JIET
Jurnal Ilmiah Ekonomi Terapan

JURNAL ILMU EKONOMI TERAPAN
https://e-journal.unair.ac.id/JIET/index

THE EFFECT OF MONEY SUPPLY ON EXCHANGE RATE IN ASEAN-5: EMPIRICAL TEST OF DORNBUSCH OVERSHOOTING MODEL

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ABSTRACT

The primary purpose of this study is to analyze the effects of the money supply on exchange rates in ASEAN-5 and whether there is an exchange rate overshooting phenomenon with the application of the Dornbusch Overshooting Model. This study uses the Autoregressive Distributed-Lag (ARDL) method to analyze the short and long-term effects and uses time series data from 1980 to 2021 in ASEAN-5. The results of this study are still ambiguous in finding the overshooting phenomenon in ASEAN-5. In the short term, the research results support overshooting in two countries, Malaysia and Thailand. However, in the long term, no positive and significant influence was found between the money supply gap and exchange rate misalignment in ASEAN-5. Besides that, the inflation gap, interest rate gap, and output gap also greatly influence changes in exchange rate misalignment and have different significant effects in the short and long term.

Keywords: *Money Supply, Exchange Rate, Dornbusch Overshooting Model, Autoregressive Distributed-Lag (ARDL), ASEAN-5*

ABSTRAK

Tujuan utama dari penelitian ini adalah menganalisis pengaruh jumlah uang beredar terhadap nilai tukar di ASEAN-5 serta menganalisis apakah terdapat fenomena overshooting nilai tukar dengan penerapan Dornbusch Overshooting Model. Penelitian ini menggunakan metode Autoregressive Distributed-Lag (ARDL) dalam menganalisis pengaruh dalam jangka pendek dan jangka panjang serta menggunakan data time series dari tahun 1980 hingga 2021 di ASEAN-5. Hasil penelitian ini masih ambigu dalam menemukan fenomena overshooting di ASEAN-5. Dalam jangka pendek, hasil penelitian mendukung adanya fenomena overshooting di dua negara yaitu Malaysia dan Thailand. Namun dalam jangka panjang, tidak ditemukan pengaruh positif dan signifikan antara money supply gap dan misalligment nilai tukar di ASEAN-5. Selain itu, inflation gap, interest rate gap, dan output gap juga memiliki pengaruh yang besar terhadap perubahan misalligment nilai tukar dan memiliki besaran pengaruh yang berbeda pada jangka pendek maupun jangka panjang.

Kata Kunci: *Jumlah uang beredar, Nilai Tukar, Dornbusch Overshooting Model, Autoregressive Distributed-Lag (ARDL), ASEAN-5*

JEL: E40; E51

ARTICLE INFO

Received:
November 23rd, 2023
Revised:
November 26th,2023
Accepted:
December 5th, 2023
Online:
June 25th, 2024

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To cite this document: Maghfiroh, U. & Jayadi, A. (2024). The Effect of Money Supply on Exchange Rate in ASEAN-5: Empirical Test of Dornbusch Overshooting Model. *Jurnal Ilmu Ekonomi Terapan, 9*(1), 11-25. https://doi.org/10.20473/jiet.v9i1.51854

Jurnal Ilmu Ekonomi Terapan p-ISSN: 2541-1470; e-ISSN: 2528-1879
DOI: 10.20473/jiet.v9i1.51854

Introduction

Exchange rates are essential in facilitating economic transactions between countries, including ASEAN-5 countries. Exchange rate uncertainty in a region can disrupt the flow of goods, services, and capital. According to Mishkin & Savastano (2001), middle-income countries are very vulnerable to shock, so the stability of aggregate demand abroad is disrupted and impacts exchange rates. The shocks from 1990-2021 are the Asian financial crisis (1998) and the global financial crisis (2008), which caused exchange rate depreciation in most countries, especially middle-income countries.

The 1997-1998 Asian financial crisis began in Thailand, causing the value of the Baht currency to depreciate due to the country's current account deficit, which skyrocketed sharply towards 1996. The crisis has impacted other countries, including ASEAN-5. Indonesia was heavily affected, and there was a sharp depreciation in the exchange rate, which increased the burden of foreign debt, especially from the private sector.

Policymakers debated the exchange rate system in ASEAN after the 1998 Asian financial crisis. Some economists argue that exchange rate flexibility is necessary so that the exchange rate can adjust to external imbalances. At that time, ASEAN-5 countries began to change the exchange rate system to a floating exchange rate, so the determination of the exchange rate was based on market mechanisms, and there was no intervention from the government.

The money supply is essential in determining exchange rate movements that caused the currency to depreciate even more during the 1998 crisis. It is in line with Nieh & Wang (2005) who explain that changes in the exchange rate due to shocks from an increase in the money supply will cause an overreaction to short-term currency depreciation with a much greater intensity than the long-term exchange rate. It occurs even though the exchange rate will gradually return to its long-term equilibrium. This phenomenon is called exchange rate overshooting. Exchange rate fluctuations can be explained through the Dornbusch overshooting model, which explains that in the short term, the price of a good is sticky. An increase in the money supply results in more significant exchange rate depreciation than depreciation in the long run.

Based on the problems above, this study analyzes the influence of money supply on exchange rates in ASEAN-5 countries, including Indonesia, Malaysia, Singapore, the Philippines, and Thailand. By applying the Dornbusch Overshooting Model, this study aims to prove the existence of an overshooting phenomenon in each ASEAN-5 country, which adheres to a floating exchange rate system so that the exchange rate fluctuates. The selection of ASEAN-5 in this research is based on the fact that the five countries are the founders of ASEAN, have the same inflation rate after the 1998 Asian financial crisis, have a money supply above 5%, and have similar trading partners (member countries ASEAN and other trading partners including China, Japan, and the United States). The research period used in this research is 1980 – 2021. In this research period, three global problems influenced changes in exchange rates and money supply: 1) The Asian financial crisis in 1977 – 1978; 2) The global financial crisis in 2007 – 2008; and 3) The Covid-19 pandemic at the end of 2019 – 2021.

