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# Structural Shocks and Macroeconomic Conditions in Indonesia

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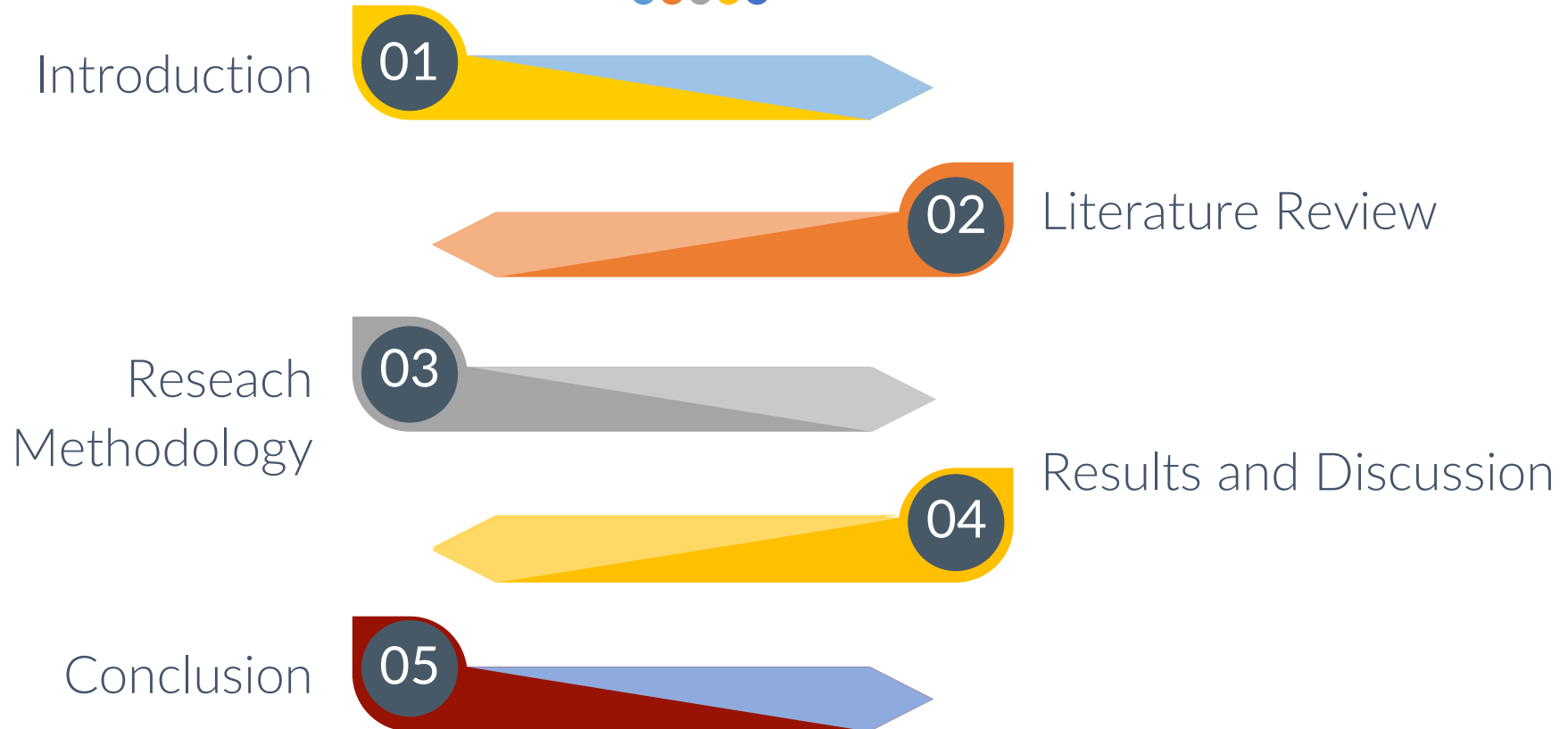
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# Outline



# Introduction

- Major international economic events bring about external disturbances to a small open economy. As a small open economy, Indonesia must meet the disturbances that may result in structural shocks as they are originated from demand and supply.
- The 2007 global financial crisis having the United States as the epicenter of the crisis has caused the macroeconomic fluctuations in numerous countries, including Indonesia. This condition has been worsened lately by the trade war between the US and China (Blanchard *et al.* 2013, Kim 2019).
- The economic slowdown in India and China affected the performance of Indonesia's trade and export. This can be seen from the decline trends appeared as an effect of the high commodity prices in the previous era that came to an end.
- The monetary side: the improvement in the United States' economy has led to a reduction in monetary stimulus. The Fed then raised the Fed's interest rate → cause reduction in global liquidity and capital outflow from funds (This were originally allocated for the developing countries, including Indonesia).
- This condition led to the widening of the current account deficit and the depreciation of rupiah against the US dollar which can result in external imbalances (Gruber and Kamin 2007).
- Furthermore, the high level of uncertainty in the global economy has affected the condition of Indonesia's external balance.

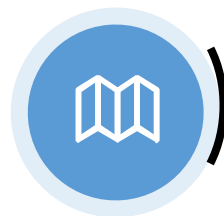


1. The economic growth is steady at 6,2 percent level.
2. Inflation rate is about 4,3 percent.
3. Rupiah was still depreciated in the range of Rp 9,358 per US dollar
4. Foreign exchange reserves had achieved more than double from the crisis period, i.e. 112,8 billion US dollars until the end of 2012.

### Indonesia's economic recovery 2012

1. The depreciation of rupiah against dollar has reached a figure of Rp 15,200 per dollar in October 2018.
2. Foreign exchange reserves also began to decline from around 130 billion US dollars at the beginning of 2018 to 120.65 billion US dollars in a few months.
3. The unemployment rate in February 2013 of 5.88% had risen to 6.18% in 2015.

