test aims to identify the long-term relationship of variables. Several testing methods that can be used consist of Johansen Co-integration Test, Engle-Granger Co-integration Test, and Co-integration Regression Durbin-Watson Test.

(iii) Determining Lag-Length

In determining lag, it depends on the number of variables that are included in the model VAR or VECM. If there are 5 variables in the VAR/VECM model, the model will consist of four lags. Moreover, Stock and Watson(2014) mentioned that in

determining VAR lag can be determined using F-test information criteria. In determining lag length, there are several tests that can be used such as Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn Criterion (HQ) . The lag-length is determined by the estimated length $\hat{p}$ that minimize BIC (p) that describe the equation as follows:

$$BIC(p) = \ln\left[det\left(\widehat{\sum u}\right)\right] + k(kp+1)\frac{\ln(T)}{T}$$

(iv) Granger Causality Test

This test is used in order to identify causality relation between variables. This testing was invented by Granger (1969) which assert that this testing aims to prove the contribution of variable X toward prediction of another series Y.

(v) Stability Test VAR

The test stability VAR is important in order to validate the impulse response function (IRF). This test will measure the root of the characteristic polynomial. If the root of polynomial value is between the unit circle, thus IRF result will be valid and the VAR model is stable.

(vi) Impulse Response Function (IRF)

Impulse Response Function (IRF) is applied to overcome the difficulties of interpretation of the VAR/VECM estimation model. This function will explain the effect of the shock in one of the endogenic variables in the present time and future time.

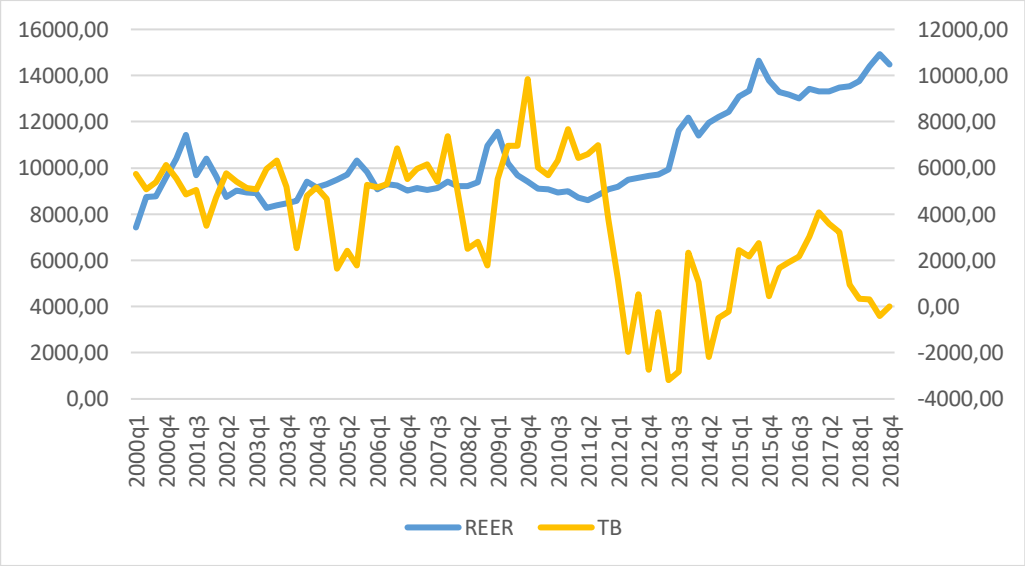
IV. EMPIRICAL RESULT AND DISCUSSION

IV.1 ANALYSIS OF THE IMPACT OF EXCHANGE RATE TOWARD TRADE BALANCE IN NATIONAL LEVEL

a. Dynamics of Exchange Rate and Trade Balance in Indonesia

During 2000-2018, several external shocks such as the recovery of the Asian Financial Crisis in early 2000, and Global Financial Crisis challenged the economic performance of Indonesia. This graph presents the trend of the real exchange rate and trade balance from 2000q1 to 2019q4.

Figure 5: Exchange Rate and Trade Balance in Indonesia



Source: Bank Indonesia, 2018

In early 2000, Indonesia encountered an economic recovery period from the Asian Financial Crisis. In this time, the real exchange rate between Rupiah (IDR) and Dollar (USD) was about 9000-9500 IDR/USD. In trade activities, the increase in export performance in oil and gas contributed to the rise of the trade balance. The increase of the trade balance was supported by the increase of export activity in the commodity industry and the main commodity of electronic (Bank Indonesia, 2002).

According to Bank Indonesia (2007) the increase of global interest rate, the increase of the oil price, and the shifting of the perception of capital flow triggered volatility of monetary and rill sector in Indonesia at 2005. In the monetary sector, rupiah depreciated from 8000 IDR/USD to about 9300 IDR/USD and the sharp decreasing of the trade balance from 2004 to 2005.

In 2007-2008, the slow growth of the world economy, the impact of the European economic crisis and sub-prime mortgage in the US significantly affected the Indonesian Economy. According to Bank Indonesia (2009), the real exchange rate of Indonesia was depreciated 5.4 percent due to the decrease of global demand, therefore the trade balance fell from 2007-2008.

In 2012, the speculation of Greece is exit from the European Union, and quantitative easing chapter 3 from The Fed significantly triggered the fluctuation of rupiah. This shock also impacted the decrease of the term of trade Indonesia, therefore, the fall in the value of Indonesia's export and the deficit of trade balance. From 2012 to 2018, either trade balance to exchange rate were worsened due to the recovery of the global economy or raising of protectionism from a developed country.

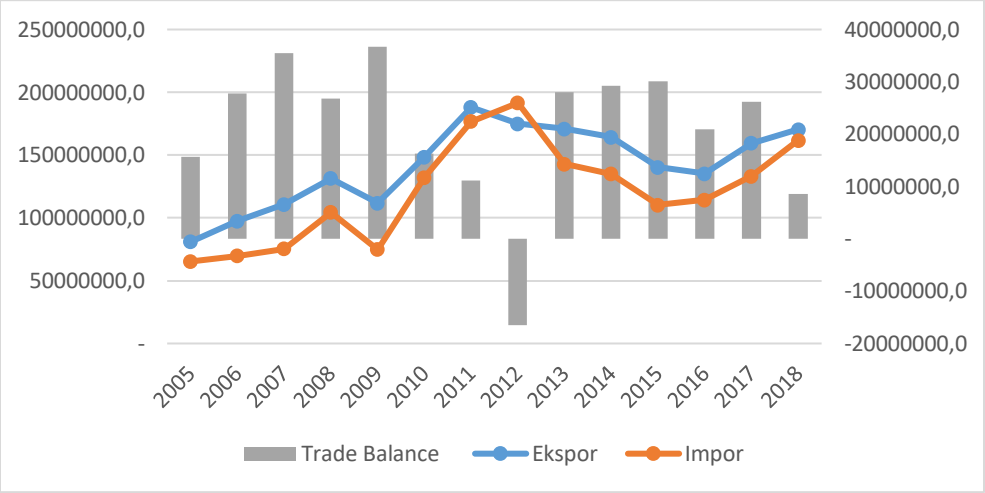
From 2012 to 2018, this period showed the high fluctuation from trade balance and exchange rate Indonesia. Rupiah remained to depreciate every period and the fall in the value of trade balance. Rupiah continued to depreciate since the fed rose the fed rate for the economic recovery of the USA and the decrease of trade balance due to the raising of protectionism.

According to the explanation above, these external shocks determine exchange rate fluctuation, and then it will impact to trade balance in Indonesia.

➢ **Dynamic of Export and Import of Indonesia**

Export and import performances in Indonesia moved alongside each other. The trend of both trading activity rose every year and reached a peak in 2011, then start to fall from 2012. In 2012, the trade balance of Indonesia was a deficit due to high import goods and services.

