# DYNAMIC RELATION OF MONEY VELOCITY, MONEY VOLATILITY AND INFLATION THRESHOLD

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**Abstract**

This paper investigates relationship between velocity of money, inflation, volatility of money, threshold inflation, output gap, and money velocity gap for two Asean countries, Indonesia and Thailand from 1995:Q1-2010:Q4. The models adopted are Autoregressive Conditional Heteroscedasticity, Hodrick-Prescott and Autoregressive Distributed Lag models. The result shows that relationship between inflation and volatility of money with velocity of money exists in Indonesia, but it does not in Thailand. Threshold inflation does not exist in Indonesia. Meanwhile, it is found that output gap can influence inflation. In addition, the fourth model shows that money velocity gap is not related with inflation for Indonesia only.

**Keywords:** Velocity of Money, Volatility of Money, Inflation Threshold, Output Gap
**JEL classification numbers:** E31, E51

**Abstrak**

Makalah ini meneliti hubungan kecepatan peredaran uang, inflasi, kemeruapan uang, *threshold* inflasi, *output gap*, dan disparitas kecepatan peredaran uang di Indonesia dan Thailand periode 1995:Q1 2010:Q4. Alat analisis yang digunakan adalah model Autoregressive Conditional Heteroscedasticity, Hodrick-Prescott *filter* dan Autoregressive Distributed Lag. Hasil penelitian menunjukkan bahwa hubungan inflasi dan kemeruapan uang dengan kecepatan peredaran uang wujud di Indonesia, namun tidak untuk Thailand. Disamping itu, *threshold* inflasi juga tidak wujud di Indonesia namun sebaliknya di Thailand. *Output gap* memiliki pengaruh terhadap inflasi. Sementara itu disparitas kecepatan peredaran uang di Indonesia tidak berhubungan dengan inflasi. Di Thailand, disparitas kecepatan peredaran uang berhubungan dengan inflasi.

**Kata Kunci:** Kecepatan Peredaran Uang, Kemeruapan Uang, Threshold Inflasi, Output Gap
**JEL classification numbers:** E31, E51

## INTRODUCTION

Global economic stability will be achieved if the relation in macroeconomic is stable. However recent economic development changes in economic structure, which generally, disturbs the economic stability in one country.

Financial management in one country in said stable if it is realized based on the assumption of fund quantity mechanism with money multiplier and money velocity. With this assumption, financial institution will be able to affect domestic nominal output. It is also affected by other factor of money velocity affecting an output of one country.

A research by Irving Fisher assumed that money velocity is constant. In fact, the value of money velocity is rarely stable. There might be some reasons of such a condition. Still, innovation is the only reason to explain long-term and short-term money velocity. Some experts also state that the change in money velocity is caused by volatility of money growth in one country. This condition leads the government to change financial policy in the country. The relation between money ve-

locity and money volatility is that the advance of money volatility will increase uncertainty that will cause the rising of money request.

Handa (2000) and other experts said that innovation is a factor that causes the change of money velocity. Therefore, in developing country, innovation regards innovation important which will, indirectly, affect the market price and cause the stability process in money velocity. It comes to a hard work to realize.

On the other hand, there are many studies conducted on the relation of inflation, minimal wage, and price. This theory is widely discussed by *New Keynesian Phillips Curve*. It states that lagged inflation indirectly lies on Phillips Curve. Therefore, inflation in the next period is the main determiner of recent inflation. It has different implication to create financial policy to reduce the inflation.

*New Keynesian Curve* is different from *expectation-augmented Philips Curve* in which *the lagged* of inflation will determine recent inflation. In *expectation-augmented Philips Curve*, recent inflation is affected by output gap and lagged inflation. Lagged inflation is a prediction of recent inflation. It brings about an abstract interpretation in understanding lagged inflation.

Related to the statement, Keyness Theory states that money velocity is not constant because money velocity, fully, depends on bank characteristics and industrial organization. Peoples' behavior in economic and income distribution among the class of the society is different that will affect money velocity. However, Keyness describes economical change in short time will place money velocity in nearly constant.

Some studies also describe that money velocity is not constant. It is due to the money velocity is affected by money growth which, then, will affect output growth. Generally, it is found in countries with high inflation in which money growth is sensitive to undergo inflation. If inflation grows high, money velocity will largely influenced by technology and institutional payment.

Long-term inflation should not always exist, but it impossible for a country with 0% inflation. Keyness said that inflation will exist because of the necessity of the low class society. It affects to the rising of the people's bargaining of goods over than its price.

Structuralists also describe that inflation will always exist. It is caused by inelastic income of export. The export value grows slower than those of other sectors. The slowness is caused by unprofitable condition in which the global price in export market is lower than that in import. Furthermore, the inelastic condition of staple domestically is one factor that triggers inflation. Because there is no equality between domestic staples and population growth, the price of staple tends to be expensive.

Research on money, price, output, and inflation is ever discussed by previous studies. They are, for example, are conducted by Mehra (1987), Hall and Nobel (1987), They discussed money velocity growth. The findings showed that in 1982 – 1983, money velocity downwards after the volatility of money velocity growth increased largely, while in 1985 – 1986, the money velocity downwards when the ability of volatility of money velocity was increasing. When Granger causality test found that money velocity was not affected by volatility of money velocity.