### The continued impact of macroeconomic fluctuations 2017



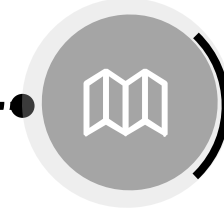
2008

### Global Financial Crisis

1. Export started to decline.
2. Economic growth showed a slowdown from 6,3 percent in 2007 to 6,1 percent at the end of 2008.
3. The inflation increased dramatically from 6,59 percent to 11,06 percent in the same period.
4. depreciation of Rupiah against US dollar. The Rupiah recorded a decline of 5,4 percent at Rp9,666 per US dollar and Indonesia's foreign exchange reserves were only at 51,6 billion US .dollars in 2008



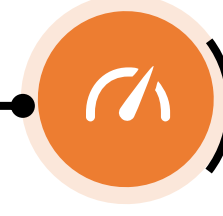
2012



2013

### Indonesia's fluctuations occurred

1. The economic growth dropped sharply to 5.58% from the previous period which reached 6.23% (yoy) in 2012 and 6.5% in 2011.
2. the inflation reached 7,66%.
3. Current account deficit and the depreciation of rupiah.



2017



The objective of this paper



To examine the impacts of structural shocks that lead to macroeconomic weakening in Indonesia during the recovery phase after the global financial crisis.



# Literature Review



# Structural shocks

Shock can be defined as the gap of actual and potentials of a variable and the gap is also called the disequilibrium (Hubbard *et al.* 2014, Insukindro 2020).

- Jiang *et al.* 2020

Shocks originating from the demand and supply sides are known as structural shocks.

- Hubbard *et al.* 2014

An unexpected occurrence that have a wide structural impact on large scale economy.

- Chugh (2015)

defines a shock as a change that cannot be explained. In the supply and demand perspective, the change is represented by the shift of the demand and supply.

# Teoritical Review



This study uses the approach of the Real Business Cycle (RBC) and the New Keynesian. They are currently the leading theories on business cycle. The RBC theory explains that economic conditions that experience periodic expansion or recession are natural events. Weakening economic conditions resulted in fluctuations output and employment is the result of the various shocks that have hit the real economy and markets make adjustments quickly to maintain the balance (Shirota 2019).

*Supply shocks* cause the macroeconomic fluctuations (Chugh, 2015; Romer, 2012)



**Real  
Business  
Cycle**

**New  
Keynesian**



*Demand shocks* cause the macroeconomic fluctuations. The government plays a role to overcome economic problems (Chugh, 2015; Romer, 2012).





# Exchange Rate Fluctuations

Asset Approach

Monetary Approach

The main factors that influence exchange rate fluctuations are the magnitude of **the rate of return from domestic assets, foreign assets, and expectations of appreciation or depreciation** of the domestic currency against foreign currency. If the rate of return from domestic assets rises, the domestic currency will experience appreciation with the assumptions that the expectations are considered fixed, vice versa (Krugman, *et al.*, 2015).

**Money market is a factor that affects the exchange rate.** Money supply is assumed to be fixed while **money demand will determine the equilibrium interest rate.** If the money supply is greater than the money demand, the interest rate will decrease and will cause domestic currency to depreciate.



# AGGREGATE DEMAND AND AGGREGATE SUPPLY

This approach is used to see the relationship between variables in the economy.

Basically there are three markets involved, called **the output market, money market and foreign exchange market (interest parity equilibrium)** (Cover and Mallick 2012, Krugman *et al.* 2015).

The model consists of (1) an IS curve that reflects the balance in the goods and services market, (2) an MP curve that illustrates the monetary policy of the Central Bank, and (3) a PC curve that represents the Phillips curve (Modified New Keynesian Phillips Curve) that describes the short-term relationship between the output gap and inflation (Cover, 2012; Giese and Wagner, 2007).

If the output gap is positive, it means that there is an expansion in the economy, the unemployment rate will decline, and the inflation will likely rise.



# Research Methodology

# Data and Variables



Data

- Quarterly data, 2007-2019.
- Data are drawn from the Census and Economic Information Center (CEIC) database and Statistik Ekonomi dan Keuangan Indonesia (SEKI) Bank Indonesia

Variables

- Unemployment
- Output Gap
- Output
- Inflation
- INDIR (domestic interest rate)
- Exchange Rate Rp/US Dollar
- Expected Exchange Rate Depreciation Rp/US Dollar
- DIR (interest rate differentials)
- BIRate

# Definition of Variable



Notation	Variable	Definition	Unit	Source
$u_t$	Unemp	Open unemployment rate	people	CEIC Database
$y_t - y_t^n$	Output Gap	Difference between real output and potential output	percentage	CEIC Database
$y_t$	Output	GDP constant price 2010	Billion Rupiah	CEIC Database
$p_t$	Inflation	consumer price indices	percentage	SEKI, BI
$i_t$	INDIR (domestic interest rate)	3 months deposits interest rate (Rupiah)	percentage	SEKI, BI
$i_t^f$	US-IR (foreign interest rate)	3 months deposits interest rate (Dollar)	percentage	SEKI, BI
$q_t$	ER	Exchange Rate Rp/US Dollar	Rp/US	CEIC Database
$q_t^e$	Exper	Expected Exchange Rate Depreciation Rp/ US Dollar	Rp/US	CEIC Database
DIR	DIR (Interest Rate Differential)	Difference between domestic dan foreign interest rate	percentage	SEKI, BI
BIRate	BIRate	Central Bank Interest Rate	percentage	SEKI, BI



The paper uses the RBC and New Keynesian approach, that has covered shock both in terms of demand and supply to analyze the link between variables used in this research model.

According to the Purchasing Power Parity (PPP) approach, the increase in inflation in a country more than the foreign inflation will result in domestic currency exchange rates depreciation.

The difference in the rate of return of assets between countries can also lead to appreciation or depreciation of currencies. In this condition, Uncovered Interest Parity (UIRP) does not hold.

UIRP condition is a condition in which the foreign exchange market is in equilibrium condition where the foreign interest rate is the same as the domestic interest rate with the assumption that there are no transaction costs and obstacles in trading. Therefore, in this condition, the differential interest rate is zero so that the arbitrage does not occur (Krugman *et al.* 2015).