Figure 6: Export, Import, Trade Balance Indonesia



Sources: Bank Indonesia, 2018

The slowdown of trade performance from 2012 to 2018 was determined by the declining world prices and the rise of domestic demand. Moreover, the government policy oriented on infrastructure also triggered the demand for imported goods for an infrastructure project in Indonesia (Bank Indonesia, 2019).

b. Data Pre-Estimation

According to the ADF test, the test showed that all variables were stationary in first difference, although some variables were stationary in level. It was indicated by the p-value of the variable was less than the significant level in 5 percent, and t-statistic in ADF testing was smaller than the critical value.

Table 2: *Stationarity Test Significance by P-Value*

Variable	Level		First Difference	
	Non-Constant	Intercept and Trend	Non-iConstant	Intercept and Trend
Ln_REER	0.721	0.064	0.0000*	0.000*
Ln_TB	0.040*	0.0000*	0.0000*	0.000*
Ln_GDP	0.000*	0.765	0.0000*	0.000*

n.b : *significant in 5%

In accordance with the result of stationary test, co-integration testing was required in order to examine the long-run relationship between variables. According to the co-integration test by Johansen-Test, the tests evidenced there was **no co-integration**. In other words, the variables could not describe the long-run relationship, hence, this study would focus on the short-run analysis. This result also was emphasized by Oskoee and Harvey (2009, p.10) that "the majority of the cases a real depreciation of rupiah has short-run effects in Indonesia".

Moreover, determining the lag-length is necessary for further process. According to the Akaike Information Criterion (AIC), the criteria showed the optimum lag-length for this model is lag 1.

c. Engle- Granger Causality Test

In regard to determining the causality (Engle-Granger) of variables, this study applied the Engle-Granger Wald Test. According to the test, it indicated the real exchange rate affected the trade balance, and this was proved by the p-value of the variables were below the significant level (5 and 10 percent), therefore it rejected H0. On the other hand, the trade balance did not cause the real exchange rate. Moreover, the test also signified there was not a significant causal relationship between GDP, trade balance and exchange rate.

In regard to this result, **this study cannot prove hypothesis number 1, " there is a bi-directional relationship between exchange rate and trade balance"**. The previous study on the relationship between exchange rate and trade balance also found that there no causal relationship between exchange rate and trade balance (Mostafa & Rashid, 2014; Shao Ziwei,2008).

Table 3. *Granger Causality*

Null Hypothesis	P-value
LN_REER_t does not Granger cause LN_TB_t	0.326
LN_REER_t does not Granger cause LN_GDP_t	0.502
LN_TBt does not Granger cause LN_REERt	0.032*
LN_TBt does not Granger cause LN_GDPt	0.355
LN_GDPt does not Granger cause LN_REERt	0.354
LN_GDPt does not Granger cause LN_TBt	0.733

*) significant in 5%

d. VAR Short-Run

In accordance with the result of the co-integration test, it showed that the variable could not capture the long-run relation. Therefore, the estimation of the short-run variance autoregression (VAR first difference) was applied in this study. According to the estimation, only the independent variable from D.Ln_Tb equation could show the significant effect between exchange rate and trade balance. It was shown by the p-value of chi-square was below 5 percent (0.0126). In regard to the equation, the real exchange rate from the previous period (t-1, and t-2) had a significant effect on the trade balance in short-run. The real exchange rate from t-2 had a positive effect on the trade balance , but the real exchange rate from t-1 has a negative impact on the trade balance.

Table 4: *VAR Short Run Estimation*

Variable	D.Ln_TB	D.Ln_REER	D.Ln_GDP
D.Ln_TB (-1)	-0.125	0.084	-0794
	(0.116)	(0.727)	(0.106)
D.Ln_TB (-2)	-0.100	0.047	-0.016
	(0.112)	(0.070)	(0.102)
D.Ln_REER (-1)	-0.474	-0.028	-0.039
	(0.192)*	(0.120)	(0.175)
D.Ln_REER (-2)	0.408	0.029	0.003
	(0.031)*	(0.118)	(0.172)
D.Ln_GDP (-1)	0.136	0.067	0.020
	(0.1300)	(0.081)	(0.118)
D.Ln_GDP (-2)	-0.009	-0.061	-0.437
	(0.230)	(0.806)	(0.117)
_Cons	-0.009	0.004	(0.029)
	(0.009)	(0.005)	(0.08)
R-sq	0.1818	0.032	0.0153
Chi^2	16.216	2.44	1.13
Prob	0.0126	0.8748	0.9799

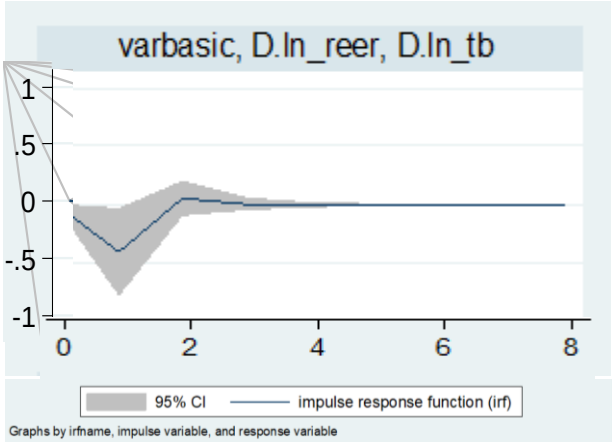
e. Impulse- Response Function (IRF)

The impulse-response function is the main part of this study. According to the unit root test, this study simply can capture short-run analysis. Therefore, the result of this impulse-response will present the short-run analysis.

Before this study will identify the result of the impulse-response function, it is necessary to examine the stability of the VAR model. According to the stability test, it denoted the VAR was stable, and it was showed by the eigenvalue lies inside the unit circle. Thus, the result of the impulse response function was valid.

Impulse response function presents the magnitude and the period of time when one of the variables will shock (impulse) by one unit of standard deviation. In regard to IRF, this study will focus on the impulse from the real exchange rate variable toward trade balance.

Figure 7: The Result of Impulse Response Function



According to the impulse response function, if there is a shock (impulse) from exchange rate about one unit of standard deviation, it will impact to the decrease of trade balance about 0.45 percent in short run. It is evidenced by the sharp decreasing in period 1, then it starts to increase until period 2. Moreover, the response of this shock will take 2 period or 6 months, and it will stabilize after 6 months. This study indicates the impulse of exchange rate only will impact significantly in short-run which is 6 month, and this result showed that there was no J-curve in Indonesia. **Therefore this study cannot fully prove the hypothesis "The depreciation of exchange rate will deteriorate trade balance in short-run, but it will improve trade balance in long-run".** The result aligned with the previous study that has been conducted in Indonesia. Ramadhona (2016) conducted the research of J-curve between Indonesia and trading partner, and the result indicated J-curve does not exist in between Indonesia and trading partner except with Japan.

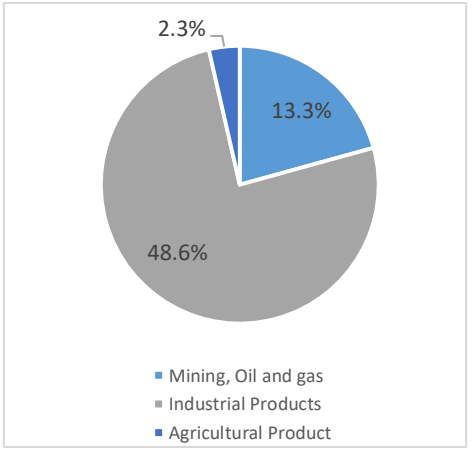
Furthermore, several studies also evidence there is no existence of J-curve in several countries such as China and Japan (Shao, 2007; Ahmad & Yang, 2004). In China, the real devaluation of the real exchange rate will improve the trade balance, and J-Curve did not exist due to there is no negative short-run response from the devaluation of Yuan (Ahmad & Yang,

2004). In addition, Shao (2007) claims exchange rate and trade balance had not a significant long-run relationship, hence J-curve did not exist in Japan.

