Stability of Money Supply, E-money, Interest Rate, and Inflation in Indonesia

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ABSTRACT
This study examines the stability of money supply, e-money, interest rates and inflation in Indonesia. Using the month data for the period 2009m1-2019m12, cointegration and VECM. The results showed that, in the short term money supply and inflation had a significant effect on money supply. While in the long run inflation has a significant effect on money supply. In the short term money supply has a significant effect on e-money. While in the long run money supply and inflation have a significant effect e-money. In the short term interest rates and money supply have a significant effect on interest rates. While in the long run money supply and inflation have a significant effect on interest rates. In the short term inflation and money supply have a significant effect on inflation. While in the long run money supply has a significant effect on inflation.

Keywords: Money Supply, E-money, Interest Rate, Inflation, VECM

1. INTRODUCTION
The increase in money demand is caused by inflation, wealth, religious holidays, monetary crisis, stock prices, foreign and domestic interest rates (Prawoto, 2010). In the long run, gross domestic product, and domestic and foreign interest rates are affect to money demand. (Sanya & A, 2014). Figure 1 shows money supply and e-money in Indonesia.

Figure 1 Money Supply and E-money in Indonesia
Source: Bank Indonesia (Authors’ calculations)
Bhatta (2010) demand for money (M1 and M2) in the long run is experiencing a equilibrium with gross domestic product and interest rates. Achsani (2010) in the short and long term gross domestic product is positively related to money supply. In the short term interest rates are negatively related to money supply while in the long run they are not related.

Imimole & Uniamikogbo (2014) in the short term gross domestic product, exchange rates, and inflation affect money demand while foreign and domestic interest rates have no effect. In the long run, gross domestic product, foreign interest rates, exchange rates and inflation affect money demand, while domestic interest rates have no effect. Suliman & Dafaalla (2011) in the long run is positively related between money demand and gross domestic product and the exchange rate and inflation are negatively related to money demand.

Kiptui (2014) in the short and long term interest rates and inflation are negatively related to money demand while gross domestic product and exchange rates are positively related. Prawoto (2010) in the short term money demand is influenced by monetary crisis, wealth, inflation and religious holidays. In the long run, the demand for money is influenced by domestic and foreign interest rates, inflation and stock prices.

Nautz & Rondoerf (2010) money demand is influenced by inflation, interest rates, and stock prices. Kumar et al (2013) there is a relationship between money demand, gross domestic product and interest rates. Sanya & A (2014) Gross domestic product, domestic and foreign interest rates are related to money demand. Bedi & Herve (2011) Gross domestic product and interest rates are related to money demand.

Adi & Riti (2017) in the long run gross domestic product and inflation are positively related to money demand. While the exchange rate, foreign interest rates are negatively related to money demand. Lim & Sek (2015) in the short term the money supply, government spending, gross domestic product, imports of goods and services are not related to inflation.

In the long run the money supply, government spending, gross domestic product, imported goods and services are related to inflation.

The specific purpose of the study is to analyze and explain the stability of money supply, e-money, interest rate, and inflation in Indonesia.

2. METHODS

This research is a de facto expo study that examines the causal relationship between economic concepts based on a country’s money supply, e-money, interest rate, and inflation. The data used were sourced from Bank Indonesia and Statistics Indonesia. The analysis model uses VECM, e-money study in Indonesia in the period 2009m1-2019m12.

Equation:

\[ MS_t = \sum_{i=0}^{q} \beta_i MS_{t-i} + \sum_{i=0}^{q} \theta_i EM_{t-i} + \sum_{i=0}^{q} \gamma_i R_{t-i} + \sum_{i=0}^{q} \delta_i INF_{t-i} + U_t \]

\[ EM_t = \sum_{i=0}^{q} \beta_i EM_{t-i} + \sum_{i=0}^{q} \theta_i MS_{t-i} + \sum_{i=0}^{q} \gamma_i R_{t-i} + \sum_{i=0}^{q} \delta_i INF_{t-i} + U_2 \]

\[ R_t = \sum_{i=0}^{q} \gamma_i R_{t-i} + \sum_{i=0}^{q} \theta_i MS_{t-i} + \sum_{i=0}^{q} \beta_i EM_{t-i} + \sum_{i=0}^{q} \delta_i INF_{t-i} + U_3 \]

\[ INF_t = \sum_{i=0}^{q} \delta_i INF_{t-i} + \sum_{i=0}^{q} \theta_i MS_{t-i} + \sum_{i=0}^{q} \beta_i EM_{t-i} + \sum_{i=0}^{q} \gamma_i R_{t-i} + U_4 \]

where MS is money supply, EM is e-money, R is interest rate, INF is inflation, and U is a residual term.