# Macroeconomic Model Specification



$$\mu_t = \mu_{t-1} - \alpha_1(y_{t-1} - y_{t-1}^n) + \varepsilon_t^P$$

Productivity

$$y_t = \beta_1\mu_t + \beta_2p_{t-1} + \beta_3i_{t-1} + \varepsilon_t^{IS}$$

IS

$$p_t = \mu_1\mu_{t-1} + \mu_2(y_{t-1} - y_{t-1}^n) + \mu_3q_{t-1} + \varepsilon_t^{AS}$$

Phillips Curve

$$BIRate_t = \lambda BIRate_{t-1} + (1 - \lambda)[\gamma_1 p_t + \gamma_2(y_{t-1} - y_{t-1}^n)] + \varepsilon_t^{MP}$$

Monetary Policy Rule

$$q_t = \kappa_1 q_t^e + \kappa_2(i_t - i_t^f) + \varepsilon_t^q$$

UIRP Exchange rate equation

To analyze the effect of structural shocks on Indonesia's macroeconomic conditions, a model consisting of productivity equations, IS equations, Phillips Curve equations, monetary policy rule equations and UIRP exchange rate equations is used (Cover and Mallick 2012, Krugman *et al.* 2015)

The approach states that output and employment fluctuations are caused by various structural shocks that hit the economy. The shocks are represented in the errors in each equation.

# SVAR Specification



The model used in this study is the Structural Vector Autoregression (SVAR) model, which is a development of the VAR model. Sims (1980) proposed the new model that does not specify exogenous and endogenous variables. Therefore, this model does not estimate the parameters but examines the interrelationship between variables. There is bivariate system (Sims, 1980; Enders, 2015):

$$\begin{cases} Y_t = a_{10} - b_{12}X_t + \gamma_{11}Y_{t-1} + \gamma_{12}X_{t-1} + e_{Yt} \\ X_t = a_{20} - b_{21}Y_t + \gamma_{21}Y_{t-1} + \gamma_{22}X_{t-1} + e_{Xt} \end{cases} \quad \begin{matrix} (1) \\ (2) \end{matrix}$$

$e_{Yt}$  and  $e_{Xt}$  are assumed as *whitenoise* and not correlated

$$\text{Basic Model : } Z_t = A_0 + A_1Z_{t-1} + \dots + A_pZ_{t-p} + \epsilon_t \quad (3)$$

$$\epsilon_{1t} = \begin{pmatrix} e_{Yt} - b_{12} e_{Xt} \\ e_{Yt} - b_{12} e_{Xt} \end{pmatrix} / \begin{pmatrix} 1 - b_{12}b_{21} \\ 1 - b_{12}b_{21} \end{pmatrix} \quad (4)$$

$$\epsilon_{2t} = \begin{pmatrix} e_{Yt} - b_{12} e_{Xt} \\ e_{Yt} - b_{12} e_{Xt} \end{pmatrix} / \begin{pmatrix} 1 - b_{12}b_{21} \\ 1 - b_{12}b_{21} \end{pmatrix} \quad (5)$$

From the above equation, it can be seen that the error terms are composite errors, namely error terms containing shocks from X and shocks from Y.

- *Structural VAR* is expected to explain the dynamic changes in the Indonesian economy caused by *structural shocks*.
- The model wants a stable equation system (eigenvalue < 1) which is located in a unit circle or stationary even though Sims does not require differencing to be stationary because it will remove a lot of information.

Because shocks occur simultaneously, the orthogonalized IRF was then used to see the effect of X shocks on Y.

Impulse Response Function (IRF) analysis is used to examine the composite shock effect in the equation system towards the variables of interest.



# Impulse Response Function

$$\begin{bmatrix} Y_t \\ X_t \end{bmatrix} = \begin{bmatrix} \bar{Y} \\ \bar{X} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \phi_{11}(i) & \phi_{12}(i) \\ \phi_{21}(i) & \phi_{22}(i) \end{bmatrix}^i \begin{bmatrix} e_{Y_{t-i}} \\ e_{X_{t-i}} \end{bmatrix}$$

$$\phi_i = \frac{A_1^i}{1 - b_{12}b_{21}} \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix}$$

It can be described as follows:

$$Z_t = \mu + \sum_{i=0}^{\infty} \phi_i e_{t-i}$$

There are four  $\phi_{jk}$  elements called *impact multipliers* (*impulse response functions*). For example  $\phi_{12}(0)$  is the effect of 1 unit of change in the  $e_{X_t}$  shocks on  $Y_t$  in which others are assumed to be constant.

# Structural VAR Model

$$A(L) y_t = A_0 (I_n - A_1 L - A_2 L^2 \dots - A_p L^p) y_t = A_0 e_t = B \varepsilon_t$$

Where:

$A(L)$  = matrix of polynomials lag of variables  
of interest

$y_t$  =  $n \times 1$  vector containing each of  $n$  variables included in the VAR

$A_0$  =  $n \times n$  matrix of contemporaneous effects between variables

$B$  = matrix of restrictions

$\varepsilon_t$  =  $n \times n$  column vector of structural shocks

$e_t$  =  $n$ -column vector of reduced form shocks

# SVAR Restriction Matrix



Structural VAR emphasizes on restrictions on responses from variables and predicts the impact of intervention. Several assumptions are applied to build a complete SVAR model as well as to develop the restrictions, they are based on economic theory and literature review (Cover and Mallick 2012, Krugman *et al.* 2015, Hubbard *et al.* 2014, Arestis and Sawyer 2008). In this paper, the restrictions that are imposed in the system are as follows.