Literature Review

Exchange Rate

According to Krugman et al. (2018), exchange rates appear when goods or services are traded, creating a comparison between the exchange rates. The way to calculate the real weighted exchange rate or Real Effective Exchange Rate (REER) is to use Purchasing Power Parity (PPP):

$$REER = \sum \omega j \pi^*_j / \pi \quad (1)$$

where ω is the trade portion with each trading partner country, the REER index determines the extent to which exchange rate growth deviates from a fundamental condition called misalignment. It is also used to measure competitiveness through the real exchange rate aspect so that its impact on import and export performance can be analyzed.

Interest rate parity (IRP) is a form of the Law of One Price on interest rates in different countries. The assumptions underlying IRPs are that the foreign currency market effectively communicates information related to changes in exchange rates, the absence of obstacles in competitive market mechanisms, perfect capital mobility, and perfect capital substitution. After considering the exchange rate, the rate of return between countries will be the same. The theory of IRP can be illustrated in the form of Covered Interest Rate Parity (CIRP) and Uncovered Interest Rate Parity (UIRP).

Dornbusch Overshooting Model

Dornbusch (1976) created the sticky-price monetary model and popularized the concept of exchange rate overshooting. The Dornbusch model assumes that prices are sticky and tend to change over time in response to shocks to the money supply. In the short term, prices are sticky, so an increase in the money supply results in low real interest rates. This condition causes capital outflows so that the domestic currency experiences overshoot or depreciation beyond normal limits due to the absence of price adjustments. Meanwhile, the price of goods will increase so that the money supply decreases and interest rates increase. This condition impacts capital inflows, which causes the value of the domestic currency to appreciate and move towards a new balance point.

Dornbusch's theory is based on two main assumptions. The first assumption is interest rate parity (IRP), which assumes that in an efficient market, bonds from various countries can replace each other perfectly:

$$d = r - r* \quad (2)$$

The *r* value indicates the domestic interest rate, while *r** indicates the foreign interest rate. Meanwhile, d shows the level of depreciation expected by market players, so equation (2) is a statement of the UIRP.

The second assumption states that currency depreciation expectations are based on the difference between the current spot rate and a balanced exchange rate and the difference in long-term inflation expectations at home and abroad.

$$d = -\theta(e - \bar{e}) + (\pi - \pi^*) \quad (3)$$

By combining equations (2) and (3), the following formula is obtained:

$$e - \bar{e} = \frac{1}{\theta}[(r - \pi) - (r^* - \pi^*)] \quad (4)$$

where e represents the logarithm of the spot rate, while π and π^* shows long-term inflation expectations at home and abroad. Equation (4) illustrates that in the short term, the exchange rate is expected to return to its equilibrium point at a level corresponding to the difference. In the long run, $e - \bar{e}$, the exchange rate is expected to change in line with the long-term $\pi - \pi^*$. The rational value of θ is closely related to the speed of price adjustment in the sticky goods markets.

The expression in parentheses in equation (4) is the real interest rate difference. In the long run $e = \bar{e}$ until $\bar{r} - \bar{r}^* = \pi - \pi^*$ applies. The notation of $\bar{r} - \bar{r}^*$ indicates long-term interest rates. Therefore, $[(r - \pi) - (r^* - \pi^*)]$ is the same as $[(r - r^*) - (r - r^*)]$. This equation explains that when implementing contractionary policy, there is an increase in the nominal interest rate differential that exceeds the long-term level. It increases capital inflows so the currency appreciates proportionally above its equilibrium value (Dornbusch, 1976).

Next, assume that purchasing power parity in the long run applies under the following conditions:

$$e = p - \bar{p} \tag{5}$$

Where $\bar{p}$ is the logarithmic form of the long-term equilibrium price level. The demand for money is assumed to be as follows:

$$m = p + \phi y - \lambda r \tag{6}$$

and the long-term money demand function is as follows:

$$\bar{m} = \bar{p} + \phi \bar{y} - \lambda \bar{r} \tag{7}$$

where m, p, and y is the logarithmic form of the money supply, price level, and output (bar notation signifies variables in the long run). By taking the differential between the two equations, then:

$$m = \bar{m} = p - \bar{p} + \phi (y - \bar{y}) - \lambda (r - \bar{r}) \tag{8}$$

With that in mind, then: $\bar{e} = r - r^* = \pi - \pi^*$

$$e = p - \bar{p} = (m - \bar{m}) - \phi (y - \bar{y}) + \lambda (r - \bar{r}) \tag{9}$$

This equation describes the monetary theory of exchange rates, which are determined by the relative demand and money supply of two currencies (Dornbusch, 1976). When the money supply increases, prices will increase, and ultimately, the exchange rate depreciates. When income increases, or inflation expectations decrease, the demand for money increases, so the exchange rate appreciates.

Equation (9) is substituted into equation (4), assuming the level of money supply equilibrium and current income are given by the actual rate of each variable. The equation for determining the current exchange rate (spot exchange rate) is:

$$e = (m - \bar{m}) - \phi (y - \bar{y}) - \frac{1}{\theta}(r - \bar{r}) + \left(\frac{1}{\theta} + \lambda\right)(\pi - \bar{\pi}) \tag{10}$$

Empirical Framework

Capistrán et al. (2019) identified Dornbusch's hypothesis using a structural vector error correction (SVEC) model. They accommodated its long-term relationship with macroeconomic variables such as PPP, which expresses interest parity, money demand, and actual output in Mexico and the United States. A contractionary monetary policy shock caused a rapid and robust exchange rate appreciation, followed by a gradual depreciation in Mexico. Research conducted by Bhadury & Ghosh (2015) used a VAR method that includes actual money demand in the model. The findings show that monetary policy contraction causes exchange rate overshooting, as proposed by Dornbusch's hypothesis. Bjørnland (2009) found that contractionary monetary policy significantly impacted exchange rate changes. After the impact, the exchange rate slowly depreciates to its base level, to Dornbusch's overshooting

concept.