3. RESULTS AND DISCUSSION

3.1. Stationary Test

Unit root test is a test that aims to determine whether there is stationarity in the data where stationarity is an important thing related to research that uses time series data. Unit root tests emerged and were developed by Dickey-Fuller or commonly known as the Dickey-Fuller (DF) unit root test. And to find out whether there is a stationary unit root test is carried out using the Augmented Dickey-Fuller (ADF) test where the ADF test is used to detect whether the data is stationary or not.

Variables were test for unit root using the ADF (Augmented Dickey-Fuller) test. The
result show that, variables were stationary in levels and first difference.

Table 1. Unit root tests

| Variable | ADF In levels | ADF In first difference |
|----------|---------------|-------------------------|
| MS       | -0.179        | -2.882**                |
| EM       | 5.001         | -3.179**                |
| R        | -3.017**      |                         |
| INF      | -10.168***    |                         |

Note: ADF is the Augmented Dickey-Fuller test. ***, ** and * donate rejection of unit root null hypothesis at the 1%, 5% and 10% level, respectively.

3.2. Lag Optimal

For optimal log testing, it can be seen from the interval candidates selected are the interval length according to the Akaike Information Criteria (AIC) criteria, the Schwaz Information Criterion (SIC), and the Hannan Quinn Criteria (HQC). Can be seen with the most * sign. the output above the most * sign in lag 6.

3.3. Cointegration Test

In this step you can know what model to use. Is the VAR model at the level of differentiation (if there is no cointegration) or VECM model (if there is cointegration). This study using Johanes cointegration test.

Cointegration testing shows that the trace test indicated that there were 4 cointegration. The relationship of mutual influence can be seen from the cointegration that occurs between the variables themselves. This shows that there is a long-term relationship between the variables of the level of money supply, e-money, and inflation. Co-integration of a variable shows the right signal to use VECM.

Table 2. VECM Money Supply

| Variable | Coefisien | t-statistik | Decision |
|----------|-----------|-------------|----------|
| Long run |           |             |          |
| Money Supply | 0.000102 | 0.15771     | Not Signifian |
| E-money | -44366.09 | -1.30677     | Not Signifian |
| Interest Rate | -498136.6 | -7.16575   | Signifian |
| Inflation |           |             |          |

| Short run |           |             |          |
| Money Supply | -0.380858 | -3.33679     | Signifian |
| E-money | -0.905334 | -7.42509     | Signifian |
| Interest Rate | 000002.43 | 0.12328     | Not Signifian |
| Inflation | -24116.25 | -0.96357    | Not Signifian |

Based on table 2 inflation with a t-statistic value of -7.16575 higher than t-table - 1.98 has a significant effect on money supply in the long run, whereas in the short term money supply is influenced by the money supply with a t-statistic value of -7.42509 more large than t-table - 1.98 and inflation with t-statistic value -3.46814 greater than t-table - 1.98.

Table 3. VECM E-money

| Variable | Coefisien | t-statistik | Decision |
|----------|-----------|-------------|----------|
| Long run |           |             |          |
| Money Supply | 9811.769  | 2.05682     | Signifian |
| Interest Rate | -4.35E+08 | -1.27860  | Not Signifian |
| Inflation | -4.89E+09 | -7.15976   | Signifian |
Based on table 3, money supply with a t-statistic value of 2.05682 higher than t-table 1.98 and inflation with a t-statistic value of -7.15976 higher than t-table -1.98 has a significant effect on e-money in the long run, whereas in the short run e-money is influenced by money supply with a t-statistic value of -11.5886 higher than t-table -1.98.