Barro (1995) in his research discussed the effect of inflation towards economical growth. The data are taken from 100 countries in 1960 – 1990. The finding showed that in using some instruments in statistic procedure, there was negative effect that appeared in inflation towards the improvement and investment. There were some factors of trust that high inflation in long period decreased the economical

growth and investment. Therefore, it needed to emphasize a clear proof to describe the high bad effect of inflation in the future.

Davis and Kanago's research (1998) discussed inflation and economical growth with 44 samples. The finding showed that inflation, uncertain inflation, and inflation crisis affected negatively, but significant, towards economical growth. In term of political stability, all inflation variables had negative correlation. The relation of political stability, output growth, and inflation might grow up when they were brought into output growth regression with an assumption that political stability was not included. When one of the variables together with political stability were brought into regression, the inflation variables were not significant.

A study by Grauwe and Polan (2001) was to obtain the relation between inflation and money growth. The study was done with 160 countries in 30 years (1969 – 1999), Their study showed that the countries with low inflation, the relation of money growth and money velocity was negative. If the money growth rose, the money velocity decreased. This condition was caused by the relation among money growth, inflation, and output growth. However, the money velocity in the countries was affected by technology development and institutional payment system.

On the other hand, in the countries with high inflation, the relation of money growth and money velocity was positive. If the money growth rose, the inflation would rise because of the tendency of exaggerate expenditure by the society. The inflation rise caused the rise of money velocity.

A research by Arize, Malindretos, and Grivoyannis (2003) was about of the rate of interest volatility and money request with 8 undeveloped countries as the samples in 1973:Q2 – 1999: Q4. The finding showed that spurious regression took place when the rate of interest volatility was not involved in the function of money request. It meant that the rate of interest volatility played a significant role in money request.

The study is also focused on the effect of the rate of interest volatility towards the total real money. The study also finds that the relation between total real money and the rate of interest volatility is negative and significant in both countries.

The study also describes that an action of financial policy aiming to domestic economic stability draws uncertainty, if they ignores inflation stability. The empiric data shows that the rate of interest volatility affects the total real money negatively, and significantly. Furthermore, real income affects money request positively.

Frain (2004) observed the relation between money growth and inflation. The study shows that a country with low inflation (< 10%), the coefficient of the money growth is still significant but it does not reach 1 %. The study also shows that there is no relation between short term money growth and long term inflation. It only shows that money bargaining rationally increases in long term period that positions the country in high inflation, and vice versa.

Serletis and Shahmoradi (2005) observed the velocity of money growth and its variance. The data was obtained in 1959: Q1 up to 2004: Q3. The study found that there was systematic causality effect of rate of interest volatility and money velocity. The conclusion of this study met the Friedman's hypothesis stating that the variance of money growth supported the money velocity because money velocity had close relationship to financial policy in one country.

Gerlach and Peng (2005) observed output gap and inflation in China using the data in Philips Curve Model in 1982 up to 2003. The study found that the application of the simple Philips Curve could not explain the data well that, probably, reflected the omission some important variables. By the considerable structural change and financial policy change in China during the

research, it made the research accepted. Specifically, it was said that it needed other regulation on price, trade liberalization, and regime change of money changer that affected the inflation.

A research of which the data was from Switzerland was conducted by Wesche and Gerlac in 2007. The research was focused on money growth, output gap, and inflation the country. The data was obtained in 1970:Q1 up to 2009:Q2. It found that the movement of money growth was related to the movement of total request that affected the output gap and inflation. The result was that the relationship did not affect the inflation, because it was done in inefficient duration. Therefore, the study found that output gap affected short-term inflation. It meant that money growth was not too important in short-term inflation. On the other hand, the effect of money growth to long-term inflation was explicit. Economic theory also states that financial shock affects short-term inflation towards the real variable as output gap.

Thus, this study observes the relationship between money volatility and inflation affecting the money velocity in Indonesia and Thailand in the first quarter in 1995.1–2010.4. This research is important conducted in both countries because they had ever undergone monetary crisis in South East Countries that was triggered by threshold inflation and affected money velocity. The next research is on money velocity and output gap that affect inflation. Then, it will see the effect of money velocity gap and output gap to inflation. Finally, the relationship among money volatility, inflation, and threshold inflation that affect money velocity is found.

To see in detail, this study is divided in some chapters. The first chapter is the background of the study. The second chapter is methodology and the data. The third chapter is discussion, and the fourth is conclusion and implication.

## METHODS

The data of this study is secondary data that is obtained from the M2 money supply, price index of consumer, and GDP data. The data used for 15 years is taken from the first quarter in1995 and the fourth quarter in 2010. The data is collected from IFS, Bank Indonesia and some research findings.

The money volatility of M2 money supply will be calculated to describe its relationship with money velocity. To calculate the money velocity, Autoregressive Conditional Heteroskedasticity (ARCH) method proposed by Robert Engle is adopted. M2 and GDP data is used to get the gap of each variable by using Hodrick-Prescott Filter. If the calculation of money volatility, money velocity gap, and output gap are achieved, the estimation with Autoregressive Distributed Lagged (ARDL) method is applied.

ARCH model is introduced by making linear estimation of conditional min and conditional variance simultaneously (Bera and Higgins, 1993), The value of conditional variance can be used as proxy of the volatility. The equation of conditional min: AR (p,q)

$$\pi_t = \theta_0 + \Sigma_{i=1}^{p} \theta_i \pi_{t-1} + \Sigma_{i=1}^{q} \lambda_i \varepsilon_{t-1} + \Sigma_{i=1}^{12} \delta_1 d_{t-1} + \varepsilon_t \quad (1)$$

$$\varepsilon_t = v_t \sigma_t$$

The equation of conditional variance: ARCH (q)

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-2}^2 + \ldots + \alpha_q \varepsilon_{t-q}^2 \quad (2)$$

$\alpha_0 > 0$ and $\alpha_i \geq 0$ to $i > 0$

in which $v_t$ is random variable which *independently and identifically distributed (idd)* with min = 0 and *variance* = 1.