Research conducted by Chiliba et al. (2019) retested the overshooting hypothesis using the ARDL procedure on the United States Dollar/Zambian Kwacha (USD/ZMK) exchange rate. The research results show no evidence of an overshooting phenomenon with no long-term relationship between the exchange rate and macroeconomic variables. Nieh & Wang (2005) tested the Dornbush model using the Johansen test and ARDL Bound test in Taiwan. The results show no long-term correlation between the NTD/USD exchange rate and macroeconomic variables. Overshooting occurs in the short term and is not applied to the current period but to the following month.

Data and Research Methods

The data used to analyze the correlation of the dependent variable (exchange rate) with the independent variables (money supply, inflation, interest rates, and real GDP) is time series data from the official World Bank website for 1980 – 2021.

Table 1: Variables, Notation, and Data

Variable	Notation	Information
Exchange rate	EX	Annual data of the Official Exchange Rate (LCU per US$, period average) in nominal units.
Money supply	MS	Annual data from broad money (M2) in percent.
Inflation	INF	Annual data from the Consumer Price Index (CPI) in units of percent.
Interest	INT	Annual data of real interest rates in units of percent.
Gross Domestic Product	GDP	Annual data of GDP growth in units of percent.

Auto-Regressive Distributed Lag (ARDL) is a method that analyzes long-term relationships by involving the concept of cointegration among variables (Pesaran et al., 1999). ARDL models can handle small samples, measure variables at different order levels, and estimate short-run and long-run relationships simultaneously (Nieh & Wang, 2005). The following is the ARDL model used in this study:

$$\begin{aligned}\Delta LNEX_t = {} & \beta_0 + \beta_1 (MS_{t-1} - \overline{MS}_{t-1}) + \beta_2 (INF_{t-1} - \overline{INF}_{t-1}) \\ & + \beta_3 (INT_{t-1} - \overline{INT}_{t-1}) + \beta_4 (GDP_{t-1} - \overline{GDP}_{t-1}) \\ & + \sum_{i=0}^{n2} \lambda_{0,i} \Delta (MS_{t-i} - \overline{MS}_{t-i}) + \sum_{i=0}^{n3} \lambda_{1,i} \Delta (INF_{t-i} - \overline{INF}_{t-i}) \\ & + \sum_{i=0}^{n4} \lambda_{2,i} \Delta (INT_{t-i} - \overline{INT}_{t-i}) + \sum_{i=0}^{n5} \lambda_{3,i} \Delta (GDP_{t-i} - \overline{GDP}_{t-i}) + e_t\end{aligned} \quad (11)$$

Information:

$\Delta LNEX_t$: exchange rate misalignment or change in the logarithmic form of the exchange rate at time t

β_0 : constant

$\beta_1, \beta_2, \beta_3, \beta_4$: speed of adjustment

$\lambda_0, \lambda_1, \lambda_2, \lambda_3$: speed of adjustment

$(MS_{t-1} - \overline{MS}_{t-1})$: money supply gap or adjustment between actual and long-term money supply on lag t-1

$(INF_{t-1} - \overline{INF}_{t-1})$: inflation gap or adjustment between actual and long-term inflation rates in lag t-1

$(INT_{t-1} - \overline{INT}_{t-1})$: interest rate gap or adjustment between actual and long-term interest rates on lag t-1

$(GDP_{t-1} - \overline{GDP}_{t-1})$: output gap or adjustment between actual and long-term GDP at lag t-1

$\Delta(MS_{t-i} - \overline{MS}_{t-i})$: money supply gap or adjustment change between actual and long-term money supply on lag t-i

$\Delta(INF_{t-i} - \overline{INF}_{t-i})$: inflation gap or change in adjustment between actual and long-term inflation rates at lag t-i

$\Delta(INT_{t-i} - \overline{INT}_{t-i})$: interest rate gap or adjustment change between actual and long-term interest rates on T-I lag

$\Delta(GDP_{t-i} - \overline{GDP}_{t-i})$: output gap or adjustment change between actual and long-run GDP at t-i lag

e_t : error term at time t

n2, n3, n4, n5 : upper limit of lag for each variable

i=0, i=1 : lower limit lag

Finding and Discussion

Hodrick Prescott Filter

Filter Hodrick-Prescott is a method of smoothing data to eliminate short-term fluctuations so that it can show long-term trends (Hodrick & Prescott, 1997). This method is a double-sided linear filter (backward-forward). The smoothed trend series for each variable can be calculated by minimizing the loss function, namely the variance of each variable around the series value with a lambda of 1600 for quarterly and 100 for annual data.

Stationarity Test

This study used the Augmented Dickey-Fuller (ADF) stationary test. The results of the stationary test show that the Philippine exchange rate data is stationary at the first difference level. In contrast, the exchange rate data for four other countries, Indonesia, Malaysia, Singapore, and Thailand, is stationary at level (0). Then, the results of the stationarity test of the independent variables (money supply gap, inflation gap, interest rate gap, and output gap) show that all independent variables in ASEAN-5 are stationary at level (0).

Optimal Lag Selection

study used four maximum lags for each variable and applied the Akaike Information Criterion (AIC). Table 2 below shows the optimal lag results obtained in the 20 ARDL models.

Table 2: Optimal Lag Selection

Country	Optimal Lag Selection
Indonesia	(4, 4, 0, 4, 2)
Malaysia	(2, 4, 2, 3, 3)
Philippines	(4, 0, 1, 0, 0)
Singapore	(1, 0, 0, 2, 0)
Thailand	(4, 3, 0, 4, 3)

ARDL Bound Test

Short-Term ARDL Estimation

The short-term ARDL estimation results in Table 3 show that exchange rate misalignment in Indonesia in the previous three years had a positive and significant effect on exchange rate misalignment in the current period. The exchange rate misalignment in the Philippines in the previous two years also positively and significantly affected the exchange rate misalignment in the current period. In addition, the exchange rate misalignment in Thailand in the previous year and the previous three years also positively and significantly affected the exchange rate misalignment in the current period. Then, the money supply gap in Malaysia in the previous 1 and 2 years and the money supply gap in Thailand in the previous two years had a positive and significant effect on exchange rate misalignment. In addition, the current gap in money supply in Malaysia has a significant negative impact on exchange rate misalignment.

