Exchange Rate Regime Performance under External Shocks A Case Study of ASEAN

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Abstract

This paper examines the effectiveness of exchange rate management in ASEAN countries. The sample size consists of 544 average weekly spot rates of ASEAN currencies traded against the US dollar from January 1, 2012 to June 5, 2022. Three quantitative tools were used to analyze the data. Time series modeling were employed to obtain predictive function and assess the stability of exchange rates. Extreme Value Theory (EVT) was used to analyze extreme devaluation of some currencies. Lastly, Weibull distribution was used to reinforce EVT under the rationale that extreme currency devaluation is a failure in monetary policy.

Among the 10 ASEAN countries, exchange rates against US dollar for currencies from Laos, Myanmar, Cambodia and Indonesia showed tail index of □ < 0 indicating significant weakening. Under AR(1) modeling, these four currencies showed high level of fluctuation through AIC information loss indicator, 10.23, 10.74, 8.77, and 13.20 respectively. Among three factors used to evaluate currency value, foreign reserves and current

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account balance played important role for ASEAN currencies. We also tracked three non-ASEAN currencies (Euro, Chinease Yuan, and Russian Ruble) and found that Euro and Yuan are two most stable currencies that should be used for pegging under manage float exchange rate regime in ASEAN. This stability was confirmed by the AR (1) vector state of -0.0000089 for EUR and 0.0000182 for CNY with significance level of p = 0.0000 in both cases.

Keywords: Exchange Rate Regime, Extreme Value Theory (EVT), Time Series, Weibull Distribution

ประสิทธิภาพของระบบอัตราแลกเปลี่ยนภายใต้แรงสั่นสะเทือนจากภายนอก กรณีศึกษาอาเซียน

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บทคัดย่อ

บทความนี้ศึกษาประสิทธิผลของการจัดการอัตราแลกเปลี่ยนในประเทศอาเซียน ขนาดของกลุ่มตัวอย่างประกอบด้วย 544 อัตราแลกเปลี่ยนสปอตเฉลี่ยต่อสัปดาห์ของสกุลเงินอาเซียนที่ซื้อขายเทียบกับดอลลาร์สหรัฐตั้งแต่วันที่ 1 มกราคม 2555 ถึง 5 มิถุนายน 2565 เครื่องมือเชิงปริมาณ 3 เครื่องมือที่ใช้ในการวิเคราะห์ข้อมูล มีการใช้แบบจำลองอนุกรมเวลาเพื่อให้ได้ฟังก์ชันการทำนายและประเมินเสถียรภาพของอัตราแลกเปลี่ยนทฤษฎีมูลค่าสูงสุด (EVT) ใช้ในการวิเคราะห์การลดค่าของบางสกุลเงิน สุดท้าย การกระจาย Weibull ใช้เพื่อเสริม EVT ภายใต้เหตุผลที่ว่าการลดค่าสกุลเงินอย่างรุนแรงเป็นความล้มเหลวในนโยบายการเงิน

ในบรรดา 10 ประเทศอาเซียน อัตราแลกเปลี่ยน เมื่อเทียบกับดอลลาร์สหรัฐสำหรับสกุลเงินจากลาว เมียนมา กัมพูชา และอินโดนีเซีย มีค่าหางที่ $\square < 0$ ซึ่งบ่งชี้ว่าอ่อนค่าลงอย่างมาก ภายใต้การสร้างแบบจำลอง AR (1) สกุลเงินทั้งสี่นี้แสดงความผันผวนในระดับสูงผ่านตัวบ่งชี้การสูญหายของข้อมูล AIC คือ 10.23, 10.74, 8.77 และ 13.20 ตามลำดับ ในบรรดาปัจจัยสามประการที่ใช้ในการประเมินค่าเงิน ทุนสำรองเงินตราต่างประเทศและดุลบัญชีเดินสะพัดมีบทบาทสำคัญ

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ต่อสกุลเงินอาเซียน นอกจากนี้ เรายังติดตามสกุลเงินนอกอาเซียนสามสกุล (ยูโร ไชนีสหยวน และรูเบิลรัสเซีย) และพบว่ายูโรและหยวนเป็นสองสกุลเงินที่มีเสถียรภาพมากที่สุดที่ควรใช้ในการตรึงภายใต้ระบบจัดการอัตราแลกเปลี่ยนแบบลอยตัวในอาเซียน ความเสถียรนี้ได้รับการยืนยันโดยสถานะเวกเตอร์ AR(1) ที่ -0.0000089 สำหรับ EUR และ 0.0000182 สำหรับ CNY โดยมีระดับนัยสำคัญ p = 0.0000 ในทั้งสองกรณี

คำสำคัญ: ระบบอัตราแลกเปลี่ยน ทฤษฎีมูลค่าสูงสุด (EVT) อนุกรมเวลา การกระจาย Weibull

Introduction

This paper examines the stability of exchange rates in the ASEAN. ASEAN is comprised of ten countries: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Two current events that motivated this paper are to examine exchange rate as a factor influencing economic stability in the ASEAN. The first factor is the COVID-19 pandemic that has been affecting the global economy since 2020. As the result of various measured imposed to control the pandemics, the global economy had edged closer to recession. During the early stage of the pandemic, international trade had been adversely affected due to curtailing of free flows of people and trade (UNTAD Report, 2022). Fear and uncertainties from the pandemic also affected exchange rate movement. Recent research shows that "adverse pandemic news at the country level cause an immediate, statistically significant, depreciation of the domestic currency vis-à-vis a basket of trade-weighted currencies" (Aquilante, Di Pace, and Masolo, 2022).

The second event that affects the global economy is the military conflicts in Ukraine. The war in Ukraine resulted in trade interruption in Ukraine and Russia; in turn, this war affects the global food and fuel prices. The rise in food and fuel prices since February 2022 had further depressed the global economy. The ASEAN economy is affected by these two global events. The Asian Development Bank reported that the ASEAN economy decline by 4% in 2020 and is expected to rebound to 5.1% by 2022 (ADB Report, 2022. The war in Ukraine brought about international sanctions against Russia; the rise of fuel cost followed after the sanction restricted Russian oil supplies to the global market. In addition, the US economy also faced rising inflation. In its attempt to fight inflation, the US Federal Reserve raised interest rates; as the result the US dollar became stronger against other currencies. These events are external shocks affecting exchange rate among currencies in the ASEAN countries.

