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# Exchange Rate Volatility, Inflation, and Economic Growth: Case Study of Thailand

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## Abstract

This paper investigate the impact of exchange rate volatility on Thailand inflation and economic growth. An empirical investigation based on a sample of Thailand over the period of first quarter 1993 to fourth quarter 2022 is conducted using the ARDL model. Results of the ARDL model (Bound test) show the existence of long-run relationship between exchange rate volatility, inflation , and economic growth of Thai economy. The findings suggest that nominal exchange rate volatility, as measured by generalized autoregressive conditional heteroskedasticity, negatively impacts economic growth. Moreover, the results indicate a positive relationship between economic growth and inflation.

**Keywords:** Exchange Rate Volatility, Economic Growth, ARDL, Thailand

## 1. Introduction

Since the 1997 financial crisis, Thailand switched to a managed floating exchange rate regime, allowing the exchange rate to fluctuate according to the market mechanism under the supervision of the Bank of Thailand. The exchange rate is the price for international transactions, so changes in the exchange rate have an impact on the costs of international transactions, leading to an impact on both microeconomics and macroeconomics. From a macroeconomics perspective, a depreciation of a domestic currency makes a country's imports more expensive and its exports become more competitive, thus enhancing the net export volume. This, in turn, has a positive effect on economic growth due to the expansion of aggregate demand. Conversely, the opposite is true when the currency appreciates. The

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management of the exchange rate is considered to be a policy for bank of Thailand to achieve economic stability and economic growth. Fluctuations in exchange rates are often referred to as exchange rate risk, which is an issue of concern not only for policymakers but also for academics. The risk or uncertainty associated with the unpredictable changes in exchange rates over time is typically referred to as exchange rate volatility.

Exchange rate volatility may be associated with macroeconomic instability through its impact on international trade and investment, which, in turn, affects economic growth. In economics, exchange rates are a variable that influences the rate of economic growth, as supported by empirical studies. Nonetheless, prior studies focused on the implications of exchange rate volatility for economic growth have yielded mixed findings. These discrepancies can be attributed to two primary factors. First, the choice of exchange rate regime by the countries under study (Jha, 2003; Barguellil, et al., 2013; Furceri & Zdzienicka, 2011). Second, the inclusion of various control variables within the analytical model, such as financial development (Aghion et al., 2009; Ndambendia & AlHayky, 2011), and the consideration of the effects of exchange rate volatility on trade flows (McKenzie, 1999; Karameros et al., 2015), among other relevant determinants, plays a pivotal role in elucidating the complex and multifaceted relationship between exchange rate volatility and economic growth.

The objective of this study is to investigate the relationship between Baht/USD exchange rate volatility, inflation, and economic growth. The paper is organized as follows: Section I is the introduction and Section II provides a review of the existing literatures that investigate the relationship between exchange rate volatility and economic growth. In Section III, we present the model specification and the method to calculate exchange rate volatility, based on the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model. In Section IV, we provide a detailed description of the data used and the empirical methodology employed. Section V presents the findings of our empirical analysis. Finally, in Section VI, we present the conclusions.

## 2. Literature review

This part reviews the relationship between exchange rate volatility and economic growth across different regions and time periods. The review encompasses studies conducted between 1995 and 2022, exploring various methodologies and datasets.

Bosworth et al. (1995) studied the determinants of economic growth, including exchange rate volatility, in 88 developed and industrial countries during the period from 1960 to 1992. They concluded that exchange rate volatility negatively affects output growth by slowing factor