- The unemployment rate is affected by output gap shocks. Based on RBC theory, cyclical unemployment occurs due to the business cycle recession.
- Output is affected by unemployment, inflation, and domestic interest rates (INDIR) shock. Negative demand shocks have a negative effect on output.
- The inflation rate is influenced by unemployment, exchange rate (ER), and output gap shocks.
- The BI Rate is influenced by inflation and output gap shocks.
- Exchange rate is affected by interest rate differential shocks (DIR) and expected exchange rate depreciation (Exper) shocks.
- The domestic interest (INDIR) rate is affected by expected exchange rate depreciation (Exper) shocks.
- Interest differential is determined by expected exchange rate depreciation (Exper) shocks.

$$\begin{bmatrix} Unemp \\ Output \\ Inflation \\ BIRate \\ ER \\ INDIR \\ DIR \\ OutputGap \\ Exper \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & a_{18} & 0 \\ b_{21} & 1 & b_{23} & 0 & 0 & b_{26} & 0 & 0 & 0 \\ c_{31} & 0 & 1 & 0 & c_{35} & 0 & 0 & c_{38} & 0 \\ 0 & 0 & d_{43} & 1 & 0 & 0 & 0 & d_{48} & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & e_{57} & 0 & e_{59} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & f_{69} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & g_{79} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{Unemp} \\ \varepsilon_{Output} \\ \varepsilon_{Inflation} \\ \varepsilon_{BIRate} \\ \varepsilon_{ER} \\ \varepsilon_{INDIR} \\ \varepsilon_{DIR} \\ \varepsilon_{outputGap} \\ \varepsilon_{Exper} \end{bmatrix}$$

One of the components of the matrix is 0, for example  $a_{13} = 0$  means that the long-term response of the unemployment variable towards the inflation variable shocks is zero.



# Results and Discussion

# Unit Root Test



## The Unit Root Test with ADF Test

The results show that the variables are stationary at the level.

No	Variable	ADF Test
1	Output	-17.963***
2	Inflation	-4.050***
3	BIRate	-4.036***
4	Unemployment	-7.064***
5	ER	-5.627***
6	INDIR	-4.736***
7	DIR	-3.425**
8	OutputGap	-17.152***
9	Exper	-6.570***

\*\*\*) indicates that the variable is stationary at a critical value of 1%,

\*\* ) indicates that the variable is stationary at a critical value of 5%,

# Stability Test Unit Circle

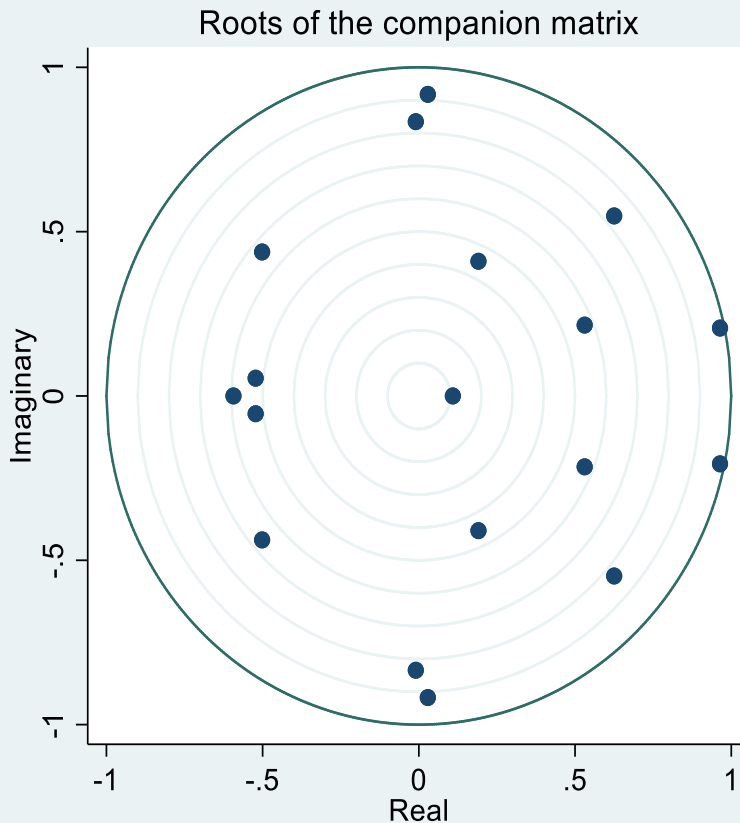


Figure 1

The stability test indicates that the system is stable with eigenvalue  $<1$  and the roots are within the unit circle.

The next step is to determine the number lag for VAR estimation. Akaike's Information Criterion (AIC), Schwarz's Bayesian Information Criterion (SBIC), and the Hannan and Quinn Information Criterion (HQIC) are used to determine the lag variable used in the VAR model. Based on the test, the results suggest that lag of three should be used.

Besides, this model passed another diagnostic test, namely the normality test, autocorrelation.



# Impulse Response Function

## Unemployment Response to *Production Shocks*

- In the first period, the production shocks originating from the output gap leads to an increase of 51,066 unemployed people. The effect levels out in the fifth period onward (Shirota 2019). This is consistent with empirical research which states that the business cycle that results in the production shocks affecting the unemployment rate (Constant and Zimmermann 2014).
- The increase in the output gap shows that the potential output is more significant than the real output resulting in a decrease in economic conditions, which can lead to increased cyclical unemployment (Okun's law).
- The model captures production shocks from the supply side in the economy (Chugh 2015, Cover and Mallick 2012, Romer 2012, Hubbard *et al.* 2014).