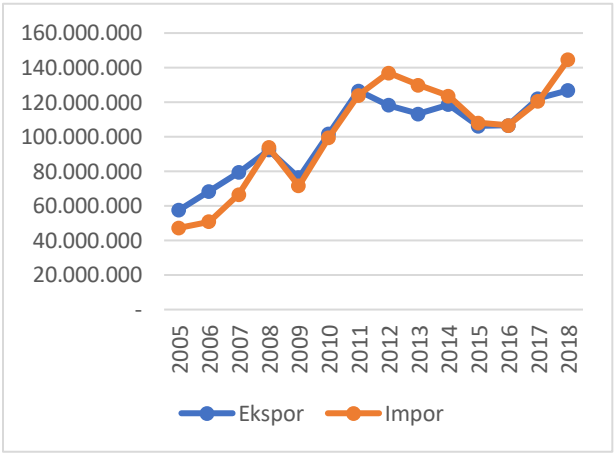
f. Discussion

In accordance with the result, this study cannot capture the long-run relationship. Therefore, it seems this study cannot prove the hypothesis 1 and 2. In addition, the identification of the trade characteristics in Indonesia is necessary to examine the intuitive reason behind this study.

Figure 8: Trade composition of Indonesia and Trade Performance on Manufactured Commodity



Souce: Ministry of Finance, 2013



Souce: Bank Indonesia, 2018

According to the trade composition in Indonesia, manufactured commodity dominate export by (48.6%) compared to another commodity, agriculture by (13.3%), and mining by (2.3%), respectively. Furthermore, the characteristic of manufactured commodity in Indonesia showed the export of commodity in Indonesia depends on imported goods. Therefore, if there is a shock in the exchange rate, the trade balance will largely deteriorate in the short run rather than in the long run, and it aligned with the result of this study.

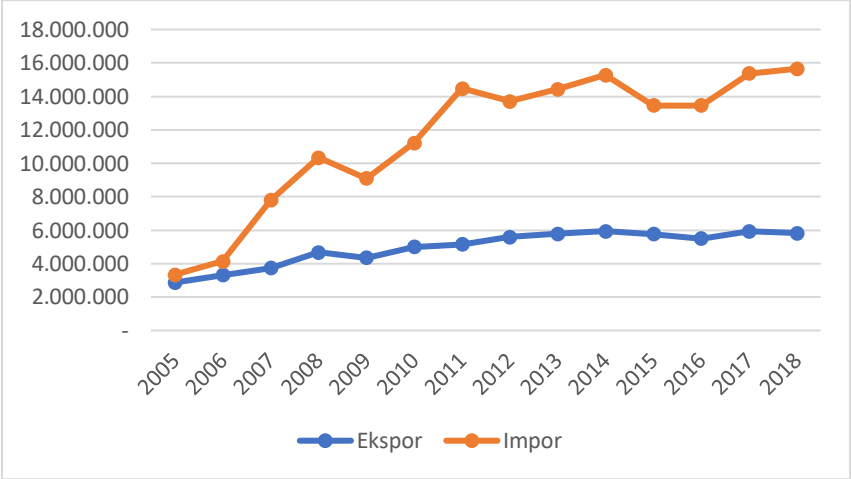
IV.2 ANALYSIS OF THE IMPACT OF EXCHANGE RATE TOWARD TRADE BALANCE IN COMMODITY LEVEL

Indonesia's export and import of are contributed by 3 main commodities consist of agriculture, manufacture, and mining (Central Statistics Bureau of Indonesia, 2018). Therefore, the dynamic of export and import Indonesia in commodities level explained as follows:

a. Trade Performance of Agricultural Commodity

Indonesia's agriculture export performance indicated a stable positive trend from 2005-2018. On the other side, import agriculture sector showed high fluctuation and positives trend compared to Indonesia's agriculture export performance.

Figure 9: Trade in Agricultural Commodity



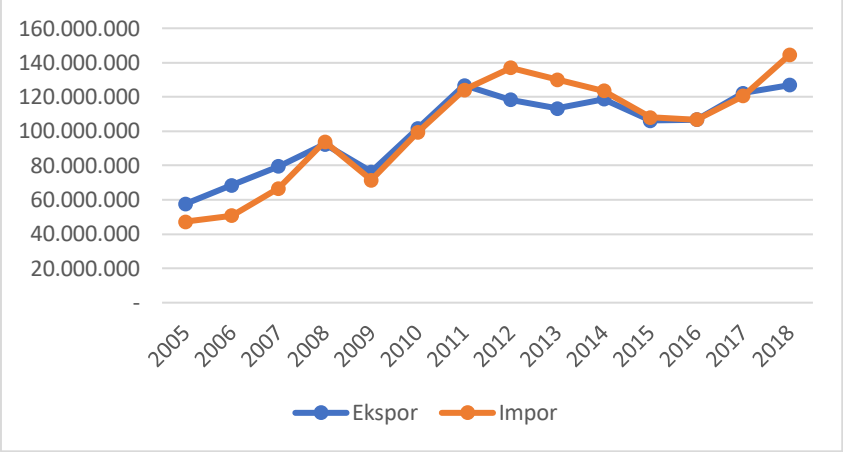
Sources: Bank Indonesia, 2018

Indonesia's import agriculture commodity increased dramatically compared to export agriculture performance. According to the Ministry of Finance of Indonesia (2014) and Bank Indonesia (2019), agriculture import goods rose due to high domestic demand for agriculture goods from Indonesia such as rice, and spices. Moreover, the declining of agriculture term of trade made the value of agriculture export decreasing.

b. Trade Performance of Manufactured Commodity

Manufactured commodity is the fundamental and main commodity toward Indonesia's economy. Manufactured export performance showed a fluctuation trend from 2005 to 2018. In 2009, Indonesia's manufacture export performance dropped dramatically, then it rose until reach peak in 2012, and fell in 2016. Then, trade balance started to rise from 2017. Furthermore. Indonesia's manufacture import performance moved alongside with the export of manufacture from 2005-2018.

Figure 10: Trade in Manufactured Commodity



Sources: Bank Indonesia, 2018

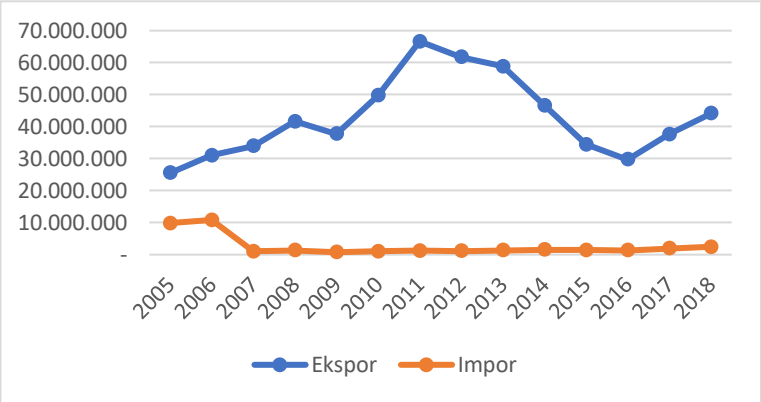
According to the graph above, the export of manufacture in Indonesia depends on imported raw goods from another country (Ministry of Industry of Indonesia, 2018). This was also emphasized by Bank Indonesia (2019) that the raw material imported goods were raised because they support input production in order to fulfill domestic demand and export.

c. Trade Performance of Mining Commodity

Indonesia has abundant of mineral and oil resources, therefore the mining commodity in Indonesia is one of the biggest contribution toward the economy. Export of mining commodity increased in the period 2005 and reached a peak in 2011, then it declined in 2016 and slightly

increased in 2018. Government of Indonesia imposed act no 4 regarding the processing and purified of mining in Indonesia, thus it deceased the export performance of Indonesia in 2012 (Central Statistics Bureau, 2018). In addition, Bank Indonesia claims the decrease of the export mining sector, because of the fall in the price of coal in the international market.