Exchange rate performance was evaluated eamong ASEAN countries under economic shock. Economic shock is defined as unpredictable change in exogenous factors that affects the economy. The global economy faces two shocks, namely the COVID-19 pandemic and the current military conflict between Ukraine and Russia. Both events are negative shocks; these shocks affect both macroeconomic and microeconomic levels in the global economy (Margalit, 2019).

There are many studies explaining the social and economic impact of COVID-19. For example, McKibbin and Fernando (2020) argued that pandemics can affect households, governments, and businesses through increased business costs. COVID-19-related restrictions have obstructed food supply chain, including production, distribution, processing, and consumption (Siche 2020), and caused damage to perishable agricultural commodities, such as meat and vegetables (Nicola et al., 2020). Some studies examined potential impacts of the pandemic on global and national economic indicators such as poverty, government expenditures, GDP growth, budget deficits, and employment (ILO 2020; Nicola et al. 2020; Sumner, Hoy, and Ortiz-Juarez 2020; UN-Habitat and WFP 2020) Kansiime et al. (2020) found that people in East African countries experienced income shocks due to the COVID-19 crisis. We want to add to this body of literature by looking at the how exchange rate of ASEAN currencies withstood external shocks, such as COVID-19 and the war in Ukraine.

Exchange rate is an important issue because international trade is not denominated in the local currency. Common currencies used in international trade are USD (US dollar), EUR (Euro) and CNY (Chinese Reminbi or Yuan). The exchange rate of the local currency against these major currencies affects the terms of trade for each country. Countries with weak currencies may face inflationary pressure for their imports through exchange rate pass-through (ERPT) inflation, i.e. weak local currency leads to price increase of imported goods without any change in the underlying fundamentals of imported goods. Faced with external shocks from COVID-19 pandemic and the war in Ukraine, the ASEAN countries are faced with economic slow down coupled with rising inflation. Countries which are traditionally dependent on imports, rising inflation and devaluation of the local currency against the US dollar present formidable challenges to cope with rising prices. The issue of effective foreign exchange management becomes a key strategy to stay afloat in the looming recession.

Among ten member countries in ASEAN, only one country (Philippines) employs a free float system for its foreign exchange regime. Table 1 below provides information about current exchange rate, foreign currency reserves, and inflation in ASEAN. The remaining nine countries use managed float system. Brunei is a special case where the Brunei dollar is pegged against Singapore dollar and the Singapore dollar, in turned, is pegged against the US dollar.

Table 1: Exchange rate regime in the ASEAN

Country	Foreign Exchange Regime	FX per USD	FX Reserves*	CPI 2022	Current Accnt Balance 2022
Brunei	Pegged to SGD	1.38	4.00	3.20	0.892**
Cambodia	Managed float	4,050	20.27	4.00	-4.519
Indonesia	Managed float	14,435	144.91	3.47	-12.69
Laos	Managed float	13,950	1.39	9.86	-1.426
Malaysia	Conventional peg	4.39	116.92	3.20	15.561
Myanmar	Managed float	1,851	18.77	8.00	-0.619
Philippines	Free float	52.90	108.75	5.40	-7.505
Singapore	Managed float	1.38	425.10	5.50	62.315
Thailand	Managed float	34.30	246.03	5.00	12.354
Vietnam	Pegged to USD	23,187	78.33	4.00	13.258

*Billion US dollars, including gold

Source: https://data.worldbank.org/indicator/FI.RES.TOTL.CD?locations=BN-KH-ID-LA-MY-MM-PH-SG-TH-VN Accessed: June 10, 2022

**IMF, World Economic Outlook 2022, amount in billions of US dollar. The figures are IMF forecast for 2022.

The research question presented in this paper is whether the ASEAN countries have effective exchange rate management to cope with external shocks (COVID-19 and the war in Ukraine) Among the ten currencies in the ASEAN community, which currency is the most stable and could deal effectively with challenges in the global market place? We argue that currency stability is defined by insignificant variance in the exchange rate against a major currency such as the US dollar in face of external shock. A currency that experiences loss in value when faced with prolonged crisis, such COVID-19 and the war in Ukraine, may reflect ineffective currency regime. Two indicators, were used namely currency valuation and inflation, to evaluate effective currency management. In this paper, currency valuation is defined as the exchange rate of the local currency traded against another currency (O'Sullivan and Sheffrin, 2003); in this paper target currency for exchange is the US Dollar. Inflation is defined as the rise of general price level with a corresponding decrease in the purchasing power (Walgenbach, Dittrich and Hanson, 1973)

The conceptual framework of this study is confined to the study of factors influencing exchange rate valuation and how does that valuation affected by external shock. The scope of this paper is confined to the assessment of how do exchange rate regimes in the ASEAN countries perform under external shock. These shocks include from COVID-19 and the on-going war in Ukraine. Secondary data was used in this study; the data consist of weekly spot exchange rates over a period of 10 years or 544 weeks from January 1, 2012 to June 30, 2022. The weekly spot exchange rate is dependent variable. Independent variables are foreign exchange reserves and current account balance. The currencies used in this study include: THAI (Thai Baht), LAK (Laotian Kip), VND (Vietnamese Dong); SGD (Singapore dollar), BND (Brunei Dollar), KHR (Cambodian Riel), MMK (Myanmar Kiat), MYR (Malaysian Ringgit), IDR (Indonesian Rupiah), PHP (Philipinnes Peso), EUR (Euro), CNY (Chinese Yuan), and RUB (Russian Ruble). The intended contribution to the literature by this study comes from the new knowledge gained through empirical evidence showing that external shocks caused by war and pandemic affects the value of currency in the ASEAN countries.

Literature Review

The literature review is presented in three parts. First, provides a background literature on exchange rate regime. Second, a review of the literature on currency valuation is presented. Third, presents literature on exchange rate regime performance under external shock.

Conceptual framework of exchange rate regime and currency valuation

Exchange rate regime

Exchange rate is the value of one country's currency in relation to another currency (O'Sullivan and Sheffrin, 2003). Exchange rate practice is dictated by exchange rate regime. Exchange rate regime as defined as the way in which the monetary authority in a country manages the exchange rate of its currency against other currencies (Duwendag et al., 1999). Each country determines its own exchange rate regime (Broz and Friedman, 2001). There are three types of exchange rate regime: (i) floating, (ii) intermediate, and (iii) fixed rate. Under floating exchange rate, the value of the local currency is allowed to fluctuate according to foreign currency market conditions. The financial sector of countries with free floating exchange rate regime is characterized by high liability dollarization, financial fragility, and strong balance sheet effects.