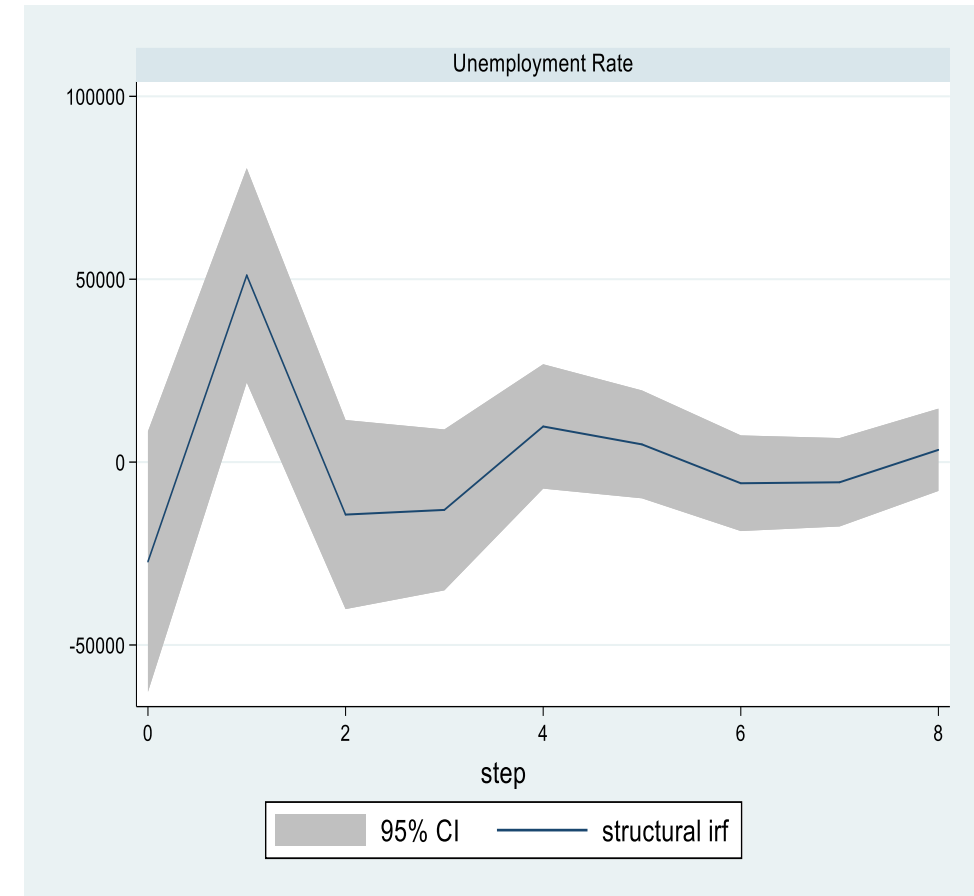


Figure 2



# Impulse Response Function

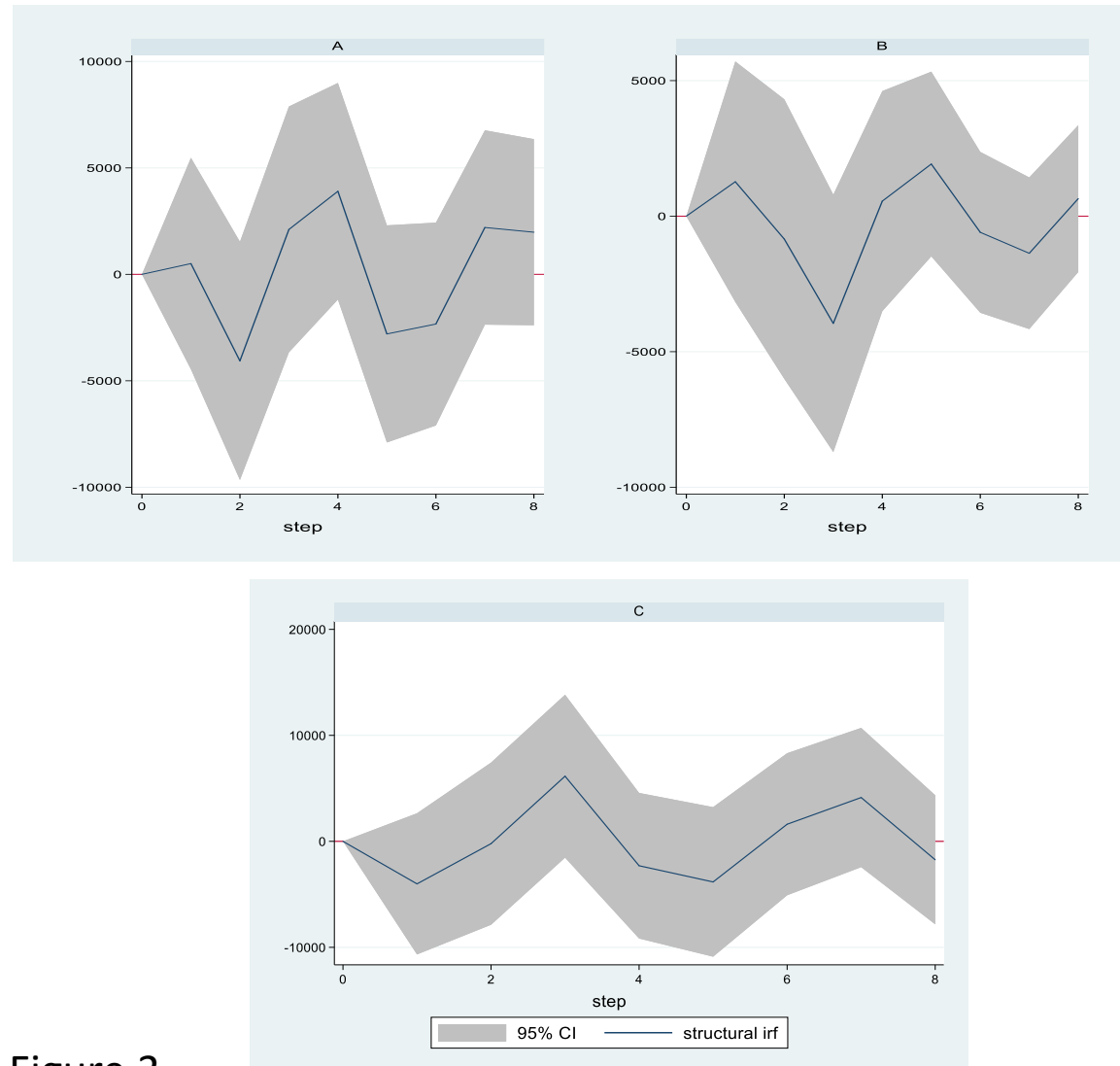


Figure 3

## Output Response to IS Shocks

The figures indicate that output oscillates around zero as a response to IS shocks originating from the unemployment, inflation, and domestic interest rates.