The threshold inflation reflects limited movement of the data chronologically in one country. Threshold is important to know the marginal limitation of negative

inflation. Threshold inflation is discussed by Khan and Senhadji (2001), it is said that the existence of threshold inflation affect money velocity.

Output gap a defined by Brouwer (1998) is real output minus potential output. This study uses Hodrick-Prescott filter to obtain real output. This technique is potential to minimize a combination between fluctuation and velocity of real money around the trend, output trend movement, and money velocity for the whole data (Gounder and Morling, 2000), The value of potential output calculated by Hodrick-Prescott Filter method is done by minimizing the value as the equation below:

$$\Sigma_{i=1}^{q}(y_t - y_t^*)^2 + \lambda\Sigma_{i=2}^{T}[(y_{t-1}^* - y_t^*) - (y_t^* - y_{t-1}^*)]^2 \quad (3)$$

Y is real output, $Y^*$ is potential output, and λ is the weighting factor that will determine the degree of the trend. Then the output variable is replaced by money velocity to obtain the money velocity gap.

λ = 1600 is the quarterly data and λ= 100 is the annual data. This assumption is derived from Burns and Mitchell. The advantage of Hodrick-Prescott Filter in obtaining the money velocity gap is to provide gap stationary gap of both variables.

**Unit Root Test**

Augmented Dickey-Fuller (ADF) is the first test method applied as unit root test. To assort the optimal long lag of each variable is applied based on the information criterion like *Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Log Likelihood (Log LL).*

**Augmented Dickey-Fuller Test**

Augmented Dickey-Fuller Test is a parametric method as the succession of Dickey-Fuller Test. Dickey-Fuller Test only uses chronological data in the form of autoregressive AR (1), *White noise* assumption will not be met if the data auto-correlates the higher lag. Therefore, ADF test is aimed to be a solution on correlation of higher lag with chronological data assumption at AR (p) (Chang and Park, 2002), Dickey Fuller uses three different regression equations to test non-stationary of the data (Dickey et.al. 1991) as follows:

$$\Delta x_t = \gamma x_{t-1} + \sum_{i=1}^{p}\beta_i \Delta x_{t-1} + \varepsilon_t \quad (4)$$

$$\Delta x_t = \alpha_0 + \gamma x_{t-1} + \sum_{i=1}^{p}\beta_i \Delta x_{t-1} + \varepsilon_t \quad (5)$$

$$\Delta x_t = \alpha_0 + \gamma x_{t-1} + \alpha_2{}^t + \Sigma_{i=1}^{p}\beta_i \Delta x_{t-1} + \varepsilon_\tau \quad (6)$$

The differences among the three regressions describe the deterministic element, they are $\alpha_0$ and $\alpha_2$. The first model is *pure random walk*. The second model is added by constantan. The third model exerts the constantan and trend at (t).

$H_0$: γ = 0 (data $x_t$ is not stationary)
$H_{1:}$ γ < 0 (data $x_t$ is stationary)

This study applies equation (5) to test every variable. Null hypothesis is rejected if the absolute statistic value is bigger than absolute critic value at trust level 1%, 5%, and 10%.

**Phillips – Perron Test**

Phillip and Perron apply other alternative to measure stationary data. Phillips-Perron test estimates the non-augmented DF equation (6) and changes coefficient ratio in which the correlated data affects the statistic of the asymptotic distribution.

**Autoregressive Distributed Lagged (ARDL)**

ARDL in this study is utilized to attain the long-term and short-term movement (Johansen and Juselius, 1990). Data $\gamma_t$ and $x_t$ will be attained if it is I(0) or I(1), The data in $x_t$ is also obtained from different integration degree either for I(0) or I(1), Error $\varepsilon_t$

can be obtained consistently as $\varepsilon_t = [\varepsilon_{y,t}, \varepsilon_{x,t}]$': ¥ (*0*,Ω) and Ω is positive as described below:

$$\Omega = \begin{bmatrix} \omega_{yy} & \omega_{yx} \\ \omega_{yx} & \omega_{xx} \end{bmatrix} \quad (7)$$

The long-term matrix coefficient is attained from λ. The matrix is as follow:

$$\lambda = \begin{bmatrix} \lambda_{yy} & \lambda_{yx} \\ \lambda_{xy} & \lambda_{xx} \end{bmatrix} = -\left(1 - \sum_{j=1}^{p} \emptyset_j\right) \quad (8)$$

Matrix I is identical. λ is unlimited, therefore, there is possibility of different integration degree either for I(0) or I(1), If $\lambda\gamma\gamma = 0$, then $\gamma$ is I(1), In the case $\lambda\gamma\gamma < 0$, $\gamma$ is I(0). The specification of ARDL [*p*,*q*] is formulated below:

$$\Delta\gamma_t = \alpha_0 + \alpha_1 t + \emptyset\gamma_{t-1} + \psi x_{t-1} + \sum_{i=1}^{p} \beta_y, \text{i}\Delta\gamma_{t-i} + \sum_{j=0}^{q-1} \beta_{x,j}\Delta x_{t-j} + \mu_t,\ t = 1,2 \quad (9)$$