Firstly, under the free float regime, liabilities are denominated in foreign currencies while assets are listed in the local currency. Unexpected devaluation of the local currency deteriorates bank and corporate balance sheets and threatens the stability of the country's financial system. Due to such risk, free floating regime is not preferred in developing economies (Calvo and Reinhart, 2002). After 1990s, especially with the experience of the Asian financial crisis in 1997, many developing economies tried to avoid floating exchange rate regime (Levy-Yeyati and Sturzenegger, 2005).

Secondly, exchange rate regime that lies between the fixed and the floating is called intermediate exchange rate regime. Under this type of exchange rate regime, the local currency is pegged or allowed to move within a certain band or range against foreign currencies, i.e. 2% (Sukumar, 2017). Under this regime in order to minimize the risk of exchange rate fluctuations, countries may also use currency basket. A basket is a portfolio of currencies to which the local currency is pegged. Each foreign currency in the basket is weighted and regularly reviewed by the monetary authority when adjustment becomes necessary (Daniels, Toumanoff and von der Ruhr, 2001).

Lastly, the third type of exchange rate regime is a fixed exchange rate system. Under fixed exchange rate regime, a currency's value is fixed or pegged to the value of another currency, a basket of other currencies, or another measure of value, such as gold. In order to achieve a fixed exchange rate the government may either buying or selling its own currency in the open market (Ellie, 2012). In order to buy and sell foreign currencies in the open market, the government must maintain foreign currency reserves. If the exchange rate drifts too far above the fixed benchmark rate (it is stronger than required), the government sells its own currency. If the exchange rate drifts too far below the desired rate, the government buys its own currency in the market by selling its reserves.

Fixed exchange-rates are not permitted to fluctuate freely or respond to daily changes in demand and supply according to open market mechanism. The government announces its own rate and sets a band within which the exchange rate is allowed to fluctuate within a preset band (O'onnell, 1968). The advantages of fixed exchange rate are that it minimizes instabilities in real economic activity, and it allows the central bank to acquire credibility by fixing their country's currency to a more disciplined economy (Garber and Svensson, 1995). The disadvantage of fixed exchange rate is that it is prone to

speculative attack (Krugman, 1979). Speculative attack occurs when investors selling off the country's currency when these investors think that the exchange rate fixed by the government is not reasonable. The country's central bank must be ready to buy back its own currency at the fixed exchange rate, paying with its holdings of foreign exchange reserves.

Currency valuation

Factors that influence exchange rate include (i) price levels, (ii) balance of payments, (iii) interest rates and (iii) exchange rate risk. The *current account balance* explains the balance of trade of the country. A balance of trade can affect currency exchange rates. A country with a high demand for its goods tends to export more than it imports; this condition increases the demand for its currency. A country that imports more than it exports will have less demand for its currency. More demand for a country's currency means that the currency is strong and vice versa. A country with negative current account has a trade deficit. The currency of such country is weaker when it is traded against US dollar. For example among the ASEAN group, these countries have negative trade balance: Cambodia, Indonesia, Laos, Myanmar, and Philippines. Likewise, the currencies of these countries have been relatively weak against the US dollar in the 10 years period covered by this study.

Another factor that affects currency value is interest rate (Kim and Ratti, 2006). When a country raises its *interest rate*, it will cause capital inflow, thereby increasing the demand for domestic currency. This simple law of supply and demand is important for stakeholders in exchange rate management. Countries that want to export more would want to maintain low valuation of its currency against the US dollar so that it can sell its goods competitively abroad. However, countries that imports components for assembly and re-export would want its currency to be strong. Strong currency allows more components of components and more export of the finish products. This type of economy would prefer higher interest rate. There is a positive correlation between interest rate and the strong of the currency (Agenor, McDermont and Ucer, 1997). The use of interest rate, as a policy tool to influence exchange rate, works only when the economy is not in crisis. During the Asian financial crisis in 1997, this policy tool did not work as currencies in the ASEAN region lost their values against the US dollar (Basurto and Ghosh, 2001). The limitation of the influence of interest rate on exchange rate was also explored by Furman and Stiglits (1998).

Lastly, *exchange rate risk* also affects the rate of exchange among currencies. Exchange rate risk refers to the difference between the forward exchange rate and the future spot rate. Forward rate comes from investor's expectation of the future exchange rate about the future spot rate. If these two rates are the same, exchange rate risk would disappear. However, when the expected future spot rate does not agree with the forward rate, there is a risk premium. Under monetarist approach, exchange rate risk is negligible because the bond interest is a reflection of supply and demand of the money supply in the market. However, under portfolio balance models, exchange rate risk depends on supply and demand of money and bonds denominated in different currencies. Differences among these two sectors may lead to different pricing of exchange rate in the market.

In explaining these three factors influencing exchange rate, this paper begins with the spot rate. The spot rate determination may be written as:

$$\%\Delta S = (\%\Delta P_A - \%\Delta P_B) + \%\Delta SREAL^e + \Delta(r_B^e - r_A^e) - \%\Delta RISK^e \quad (1)$$

where S = the spot exchange rate in unit of currency A per unit of currency B; PA, P_B = price levels in country A and B; SREAL = expectation of real exchange rate for the long-run; r_B^e, r_A^e = nominal interest rate adjusted for inflation; and $RISK^e$ = premium that investors expected to earn bearing exchange risk.

The spot rate is influenced by investor's expectation; therefore, the spot rate is a function of the forward rate and the nominal interest rate in countries A and B. In this paper, the difference in forward rate and nominal rate among the ASEAN countries and that of the US determines the spot rate. The spot exchange rate is rewritten as:

$$S = \frac{F(1+R_B)}{(1-R_A)} \quad (2)$$

The risk factor is defined as the ratio between the expected future spot rate to the forward rate:

$$RISK^e = \frac{S^e}{F} \quad (3)$$

The real exchange rate is the nominal exchange rate adjusted for different price level:

$$SREAL = S\left(\frac{P_B}{P_A}\right) \tag{4}$$

Real long-run interest rate may be approximated by:

$$r_A = R_A - \hat{P}_A^e \tag{5}$$

$$r_B = R_B - \hat{P}_B^e \tag{6}$$

$\hat{P}_A^e, \hat{P}_B^e$ are percentage changes in the price level expected to occur in the long-run.

The weekly spot exchange rates for the ten currencies in ASEAN are time series data. Time series modeling is used for forecasting times series data (Chen and Chiu, 2021). Time series modeling was employed to find patterns of currency exchange rates movement in the ASEAN (Sakar, Spott, Blackwell et al., 2016). When modeling time series data, three types of models are available; these are autoregressive (AR) models, the integrated (I) models, and the moving average (MA) models (Gershenfeld, 1999). In this paper, we employed AR model. AR model is used to forecast the variable of interest using a linear combination of past values of the variable. In this paper, the variable of interest is the value of the local currencies in the ASEAN traded against the US dollar (exchange rate). Weekly spot rates are used as the observed variable. Under AR model, the current week's spot rate is predicted by the prior week's spot rate. The term autoregression indicates that it is a regression of the current exchange rate against the prior exchange rate.