The inflation gap positively and significantly affects currency exchange rates in Malaysia and the Philippines. The interest rate gap positively and significantly influenced the exchange rate misalignment in Indonesia and Malaysia in the previous three years. Apart from that, the interest rate gap has a negative and significant effect on exchange rate misalignment in Malaysia in the previous 1 and 2 years and in Thailand in the current period, the previous two years, and the previous three years. Finally, the output gap positively and significantly influenced the misalignment of the exchange rate in Indonesia in the previous year. Apart from that, the output gap has a negative and significant effect on exchange rate misalignment in Malaysia for the current period and the previous two years, as well as in Thailand.

Table 3: Short-Term ARDL Estimation

Variable	Indonesia	Malaysia	Philippines	Singapore	Thailand
Constant	0.001 (0.15)	-0.003 (-0.56)	-0.001 (-0.16)	-0.001 (-0.16)	-0.001 (-0.15)
$\Delta LNEX_{(t-1)}$	0.081 (0.58)	0.229* (1.76)	0.297* (1.86)	-	0.581** (2.77)
$\Delta LNEX_{(t-2)}$	-0.087 (-0.63)	-	0.403** (2.40)	-	0.364* (1.88)
$\Delta LNEX_{(t-3)}$	0.259** (2.27)	-	0.248* (1.80)	-	-
$\Delta LNEX_{(t-4)}$	-	-	-	-	-0.001 (0.30)
$\Delta (MS_t - \overline{MS}_t)$	0.001 (0.26)	-0.003** (-5.01)	-	-	0.002 (0.67)
$\Delta (MS_{t-1} - \overline{MS}_{t-1})$	0.002 (0.76)	0.004** (3.34)	-	-	0.005** (2.19)
$\Delta (MS_{t-2} - \overline{MS}_{t-2})$	0.004* (1.90)	0.002** (3.34)	-	-	-
$\Delta (MS_{t-3} - \overline{MS}_{t-3})$	0.002 (1.45)	0.001 (1.59)	-	-	-
$\Delta (MS_{t-4} - \overline{MS}_{t-4})$	-	-	-	-	-
$\Delta (INF_t - \overline{INF}_t)$	-	0.028** (3.81)	0.020** (4.00)	-	-
$\Delta (INF_{t-1} - \overline{INF}_{t-1})$	-	-0.009 (-1.61)	-	-	-
$\Delta (INF_{t-2} - \overline{INF}_{t-2})$	-	-	-	-	-
$\Delta (INF_{t-3} - \overline{INF}_{t-3})$	-	-	-	-	-
$\Delta (INF_{t-4} - \overline{INF}_{t-4})$	-	-	-	-	-
$\Delta (INT_t - \overline{INT}_t)$	0.003 (0.94)	0.009** (3.34)	-	-0.002 (-0.70)	-0.025** (-3.26)
$\Delta (INT_{t-1} - \overline{INT}_{t-1})$	0.002 (0.38)	-0.020** (-4.80)	-	-0.003 (-1.68)	-0.001 (-0.19)
$\Delta (INT_{t-2} - \overline{INT}_{t-2})$	0.005 (1.35)	-0.013** (-5.82)	-	-	-0.014** (2.73)
$\Delta (INT_{t-3} - \overline{INT}_{t-3})$	0.006** (2.59)	-	-	-	-0.010** (-2.31)

Variable	Indonesia	Malaysia	Philippines	Singapore	Thailand
$\Delta(INT_{t-4} - \overline{INT}_{t-4})$	-	-	-	-	-
$\Delta(GDP_t - \overline{GDP}_t)$	-0.015* (-2.03)	-0.008** (-4.01)	-	-	-0.020** (-6.74)
$\Delta(GDP_{t-1} - \overline{GDP}_{t-1})$	0.025** (2.97)	-0.005 (-1.18)	-	-	-0.009* (-1.94)
$\Delta(GDP_{t-2} - \overline{GDP}_{t-2})$	-	-0.008** (-2.91)	-	-	0.004 (1.32)
$\Delta(GDP_{t-3} - \overline{GDP}_{t-3})$	-	-	-	-	-
$\Delta(GDP_{t-4} - \overline{GDP}_{t-4})$	-	-	-	-	-

Note:(**) significant at 5%; (*) significant at 10%
The sign in parentheses represents the value of t-statistic
T-table value 5% (1.98); 10% (1.66)

Long-Term ARDL Estimation

Table 4: Long-Term ARDL Estimation

Country	Constant	$(MS - \overline{MS})$	$(INF - \overline{INF})$	$(INT - \overline{INT})$	$(GDP - \overline{GDP})$
Indonesia	0.001 (-0.15)	-0.009 (-0.92)	0.041** (3.83)	0.012 (0.73)	-0.085** (-2.50)
Malaysia	-0.003 (-0.56)	-0.021** (-3.68)	0.087** (2.24)	0.090** (2.55)	0.015 (0.83)
Philippines	-0.001 (0.16)	-0.005 (-1.24)	0.018** (2.35)	0.049** (2.60)	-0.003 (-0.52)
Singapore	-0.001 (-0.16)	0.003 (1.05)	-0.033** (-2.56)	0.014 (1.18)	-0.015** (-2.20)
Thailand	-0.001 (-0.15)	0.006 (0.86)	-0.040** (-3.41)	-0.015 (-0.74)	-0.017 (-1.33)

Note: (**) significant at 5%; (*) significant at 10%
The sign in parentheses represents the value of t-statistic
T-table value 5% (1.98); 10% (1.66)

Table 4, the result of long-term ARDL estimation, shows that the money supply gap negatively and significantly influences the real exchange rate only in Malaysia. Then, the inflation gap positively and significantly influences the real exchange rate in Indonesia, Malaysia, and the Philippines in the long term. Meanwhile, the inflation gap negatively and significantly influences the real exchange rate in Singapore and Thailand in the long term. The interest rate gap positively and significantly affects the real exchange rate in Malaysia and the Philippines. Finally, the output gap negatively and significantly affects the real exchange rate in Indonesia and Singapore.