$\emptyset$ and $\psi$ are long-term coefficient, $\beta\gamma$,i and $\beta_{x,j}$ are short-term coefficient. we test that $\gamma$ and $x_t$ move together by using specification (9), It is called degree test. We have two methods to test, they are: First, we estimate the equation (9) by using a method of smallest quadrate (OLS), Second, we test the existence of long-term relation between $\gamma_t$ and $x_t$ by marginal coefficient $\gamma_{t-1}$ and $x_{t-1}$ is null. The test of degree is fulfilled by *Wald-type test* (statistic F) with the following Ho and Ha:

Ho: $\emptyset = 0$ and $\psi = 0$
Ha: $\emptyset \neq 0$ and $\psi \neq 0$

There is no relationship between $y_t$ and $x_t$ of asymptotic diffusion of equation statistic test under null hypothesis. F-statistic calculated under null hypothesis is compared by critic value proposed by Narayan (2005), The F statistic ($F_{Bound}$) is calculated by comparing *Lower Critical Bound (LCB)* and *Upper Critical Bound (UCB).*

Some specifications with different lags have been tested by co-integration method to emphasize, statistically, the significance of the findings. The criteria of AIC and SIC is applied to choose the length of the lag which should be at the same length in ARDL model. The shortest value of ACI and SIC shows the best model.

To achieve the best and adequate model which meets the determined lag and variable used, diagnostic test is need to be applied. The diagnostic test is lag range multiplier serial correlation, using *Breusch-Godfrey Test, ARCH Test, Normal Jarque Bera Test*, and stability test by using CU-SUM Test.

## FINDINGS AND ANALYSIS

### Stationary Test Analysis

The data for the whole variables used in both countries need to have stationary test. The test is applied by *Augmented Dickey-Fuller (ADF) Approach* and *Phillips-Perron (PP) Approach* towards the whole variables chronologically in this study.

The stationary test of Indonesia is different between ADF and PP. it is seen in table 1 at panel A. ADF Approach shows that the data of money velocity accepts null hypothesis, it does not mean stationary. It is proved by the absolute value of statistic test that is smaller than absolute critic value of Mac-Kinnon at trust rate 1%, 5%, and 10%. It contradicts with those found in PP Approach that rejects null hypothesis which means stationary.

In Thailand, both approaches have the same value with that of Indonesia. The absolute value of statistic test is smaller than absolute critic value of Mac-Kinnon at trust rate 1%, 5%, and 10%. It contradicts with those found in PP Approach that rejects null hypothesis which means stationary.

Table 1 panel B shows that money velocity in Indonesia and Thailand obtained from both approach either ADF or PP is not stationary towards the trust rate. ADF approach shows the gap of money velocity reflecting the stationary towards the whole trust rate, while PP approach is stationary towards the whole trust rate.

**Table 1:** Stationary Test

| Panel A: Stationary Test | Money Velocity(VELO) | | | |
|---|---|---|---|---|
| | Indonesia | | Thailand | |
| | ADF | PP | ADF | PP |
| Statistic Test | -2.8428 | -4.5266 | -1.8733 | -2.4442 |
| Critic Value:1% | -4.1706 | -4.1657 | 4.1706 | -4.1657 |
| Critic Value:5% | -3.5108 | -3.5085 | 3.5107 | -3.5085 |
| Critic Value:10% | -3.1855 | -3.1842 | 3.1855 | -3.1842 |
| AIC | -2.9731 | -2.8438 | 4.9596 | -4.9076 |
| SC | -2.8141 | -2.7257 | -4.8006 | -4.7895 |
| Panel B: Stationary Test | The Gap of Money Velocity (VG) | | | |
| | Indonesia | | Thailand | |
| | ADF | ADF | ADF | PP |
| Statistic Test | -6.4747 | -5.2959 | -5.2959 | -2.6259 |
| Critic Value:1% | -4.1657 | -4.1657 | -4.1657 | -4.1657 |
| Critic Value:5% | -3.5085 | -3.5085 | -3.5085 | -3.5085 |
| Critic Value:10% | -3.1842 | -3.1842 | -3.1842 | -3.1842 |
| AIC | -3.1286 | -5.2553 | -5.2553 | -4.9594 |
| SC | -3.0106 | -5.1372 | -5.1372 | -4.8413 |

Source: calculated data

**Table 2:** Stationary Test

| Panel A: Stationary Test | Inflation (INF) | | | |
|---|---|---|---|---|
| | Indonesia | | Thailand | |
| | ADF | PP | ADF | PP |
| Statistic Test | -4.2026 | -3.9942 | -5.1236 | -4.7519 |
| Critic Value:1% | -4.1756 | -4.1657 | -4.2191 | -4.1658 |
| Critic Value:5% | -3.5131 | -3.5085 | -3.5331 | -3.5085 |
| Critic Value:10% | -3.1868 | -3.1842 | -3.1983 | -3.1842 |
| AIC | 6.0733 | 6.0983 | 6.2072 | 6.2733 |
| SC | 6.2740 | 6.2164 | 6.7243 | 6.3914 |
| Panel B: Stationary Test | Quadratic Inflation (Threshold) | | | |
| | Indonesia | | Thailand | |
| | ADF | ADF | ADF | PP |
| Statistic Test | -4.0435 | -3.4866 | 3.4867 | -4.9836 |
| Critic Value:1% | -4.1657 | -4.1923 | 4.1923 | -4.1658 |
| Critic Value:5% | -3.5085 | -3.5208 | 3.5208 | -3.5085 |
| Critic Value:10% | -3.1842 | -3.1913 | 3.1913 | -3.1842 |
| AIC | 11.9259 | 11.5743 | 11.5743 | 2.9925 |
| SC | 12.0440 | 11.9053 | 11.9053 | 3.1106 |