Thus, AR modeling goes through AR(*p*) process where *p* refers to the number of prior period used for regressing or lag period. For example, the simplest AR process is AR(0), which has no dependence between the terms. Only the error, innovation, or noise term contributes to the output of the process. Whereas an AR(1) process with a positive phi (γ), only the previous term in the process and the noise term contributes to the output. For an AR(2) process, the previous two terms and the noise term contribute to the output. In this study, we employed AR(1). We selected a lag of one period because we want to look for fluctuation. If the exchange rate time series data is not stationary at one lag period, it means that there is new mean for the series or equivalently, we assert that the exchange rate has fluctuated. Significant fluctuation is evidence of poor exchange rate regime performance.

The AR(1) model is given by the following notation:

$$X_t = c + \varphi X_{t-1} + \varepsilon_t \tag{7}$$

where ε_t is the process white noise with zero mean and constant variance of σ_ε^2. The process is stationary is $|\varphi|$ < 1 ; however, if $|\varphi|$ = 1 then the variance of X_t depends on time lag and the series is not wide sense stationary. If $|\varphi|$ < 1 then the mean $E(X_t)$ is identical for all *t* by definition of wide sense stationary. Assume that μ is the mean, then the expected value for the series $E(X_t)$ is given by:

$$E(X_t) = E(c) + \varphi E(X_{t-1}) + E(\varepsilon_t) \tag{8}$$

That the mean $\mu = c + \varphi\mu + 0$ therefore $\mu = \frac{c}{1-\varphi}$. Under this statement, if $c = 0$ then $\mu = 0$. The variance is:

$$\text{var}(X_t)) = EX_t^2 - \mu^2 = \frac{\sigma_\varepsilon^2}{1-\varphi^2} \tag{9}$$

where σ_ε is the standard deviation of the noise ε_t which can be shown by $\text{var}(X_t) = \varphi^2 \text{var}(X_{t-1}) + \sigma_\varepsilon^2$. The autocovariance is given by:

$$B_n = E(X_{t+1} \mid X_t) - \mu^2 = \frac{\sigma_\varepsilon^2}{1-\varphi^2}\varphi^{|n|} \tag{10}$$

AR(1) is discrete time series with parameter θ which cab also be written as:

$$X_{t+1} = X_t + (1+\theta)(\mu - X_t) + \varepsilon_{t+1} \tag{11}$$

where $|\theta| < 1$ and μ is the model mean, by putting it in the form $X_{t+1} = c + \phi X_t + \varepsilon_{t+1}$ we can write that the expected value for the next period is:

$$E(X_{t+1} \mid X_t) = \mu[1-\theta] \tag{12}$$

with variance of $\text{var}(X_{t+1} \mid X_t) = \sigma^2\left(\frac{1-\theta^{2n}}{1-\theta^2}\right)$. We can now write the general; form for AR(p) as:

$$X_t = \sum_{i=1}^{p} \varphi_i X_{t-i} + \varepsilon_t \tag{13}$$

The parameter φ_i where i = 1, 2, ..., p the value for φ can be determined by using the Yule-Walker equation:

$$\gamma = \sum_{i=1}^{p} \varphi_k \gamma_{m-k} + \sigma_\varepsilon^2 \sigma_{m,0} \qquad (14)$$

where $m = 0$, ..., p giving p + 1, the parameter γ_m is the autocovariance function of is X_t, σ_ε the standard deviation of the input noise. The input in this case is the weekly exchange rate; the noise is the fluctuation of the exchange rate. If $m > 0$ then matrix form is given by:

$$\begin{bmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \\ \vdots \\ \gamma_p \end{bmatrix} = \begin{bmatrix} \gamma_0 & \gamma_{-1} & \gamma_{-2} & \cdots \\ \gamma_1 & \gamma_0 & \gamma_{-1} & \cdots \\ \gamma_2 & \gamma_1 & \gamma_0 & \cdots \\ \vdots & \vdots & \vdots & \\ \gamma_{p-1} & \gamma_{p-2} & \gamma_{p-3} & \end{bmatrix} \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \\ \vdots \\ \gamma_p \end{bmatrix}$$

Solve for all $\{\varphi_m; m = 1,2,...,p\}$ where $m = 0$ we have: $\gamma_0 \sum_{i=1}^{p} \varphi_k \gamma_k + \sigma_\varepsilon^2$.

In an alternative expression, we can summarize the autoregressive model order p is a simplified version as:

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_p y_{t-p} + \varepsilon_t \qquad (15)$$

where ε_t is white noise. The model is structured is ia form of multiple regression using the lag values of y_t as predictors. Thus, it is called AR(p) model or autoregressive model of order p. As general rules of interpretation, for AR(1) model when $\phi_1 = 0$, y_t is equal to white noise; when $\phi_1 = 1$ and $c \neq 0$, y_t is equal to a random walk; when $\phi_1 = 1$ and $c \neq 0$, y_t, is equal to random walk with drift; and when $\phi_1 = 0$, y_t tends to oscillate around the mean. This paper looks at the exchange rate stability under autoregressive model. Therefore, the model is restricted to stationary data. The constraints on the values of the parameters are required as follows: (i) for AR(1) model: $-1 < \phi_1 < 1$, and (ii) for AR(2) model: $-1 < \phi_2 < 1, \phi_1 + \phi_2 < 1, \phi_2 - \phi_1 < 1$. For the purpose of testing for exchange rate stability, as a means to evaluate the effectiveness of exchange rate performance, we limit the lag to no more than 2 lag periods.

In this study, we employed AR(1) model because the exchange rate for most of the ASEAN currencies are stationary at $p = 1$. As for Laotian kip (LAK) and Vietnamese Dong (VND), we did not seek to test for integration because the loss in value of these two currencies had been steady. The continued weakening of these two currencies are outside of manageable ban under the current exchange rate regime, i.e. allowable fluctuation within a fixed band.

External shock and exchange rate regime performance

In this paper, we defined external shocks as COVID-19 pandemic and the on-going war in Ukraine. These shocks affect exchange rate in the ASEAN economies. We are using these shocks as independent variables to evaluate the performance of exchange rate regime in the ASEAN countries.