Cointegration Test

A cointegration test is performed to determine whether there is a long-term relationship between variables in the model using the bound test introduced by (Pesaran et al., 1999). The estimation of the cointegration test shows that all countries are cointegrated in the long run at a rate of 5%.

Diagnostic Test

The ECMt-1 coefficient value in the entire model is negative and significant at the 5% level. The largest ECMt-1 coefficient value was shown by Thailand, namely -0.58, which means that the speed of adjustment between the long term and the short term was 58%. In

the results of the Lagrange Multiplier (LM) test, only one model experienced autocorrelation (rejected the null hypothesis), namely the Philippines because the probability value of 0.04 was smaller than the 5% significance level.

Table 5: Diagnostic Test Results

Country	ECM_{t-1}	LM	RESET	Adj. R^2
Indonesia	-0.45** (-8.89)	0.36	0.039	0.943
Malaysia	-0.38** (-7.38)	2.82	2.075	0.817
Philippines	-0.54** (-6.24)	3.65**	0.001	0.627
Singapore	-0.29** (-7.20)	0.85	2.059	0.575
Thailand	-0.58** (-6.00)	0.33	0.000	0.804

Note: (**) significant at 5%; (*) significant at 10%
In particular for ECM_{t-1}, the sign in parentheses expresses the t-statistic value
T-table value 5% (1.98); 10% (1.66)
For LM and RESET, the results are significant if Prob > 0.05

The Ramsey RESET test results show that the probability in all countries is greater than 5%, so all models are excellent and precise. Finally, the adjusted R2 test shows that the model with the highest level of suitability is the model in Indonesia, namely 0.943. The independent variables (money supply, inflation, interest rate, and output gap) can explain 94% of the dependent variable (exchange rate misalignment) in Indonesia. Meanwhile, the rest is influenced by other unexpected variables.

Robustness Test

The results of the CUSUM test show that ASEAN-5 has a stable model. Then, the CUSUMQ test showed two countries with unstable models, Malaysia and Thailand, while the other three countries had stable models.