Figure 11: Trade Activity in the Mining Commodity



Sources: Bank Indonesia, 2018

However, Indonesia imports small size of mining commodity from another country, because Indonesia can fulfill the domestic demand for mining.

d. Data Pre-Estimation

Before this study will identify the J-curve in commodity level, it is necessary to examine the level of unit root test, by ADF test. According to the test, the variables in commodities were stationary in level I(0). It was indicated by the p-value of the variable is below 5 percent significant level. Therefore, the analysis in the commodity level could capture long-run, and analysis variance autoregression (VAR) will be applied in this analysis. The stationary table was presented as follow:

Table 5: *Stationarity Test Significance by P-Value*

Variable	Level
	Non-Constant
Ln_REER	0.007*
Ln_TB Agriculture	0.007*
Ln_TB Manufacture	0.046*
Ln_Mining	0.014*

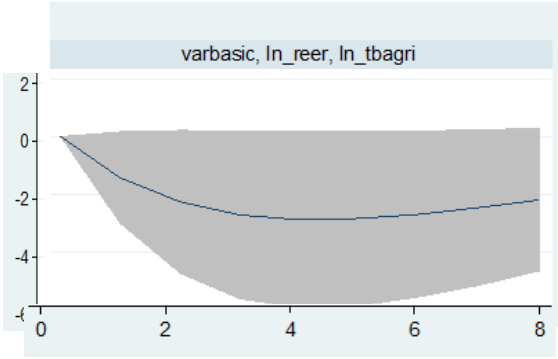
n.b : *significant in 5%

Moreover, VAR stabilization test will be required to examine the validity of IRF and FEVD the next section. According to the test, all the eigenvalues lie inside the unit circle, therefore, VAR was sable. In addition, The optimum lag-length is at 1.

e. Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD)

Aligned with the previous section on IRF for the national level, this section also is the main important part of this study. In this section, there are 3 figures which will show the shock (impulse) of the real exchange rate toward trade balance in 3 main sectors in Indonesia.

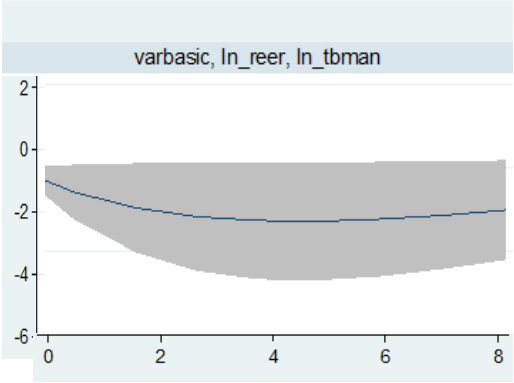
Figure 12: Impulse of Real Exchange Rate toward Trade Balance in Agricultural Commodity



According to IRF in agricultural commodity, if the real exchange rate depreciates the trade balance of agricultural commodity will gradually deteriorate every period until the 8th

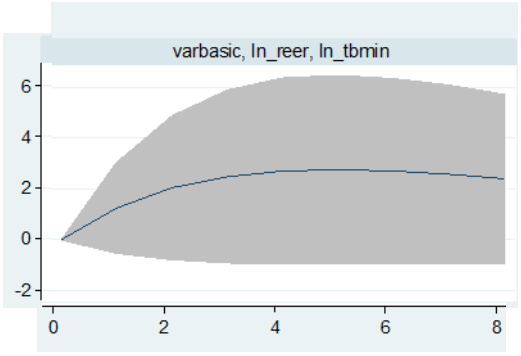
period or 2 years. According to FEVD, the worst deterioration of agricultural trade balance is 0.14 percent at 8th period or at 2nd years. Based on IRF, we can conclude the J-Curve does not exist in agriculture commodity.

Figure 13: Impulse of Real Exchange Rate toward Trade Balance in Manufactured Commodity



Furthermore, manufactured commodity has high elasticity toward exchange rate. Hence, if the real exchange rate depreciates, the trade balance of manufactured commodity will gradually deteriorate every period until the 8th period or 2 years. Based on FEVD, the worst point is 0.118 percent at 8th period or in 2nd years. In accordance with the analysis, we can conclude that J-Curve also does not exist in manufactured commodity.

Figure 14: Impulse of Real Exchange Rate toward Trade Balance in Mining Commodity



In contrast, mining commodity response differently when there is depreciation of the real exchange rate. If the real exchange rate depreciates, the trade balance will gradually increase until 8th period or at 2nd year. Based on FEVD, the highest point is 0.99 percent at 8thperiod or in 2nd years. J-curve also does not exist in mining commodity.

f. Discussion

In accordance with the analysis above, we can examine that agricultural commodity get higher deterioration compared to manufactured commodity. In contrast, mining commodity will increase if there is depreciation of the real exchange rate. In addition, J-curve also does not exist among the three commodities. Therefore, this study also cannot prove the hypothesis 2, "the depreciation of exchange rate will deteriorate trade balance in short- run, but it will improve trade balance in long-run" in commodity level.

If we examine the character of commodity trade in Indonesia in the previous section, we can identify every commodity has its own characteristic. Hence, we can identify the intuitive reason behind the result of this study. In agricultural commodity, the import of agricultural commodity is larger than export, and the export and import of manufactured commodity move alongside each other. Therefore, if the depreciation of the real exchange rate happens, the impact of agricultural commodity is larger than manufactured commodity. On the other hand, the export of mining commodity is bigger than import. Therefore, this study found that if there is depreciation of the real exchange rate, it will improve the trade balance.

V. CONCLUSION

V.1 THE MAIN CONCLUSION

According to this study, it can be concluded, as follows:

1. The relationship between trade balance and exchange rate in Indonesia is one-way. Only the exchange rate affects the trade balance in Indonesia. Therefore, this study cannot prove the hypothesis "there is a bi-directional relationship between exchange rate and trade balance".
2. If there is a shock (impulse) from exchange rate about one unit of standard deviation, it will lead to a decrease of trade balance about 0.45 percent in the short run.
3. The trade balance will deteriorate until 6 months, then it will be stable after 6 months.
4. There is no J-curve condition in Indonesia because there is no long-run relationship at the national level. Therefore, this study cannot prove the hypothesis "The depreciation of exchange rate will deteriorate trade balance in short-run, but it will improve trade balance in long-run
5. In the commodity level, agricultural commodity gets higher deterioration compared to manufactured commodity. However, mining commodity will increase if there is depreciation of the exchange rate.

Furthermore, in accordance with the trade characteristic in Indonesia, the depreciation of the real exchange rate will give greater impact, if the volume of import is larger than export. It was shown by the impact of trade balance in national and commodity level.

V.2 POLICY RECOMMENDATION

In response to the conclusion of this study, we can conclude some policy recommendation, as follows:

1. The Central Bank should focus on overcoming the impact on the volatility of exchange rate in short-term, such as interfering asset and money market due to the impact is larger in the short run.
2. Hedging could be the alternative for the exporter to mitigate the volatility of the exchange rate in the short run.
3. In regard to commodity level, it is necessary to have import-substitution goods in agriculture and manufacture and increasing local production on agriculture by empowering MSMEs. In mining commodity, it needs to increase value added to the mining commodity in order to gain higher trade balance in the long-term.

V.3 RECOMMENDATION FOR FURTHER STUDIES

This study has filled the gap from the previous studies whereas adds the analysis of the impact of exchange rate toward trade balance in commodity level. In contrast, this study still has a limitation, and it can be enhanced in further study.

For the further study which has the same scope of analysis, further studies can consider adding the price of the import. Therefore, it can identify the exchange rate pass-through, and it can measure the value and volume effect. Furthermore, the further study also can consider adding world GDP as a controlled variable.

Moreover, further study can consider analysing the impact of depreciation exchange rate before and after the crisis by adding a dummy variable in the model. Another time series forecasting analysis can be considered for further studies.