Prior research shows that "adverse pandemic news at the country level cause an immediate, statistically significant, depreciation of the domestic currency vis-à-vis a basket of trade-weighted currencies" (Aquilante, Di Pace, and Masolo, 2022). Fluctuations in the exchange rates can be attributed several economic variables; these variables include relative productivity levels, price levels, interest rates, preferences for local or foreign goods, and trade barriers (Musa, 1984). The impact of COVID-19 on exchange rate was studied by Jamal and Bhat (2022) who examine the effect of COVID-19 on exchange rate in 6 hot spots. Jamal and Bhat argued that "the impact of the COVID-19 on currency markets worked its way through the channel of changing relative expectations of future economic growth" (Id., p 3). A country with high incidence of COVID-19 cases will have growth expectation downgraded. As the result, the demand for the local currency is reduced. The weakening of the local currency due to the country's report of COVID-19 death rates also had been found other researchers (Czech et al., 2020; Dineiri and Cutcu, 2020; Tao. Diao and Cheng, 2021). We will extend the study of this relationship in the study of the effect of COVID-19 on currencies in the ASEAN countries. Unlike prior literature which proved the relationship between COVID-19 and the weakening of the currency, this paper assess how well does the exchange rate regime perform under external shock (COVID-19 pandemic).

A second shock factor that we will examine is the effect of the on-going war in Ukraine and its affect on exchange rate regime performance in the ASEAN countries. The war in Ukraine started in February 2022, by May 2022 a study by Lim et al. (2022) warned that this war will bring negative impact on business throughout the world. The negative impact will come from "limited access to funds, reduced purchasing power, an increasing inflation rate, and a threat to sustainable growth and restrictions on trade as a result of sanctions" (Prohorovs, 2022). The war in Ukraine contributed to sharp rise of the cost for food and fuel throughout the world. This rise in food and fuel cost further contributed to global inflation in 2022. In response to inflation, the US increased its interest rate. As the result, many currencies among the ASEAN countries lost their value as seen through exchange rates of ASEAN currencies against the US dollar. The effect of war in Ukraine is a second shock we claim contributed to the weakening of many currencies in the ASEAN countries.

Data and Methodology

The sample size for this study consists of 544 weeks of average spot exchange rate of each country's currency traded against the US dollar from January 1, 2012 to June 5, 2022. Sample size requirement for time series modeling varies. For example, Poole et al. suggested "... 40 observations is often mentioned as the minimum number of observations for a time-series analysis" (Poole et al., 2002, p. 56). Another source of literature stated that "... many models require at least 50 observations for accurate estimation (McCleary et al., 1980, p. 20; Jebb et al., 2015, p. 3), "Most time-series experts suggest that the use of time-series analysis requires at least 50 observations in the time series." (Warner, 1998, pp. 2-3). In this study, the sample size consists of 544 data points of weekly sport exchange rate for ten currencies of the ASEAN countries. The exchange rate data was obtained from a financial portal at www.investing.com. We employed methodologies in three areas. Firstly, the data used in this study is times series because it is the average weekly spot rate between January 1, 2012 to June 5, 2022; a period of 10 years with a sample size of 544 weeks. Myanmar's exchange rate between January 1, 2022 and March 25, 2022 was pegged against the Special Drawing Right (SDR) at 6.435 per USD. This period of SDR pegging was removed from out analysis. For MMK, the period between April 1, 2012 to May 29, 2022 was used; a total of 516 weeks.

From the sample of 544 weeks, we separated extreme fluctuation in exchange rate and analyzed the data under Extreme Value Theory (EVT). By using the tail index under EVT, we classified the exceedance set of data into their respective distribution types according to the tail index. Lastly, to study the weakening of currencies, we used Weibull distribution to explain the incidence under the pretext that over-valuation or under-valuation is not normal.

Data characteristics of weekly spot rates of ASEAN currencies

We began with the examination of the characteristics of the ten currencies in ASEAN plus three target currencies, namely CNY (Chinese Renminbi or Yuan), EUR (Euro), and RUB (Russian Ruble). The Chinese Yuan was selected for comparison because China is a large economy and plays a significant role in the global market. The Euro is a common currency representing a large EU market which is relevant to all ASEAN countries as a trading partner. Lastly, the Russian Ruble was selected as a comparative currency because of Russia's role, influence, and size in the global market.

Table 2: Selected currencies by weekly spot rates traded against US dollar

	Mean	STD	μ	σ	Skewness	Kurtosis
THAI	32.48	1.70	32.36	1.69	0.42	(0.61)
LAK	8,575.53	906.35	8,511.80	900.86	2.63	8.25
VND	22,278.80	895.21	22,215.85	889.78	(0.46)	(1.38)
SGD	1.34	0.06	1.34	0.06	(0.43)	(0.82)
BND	1.34	0.06	1.34	0.06	(0.43)	(0.81)
KHR	4,048.63	35.65	4,046.12	35.43	(0.41)	(0.20)
MMK	1,272.37	269.86	1,252.89	268.22	0.15	(0.67)
MYR	3.85	0.47	3.82	0.47	(0.67)	(1.17)
IDR	12,956.42	1,725.01	12,835.13	1,714.56	(1.02)	(0.11)
PHP	47.75	3.73	47.49	3.71	(0.27)	(1.18)
EUR	0.85	0.06	0.85	0.06	(0.44)	(9.97)
CNY	6.52	0.30	6.50	0.30	0.38	(1.07)
RUB	57.12	16.43	55.96	16.33	(0.40)	(0.68)

We used the law of large number and statistical stability as tools to verify the stability of exchange rate. Stability of exchange rate is defined by statistically insignificant fluctuation of the currency's exchange value against the US dollar. The stability of the exchange rate reflects the effectiveness of exchange rate regime. In the ASEAN, with the exception of Philippines which uses free float system; the remaining nine countries employ one form or another of managed float regime. We assert that if the exchange rate management is effective, the exchange rate fluctuation should produce minimal variance. We define minimal fluctuation by using the Z score at 95% confidence interval as the indicator (Kreyszig, 1979). Under this standard of evaluation, we allowed the fluctuation a band of $\pm$ 5%.