### Table 4. VECM Interest Rate

| Variable       | Coefisien | t-statistik | Decision       |
|----------------|-----------|-------------|----------------|
| **Long run**   |           |             |                |
| Interest Rate  |           |             |                |
| Money Supply   | -2.25E-05 | -2.09633    | Significan     |
| E-money        | -2.30E-09 | -0.15727    | Not Significan |
| Inflation      | 11.22787  | 7.27578     | Significan     |
| **Short run**  |           |             |                |
| CointEq1       | 0.008534  | 0.40719     | Not Significan |
| Interest Rate  | -0.853899 | -8.24371    | Significan     |
| Money Supply   | 1.33E-06  | 2.29110     | Significan     |
| E-money        | -4.19E-10 | -0.51400    | Not Significan |
| Inflation      | -0.100270 | -0.47161    | Not Significan |

Based on table 4, the money supply with a t-statistic value of -2.09633 higher than t-table 1.98 and inflation with a t-statistic value of 7.27578 higher than t-table 1.98 which has a significant effect on interest rates in the long run, whereas in the short term interest is influenced by interest rates with a t-statistic value of -8.24371 higher than t-table 1.98 and money supply with a t-statistical value of 2.29110 higher than t-table 1.98.

### Table 5. VECM Inflation

| Variable       | Coefisien | t-statistik | Decision       |
|----------------|-----------|-------------|----------------|
| **Long run**   |           |             |                |
| Inflation      |           |             |                |
| Money Supply   | -2.01E-06 | -2.05099    | Significan     |
| E-money        | -2.05E-10 | -0.15713    | Not Significan |
| Interest Rate  | 0.089064  | 1.29814     | Not Significan |
| **Short run**  |           |             |                |
| CointEq1       | -3.301331 | -5.42679    | Significan     |
| Inflation      | 1.917977  | 3.48939     | Significan     |
| Money Supply   | -4.49E-06 | -3.44425    | Significan     |
| E-money        | 3.00E-10  | 0.14227     | Not Significan |
| Interest Rate  | -0.037933 | -0.14166    | Not Significan |

Based on table 5, money supply with a t-statistic value of -2.05099 higher than t-table 1.98 has a significant effect on inflation in the long run, whereas in the short term inflation is influenced by inflation the value of t-statistics 3.48939 higher than t-table 1.98 and money supply is the value of t-statistic -3.44425 higher than t-table 1.98.
3.4. Variable Response Test

The Impulse Response Function tracks the effect of changing one standard deviation of one innovation of a variable on the present and future value of another variable in the VECM equation system. This method can be used to determine the response of an endogenous variable to a particular variable. Because actually the shock of a variable to one does not only affect that one variable, but also is transmitted to all other endogens through dynamic structures or lag structures in VECM.

![Figure 2](image-url)

In figure 2 can be seen the first Impulse Response Function (IRF) between the money supply and e-money. The results of the IRF analysis show that changes that occur in e-money are responded positively and negatively and fluctuate every year. In the eighth year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that experiencing positive and negative changes that fluctuate from year to year. Second is the response of the money supply and interest rates. The results of the IRF analysis show that changes in interest rates respond positively and negatively and fluctuate each year. In the ninth year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that experiencing positive and negative changes that fluctuate from year to year. The fifth is e-money response and interest rates. The results of the IRF analysis show that changes in interest rates respond positively and negatively and fluctuate each year. In the ninth year the fluctuations begin to shrink and approach the equilibrium point.

In the seventh year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that experiencing a positive response from year to year. Fourth is the e-money response and the money supply. The results of the IRF analysis show that changes in the money supply are responded positively and negatively and fluctuate every year. In the eighth year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that experiencing positive and negative changes that fluctuate from year to year. The sixth is the e-money response and inflation. The results of the IRF analysis show that changes that occur in inflation are responded negatively every year. In the eighth year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that experiencing negative changes that fluctuate from year to year. The seventh is
the response to interest rates and the money supply. The results of the IRF analysis show that changes that occur in the money supply are responded positively each year. In the seventh year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that there is a positive change that fluctuates from year to year. The eighth is the interest rate and e-money response. The results of the IRF analysis show that changes that occur in e-money are responded negatively if every year. In the seventh year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that there is a negative change if it fluctuates from year to year. The ninth is the response to interest rates and inflation. The results of the IRF analysis show that changes in inflation are responded positively each year.