Source: calculated data

Table 2 panel A shows that the data of inflation in Indonesia is stationary towards the whole trust rate with ADF Approach, and not stationary with PP Approach at 1%. It indicates that absolute value of statistic test is bigger than absolute critic value of trust rate at 1%. On the other hand, both approaches show the inflation data of Thailand that is not stationary to the whole trust rate.

**Table 3:** stationary Test

| Panel A: Stationary Test | Money Volatility (VOLA) | | | |
|---|---|---|---|---|
| | Indonesia | | Thailand | |
| | ADF | ADF | ADF | PP |
| Statistic Test | -2.8428 | -1.3287 | -1.3287 | -0.2988 |
| Critic Value:1% | -4.1706 | -4.1657 | -4.1657 | -4.1657 |
| Critic Value:5% | -3.5107 | -3.5085 | -3.5085 | -3.5085 |
| Critic Value:10% | -3.1855 | -3.1842 | -3.1842 | -3.1842 |
| AIC | -2.9731 | 31.2430 | 31.2430 | 57.5899 |
| SC | -2.8141 | 31.3611 | 31.3611 | 57.7080 |
| Panel B: Stationary Test | output gap (OG) | | | |
| | Indonesia | | Thailand | |
| | ADF | PP | ADF | PP |
| Statistic Test | -3.7281 | 3.4749 | -3.4749 | 2.7929 |
| Critic Value:1% | -4.1864 | 4.2050 | -4.2050 | 4.1658 |
| Critic Value:5% | -3.5180 | 3.5266 | -3.5266 | 3.5085 |
| Critic Value:10% | -3.1897 | 3.1946 | -3.1946 | 3.1842 |
| AIC | 5.3159 | 0.7231 | 0.7231 | 15.9603 |
| SC | 5.6026 | 1.1453 | 1.1453 | 16.0784 |

Source: calculated data

Table 2 panel B describes that ADF and PP approaches show that the quadratic inflation of Indonesia accepts null hypothesis that is not stationary to trust rate at 1%. While in Thailand, ADF approach shows quadratic inflation that is stationary at 1% and 5%, and towards trust rate at 10%. On the other hand, PP approach shows quadratic inflation that is not stationary to the whole trust rate.

Table 3 panel A, ADP approach shows that money volatility in Indonesia is not stationary to the whole trust rate. In contrast, PP approach shows that money volatility in Indonesia is stationary to the whole trust rate. On the other hand, both approaches show that money volatility in Thailand is not stationary to the whole trust rate.

Table 3 panel B, ADF approach shows output gap that is stationary to trust rate at 1% in Indonesia, and PP approach shows that it is stationary to the whole trust rate. In Thailand, ADF approach shows the output gap that is stationary to trust rate at 1% and 5% and PP approach shows 1%.

## ARDL Bound Test

Empirical study observes long-term relationship variable in model between Indonesia and Thailand using ARDL Bound Test. It results a prediction for long-term and short term coefficient.

Table 4 panel A shows that the value of F-Statistic is higher than upper critic bounds, the null hypothesis is rejected. Therefore, there is co-integration between money velocity with money volatility and inflation in Indonesia at trust rate 1% and 10%. It is proved by F-statistic value that amounts to 11.502.

In Thailand, the value of F-statistic is 3.111. It lies under the upper critic bounds of the whole trust rate. It means there in no co-integration between money velocity with money volatility and inflation.

**Table 4:** Co-Integration Analysis

| Panel A: Country | Money Velocity with Inflation and Money Volatility | | | | | | |
|---|---|---|---|---|---|---|---|
| | Statistic-F | Critic Bounds | | | | | |
| | | 1% | | 5% | | 10% | |
| | | Lower | Upper | Lower | Upper | Lower | Upper |
| Indonesia | 11.502 | 4.865 | 6.360 | 3.500 | 4.700 | 2.873 | 3.973 |
| Thailand | 3.111 | 4.865 | 6.360 | 3.500 | 4.700 | 2.873 | 3.973 |
| Panel B: Country | Money Velocity with Inflation and Threshold Inflation | | | | | | |
| | Statistic-F | Critic Bounds | | | | | |
| | | 1% | | 5% | | 10% | |
| | | Lower | Upper | Lower | Upper | Lower | Upper |
| Indonesia | 4.618 | 5.050 | 6.182 | 3.730 | 4.666 | 3.174 | 4.004 |
| Thailand | 8.849 | 4.865 | 6.36 | 3.500 | 4.700 | 2.873 | 3.973 |
| Panel C Country | Inflation with Money Velocity and output gap | | | | | | |
| | Statistic-F | Critic Bounds | | | | | |
| | | 1% | | 5% | | 10% | |
| | | Lower | Upper | Lower | Upper | Lower | Upper |
| Indonesia | 5.8599 | 4.865 | 6.360 | 3.500 | 4.700 | 2.873 | 3.973 |
| Thailand | 9.116 | 5.050 | 6.182 | 3.730 | 4.666 | 3.174 | 4.004 |
| Panel D: Country | Inflation with the Gap of Money Velocity and output gap | | | | | | |
| | Statistic-F | Bounds Kritis | | | | | |
| | | 1% | | 5% | | 10% | |
| | | Lower | Upper | Lower | Upper | Lower | Upper |
| Indonesia | 5.718 | 4.865 | 6.360 | 3.500 | 4.700 | 2.873 | 3.973 |
| Thailand | 37.719 | 5.050 | 6.182 | 3.730 | 4.666 | 3.174 | 4.004 |