The unemployment shocks resulted in an increase in output of 506.158 billion rupiah in the first period, but it decreases output in the second period (Figure 3a).

Similar to the output response to unemployment shocks, the inflation shocks resulted in a temporary increase in output at the beginning of the period and then declined again in the third period. In the first period, the inflation shocks will cause real money demand to fall, domestic interest rates to rise, investment to fall, which leads to the fall of the output (Figure 3b).

The domestic interest rate shocks affect output in the same pattern, but initial effect is negative (Figure 3c). This result is in line with the study of (Đurčová 2012).





## Inflation Response to AS Shocks

- The figure generally shows the effect of AS shocks on the inflation rate in Indonesia. The figures indicate that inflation response differently to the three shocks, the AS shock originating from unemployment, output gap, and exchange rate. Overall the response of inflation to these shocks is relatively small.
- The unemployment shocks result in a decrease in inflation by 0.232% in the first period.
- The output gap shocks increase in inflation by 0.143% at the beginning of the period. The increase in the output gap shows that the potential output is larger than the real output that lead to the rise of inflation.
- The exchange rate shocks increase inflation instantly. The exchange rate shocks result in depreciation, an increase in exports, an increase in foreign exchange from the export results, increase in income, an increase in purchasing power, an increase in consumption, which then leads to inflation that comes from the demand-pull inflation by 0.06% (Figure 4c). However, in the subsequent period inflation drops to -0.35%. This result is in line with the study of Batini *et al.* (2005).

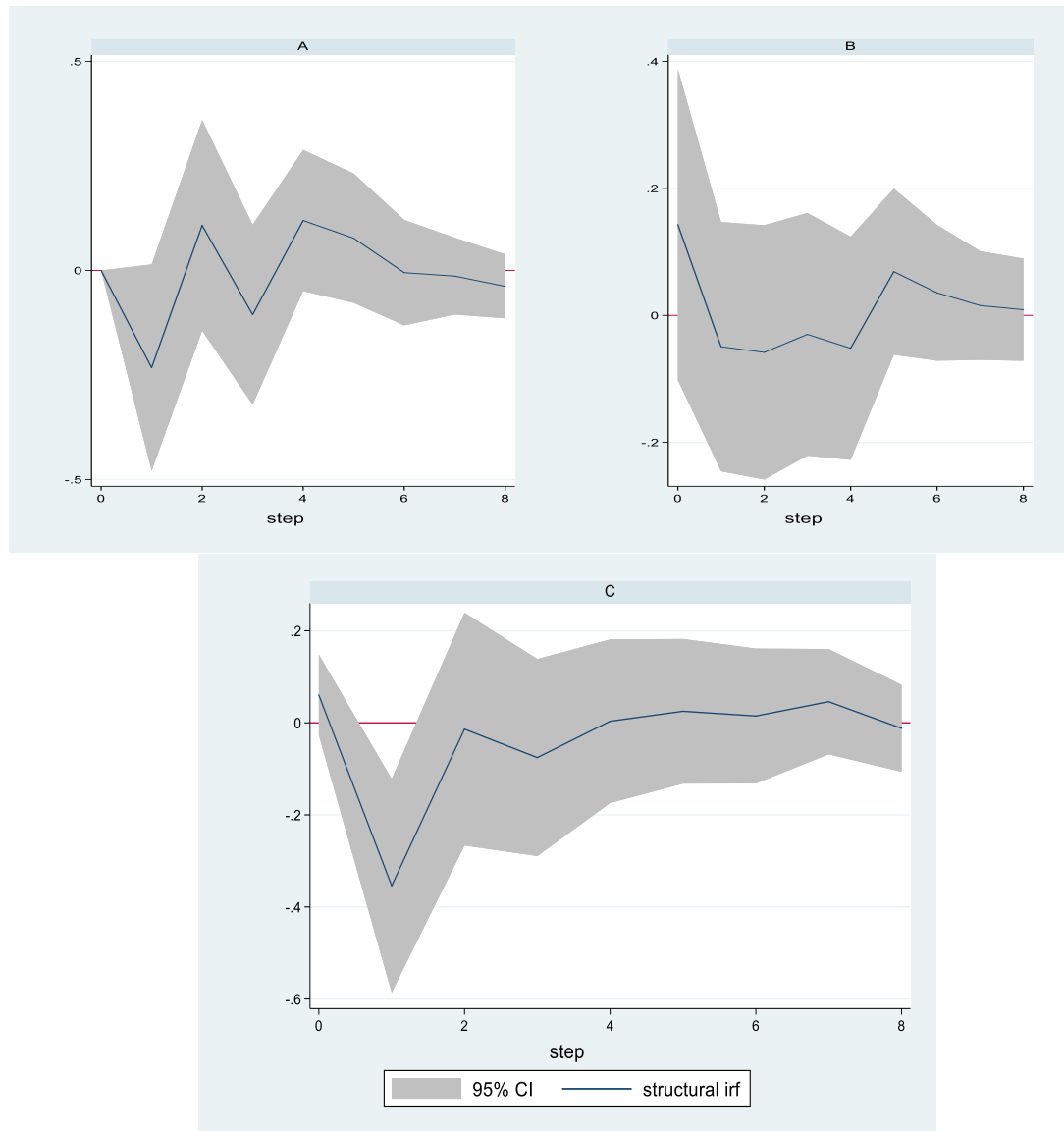


Figure 4



# • BI Rate Response to Monetary Policy Shocks

Figure 5 shows the increase in the BI Rate due to monetary policy shocks originating from inflation and the output gap of one standard deviation. The inflation shocks resulted in an increase in the BI Rate by 0.03% (Figure 5a).

The output shocks resulted in an increase in the BI Rate by 0.06% immediately but it decreases BI Rate afterward (Figure 5b).