Indonesia

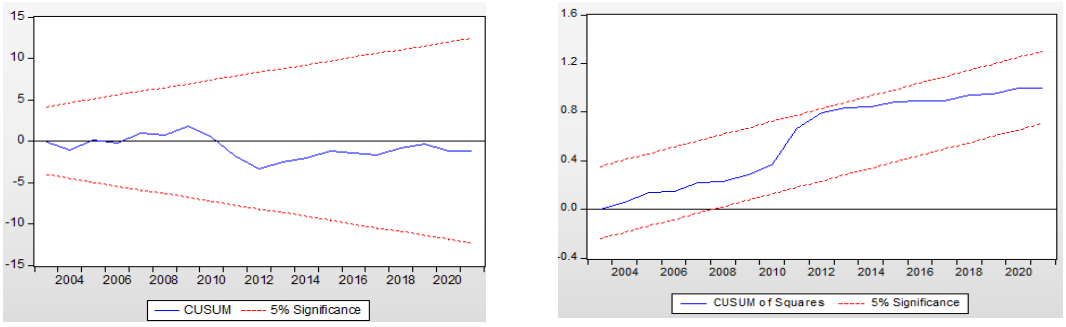

Figure 1: CUSUM Test

Malaysia

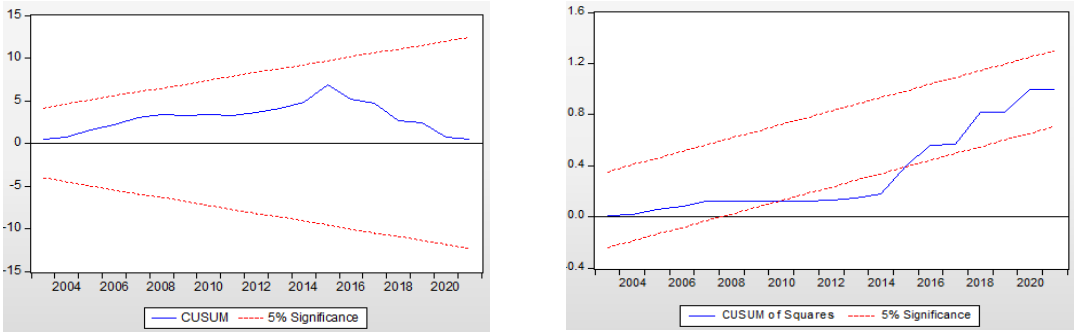

Figure 2: CUSUM Test

Philippines

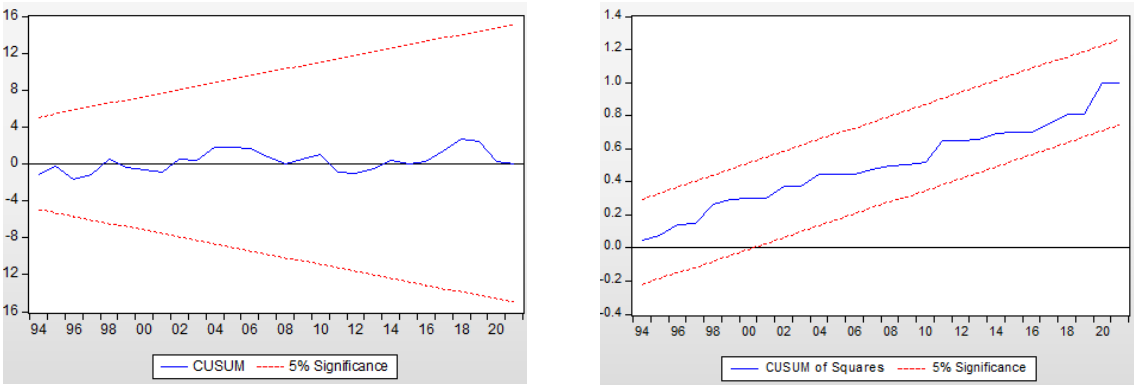

Figure 3: CUSUM Test

Singapore

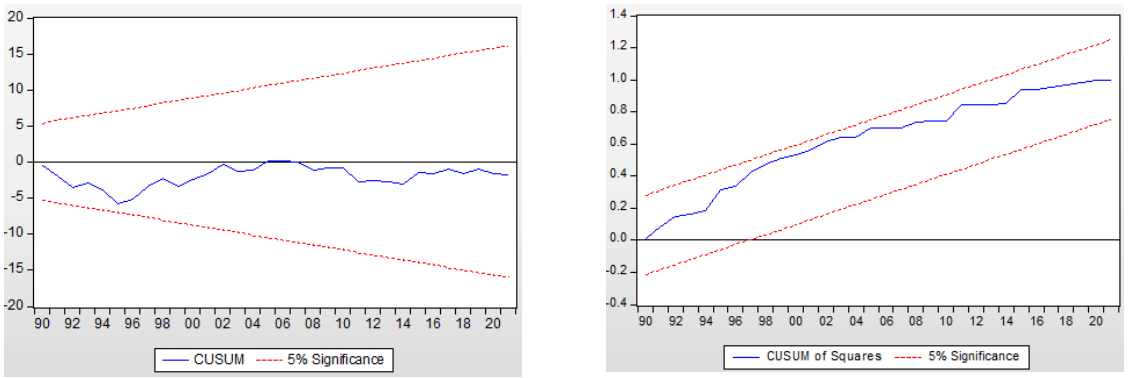

Figure 4: CUSUM Test

Thailand

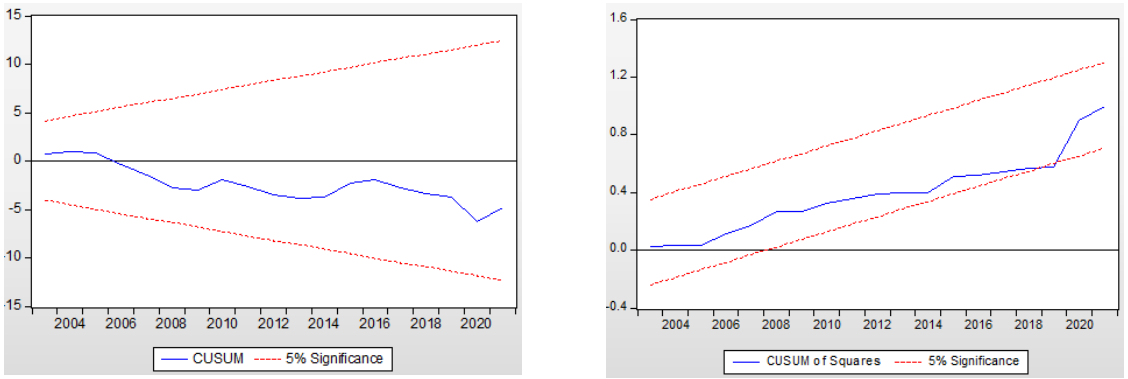

Figure 5: CUSUM Test

Discussion

The Effect of Money Supply Gap on Exchange Rate Misalignment

Based on the estimation results using the ARDL method, the money supply gap has a positive and significant influence on exchange rate misalignment in the short term in two countries, namely Malaysia and Thailand. When the gap in the money supply increases, the exchange rate will also experience an increase in value (depreciation) in the short term. The influence of the money supply gap on exchange rate mitigation in Malaysia can be explained in the short term. When the gap in the money supply in the previous period increases by 1%, the current exchange rate will also experience an increase (depreciation) of 0.4%. Then,

when the gap in the money supply in the two previous periods increases by 1%, the current exchange rate will depreciate by 0.2%. Furthermore, when the money supply gap in Thailand's two previous periods increases by 1%, the exchange rate will rise (depreciate) by 0.5% in the short term.

The results of this research align with Dornbusch (1976), who explains that in the short term, prices are sticky, so an increase in the money supply causes a decrease in real interest rates and capital outflow. It causes the value of the domestic currency to depreciate. Nieh & Wang (2005) explain that an increase in the money supply will create an overreaction to short-term currency depreciation with a much greater intensity compared to long-term exchange rates. It occurs even though the exchange rate will gradually return to its long-term equilibrium.

The money supply gap negatively and significantly influences exchange rate misalignment in Malaysia in the short and long term. It means that when the gap in the money supply increases, the exchange rate will decrease (appreciate). When the money supply gap in Malaysia increases by 1%, the exchange rate will increase by 0.3% in the short term. In the long term, when the money supply gap in Malaysia increases by 1%, the exchange rate will also increase by 2%.

The Effect of Inflation Gap on Exchange Rate Misalignment

Based on ARDL estimation results in the short term, the inflation gap positively and significantly influences exchange rate misalignment in Malaysia and the Philippines. It means that when there is an increase in the inflation gap in Malaysia and the Philippines, exchange rate misalignment (depreciation) will increase. In detail, the influence of the inflation gap on exchange rate misalignment in Malaysia means that in the short term, when the inflation gap increases by 1%, the exchange rate misalignment will also increase or depreciate by 2.8%. Likewise, when the inflation gap increases by 1% in the Philippines, the exchange rate misalignment will depreciate by 2% in the short term.