Source: calculated data

Table 4 panel B shows co-integration between money velocity with inflation and threshold inflation. It results 4.618 for F-statistic in Indonesia. It is higher 10% than upper critic bounds to the trust rate. It means that there is co-integration between money velocity with inflation and threshold inflation in which the existence of threshold inflation co-integrates with money velocity. In Thailand, there is co-integration between money velocity and threshold inflation to the whole trust rate with F-statistic 8.849 that is higher that upper critic bounds.

Table 4 panel C shows that there is co-integration between inflation with money velocity, and output gap. It is proved by F-statistic that amounts to 5.859. it is higher 5% and 10% that upper critic bounds to trust rate. In Thailand, the value F-statistic is 9.116. it is significant and at the top of upper critic bounds at 1%, 5%, and 10%. It means that there is co-integration between inflation with money velocity and output gap in the country.

Table 4 panel D shows that there is co-integration between inflation with the gap of money velocity and output gap. It is caused by the value of F-statistic that amounts to 5.718 that is higher 5% and 10% than upper critic bounds to the trust rate.

In Thailand, there is also co-integration between inflation with the gap of money velocity and output gap to the whole trust rate with F-statistic value 37.719 that is higher than upper critic bounds.

**Tabel 5:** Long-Term Relationship Elasticity

| Money Velocity and Inflation, Threshold inflation and Money Velocity | | | | | | |
|---|---|---|---|---|---|---|
| Panel A: | Dependent Variable: VELO | | | | | |
| Country | Variable | Coefficient | P Value | Variable | Coefficient | P Value |
| Indonesia | INF | -0.0527 | 0.0005* | INF | -0.0416 | 0.2175 |
| | VOLA | 0.5095 | 0.0040* | Threshold | -0.0259 | 0.2920 |
| Thailand | INF | -0.0031 | 0.7868 | INF | 0.0605 | 0.0042* |
| | VOLA | 1.7561 | 0.0770*** | Threshold | -0.0706 | 0.0090* |
| Inflation, Money Velocity, The Gap of Money Velocity and output gap | | | | | | |
| Panel B: | Dependent Variable: VELO | | | | | |
| Country | Variable | Coefficient | P Value | Variable | Coefficient | P Value |
| Indonesia | VELO | 2.9955 | 0.4631 | VG | 1.57E-11 | 0.5673 |
| | OG | 1.90E-11 | 0.1586 | OG | 1.75E-11 | 0.1903 |
| Thailand | VELO | 4.2712 | 0.7310 | VG | 2.12E-09 | 0.0000* |
| | OG | -9.02E-10 | 0.0807*** | OG | 1.19E-09 | 0.0004* |

Source: calculated data

Note: (*), (**) and (***) show significances at alpha 1%, 5% and 10%.

Table 5 Panel A shows that in Indonesia and in Thailand, the inflation causes an insistence to enact the money velocity to get out, and money volatility causes an insistence to enact money velocity to get in. However, there is no long-term relationship in Thailand. While in Indonesia, when the inflation rises 1%, and it will decrease money velocity up to 0.0527%, and when the money volatility rises 1%, it will increase money velocity up to 0.5095%. In Thailand, when the money volatility rises 1%, it will increase money velocity up to 1.7561%.

Table 5 Panel A shows that inflation and threshold inflation have long-term relationship with money velocity in Thailand. Inflation gives an insistence to enact money velocity to get in, and threshold inflation gives an insistence to enact money velocity to get out. On the other hand, in Indonesia, inflation has no long-term relationship with money velocity and output gap, while in Thailand; money velocity has no long-term relationship with output gap and insists on to get out for inflation.

The table also shows us that the gap of money velocity and output gap have no long-term relationship with inflation, while in Thailand, the gap of money velocity and output gap gives an insistence to enact inflation to get in.

**Short-Term Elasticity**

Table 6 Panel A shows that inflation in Indonesia has short-term relationship with money velocity and in enacts it to get in, and money volatility has no short-term relationship with money velocity. In Thailand, inflation and money volatility have short-term relationship with money velocity. The inflation enacts money velocity to get out and money volatility enacts it to get in.

Table 6 Panel B shows that inflation and threshold inflation have no short-term relationship with money velocity in Indonesia. However, both variables have short-term relationship with money velocity and enact it to get in.

Table 6 Panel C shows that in both countries there is short-term relationship between money velocity and output gap towards inflation. In Indonesia, money velocity and output gap enact inflation to get out, while in Thailand, the increase of money velocity is 1%, and it will reduce the inflation up to 342.6544%; and the increase of output gap is 1%, and it will increase inflation up to 4.8465%.