Under the law of large numbers, the outcome of repeated experiments is equal to the expected value. The expected value is the mean or average (Dekking, 2005). In illustrating the law of large numbers, Monte Carlo simulation is commonly used (Kroese, Breton, Taimre et al., 2014). The strong law of large numbers (also called Kolmogorov's law) states that the sample average converges almost surely to the expected value (Loève, 1977) and the weak law of large numbers (also called Khinchin's law) states that the sample average converges in probability towards the expected value. Another characteristic of the law of large number is statistical stability whereby the outcome of repeated events obeys the law of average. In case of instability, the sample average is not stabilized, even for long averaging intervals (Gorban, 2014). The instability may be caused by progressive error or drift, and noise (Zhigalskiy, 2003). Among the ASEAN currencies, we found that following fluctuations: Laotian Kip (σ = 11%), Malaysian Ringit (σ = 12%), and Indonesia Rupiah (σ = 13%). These currencies showed expected standard deviation of more than 10%. This large sigma value indicates significant fluctuation of the exchange rates. While the three currencies that we used as a reference group (Chinese Yuan, Euro, and Russian Ruble), only the Ruble showed significant fluctuation (σ = 29%).

Weibull analysis and extreme value theory (EVT)

Secondary data of weekly average spot exchange rates spanning from January 1, 2012 to June 5, 2022 were used in this research. The sample is comprised of 544 weeks of spot rates of selected currencies traded against the US dollar. This case studied employed 544 samples. The currencies selected for this study consist of the ASEAN currencies where

the Thai Baht (BHT) was used as a target currency for analysis. Additional currencies used include Chinese Yuan (CNY), Euro (EUR) and Russian Ruble (RUB). These three currencies were used as control variables because they play significant role in global trade. The Chinese Yuan, for example, has been fast becoming a currency of choice for foreign exchange reserves in many countries. The Euro has been used for international trade between countries and countries in the EU zone. Lastly, the Russian Ruble was selected as a control variable due to the current economic and political influence played by Russia, especially with the current economic and political sanctions imposed on Russia and that country's recent insistence of using RUB by its trading partners.

Generally, Weibull distribution is used for failure rate analysis. In this study, we examined exchange rate for two groups of currencies: ASEAN and proxy group which comprised of the Euro, Chinese Yuan and Russian Ruble. Prior research asserted that weak currency, unless it is intentionally devalued by policy tools to achieve certain policy goals, is seen as a possible mismanagement of exchange rate by the country's central bank (Kirshner, 2002). The goals of monetary policy are: (1) high employment, (2) economic growth, (3) price stability, (4) interest-rate stability, (5) stability of financial markets, and (6) stability in foreign exchange markets (Yeyati and Sturzenegger, 2010). Central banks in the ASEAN countries shared these monetary policy goals. With the rise of price level of food and fuel resulted from the twin shocks of COVID-19 pandemic and the war in Ukraine, the inability of the monetary authorities of central banks in the ASEAN indicates inadequacy of meeting central bank's policy goal. The weakening of some currencies in the ASEAN countries also indicated monetary goal short falls in achieving stability in foreign exchange market. The increase of interest rate by the US Reserve led to the appreciation of the US dollar against local currencies in the ASEAN countries. The weakening of the local currencies, for example, Laotian Kip (LAK) and Vietnamese Dong (VND), is indicative of central banks in those countries in fulfilling their monetary policy goals.

In our examination of 13 currencies over a period of 544 weeks, we found that currencies of Laos (LAK) and Vietnam (VND) had been weakened and exchange rates for these two currencies against US dollar had been unstable. In the case of Laos, the failure had been significant to the point that certain period of LAK's fluctuation had to be separated and treated with Extreme Value Theory (EVT). To the extent that we expect

to see the government to defend its own currency with effective intervention policies, Weibull distribution allows monetary authorities to put the weakening of the currency into context, i.e. by monitoring the value of beta (β), we can predict the weakening trend for the currency. Throughout this paper, failure in exchange rate regime as significant weakening of the local currency against US dollar. According to Kirshner (2002) the inability of the central bank to defend the value of its currency is seen as a weakness or failure of the monetary authority.

Analysis and Discussion

In the ASEAN countries, only Philippines employs free float exchange rate regime. The remaining nine other countries adopted managed float system where the local currency of each country is pegged to another currency. One unique pegging practice in ASEAN is practiced by Brunei. The Brunei dollar pegged its currency to the Singapore dollar. Singapore in turn employs managed float regime that pegs the Singapore dollar against the US dollar. For the past ten years, our examination of 544 weeks of sport rate shows that Brunei dollar and Singapore dollar had correlation coefficient of R = 1.00, a perfect positive correlation. For purposes of stabilizing its currency, Brunei benefited from the stability of the Singapore dollar. With a foreign currency reserve of 425.10 billion dollars, the Singapore dollar had shown remarkable stability for the past 10 years with variance of 0.0033 in its trade against the US dollar. Consequently, since the Brunei dollar is pegged against Singapore dollar, Brunei's currency also shows a mirror image of this unusually small variance (0.0033) in Brunei dollar trading against US dollar.

Traditionally, it has been argued in some literature that there are relationships between foreign exchange reserves, CPI and account balance. In this study, we tested these three factors for the ASEAN countries and found that there is a relationship between account balance and foreign exchange reserves. We defined account balance as a dependent variable (Y) and foreign exchange reserves as a dependent variable (X); we found that Y = -7.31 + 0.31X. The R square for this relationship is 0.65. Without exchange reserves, we expect to see -7.31 in account balance. The unit of measurement in billion US dollars; there is factor of 0.31 in unit change in foreign exchange reserves adjusted for the intercept of -7.31, see Table 1. There is no significant relationship between CPI and foreign exchange reserves, and between CPI and account balance.

System analysis under non-time series approach

We verified the trend of currency valuation as they were traded against US dollar. By using Weibull distribution as the verifier of trend of currency valuation, we designated the *beta* value as the trend indicator. If $\beta < 1$, the currency's trading against US dollar is likely to be weaken; if $\beta \approx 1$ the exchange rate for that currency is fairly stable. Finally, if $\beta < 1$ it means that the strength of the currency as it is traded against USD will tend to be weaken as time progresses. The summary of all selected currencies for the 544 weeks treated under Weibull analysis is presented in Table 3.