Furthermore, the inflation gap positively and significantly influences exchange rate misalignment in the long term in three countries, namely Indonesia, Malaysia, and the Philippines. The influence of the inflation gap on exchange rate misalignment in Indonesia means that when the inflation gap in Indonesia increases by 1%, the exchange rate misalignment will also experience an increase (depreciation) of 4.1% in the long term. The influence of the inflation gap on exchange rate misalignment in Malaysia also means that when the inflation gap in Malaysia increases by 1%, the exchange rate misalignment will also experience an increase (depreciation) of 8.7% in the long term. Likewise, when the inflation gap increases by 1% in the Philippines, the exchange rate misalignment will depreciate by 1.8% in the long term. This research results align with Carbaugh (2014), who stated that the exchange rate would further depreciate when import prices and price levels increase due to continued inflation.

Meanwhile, the inflation gap negatively influences long-term exchange rate mitigation in Singapore and Thailand. It means that when the inflation gap gets bigger, the exchange rate will experience a decline (appreciation). In detail, the influence of the inflation gap on exchange rate mitigation in Singapore means that when the inflation gap increases by 1%, the exchange rate misalignment is indicated to decrease or appreciate by 3.3% in the long term. The influence of the inflation gap on exchange rate mitigation in Thailand also means that when the inflation gap increases by 1%, the exchange rate misalignment will also be indicated to experience a decrease (appreciation) 4% in the long term.

The Effect of Interest Rate Gap on Exchange Rate Misalignment

The interest rate gap positively and significantly influences exchange rate misalignment in Indonesia and Malaysia in the short term. When the interest rate gap increases, the exchange rate will also rise (depreciate) in the short term. The effect of the interest rate gap on exchange rate mitigation in Indonesia means that in the short term when the interest rate gap in the previous three periods increases by 1%, the current exchange rate will increase or depreciate by 0.6%. Likewise, when the interest rate gap increases by 1% in Malaysia, the current exchange rate will rise (depreciate) by 0.9% in the short term.

Furthermore, in the long term, the interest rate gap positively and significantly influences currency exchange rates in Malaysia and the Philippines. In detail, the effect of the interest rate gap on exchange rate misalignment in Malaysia means that when the interest rate gap increases by 1%, the exchange rate will increase or depreciate by 9%. Likewise, when the interest rate gap increases by 1% in the Philippines, the exchange rate will depreciate by 5% in the long term.

This study's results align with Capistrán et al. (2019), who found a positive and significant relationship between interest and exchange rates. Interest rates that rise after output or exchange rate shocks in Mexico and the United States tend to lead to higher inflation. It reflects that to avoid unwanted currency depreciation, which could result in high inflation, the monetary authority needs to increase domestic interest rates after an increase in interest rates abroad.

Meanwhile, the interest rate gap has a negative and significant influence on exchange rate mitigation in the short term in two countries, namely Malaysia and Thailand. It means that when the interest rate gap increases, the exchange rate will experience a decrease (appreciation). The effect of the interest rate gap on the assessment of the exchange rate in Malaysia in the short term means that if the interest rate gap in the previous period increases by 1%, the exchange rate will fall or appreciate by 2%. Meanwhile, if the difference in interest rates in the two previous periods rose by 1%, the exchange rate would fall or appreciate 1.3%. A similar thing also happened in Thailand. If the interest rate difference for the current period increases by 1%, the exchange rate will fall or appreciate by 2.5% in the short term. Meanwhile, if interest rates in the previous two periods increased by 1%, the current exchange rate will fall or appreciate by 1.4% in the short term. In addition, when interest rates in the previous three periods rose by 1%, the current exchange rate will fall or appreciate by 1% in the short term.

This research results align with Carbaugh (2014), who explains that contractionary monetary policy causes an increase in domestic interest rates, investment inflows, and demand for domestic currency. It means that low interest rates affect the depreciation of the exchange rate. Dornbusch (1976) stated that when a contractionary policy is implemented, the nominal differential interest rate will increase above the long-term interest rate. It increases capital inflows so the currency appreciates proportionally above its equilibrium value. It also shows that a decrease or low interest rate will cause the exchange rate to depreciate. Arifin (2003) also explains that contractionary monetary policy encourages an increase in interest rates, which can impact the appreciation of the Rupiah exchange rate during a crisis.

The Effect of Output Gap on Exchange Rate Misalignment

In the short term, the output gap positively and significantly influences exchange rate misalignment in Indonesia. It means that when there is an increase in the output gap in Indonesia, the exchange rate misalignment will increase (depreciate). In detail, the influence of the output gap on exchange rate misalignment in Indonesia means that when the output

gap in the previous period increases by 1%, the exchange rate misalignment will also increase or depreciate by 2.5%. Silitonga et al. (2017) reveal that an increase in trade surplus causes a country's currency to depreciate.

Meanwhile, the output gap has a negative and significant influence on exchange rate mitigation in the short term in two countries, namely Malaysia and Thailand. When the output gap increases, the exchange rate will experience a decrease (appreciation). In detail, the influence of the output gap on exchange rate mitigation in Malaysia means that when the current output gap and the previous two periods increase by 1%, the exchange rate will fall or appreciate by 0.8% in the short term. A similar thing happens in Thailand: when the output gap increases by 1%, the exchange rate will increase by 2%.

In the long term, the output gap negatively influences exchange rate misalignment in Indonesia and Singapore. These results show that when the output gap in Indonesia increases by 1%, the exchange rate misalignment will decrease or appreciate by 8.5%. Likewise, when the output gap increases by 1% in Singapore, the exchange rate misalignment will increase by 1.5%. The results of this research align with Dornbusch (1976), who states that an increase in income or a decrease in inflation expectations will increase domestic money demand so that the currency appreciates. Krugman et al. (2018) explain that an increase in actual output will increase interest rates, thereby triggering exchange rate appreciation.

The Phenomenon of Exchange Rate Overshooting with the Application of the Dornbusch Overshooting Model

The money supply gap positively and significantly influences exchange rate misalignment in Malaysia and Thailand in the short term. In the short term, when the gap in the money supply in the previous period increased by 1%, the current exchange rate also experienced an increase (depreciation) of 0.4%. In addition, when the gap in the money supply in the two previous periods increased by 1%, the current exchange rate is indicated to have depreciated by 0.2%. Furthermore, in Thailand, when the gap in the money supply in the two previous periods increased by 1%, the exchange rate was indicated to experience an increase (depreciation) of 0.5% in the short term.