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APPENDIX

1. The Stationarity Test
   a) LN_REER (LEVEL)
      i. Intercept and Trend

Dickey-Fuller test for unit root — Number of obs = 75

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.882	-4.095	-3.475	-3.165

MacKinnon approximate p-value for Z(t) = 0.6640

D.ln_reer	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_reer						
L1.	-.1057983	.056217	-1.88	0.064	-.2178649	.0062682
_trend	.0002114	.000297	0.71	0.479	-.0003806	.0008033
_cons	.4665482	.2439029	1.91	0.060	-.0196633	.9527598

      ii. Non-Constant, Regress

Dickey-Fuller test for unit root — Number of obs = 75

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	0.359	-2.610	-1.950	-1.610

D.ln_reer	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_reer						
L1.	.0003953	.0011008	0.36	0.721	-.001798	.0025887

iii. LN_REER (First Different)

Dickey-Fuller test for unit root — Number of obs = 74

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-8.449	-3.546	-2.911	-2.590

MacKinnon approximate p-value for Z(t) = 0.0000

D2.ln_reer	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_reer LD.	-.9626409	.113939	-8.45	0.000	-1.189774	-.7355077
_cons	.0031675	.0048576	0.65	0.516	-.0065158	.0128509

b) LN_TB :

i. Intercept and Trend

Dickey-Fuller test for unit root — Number of obs = 75

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.891	-4.095	-3.475	-3.165

MacKinnon approximate p-value for Z(t) = 0.0125

D.ln_tb	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_tb L1.	-.350078	.0899664	-3.89	0.000	-.5294227	-.1707332
_trend	-.0020514	.0006702	-3.06	0.003	-.0033875	-.0007153
_cons	.1354808	.0409886	3.31	0.001	.0537715	.2171901

ii. Non-constant

Dickey-Fuller test for unit root — Number of obs = 75

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.086	-2.610	-1.950	-1.610

D.ln_tb	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_tb L1.	-.0697659	.0334396	-2.09	0.040	-.1363957	-.003136

iii. First Different

Dickey-Fuller test for unit root — Number of obs = 74

	Test Statistic	Interpolated Dickey-Fuller: 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-10.674	-2.610	-1.950	-1.610

D2.ln_tb	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_tb LD.	-1.210526	.1134047	-10.67	0.000	-1.436542	-.984511

c) LN_GDP:

i. Intercept dan trend

Dickey-Fuller test for unit root — Number of obs = 75

	Test Statistic	Interpolated Dickey-Fuller: 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	0.301	-4.095	-3.475	-3.165

MacKinnon approximate p-value for Z(t) = 0.9963

D.ln_gdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_gdp L1.	.0131578	.0437619	0.30	0.765	-.0740799	.1003956
_trend	-.0011682	.0015893	-0.74	0.465	-.0043365	.0020001
_cons	-.1105269	.5537461	-0.20	0.842	-1.2144	.9933458

ii. No constant regress

Dickey-Fuller test for unit root — Number of obs = 75

	Test Statistic	Interpolated Dickey-Fuller: 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	4.114	-2.610	-1.950	-1.610

D.ln_gdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_gdp L1.	.0020304	.0004936	4.11	0.000	.0010469	.0030139

iii. First Different

Dickey-Fuller test for unit root — Number of obs = 74

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-8.298	-3.546	-2.911	-2.590

MacKinnon approximate p-value for Z(t) = 0.0000

D2.ln_gdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_gdp LD.	-.9804669	.1181566	-8.30	0.000	-1.216008	-.744926
_cons	.0286058	.0078508	3.64	0.001	.0129554	.0442562

2. Co-Integration Test

Johansen tests for cointegration

Trend: constant — Number of obs = 74

Sample: 2000q3 - 2018q4 — Lags = 2

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	12	333.8424	.	28.9936*	29.68
1	17	341.93461	0.19644	12.8091	15.41
2	20	345.72556	0.09738	5.2272	3.76
3	21	348.33917	0.06820		

3. Maximum-Lag

```
. varsoc ln_tb ln_reer ln_gdp , maxlag(10)

Selection-order criteria
Sample:  2002q3 - 2018q4                        Number of obs      =        66
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	100.793				.00001	-2.96341	-2.92408	-2.86388
1	324.41	447.23	9	0.000	1.6e-08*	-9.46697*	-9.30966*	-9.06886*
2	327.895	6.9704	9	0.640	1.8e-08	-9.29986	-9.02456	-8.60315
3	336.045	16.3	9	0.061	1.9e-08	-9.2741	-8.88081	-8.2788
4	341.154	10.217	9	0.333	2.2e-08	-9.15617	-8.6449	-7.86229
5	345.7	9.0924	9	0.429	2.5e-08	-9.02121	-8.39195	-7.42873
6	354.487	17.574	9	0.040	2.6e-08	-9.01475	-8.2675	-7.12369
7	358.863	8.7526	9	0.460	3.0e-08	-8.87464	-8.0094	-6.68498
8	368.716	19.705	9	0.020	3.1e-08	-8.90048	-7.91726	-6.41224
9	387.447	37.462	9	0.000	2.4e-08	-9.19536	-8.09414	-6.40852
10	398.024	21.156*	9	0.012	2.5e-08	-9.24317	-8.02397	-6.15774

```
Endogenous:  ln_tb ln_reer ln_gdp
 Exogenous:  _cons
```

4. VAR-Stabilization

Eigenvalue stability condition

Eigenvalue	Modulus
-.05755388 + .4477387*i*	.451423
-.05755388 - .4477387*i*	.451423
.3191547	.319155
-.07223895 + .1938175*i*	.206842
-.07223895 - .1938175*i*	.206842
-.1922862	.192286

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

5. VAR Short-run Estimation

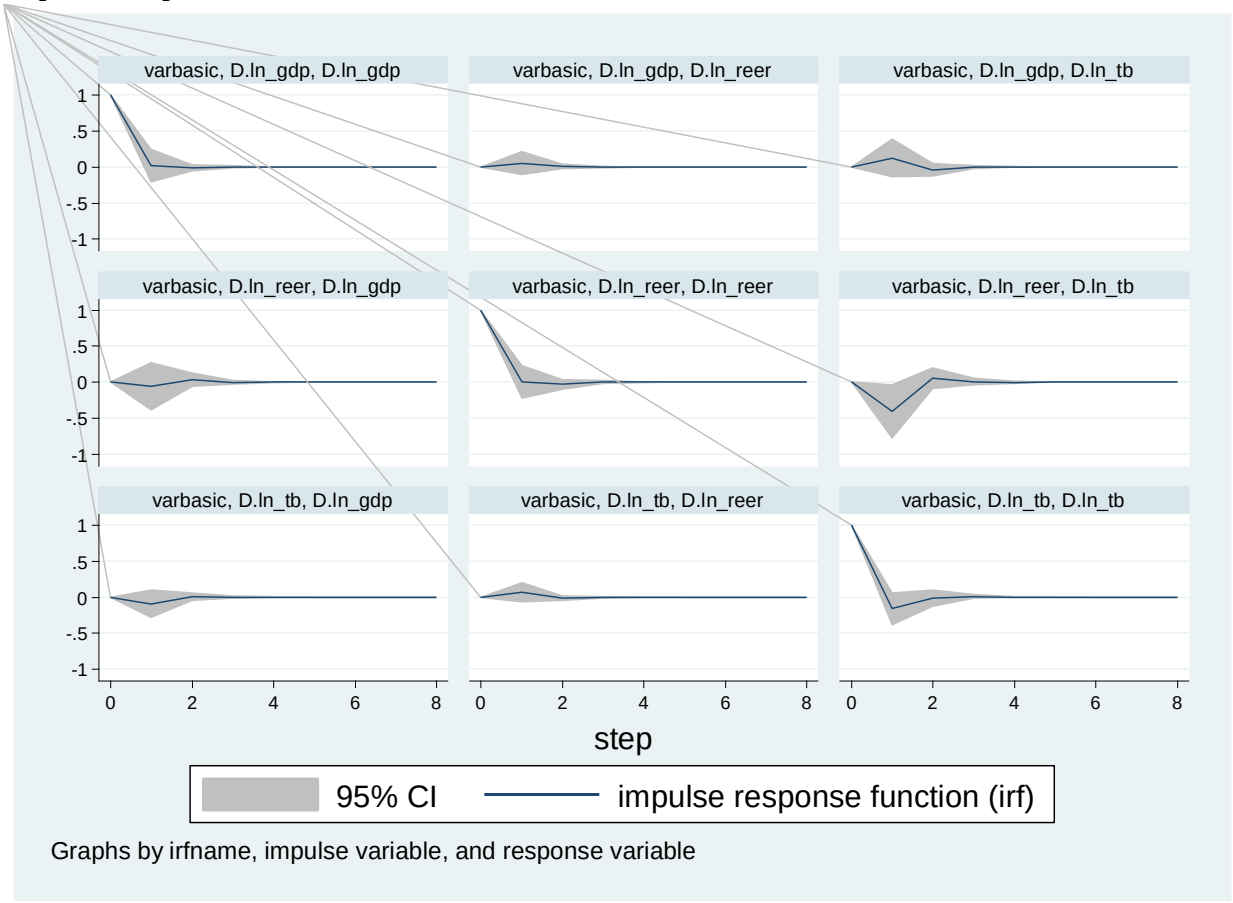
```
Vector autoregression