Table 3: Selected currencies treated under Weibull without extreme value separation

Currency*	a	b	Beta	Eta	CDF	PDF	R	H(t)
THAI	3.47	0.01	142.91	32.01	0.63	0.01	0.37	36.15
LAK	8.92	0.11	8.9	7,507.29	0.64	0.0001	0.36	0.003
VND	9.95	0.05	21.03	20,853.28	0.63	0.0001	0.37	0.004
SGD	0.27	0.02	51.23	1.31	0.63	6.15	0.37	111.03
BND	0.27	0.02	51.2	1.31	0.63	6.14	0.37	110.95
KHR	8.27	0.02	54.16	3,915.26	0.63	0.00	0.37	0.08
MMK	6.87	0.29	3.50	965.65	0.70	0.00	0.30	0.018
MYR	1.26	0.08	12.34	3.52	0.63	0.46	0.37	9.76
IDR	9.33	0.11	8.85	11,277.26	0.64	0.0001	0.36	0.002
PHP	3.8	0.06	17.1	44.61	0.63	0.05	0.37	1.146
EUR	-0.2	0.03	29.82	0.82	0.63	5.60	0.37	102.27
CNY	1.85	0.02	50.41	6.36	0.63	0.8995	0.37	26.036
RUB	3.75	0.24	4.18	42.64	0.66	0.01	0.34	0.25

Source: https://www.investing.com/currencies/usd-*.*-historical-data
Accessed: June 10, 2022.

All currencies were checked for extreme values, i.e. extremely weak or extremely strong. Extreme value defined by the "Peak Over Threshold" (POT) value (Leadbetter, 1991). In this paper, the threshold value for POT is 95% confidence interval obtained through the standard score equation. The standard score equation under 0.95 confidence interval with a Z value of ± 1.65 was used as the demarcation point for POT. The proxy currency (THAI) had been stable. Although there were short periods of the baht being weak (Z > 1.65) and strong (Z <-1.65), these periods of aberration did not last long to be significant devaluation or appreciation. However, some currencies had experienced significant weakness. These periods of weakness among some currencies had caused serious problem in bringing about inflationary pressure and adversely affecting local economies. The summary of significant fluctuations of currencies is listed in Table 4.

Table 4: Significant appreciation and devaluation of currency traded against USD

	k < -1.65	k > 1.65	Period for k	ζ Tail Index*	Distribution Type
THAI	-	-	-	-	-
LAK	-	33	Jan - May '22	(1,628.30)	Weibull
VND	-	-	-	-	-
SGD	36	12**	Apr'12 - Oct'13	4.28	Frechet
BND	36	11	Apr'12 - Oct'13	4.29	Frechet
KHR	39	-	Jan'13 - Mar'14	(26.43)	Weibull
MMK	-	39	Fb'21 - Nov'21	(102.51)	Weibull
MYR	44	-	Jan'12 - May'13	3.28	Frechet
IDR	77	-	Jan'12 - Jul'13	(483.83)	Weibull
PHP	35	-	Sep'12 - May'13	0.12	Frechet
EUR	-	48	Sep'13 - Aug'14	4.48	Frechet
CNY	-	34	Aug'19 - May-20	2.69	Frechet
RUB	-	-	-	-	-

*: *Fréchet* = $\zeta > 0$, *Weibull* = $\zeta < 0$ *and Gumbel* = $\zeta = 0$. **Disregard as insignificant for k < 30.

We found that extreme cases of weak currency has an exceedance level of $k > 1.65$ with the tail index $\zeta > 0$, and the data is Frechet distributed. In general, a strong currency was commonly seen as a mark of prestige, while devaluation was associated with weak governments (Kirshner, 2002). This is particularly true for countries with import dependence and has small export volume. However, for a country such as China who maintains a significant export market abroad, weak currency may be preferable because it makes Chinese products more competitive in the global market. Weak currency with tail index under EVT $\zeta < 0$, the data is Weibull distributed. Kirshner may be correct in asserting that weak currency among import dependence economies may mean weak government (Kirshner, 2002). Our data shows LAK (Laotian Kip), KHR (Cambodian Riel), MYR (Malaysian Ringgit), and IDN (Indonesian Rupiah) are Frechet distributed. In 2022, Laos has a positive balance of trade; however, in the past, it consistently had trade deficit. In 2022, Cambodia has a negative balance of trade; Indonesia and Malaysia have positive balance of trade. It is not conclusive whether balance of trade is a decisive factor for exchange rate stability.

Time series modeling

Autoregressive (AR) model is used for modeling the exchange rate for all currencies analyzed in this paper. We used the Akaike information criterion (AIC) and Bayesian information criterion (BIC) to evaluate the accuracy of the model. AIC is an estimator of prediction error; it evaluates the quality of statistical models for a given set of data (Stoica and Selen, 2014; McElreath, 2016; and Taddy, 2019). Among the available models, the preferred model is the one with the minimum AIC value (Akaike, 1974; and Burnham and Anderson, 2002). Both AIC and BIC were tools used for model quality evaluation. Similar to AIC, models with lower BIC are generally preferred (Schwarz, 1978). Table 5 provides model fitting and its evaluation.

Table 5: Model fit under autoregressive (AR) modeling

	Log L	Err Var	R^2	Rd^2	AIC	BIC	RMSE
THAI	(81.53)	0.06	0.9781	-0.0806	0.31	0.32	0.1507
LAK	(2,781.49)	2,386.18	0.9971	-0.0805	10.23	10.25	17.4551
VND	(3,026.83)	2,777.12	0.9965	-0.0806	11.14	11.15	33.0905
SGD	1,776.41	0.00	0.9749	0.0014	(6.51)	(6.46)	0.0003
BND	1,719.89	0.00	0.9730	-0.0806	(6.32)	(6.30)	0.0057
MMK	-2840.61	2763.58	0.9751	-0.7730	10.7382	10.78	20.5201
KHR	(2,384.34)	375.92	0.7047	-0.0806	8.77	8.79	11.4862
MYR	945.47	0.00	0.9933	-0.0806	(3.47)	(3.45)	0.0229
IDR	(3,588.54)	20,259.52	0.9932	-0.0806	13.20	13.22	87.5201
PHP	(228.54)	0.10	0.9930	-0.0806	0.85	0.86	0.1958
EUR	1,696.66	0.00	0.9752	-0.0806	(6.23)	(6.21)	0.0060
CNY	1,032.17	0.00	0.9883	-0.0806	(3.79)	(3.77)	0.0180
RUB	(1,292.81)	3.93	0.9855	-0.0806	4.76	4.78	1.3050

According to AIC standard practice for model selection, the lower the AIC number the less the probability of information loss produced by the model, i.e. the smaller the AIC number the better it is for the proposed model. Our result shows that, Thailand, Philippines, Singapore, Brunei and Malaysia show the lowest AIC index among the ASEAN currencies with AIC < 1. Among the comparative currencies (CYN, EU and RUB), CNY and EUR has AIC < 1. Low AIC means that the data conforms better to the proposed time series AR(1). As for currencies with higher AIC, AR(1) model may not be an appropriate tool for their modeling and the exchange rate data fluctuation may have greater instability.