The estimation results explain that Malaysia and Thailand are indicated to experience the exchange rate overshooting phenomenon because, in the short term, there is a positive and significant influence between the money supply gap and exchange rate misalignment. However, only negative and significant impacts were found in the long term. The exchange rate overshooting in Malaysia occurred because the Ringgit experienced intense pressure in the 1990s due to a current account deficit that was still maintained. Regarding the monetary cycle in Malaysia, exchange rate stability is also caused by a rapidly changing exchange rate regime. This unstable condition brought Malaysia to a state of weakening people's purchasing power, which ultimately caused the exchange rate to exceed its limits.

Meanwhile, the dynamics of the movement of the money supply in Thailand is one of the causes of the overshooting phenomenon. Data from the ASEAN Finance and Macroeconomic Surveillance Unit (FMSU) shows that Thailand experienced growth in the money supply at the start of the 1997 crisis, reaching 16.4%. In 1997, Bath's exchange rate used a fixed exchange rate and was pegged to a basket of currencies. This monetary system was implemented from 1984 to 1997. The Exchange Equalization Fund announced it would maintain the bath exchange rate against the US dollar during this period. However, these financial and monetary policies kept the exchange rate depreciating.

Conclusion

The estimation results of this research show that in the research period, namely the period 1980 – 2021, the coefficient of influence of the money supply gap on short-term exchange rate misalignment was 0.4% in Malaysia and 0.5% in Thailand. It means there will be an overshooting phenomenon in Malaysia and Thailand in the short term. Meanwhile, in the long term, there is no positive and significant influence between the money supply gap and exchange rate misalignment in ASEAN-5. Therefore, this research is still ambiguous in finding the phenomenon of exchange rate overshooting by applying the Dornbusch Overshooting Model in ASEAN-5.

The inflation gap positively and significantly affects exchange rate misalignment in Malaysia and the Philippines in the short term. Meanwhile, in the long term, the inflation gap positively and significantly affects exchange rate misalignment in Indonesia, Malaysia, and the Philippines. Furthermore, in the long term, the inflation gap has a negative impact on exchange rate misalignment in Singapore and Thailand. Meanwhile, in the short term, the interest rate gap negatively and significantly affects exchange rate misalignment in Malaysia and Thailand. Then, the interest rate gap positively affects exchange rate misalignment in Indonesia and Malaysia in the short term and Malaysia and the Philippines in the long term. Finally, the output gap has a positive and significant influence on exchange rate mitigation in Indonesia in the short term. Meanwhile, the output gap has a negative impact on exchange rate misalignment in Malaysia and Thailand in the short term and Indonesia and Singapore in the long term.

Based on the conclusions above, monetary policymakers must pay attention to factors influencing exchange rate fluctuations, namely the money supply, to maintain exchange rate stability. Then, theoretical suggestions are addressed to academics so that future research can involve many countries, and the results can produce more complex recommendations regarding exchange rate stability.

References

Arifin, S. (2003). Efektifitas Kebijakan Suku Bunga dalam Rangka Stabilisasi Rupiah di Masa Krisis [The Effectiveness of Interest Rate Policy in Stabilizing Rupiah during Crisis Period]. *Buletin Ekonomi Moneter Dan Perbankan*, *1*(3), 1–26. https://doi.org/10.21098/bemp.v1i3.174

Bhadury, S. S., & Ghosh, T. (2015). *Reassessing Exchange Rate Overshooting in a Monetary Framework* (WP-2015-017). http://www.igidr.ac.in/pdf/publication/WP-2015-017.pdf

Bjørnland, H. C. (2009). Monetary policy and exchange rate overshooting: Dornbusch was right after all. *Journal of International Economics*, *79*(1), 64–77. https://doi.org/10.1016/j.jinteco.2009.06.003

Capistrán, C., Chiquiar, D., & Hernández, J. R. (2019). Identifying Dornbusch's Exchange Rate Overshooting with Structural VECs: Evidence from Mexico. *International Journal of Central Banking*, *15*(5), 207–254.

Carbaugh, R. (2014). *International Economics* (15th ed.). Boston: Cengage Learning.

Chiliba, L., Alagidede, P., & Schaling, E. (2019). A re-examination of the exchange rate overshooting hypothesis: Evidence from Zambia. *Southern African Business Review*, *20*, 468–491. https://doi.org/10.25159/1998-8125/6060

Dornbusch, R. (1976). Expectations and Exchange Rate Dynamics. *Journal of Political Economy*, *84*(6), 1161–1176. https://doi.org/10.1086/260506

Hodrick, R. J., & Prescott, E. C. (1997). Postwar US business cycles : An empirical investigation. *Journal of Money, Credit and Banking*, *29*(1), 1–16. https://doi.org/10.4324/9780203070710-43

Krugman, P. R., Obstfeld, M., & Melitz, M. J. (2018). *International Economics: Theory and Policy* (Global Edition). Harlow: Pearson.

Mishkin, F. S., & Savastano, M. A. (2001). Monetary policy strategies for Latin America. *Journal of Development Economics*, *66*(2), 415–444. https://doi.org/10.1016/S0304-3878(01)00169-9

Nieh, C.-C., & Wang, Y.-S. (2005). ARDL Approach to the Exchange Rate Overshooting in Taiwan. *Review of Quantitative Finance and Accounting*, *25*(1), 55–71. https://doi.org/10.1007/s11156-005-3179-6

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*, *94*(446), 621–634. https://doi.org/10.1080/01621459.1999.10474156

Silitonga, R. B., Ishak, Z., & Mukhlis. (2017). Pengaruh ekspor, impor, dan inflasi terhadap nilai tukar rupiah di Indonesia [The effect of exports, imports, and inflation on the rupiah exchange rate in Indonesia]. *Jurnal Ekonomi Pembangunan*, *15*(1), 53–59. https://ejournal.unsri.ac.id/index.php/jep/index