**Table 6:** Short-Term Relationship Elasticity

| Money Velocity with Inflation and Money Volatility | | | | |
|---|---|---|---|---|
| Panel A: | Variable: Inflation | | Variable: Money Volatility | |
| Country | Coefficient | P Value | Coefficient | P Value |
| Indonesia | -2.82E-08 | 0.1267 | 0.0247 | 0.0152** |
| Thailand | 1.81E-09 | 0.0016* | -0.0012 | 0.0017* |
| Money Velocity with Inflation and Threshold Inflation | | | | |
| Panel B: | Variable: Inflation | | Variable: Threshold Inflation | |
| Country | Coefficient | P Value | Coefficient | P Value |
| Indonesia | -0.0001 | 0.1585 | -0.0017 | 0.3257 |
| Thailand | 0.0006 | 0.0000* | -0.0055 | 0.0007* |
| Inflation with Money Velocity and Output Gap | | | | |
| Panel C: | Variable: Money Velocity | | Variable: output gap | |
| Country | Coefficient | P Value | Coefficient | P Value |
| Indonesia | -1.0189 | 0.000* | -21.053 | 0.0729*** |
| Thailand | 4.8465 | 0.0021* | -342.6544 | 0.000* |
| Inflation with the Gap of Money Velocity and output gap | | | | |
| Panel D: | Variable: Gap of Money Velocity | | Variable: output gap | |
| Country | Coefficient | P Value | Coefficient | P Value |
| Indonesia | -0.9757 | 0.0003* | -22.3269 | 0.1007 |
| Thailand | 17.3153 | 0.0002* | -83.7106 | 0.0000* |

Source: calculated data

**Note:** (*), (**) and (***) each shows significance at

Table 6 Panel D shows that it is only the gap of money velocity which has no short-term relationship with inflation. In Thailand, the gap of money velocity has shot-term relationship with inflation. On the other hand, the output gap in both countries has long-term relationship with inflation.

**Diagnosis**

The first model in table 7 shows that Breusch Godfrey BG) and Serial Correlation Lagrange Multiplier (LM) tests result that null hypothesis is received by both countries. It means that the residual of both countries is not white noise with constant min and inconstant variance. F-statistic from the ARCH test finds that null hypothesis is rejected in both countries, that ARCH/heteroskedastity has no effect. Furthermore, the normality test using Jarque Bera test shows that the data in Indonesia is anomaly.

The second model in table 7 concludes that the diagnosis test for threshold inflation affects money velocity. Based on the autoregressive test using Breusch Godfrey BG) and Serial Correlation Lagrange Multiplier (LM) tests, null is accepted in Indonesia and rejected in Thailand. It means that the residual is white noise with constant min and variance. The ARCH test shows that null hypothesis is accepted in both countries. It means that there is no heteroskedastity in that country. Finally, the normality test shows that the anomaly data is only found in Indonesia.

The diagnosis test for the third model is seen in table 7. Based on the autoregressive test using Breusch Godfrey BG) and Serial Correlation Lagrange Multiplier (LM) tests, it is found that null hypothesis, finally, accepted in Indonesia; and ARCH test shows that there is no heteroskedastity in Thailand. The normality test shows that the data of both countries is anomaly.

**Table 7:** DianogsticTest

| First Model | | | |
|---|---|---|---|
| | **AR Test** *(BG Serial Correlation LM Test)* | **ARCH Test** *(ARCH Test)* | **Normality Test** *(Jarque Bera Test)* |
| Hypothesis | $H_0$: Residual is *white noise* | $H_0$: ARCH Has no Effect | $H_0$: Normal |
| Indonesia | Statistic F = 2.6329 | Statistic F = 0.2544 | Statistic F = 268.0199 |
| | P Value = 0.0571*** | P Value = 0.6167 | P Value = 0.0000* |
| Thailand | Statistic F = 2.6331 | Statistic F = 0.6327 | Statistic F = 0.6401 |
| | P Value = 0.0571*** | P Value = 0.6426 | P Value = 0.7261 |
| Second Model | | | |
| | **AR Test** *(BG Serial Correlation LM Test)* | **ARCH Test** *(ARCH Test)* | **Normaly Test** *(Jarque Bera Test)* |
| Hypothesis | $H_0$: Residual is *whit noise* | $H_0$: ARCH Has no Effect | $H_0$: Normal |
| Indonesia | Statistic F = 0.7656 | Statistic F = 0.4804 | Statistic F = 148.8653 |
| | P Value = 0.3872 | P Value = 0.4920 | P Value = 0.0000* |
| Thailand | Statistic F = 2.3918 | Statistic F = 0.4335 | Statistic F = 1.0231 |
| | P Vala = 0.0789*** | P Value = 0.7303 | P Value = 0.5996 |
| Third Model | | | |
| | **AR Test** *(BG Serial Correlation LM Test)* | **ARCH Test** *(ARCH Test)* | **Normality Test** *(Jarque Bera Test)* |
| Hypothesis | $H_0$: Residual is *white noise* | $H_0$: Tidak wujud penga-ruh ARCH | $H_0$: Normal |
| Indonesia | Statistic F = 0.8549 | Statistic F = 0.0018 | Statistic F = 101.3365 |
| | P Value = 0.3611 | P Value = 0.9662 | P Value = 0.0000* |
| Thailand | Statistic F = 3.7811 | Statistic F = 0.0064 | Statistic F = 303.1466 |
| | P Value = 0.0595*** | P Value = 0.9366 | P Value = 0.0000* |
| Fourth Model | | | |
| | **AR Test** *(BG Serial Correlation LM Test)* | **ARCH Test** *(ARCH Test)* | **Normality Test** *(Jarque Bera Test)* |
| Hypothesis | $H_0$: Residual is *white noise* | $H_0$: ARCH Has no Effect | $H_0$: Normal |
| Indonesia | Statistic F = 0.7456 | Statistic F = 0.0056 | Statistic F = 98.7000 |
| | P Value = 0.3934 | P Value = 0.9406 | P Value = 0.0000* |
| Thailand | Statistic F = 0.8291 | Statistic F = 0.1286 | Statistic F = 12.7117 |
| | P Value = 0.5198 | P Value = 0.9710 | P Value = 0.0017* |

Source: calculated data

Note: (*), (**) and (***) Each refers to significance at alpha 1%, 5% and 10%.