In the sixth year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that there is a positive change that fluctuates from year to year. The tenth is the response of inflation and the money supply. The results of the IRF analysis show that changes in the money supply are responded positively and negatively and fluctuate every year. In the eighth year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that experiencing positive and negative changes that fluctuate from year to year. To eleven is the response inflation and e-money.

The results of the IRF analysis show that changes that occur in e-money are responded positively and negatively and fluctuate every year. In the fifth year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that experiencing a balance from year to year. To twelve is a response to inflation and interest rates. The results of the IRF analysis show that changes in interest rates respond positively and negatively and fluctuate each year. In the eighth year the fluctuations begin to shrink and approach the equilibrium point. Economically it can be concluded that experiencing a balance at the end of the year.

### 3.5 Variance Decomposition

Variance Decomposition (VD) provides information about how important changes in each random innovation are relative to changes in VECM.

| Period | S.E.   | D(MS)   | D(EM)   | D(R)    | D(INF)  |
|--------|--------|---------|---------|---------|---------|
| 1      | 41004.16 | 100.0000 | 0.000000 | 0.000000 | 0.000000 |
| 2      | 42618.86 | 98.61203 | 4.70E-05 | 0.072416 | 1.315508 |
| 3      | 44136.62 | 92.71059 | 0.861547 | 0.083455 | 6.344112 |
| 4      | 45199.97 | 91.73079 | 1.283480 | 0.837153 | 6.148582 |
| 5      | 45723.80 | 89.79513 | 2.114275 | 1.141281 | 6.949316 |
| 6      | 47258.32 | 87.04486 | 2.103063 | 1.093363 | 9.758713 |
| 7      | 51168.20 | 88.18411 | 2.291200 | 1.199340 | 8.325352 |
| 8      | 51774.77 | 86.25723 | 4.298648 | 1.299177 | 8.144942 |
| 9      | 51893.73 | 85.86359 | 4.367288 | 1.479386 | 8.289735 |
| 10     | 53082.40 | 85.97421 | 4.182057 | 1.430311 | 8.413425 |

Based on table 6 shows the variable money supply, where the money supply in the first period, the estimated error variance is entirely 100% explained by the variable money supply itself, which means that the probability of the money supply is influenced by itself compared to the shock that occurs from e-money, inflation, and the money supply as well as the one that shocks or gives the biggest shock is inflation, where the variable money supply Variance Decomposition is greater when giving shocks to the money supply compared to shock given by e-money and inflation of the money supply.
### Table 7. Variance Decomposition E-money

| Period | S.E.  | D(MS)  | D(EM)  | D(R)  | D(INF)  |
|--------|-------|--------|--------|-------|---------|
| 1      | 19932404 | 0.198474 | 99.80153 | 0.000000 | 0.000000 |
| 2      | 20084981 | 0.222594 | 99.36391 | 0.412411 | 0.001089 |
| 3      | 20647647 | 0.487003 | 98.16477 | 1.346393 | 0.001830 |
| 4      | 21039610 | 0.975281 | 96.32783 | 1.695072 | 0.001815 |
| 5      | 22326217 | 2.099453 | 95.11126 | 1.809085 | 0.980207 |
| 6      | 23746143 | 2.608977 | 94.84329 | 1.676452 | 0.871281 |
| 7      | 24357932 | 4.025568 | 92.83374 | 2.305311 | 0.835382 |
| 8      | 24876348 | 4.215568 | 92.72555 | 2.211092 | 0.847789 |
| 9      | 25227523 | 4.267052 | 92.66111 | 2.190448 | 0.881389 |
| 10     | 25515680 | 4.329661 | 92.63856 | 2.146177 | 0.885606 |

Based on table 7 shows the e-money variable, where e-money in the first period, the estimated error variance is entirely 99.80% explained by the e-money variable itself, which means that the probability level of e-money is influenced by itself compared to the shock that occurs from the amount of money circulation, interest rates, and inflation as well as those that shake or give the biggest shock is money supply Variance Decomposition is greater when giving shocks to e-money compared to shocks given by interest rates and inflation against e-money.