Sample:  2000q4 - 2018q4                        No. of obs      =         73
Log likelihood =  332.0043                      AIC             = -8.520665
FPE            =  4.01e-08                      HQIC            = -8.258083
Det(Sigma_ml)  =  2.25e-08                      SBIC            = -7.861766

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
D_ln_tb                7     .068348   0.1818   16.21608   0.0126
D_ln_reer              7     .042723   0.0324   2.443268   0.8748
D_ln_gdp               7     .062337   0.0153   1.136337   0.9799
------------------------------------------------------------------
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_ln_tb						
ln_tb						
LD.	-.1252995	.1163762	-1.08	0.282	-.3533926	.1027936
L2D.	-.1003716	.1120472	-0.90	0.370	-.31998	.1192368
ln_reer						
LD.	-.4746956	.1924752	-2.47	0.014	-.8519399	-.0974512
L2D.	.4082222	.1896513	2.15	0.031	.0365124	.779932
ln_gdp						
LD.	.1367939	.1300765	1.05	0.293	-.1181513	.3917392
L2D.	-.0009952	.1290346	-0.01	0.994	-.2538983	.2519079
_cons	-.0092241	.0093149	-0.99	0.322	-.027481	.0090329
D_ln_reer						
ln_tb						
LD.	.0841535	.0727449	1.16	0.247	-.0584239	.2267309
L2D.	.0470221	.0700389	0.67	0.502	-.0902516	.1842959
ln_reer						
LD.	-.0280239	.1203132	-0.23	0.816	-.2638334	.2077856
L2D.	.0290832	.118548	0.25	0.806	-.2032667	.2614331
ln_gdp						
LD.	.0677215	.0813088	0.83	0.405	-.0916407	.2270837
L2D.	-.0610655	.0806575	-0.76	0.449	-.2191512	.0970202
_cons	.0043014	.0058226	0.74	0.460	-.0071107	.0157135
D_ln_gdp						
ln_tb						
LD.	-.0794426	.1061409	-0.75	0.454	-.287475	.1285898
L2D.	.0164842	.1021927	0.16	0.872	-.1838097	.2167782
ln_reer						
LD.	-.0391239	.175547	-0.22	0.824	-.3831898	.3049419
L2D.	.0037076	.1729716	0.02	0.983	-.3353104	.3427256
ln_gdp						
LD.	.0206063	.1186363	0.17	0.862	-.2119166	.2531292
L2D.	-.0437898	.117686	-0.37	0.710	-.2744501	.1868705
_cons	.0291166	.0084957	3.43	0.001	.0124654	.0457679

6. Impulse Response



Engle-Granger

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
D_ln_tb	D.ln_reer	4.5983	1	0.032
D_ln_tb	D.ln_gdp	.85507	1	0.355
D_ln_tb	ALL	5.0948	2	0.078
D_ln_reer	D.ln_tb	.96582	1	0.326
D_ln_reer	D.ln_gdp	.45119	1	0.502
D_ln_reer	ALL	1.3398	2	0.512
D_ln_gdp	D.ln_tb	.85983	1	0.354
D_ln_gdp	D.ln_reer	.11603	1	0.733
D_ln_gdp	ALL	1.187	2	0.552

- Analysis in Sector (Quarterly)
  1) Stationary test
     a) Ln_REER

Dickey-Fuller test for unit root — Number of obs = 55

	Test Statistic	Interpolated Dickey-Fuller: 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.786	-3.573	-2.926	-2.598

MacKinnon approximate p-value for Z(t) = 0.0603

D.ln_reer	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_reer L1.	-.1934511	.0694443	-2.79	0.007	-.3327387	-.0541634
_cons	.8756962	.3136883	2.79	0.007	.2465171	1.504875

     b) Ln_TB Agriculture

Dickey-Fuller test for unit root — Number of obs = 55

	Test Statistic	Interpolated Dickey-Fuller: 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.819	-3.573	-2.926	-2.598

MacKinnon approximate p-value for Z(t) = 0.0557

D.ln_tbagri	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_tbagri L1.	-.186061	.0660118	-2.82	0.007	-.318464	-.0536581
_cons	-.0504479	.048397	-1.04	0.302	-.14752	.0466242

c) Ln_TB Manufacture

Dickey-Fuller test for unit root — Number of obs = 55

	Test Statistic	Interpolated Dickey-Fuller: 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.040	-3.573	-2.926	-2.598

MacKinnon approximate p-value for Z(t) = 0.2695

D.ln_tbman	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_tbman L1.	-.1594772	.0781934	-2.04	0.046	-.3163133	-.002641
_cons	-.0021513	.0111021	-0.19	0.847	-.0244194	.0201168

d) LN_TB Mining

Dickey-Fuller test for unit root — Number of obs = 55

	Test Statistic	Interpolated Dickey-Fuller: 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.530	-3.573	-2.926	-2.598

MacKinnon approximate p-value for Z(t) = 0.1083

D.ln_tbmin	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_tbmin L1.	-.1331339	.0526184	-2.53	0.014	-.2386731	-.0275947
_cons	.4571599	.1745883	2.62	0.011	.1069801	.8073397

2) Lag Optimum for Agriculture, Manufacture, and Mining Commodities

```
. varsoc ln_tbagri ln_reer , maxlag(10)

   Selection-order criteria
   Sample:  2007q3 - 2018q4                  Number of obs      =        46
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	77.3814				.000129	-3.27745	-3.24767	-3.19795
1	112.289	69.816	4	0.000	.000034	-4.62128	-4.53193	-4.38276*
2	116.849	9.1198	4	0.058	.000033	-4.64562	-4.4967	-4.24809
3	125.483	17.267	4	0.002	.000027	-4.84708	-4.6386	-4.29054
4	131.79	12.615	4	0.013	.000025	-4.94741	-4.67936	-4.23185
5	134.007	4.4335	4	0.351	.000027	-4.86987	-4.54226	-3.99531
6	134.887	1.7593	4	0.780	.000031	-4.73421	-4.34702	-3.70063
7	139.744	9.7146	4	0.046	.00003	-4.77148	-4.32473	-3.57889
8	155.387	31.285*	4	0.000	.000019*	-5.27769*	-4.77137*	-3.92608
9	157.145	3.5164	4	0.475	.000021	-5.18021	-4.61433	-3.6696
10	159.489	4.6891	4	0.321	.000024	-5.10824	-4.48278	-3.43861

```
   Endogenous:  ln_tbagri ln_reer
    Exogenous:  _cons

. varsoc ln_tbman ln_reer , maxlag(10)