The fourth model in table 7 shows that autoregressive test using Breusch Godfrey (BG) and Serial Correlation Lagrange Multiplier (LM) tests find that null hypothesis is, finally, accepted in both countries; and F-statistic through ARCH test shows that null hypothesis is not rejected in both countries; while normality test using Jarque Bera Test finds that the data in both countries is anomaly.

### Stability Test

The stability test applies CUSUM test with 5% interval of satisfaction. The test shows that the first model describes instability in Indonesia, because the plot of CUSUM sta-

tistic outstrips the interval of satisfaction at 5%; and in Thailand, the second and the fourth models are stable. Thoroughly, there is synchronic data between diagnosis tests with the financial series data applied in this study.

## CONCLUSION

The finding of the first study is obtained to describe how inflation rate and money volatility affects money velocity. In Indonesia, it was found that there was co-integration between inflation rate and money volatility with money velocity. This study was in line with Zapata (2003) that states that the enhancement in inflation would increase money velocity. The prediction of elasticity also proved that inflation and money volatility gave long-term effect to money velocity. The inflation affected negatively, and money volatility affected positively to money velocity. However, it was only inflation that had short-term and negative relationship with money velocity. Moreover, money volatility had no short-term relationship to money velocity.

The study finds that in Thailand, there was no co-integration among inflation, money volatility and money velocity, but money volatility gave long-term effect positively to money velocity. On the other hand both inflation and money volatility gave short-term effect to money velocity. Inflation had negative effect to money velocity and money volatility had positive relationship.

The finding of the second study was to see how inflation and threshold inflation affected money velocity. It showed that there was co-integration between inflation and threshold inflation with money velocity at satisfaction degree 10% in Indonesia. However, the relationship in each variable of inflation with threshold inflation showed long-term and short-term relationship with money velocity.

In Thailand, there was co-integration existence between inflation and threshold inflation with money velocity. Both variables described long-term and short-term relationship with money velocity. Inflation gave long-term and positive effect, while threshold inflation gave long-term and negative effected to money velocity. It was found contrast in short-term relationship in which the inflation affected negatively and threshold inflation affected positively to money velocity.

The third study is aimed to observe the relationship between money velocity and output gap affecting inflation. The finding of the study conducted in Indonesia showed that there was co-integration at satisfaction degree 5% for the relationship of money velocity and output gap with inflation. Still, in each variable, there was no long-term relationship between money velocity and output gap with inflation. They had negative relationship with inflation through short-term test.

On the other hand, there was co-integration among the three variables in Thailand. It was only output gap that had long-term and negative relationship with inflation. In short-term relationship, both variables showed relationship with inflation; money velocity shows negative relationship, and output gap shows positive relationship.

The fourth study finds that there was co-integration 5% at satisfaction degree between the gap of money velocity and output gap with inflation in Indonesia. Both variables did not have long-term relationship with inflation separately. In short-term relationship, the gap of money velocity did not have short-term relationship with inflation. It was contradictory with output gap whose long-term relationship with inflation is negative.

The study proves that there was co-integration between the gap of money velocity and output gap with inflation at satisfaction degree 1% in Thailand. Both variables had long-term and short-term relationship with inflation. They showed posi-

tive long-term relationship and negative short term relationship with inflation.

The study describes the relationship among money velocity with inflation and money volatility and inflation with the gap of money velocity and output gap clearly. In Indonesia, the inflation and money velocity show short-term and long-term relationship negatively. It means that if the inflation increases, it will decrease the money velocity. It happened in the monetary crisis in some south east countries. In Indonesia, the monetary crisis affects the high inflation. It also affects the goods price and incredibility of the people towards financial institution (banks), They draw their deposit and save their money to banks in other countries (capital flight), One condition that government paid attention on is price stability policy as financial policy. Money volatility also deserves to be settled because it will give positive effect to long-term-money velocity. It will be an aid to estimate money velocity affecting to issue financial policy.

In Indonesia, the inexistence of threshold inflation will affect money velocity. It means that the country should be aware for the inflation control. Without limitation, the government should be sensitive to what really takes place in the society. There is no long-term relationship between output gap and inflation. It is found that it has only short-term relationship. It means that output gap, in short time, will affect the inflation. If it is true, then the government should control the output as the production of the country. The control might be fulfilled by productivity increase.

In Thailand, the inflation affects money velocity. The increase in inflation will decrease money velocity in short span. The high inflation reflects the high price. People tend to save their money in bank because of the high rate of interest. The existence of threshold inflation in Thailand is quite good that could help the government to realize their financial policy. The output gap will decrease the inflation in long span. It means that the government should highlight the policy on the output to settle the inflation. Furthermore, the gap of money velocity gives positive effect in long span. Therefore, the government should control the money velocity as the main facto to determine inflation, and it is not only inflation that determined money velocity.

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