Vector state of AR modeling described in Table 5 allows us to forecast the exchange rate of each currency against the US dollar and assess the stability of the exchange rate. The slope of the predictive value allows us to assess the stability of the exchange rate for the currency. Lower the slope coefficient means that the exchange rate for that currency is stable and is closely pegged to the US dollar. For instance, among 12 currencies, most are stable except the Laotian Kip (LAK). LAK shows the highest level of sensitivity. Even a point change in the US dollar will translate into a factor of 304.04 LAK units for loss in value against the US dollar.

Table 6 summarizes the rate of change of the local currency against one unit change of US dollar. As a tool for effective exchange rate management indicator, the slope in Table 6 allows stakeholders to assess risk of currency fluctuation. Positive slope means the local currency becomes weaker and negative slope means the local currency becomes stronger with every unit change in US dollar. The larger the value of the slope (β) means the greater the sensitivity of the local currency as it is traded against the US dollar.

Among the ASEAN countries, countries whose currencies are stable include: Thailand, Singapore, Brunei, Malaysia and Philippines. The slope of the AR(1) model of these countries are 0.03 for Thailand, 0.0002 for Singapore, (0.0005) for Brunei, 0.01 for Malaysia, and 0.10 for Philippines. As for the proxy currencies (EUR, CNY, and RUB), all showed slopes less than 1 which means the exchange rate is stable against the US dollar. Stability of exchange rate over time reflects the government's effective management of the country's exchange rate. This is an indicator of good performance of the exchange rate regime in that country. In Table 6, the countries that manifest large exchange rate fluctuation included Laos (β = 304.08), and Vietnam (β = 43.99). These two ASEAN countries are sensitive to the movement of US dollar.

Table 6: Vector state under AR modeling

	State vector components			Level		
	Level	Slope (β)	AR(1)	Std. Err.	T Stat	Prob
THAI	34.37	0.03	-7.38E-04	0.17	196.46	0.0000
LAK	13,765.93	304.08	4.97	33.94	405.54	0.0000
VND	23,207.35	43.99	0.769	36.62	633.73	0.0000
SGD	1.38	0.0002	8.36E-09	0.00	1,010.37	0.0000
BND	1.38	(0.0005)	-3.73E-05	0.01	210.92	0.0000
MMK	6.1214	2.51	0.6616	38.00	0.9450	0.3451
KHR	4,052.71	2.60	0.0686	13.47	300.80	0.0000
MYR	4.40	0.01	9.76E-05	0.03	165.33	0.0000
IDR	14,538.41	1.27	-0.1824	98.91	146.99	0.0000
PHP	52.63	0.10	8.39E-04	0.22	242.95	0.0000
EUR	0.94	(0.001)	-8.98E-05	0.01	135.51	0.0000
CNY	6.72	0.02	1.82E-04	0.02	297.70	0.0000
RUB	60.43	(2.17)	-0.0364	1.38	43.87	0.0000

Limitation of the current study

The findings and discussion of this paper are limited to the performance of exchange rate regime in the ASEAN countries during a period of external shocks from COVID-19 and the war in Ukraine. These shocks are externalities beyond the control of each country in the ASEAN. Future research in this area may extend the evaluation of exchange rate regime performance under shock from domestic policies. For example, the increase of money supplies among the ASEAN countries may be looked at as a potential cause for the loss in value of the local currency against the US dollar.

The poor performance of LAK in Laos and VND in Vietnam may be partly explained by the money supply of the countries. At the end of 1999, Laos' money supply was 203.224 million USD. By September 2021, this figure expanded to 12.882 billion USD. Similarly, throughout 2021, Vietnam had consistently increased its money supply. At the end of 2000, Vietnam's money supply was 13.573 billion USD. This amount was increased to 551.956 billion USD by January 2022. Both countries saw rapid increase in money supply in the same period. During the same period, both currencies also lost their values rapidly.

A rapid increase in money supply contributes to long-term inflation (Sysoyeva et al., 2021). Since there is a direct correlation between money supply and inflation, monetary policy is a tool for controlling inflation (Friedman, 1987). Money supply may be created from two sources: fractional banking by commercial banks, and open market operations by the central bank. In rational banking, banks accept deposits from the public and hold a proportion of these deposits liabilities in liquid assets as a reserves, and lend the remainder to borrowers (Abel and Bernanke, 2005. The fraction that the bank is required to hold is called reserves requirement. Since the reserves is only a fraction of total deposits, commercial banks would have to turn to the central bank for coverage if the demand for withdraw exceeds it reserves level (Mankiw, 2022). In developed economies, the central bank uses interest rate as a tool to control money supply. High interest rate results in contractionary money supply and has the effect of curtailing inflation. Low interest rate leads to increase money supply in the market and contributes to inflation. The issues are potential areas for further research under the topic of performance evaluation of exchange rate regime.

Conclusion

The ASEAN has ten countries and each country has its own currency. With ten different currencies in use, there is no common policy in the ASEAN Economic Community. Despite this diversity, two countries maintain perfectly correlated exchange rates. Brunei pegged its currency to the Singapore dollar. The correlation between exchange rate movement between SGD and BRD is +1.00. The remaining eight countries in the ASEAN adopted manage float exchange rate regime; however, since each country follows its own monetary policy, the exchange rate for each country in the past 10 years also followed different paths as they are traded against US dollar.

From the proxy group of currency against ASEAN currencies, we learned that the Euro and Chinese Yuan are the most stable and could be used as possible components of basket of currencies for the purpose of pegging local currencies in the ASEAN, especially in Laos and Vietnam whose currencies experienced significant weakening. We also learned that with R square of 0.65 between foreign reserves and account balance, policy makers in Laos and Vietnam could best pursue policy in increasing their foreign reserves.

It should be noted that an increase in foreign reserves has a tendency to devalue the local currency; however, with the experience of Singapore showing the highest foreign reserves and has one of the most stable currency in the region, high foreign reserves accompanied by good monetary policy can effectively stabilize the local currency. These countries need to explore possible means to increase foreign reserves that do not involve exchanging the local currency for US dollars.

As for pegging under managed float regime, EUR and CNY are strong candidates for foreign reserves. Due to the close trade ties between ASEAN and China, stakeholders in the ASEAN countries may seriously explore the inclusion of CNY into their foreign reserves. As shown through 544 weeks of data of the spot rates in this study, CNY had stable expected value of 6.50 ± 0.30 as it was traded against USD. This strength and stability of CNY was further supported by the AR(1) model where the slope was only 0.02 which means that if the ASEAN currencies are pegged to CNY, there is less prone to fluctuations.

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