   Selection-order criteria
   Sample:  2007q3 - 2018q4                  Number of obs      =        46
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	107.442				.000035	-4.58443	-4.55465	-4.50493
1	149.654	84.425	4	0.000	6.6e-06*	-6.24585*	-6.1565*	-6.00733*
2	152.729	6.1498	4	0.188	6.9e-06	-6.20562	-6.05671	-5.80809
3	154.645	3.8307	4	0.429	7.6e-06	-6.11499	-5.9065	-5.55844
4	160.315	11.34	4	0.023	7.1e-06	-6.18759	-5.91954	-5.47204
5	165.571	10.512*	4	0.033	6.8e-06	-6.2422	-5.91458	-5.36763
6	168.702	6.2639	4	0.180	7.1e-06	-6.20446	-5.81727	-5.17088
7	169.391	1.3779	4	0.848	8.4e-06	-6.0605	-5.61375	-4.86791
8	171.217	3.6502	4	0.455	9.5e-06	-5.96594	-5.45962	-4.61433
9	173.088	3.7421	4	0.442	.000011	-5.87337	-5.30749	-4.36276
10	173.804	1.4331	4	0.838	.000013	-5.73061	-5.10516	-4.06098

```
   Endogenous:  ln_tbman ln_reer
    Exogenous:  _cons

. varsoc ln_tbmin ln_reer , maxlag(10)

   Selection-order criteria
   Sample:  2007q3 - 2018q4                  Number of obs      =        46
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	46.6154				.000493	-1.9398	-1.91002	-1.8603
1	99.7291	106.23	4	0.000	.000058	-4.07518	-3.98583	-3.83666*
2	104.78	10.102	4	0.039	.000056	-4.12088	-3.97196	-3.72335
3	106.429	3.2981	4	0.509	.000062	-4.01866	-3.81018	-3.46212
4	114.025	15.191	4	0.004	.000053	-4.175	-3.90695	-3.45944
5	119.269	10.488	4	0.033	.000051	-4.22908	-3.90146	-3.35451
6	123.49	8.4414	4	0.077	.000051	-4.23868	-3.85149	-3.2051
7	126.902	6.8244	4	0.145	.000053	-4.21312	-3.76637	-3.02053
8	146.202	38.6*	4	0.000	.000028*	-4.87834	-4.37203*	-3.52674
9	150.331	8.2582	4	0.083	.000029	-4.88396*	-4.31807	-3.37334
10	153.007	5.3519	4	0.253	.000032	-4.82639	-4.20094	-3.15676