### Table 8. Variance Decomposition Interest Rate

| Period | S.E.   | D(MS)  | D(EM)  | D(R)  | D(INF)  |
|--------|--------|--------|--------|-------|---------|
| 1      | 0.169702 | 0.194278 | 0.287573 | 99.51815 | 0.000000 |
| 2      | 0.174928 | 3.481994 | 0.611705 | 95.89469 | 0.011615 |
| 3      | 0.195007 | 3.601510 | 0.501762 | 95.53326 | 0.363469 |
| 4      | 0.207353 | 5.588076 | 0.660822 | 92.60303 | 1.148076 |
| 5      | 0.217008 | 5.185639 | 0.613947 | 92.60460 | 1.595810 |
| 6      | 0.229560 | 6.144664 | 0.566164 | 91.82305 | 1.466126 |
| 7      | 0.240133 | 5.627654 | 0.597849 | 91.45686 | 2.317636 |
| 8      | 0.251551 | 5.863626 | 0.550546 | 91.16517 | 2.420656 |
| 9      | 0.260524 | 6.144241 | 0.688458 | 90.85331 | 2.313994 |
| 10     | 0.270145 | 6.312544 | 0.641661 | 90.81149 | 2.234301 |

Based on table 8 shows the interest rate variable, where the interest rate in the first period, the estimated error variance of all 99.52% is explained by the interest rate variable itself, which means that the probability of the interest rate is influenced by itself compared to the shock that occurs from the money supply, e-money and inflation and that which shakes or gives the biggest shock is the money supply which is the variable money supply Variance Decomposition is greater when it gives a shock to the interest rate compared to the change/shock given by interest rates and inflation against e-money.

### Table 9. Variance Decomposition Inflation

| Period | S.E.   | D(MS)  | D(EM)  | D(R)  | D(INF)  |
|--------|--------|--------|--------|-------|---------|
| 1      | 0.438724 | 6.810621 | 0.147303 | 0.022044 | 93.02003 |
| 2      | 0.473556 | 6.632032 | 0.240387 | 1.555219 | 91.57236 |
| 3      | 0.522724 | 7.966588 | 0.259372 | 1.277822 | 90.49622 |
| 4      | 0.528821 | 8.546648 | 0.404659 | 2.475249 | 88.57344 |
| 5      | 0.546835 | 11.85897 | 0.448050 | 2.498721 | 85.19426 |
| 6      | 0.554479 | 12.05203 | 0.522482 | 3.037948 | 84.38754 |
Table cont...

|   |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|
| 7 | 0.575831 | 13.73978 | 0.513974 | 7.380570 | 78.36568 |
| 8 | 0.591149 | 15.64035 | 0.532242 | 9.426556 | 74.40085 |
| 9 | 0.595592 | 16.47949 | 0.572441 | 9.287349 | 73.66072 |
| 10 | 0.597471 | 16.76280 | 0.606862 | 9.255218 | 73.37512 |

Based on table 9 shows the inflation variable, where inflation in the first period, the estimated error variance of all 93.02 % is explained by the inflation variable itself, which means that the rate of inflation probability is influenced by itself compared to the shock that occurs from the money supply, e-money and interest rates and the one that shakes or provides the greatest shock is the money supply, where the variable money supply Variance Decomposition is greater when it gives a shock to inflation compared to the shock given by e-money and the interest rate to inflation.

4. CONCLUSIONS

This study examines stability of money supply, e-money, interest rates and inflation in Indonesia. Using the month data for the period 2009m1-2019m12, cointegration and VECM. The results showed that, in the short term money supply and inflation had a significant effect on the money supply. While in the long run inflation has a significant effect on money supply. In the short term money supply has a significant effect on e-money. While in the long run money supply and inflation have a significant effect on e-money. In the short term interest rates and money supply have a significant effect on interest rates. While in the long run money supply and inflation have a significant effect on interest rates. In the short term inflation and money supply have a significant effect on inflation. While in the long run money supply has a significant effect on inflation. Based results of these studies the need for policies to regulate stability money supply, e-money, interest rates, and inflation.

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