The results of this study show that Bank Indonesia responded quickly to the structural shocks. According to the Keynesian, in disequilibrium condition, interest rates have a direct relationship with prices or inflation (Insukindro, 2020).

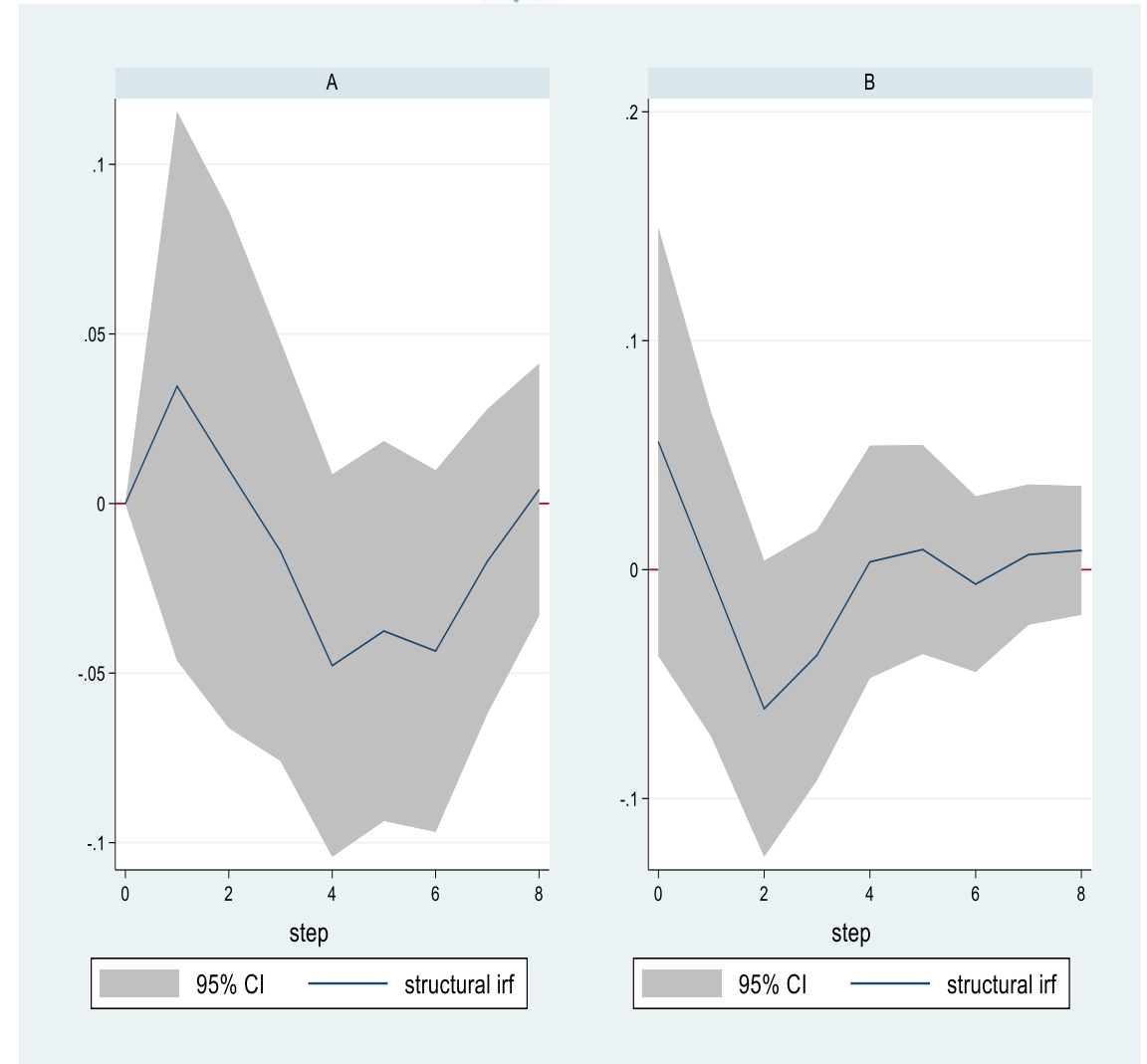


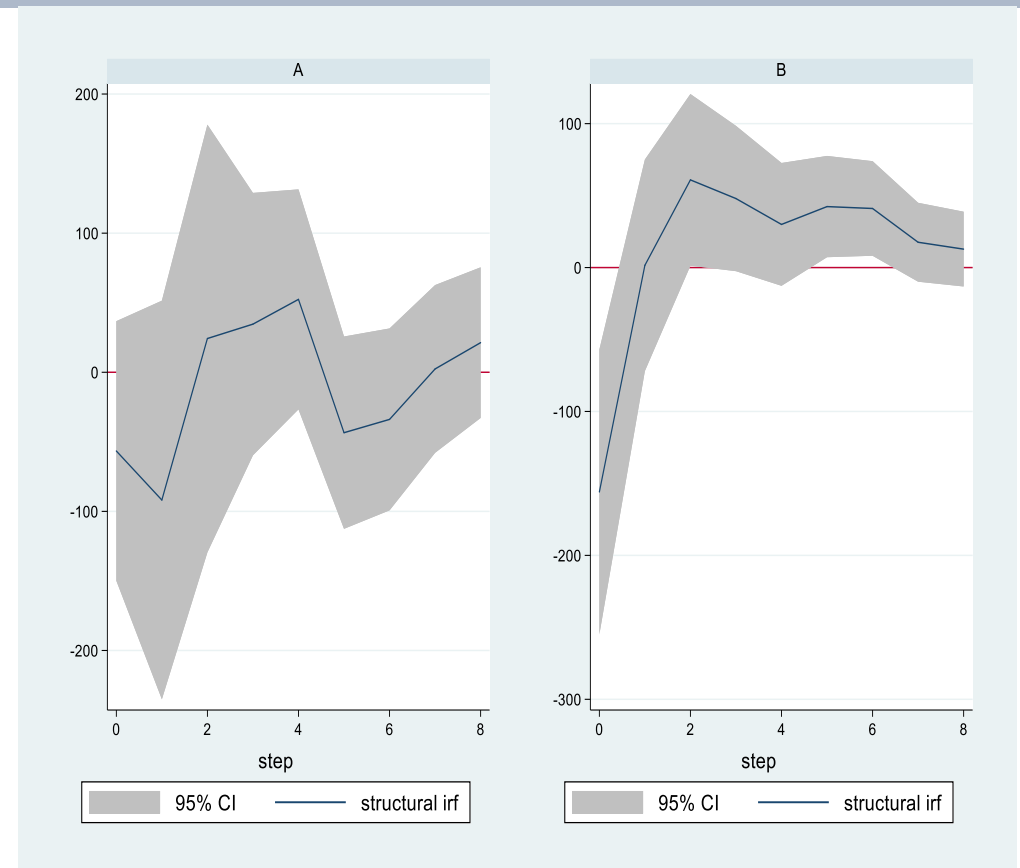
Figure 5

# Exchange Rate Response to Exchange Rate Shocks

Figure 6 show the response of exchange rate due to exchange rate shocks. The shocks are originating from interest rate differential and expected exchange rate depreciation.

Both shocks lead to depreciation of rupiah. The exchange rate differential shocks result in an exchange rate depreciation of Rp56.67 per Dollar (Figure 6a).

The difference in interest rate encourages arbitrage between countries, which leads to the capital flight and then the exchange rate depreciation. The expected exchange rate depreciation shocks result in the exchange rate depreciation of Rp155.91 per dollar (Figure 6b)(Peersman, 2011).





## Domestic Interest Rate Response to Expected Exchange Rate Depreciation

- The shocks resulted in a decrease in the domestic interest rate of 0.07% if there is an expected exchange rate depreciation shocks.
- The results of the study showed that the UIRP condition was not reached.

Therefore, structural shocks affect the weakening of economic conditions, in which the unemployment rate increases, the output falls, the inflation is high, and the depreciation of the exchange rate. This is following the theory of Real Business Cycle (RBC) and New Keynesian, which state that a decrease in aggregate demand results in a recession caused by various shocks that hit the economy (Chugh 2015).