```
   Endogenous:  ln_tbmin ln_reer
    Exogenous:  _cons

.
```

3) VAR stability Agriculture Commodities

```
. varstable
```

Eigenvalue stability condition

Eigenvalue	Modulus
.7439136 + .08116867*i*	.748329
.7439136 - .08116867*i*	.748329
-.4370569	.437057
.3532681	.353268

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

4) VAR stability Manufacture Commodities

Eigenvalue stability condition

Eigenvalue	Modulus
.7558957 + .183917*i*	.777948
.7558957 - .183917*i*	.777948
.1502132 + .1283725*i*	.197594
.1502132 - .1283725*i*	.197594

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

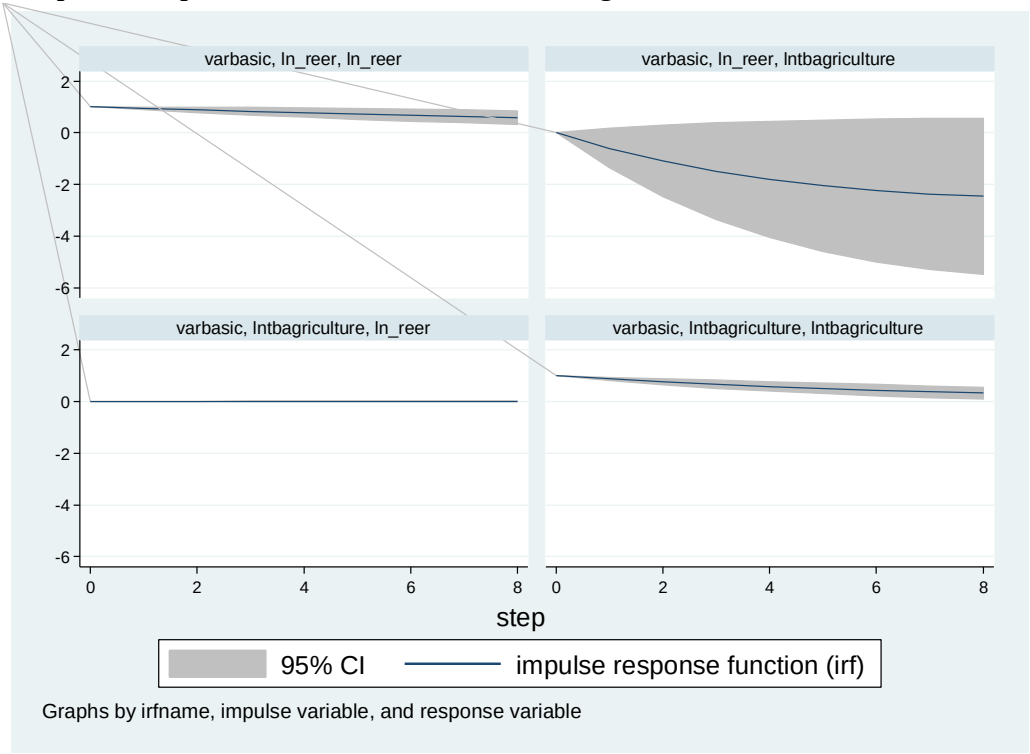
5) VAR stability Mining Commodities

Eigenvalue stability condition

Eigenvalue	Modulus
.8253015	.825301
.470866 + .08582242*i*	.478623
.470866 - .08582242*i*	.478623
-.09674195	.096742

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

6) Impulse Response Function and FEVD for Agriculture Commodities



Results from varbasic

step	(1) fevd	(1) Lower	(1) Upper
0	0	0	0
1	1	1	1
2	.989349	.964324	1.01437
3	.969185	.898223	1.04015
4	.944258	.819187	1.06933
5	.918539	.740954	1.09612
6	.894734	.671754	1.11771
7	.874294	.615001	1.13359
8	.857703	.570919	1.14449

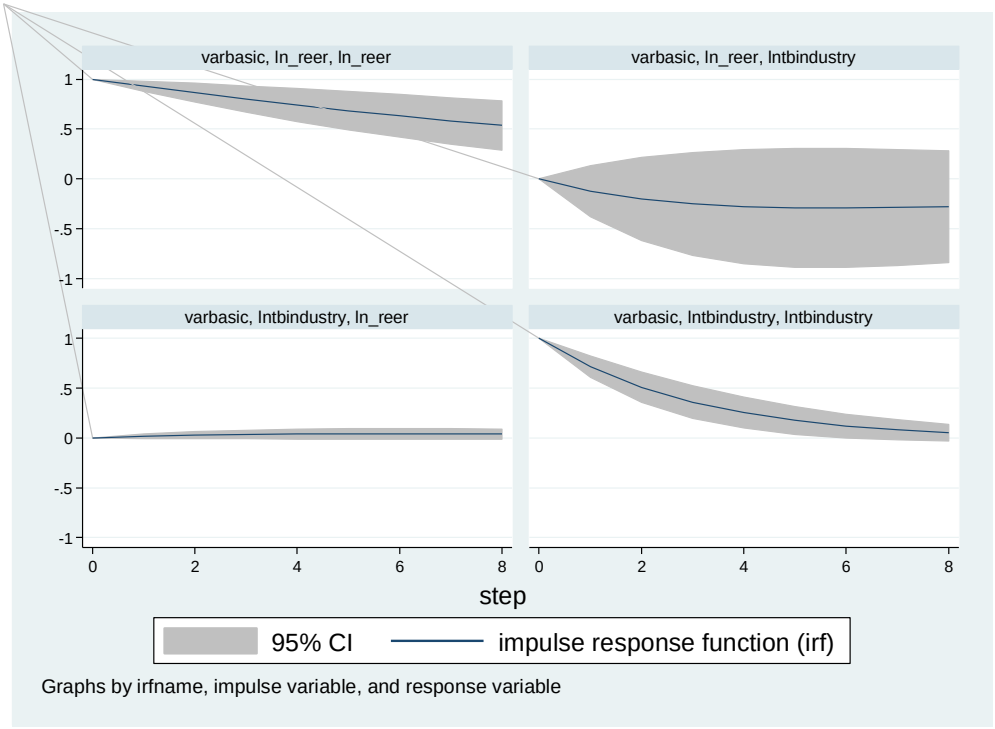
step	(2) fevd	(2) Lower	(2) Upper
0	0	0	0
1	.000146	-.006233	.006524
2	.002366	-.013552	.018285
3	.007101	-.032777	.046979
4	.012991	-.051999	.077982
5	.019108	-.07031	.108525
6	.024859	-.086841	.136559
7	.029915	-.101059	.160889
8	.034135	-.112771	.18104

step	(3) fevd	(3) Lower	(3) Upper
0	0	0	0
1	0	0	0
2	.010651	-.014374	.035676
3	.030815	-.040147	.101777
4	.055742	-.069329	.180813
5	.081461	-.096125	.259046
6	.105266	-.117713	.328246
7	.125706	-.133587	.384999
8	.142297	-.144487	.429081

step	(4) fevd	(4) Lower	(4) Upper
0	0	0	0
1	.999854	.993476	1.00623
2	.997634	.981715	1.01355
3	.992899	.953021	1.03278
4	.987009	.922018	1.052
5	.980892	.891475	1.07031
6	.975141	.863441	1.08684
7	.970085	.839111	1.10106
8	.965865	.81896	1.11277

95% lower and upper bounds reported
(1) irfname = varbasic, impulse = ln_tbagri, and response = ln_tbagri
(2) irfname = varbasic, impulse = ln_tbagri, and response = ln_reer
(3) irfname = varbasic, impulse = ln_reer, and response = ln_tbagri
(4) irfname = varbasic, impulse = ln_reer, and response = ln_reer

7) Impulse Response Function and FEVD for Manufacturing Industry



Results from varbasic

step	(1) fevd	(1) Lower	(1) Upper
0	0	0	0
1	1	1	1
2	.991904	.97323	1.01058
3	.976332	.92237	1.03029
4	.956544	.859109	1.05398
5	.935383	.793424	1.07734
6	.915025	.732457	1.09759
7	.896892	.680331	1.11345
8	.881711	.638614	1.12481

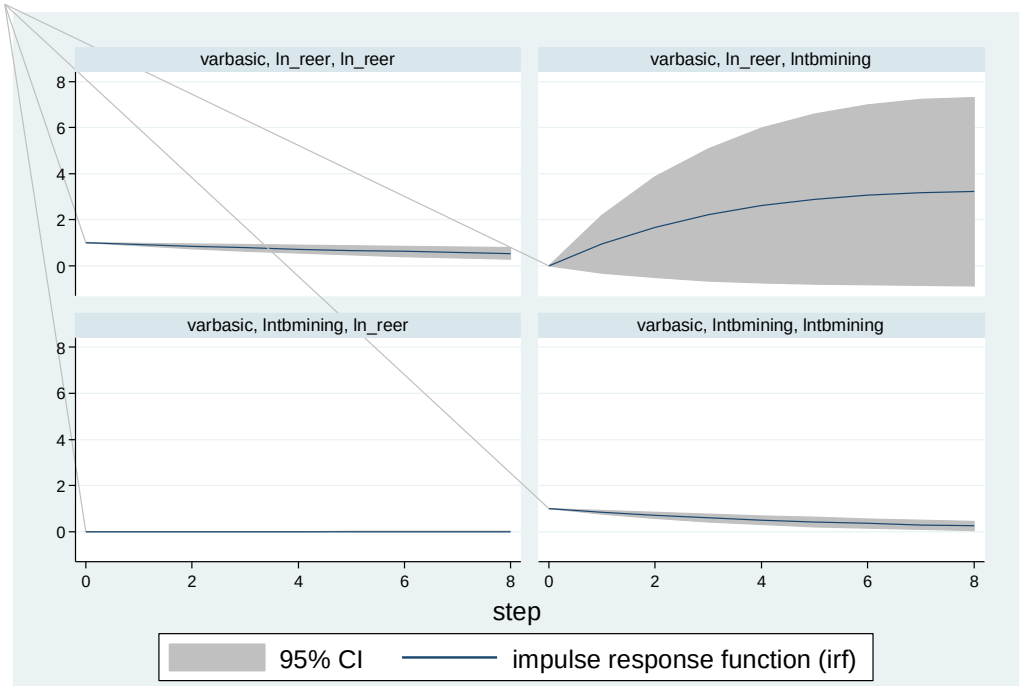
step	(2) fevd	(2) Lower	(2) Upper
0	0	0	0
1	.027805	-.057881	.113492
2	.05461	-.064409	.173628
3	.084479	-.075692	.24465
4	.114257	-.090592	.319106
5	.141758	-.106155	.389672
6	.165683	-.120312	.451678
7	.185464	-.132072	.503
8	.201084	-.141184	.543353

step	(3) fevd	(3) Lower	(3) Upper
0	0	0	0
1	0	0	0
2	.008096	-.010579	.02677
3	.023668	-.030294	.07763
4	.043456	-.053978	.140891
5	.064617	-.077343	.206576
6	.084975	-.097594	.267543
7	.103108	-.113453	.319669
8	.118289	-.124808	.361386

step	(4) fevd	(4) Lower	(4) Upper
0	0	0	0
1	.972195	.886508	1.05788
2	.94539	.826372	1.06441
3	.915521	.75535	1.07569
4	.885743	.680894	1.09059
5	.858242	.610328	1.10616
6	.834317	.548322	1.12031
7	.814536	.497	1.13207
8	.798916	.456647	1.14118

95% lower and upper bounds reported
(1) irfname = varbasic, impulse = ln_tbman, and response = ln_tbman
(2) irfname = varbasic, impulse = ln_tbman, and response = ln_reer
(3) irfname = varbasic, impulse = ln_reer, and response = ln_tbman
(4) irfname = varbasic, impulse = ln_reer, and response = ln_reer

8) Impulse Response Function and FEVD FOR Mining Commodities



Graphs by irfname, impulse variable, and response variable

Results from varbasic

step	(1) fevd	(1) Lower	(1) Upper
0	0	0	0
1	1	1	1
2	.993067	.972708	1.01343
3	.980413	.923636	1.03719
4	.964997	.865062	1.06493
5	.948942	.805483	1.0924
6	.933605	.749929	1.11728
7	.919743	.700866	1.13862
8	.907689	.659091	1.15629

step	(2) fevd	(2) Lower	(2) Upper
0	0	0	0
1	.00001	-.001671	.001691
2	.000011	-.000483	.000505
3	.00003	-.001733	.001794
4	.000062	-.003569	.003693
5	.0001	-.005507	.005706
6	.00014	-.007417	.007697
7	.000179	-.009208	.009565
8	.000214	-.010818	.011247

step	(3) fevd	(3) Lower	(3) Upper
0	0	0	0
1	0	0	0
2	.006933	-.013425	.027292
3	.019587	-.037191	.076364
4	.035003	-.064932	.134938
5	.051058	-.092401	.194517
6	.066395	-.117281	.250071
7	.080257	-.13862	.299134
8	.092311	-.156287	.340909

step	(4) fevd	(4) Lower	(4) Upper
0	0	0	0
1	.99999	.998309	1.00167
2	.999989	.999495	1.00048
3	.99997	.998206	1.00173
4	.999938	.996307	1.00357
5	.9999	.994294	1.00551
6	.99986	.992303	1.00742
7	.999821	.990435	1.00921
8	.999786	.988753	1.01082

95% lower and upper bounds reported
(1) irfname = varbasic, impulse = ln_tbmin, and response = ln_tbmin
(2) irfname = varbasic, impulse = ln_tbmin, and response = ln_reer
(3) irfname = varbasic, impulse = ln_reer, and response = ln_tbmin
(4) irfname = varbasic, impulse = ln_reer, and response = ln_reer

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