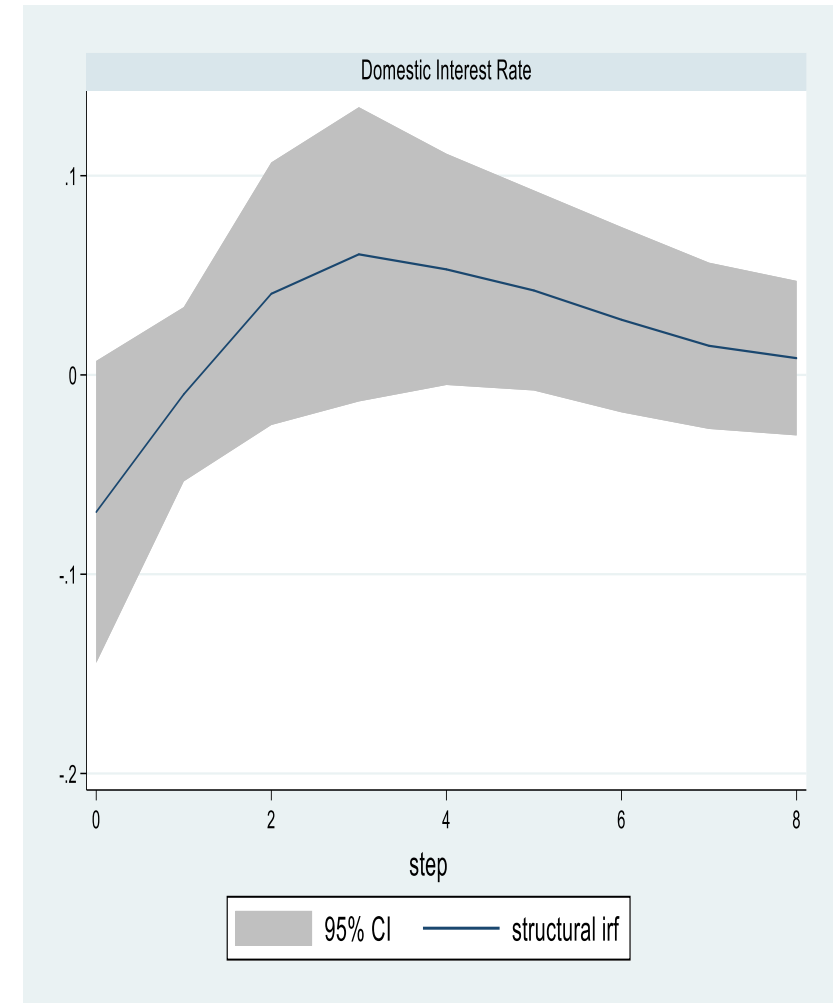


Figure 7

# CONCLUSION



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The global financial crisis and unexpected events generate structural shocks to the Indonesia's economy. This study identified the shocks that lead to the weakening of macroeconomic conditions in Indonesia by using a Real Business Cycle (RBC) and New Keynesian approach. The approaches are used as they incorporate both shocks from the demand and the supply side and thus are better in representing the reality.

The results showed that in general the relationship of various shocks and the macroeconomic variables are consistent with the economic theory.



The production shocks affect the unemployment rate by increasing it. Exchange rate depreciates as a response of exchange rate shocks from either interest differentials or expectation of depreciation.



The responses of inflation and output vary depending on the types of shocks. Demand shocks particularly from inflation and domestic interest rates leads a decrease in output. Inflation responses due to aggregate supply are found to be relatively small. In term of monetary policy, the monetary policy shocks originating from inflation and output gap immediately increase BI Rate.

# Recommendations



The government is expected to create a stable economic condition to minimize the macroeconomic volatility.



We recommend imposing a restriction in the SVAR model on the exchange rate shocks so that it has a direct effect towards the BI Rate.



Effectiveness of an economic policy on stabilizing the economy can be evaluated using counterfactual simulation.



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