productivity growth. Schnabl (2009) investigated the relationship between exchange rate volatility and economic growth in emerging European and East Asian countries. The results show that there is negative impacts of exchange rate volatility on economic growth in these countries. Vieira et al. (2013) showed the negative effect of exchange rate volatility on economic growth in 82 advanced and emerging economies. Katusiime et al. (2015) concluded that the exchange rate volatility has positive effects on economic growth in Uganda in both short- and long-run. Achouak, Ousama, and Mourad (2018) conducted an empirical investigation based on a sample of 45 developing and emerging countries over the period from 1985 to 2015, utilizing difference and system generalized method of moment estimators (GMM). Their findings suggested that the measure of nominal and real exchange rate volatility based on generalized autoregressive conditional heteroskedasticity has a negative impact on economic growth. Lean and Ehigiamusoe (2019) investigated the relationship between volatility in the exchange rate and the finance-growth nexus in West African countries for the 1980–2014 period and showed that financial deepening exhibits long-term positive effects on the GDP within the region, even though this effect is weakened by exchange rate variation. Morina et al. (2020) used annual data for fourteen CEE countries for the period 2002–2018 to examine the nature and extent of the impact of exchange rate volatility on growth. They concluded that the volatility of the exchange rate has a significant negative effect on real economic growth in these fourteen CEE countries. Olamide, Ogujiuba, and Maredza (2022) examined the influence of exchange rate instability on the inflation–growth nexus in the Southern African Development Community (SADC) region for the period from 2000 to 2018. The finding of the study revealed a negative relationship between exchange rate instability, inflation, and economic growth in the region.

Previous research on the relationship between exchange rate volatility and economic growth has also found evidence supporting a positive impact of exchange rate volatility on growth. For instance, Ali (2022) examined the link between exchange rate volatility, financial stability, foreign debt, and economic growth in several South Asian nations from 1985 to 2020. His findings showed that foreign debt has a negative and insignificant influence on the level of growth, whereas exchange rate volatility has a positive and significant relationship with economic growth.

## 3. Model Specification

Our studies have empirically examined the relationship between exchange rate volatility and the key determinants of economic growth, namely, oil price, and inflation. Following Olamide, Ogujiuba, and Maredza (2022), we specified the model as following:

$$lrgdp_t = \alpha_0 + \alpha_1 exvol_t + \alpha_2 inf_t + \alpha_3 oil_t + \mu_t \qquad (1)$$

where $lrgdp$ represents economic growth, $inf$ is inflation rate calculated from consumer price index, $exvol$ is nominal exchange rate volatility measured by GARCH(1,1) and $\mu$ is the error term . Additionally, we use oil price $oil$ as a control variable in the study. To examine the relationship of dependent and independents variables the Autoregressive Distributed Lag Model (ARDL), developed by Pesaran et al.,2001), is employed as detailed later.

### 3.1 Exchange Rate Volatility

In this section, we present the methodology for the exchange rate volatility estimation of the GARCH (1,1) model. Bollerslev (1986) proposed an extension to the ARCH model called the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model. He developed the ARCH model by incorporating an additional term that accounts for the previous variances of the time series. Therefore, the formula for the GARCH (p, q) model, which includes p lags of the conditional variance in the linear ARCH(q), is as follows:

$$ex_t = \beta_0 + \sum_{i=1}^{p} \beta_i ex_{t-i} + \varepsilon_t \qquad (2)$$

$$\sigma_t^2 = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \mu_{0i} \sigma_{t-i}^2 \qquad (3)$$

where $ex_t$ and $\sigma_t^2$ denote the nominal exchange rate and the conditional variance, respectively. The construction of the quarterly exchange rate volatility using the GARCH (1, 1) model is based on the estimation of equations (2). According to equation (3), $\sigma_t^2$ represents the one period ahead forecast for exchange rate variance as a result of past information (volatility), the GARCH term (previous volatility) is $\sigma_{t-i}^2$ and $\varepsilon_{t-i}^2$ remains the previous information concerning the ARCH term volatility, and hence, the eq. (3) is referred to as a conditional variance equation. The GARCH (1, 1) of the above equation is employed in

generating the quarterly data of exchange rate volatility. The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models family has been utilized in numerous studies to gauge exchange rate volatility (Alper, 2017; Baguellil et al., 2018; Lean & Ehigiamusoe, 2019).

## 4. Data and Methodology

This study uses data of Thailand from first quarter of 2000 to fourth of 2022. Economic growth was proxied by GDP in constant 2010 USD (in natural log form and seasonal adjustment). The measurement of exchange is the official nominal exchange rate in the local currency unit per USD and inflation rate is proxied by changing in the quarterly consumer price index. The data for economic growth, exchange rate and the inflation were all sourced from the NESDB and BOT. Oil price was measured by US closing price of the West Texas Intermediate (WTI).

The method we employed in the study is known as ARDL model and initially proposed by Pesaran et al. (2001). This methodology follows ordinary least square estimation procedure but it can incorporate I(0) and I(1) variables in same estimation and can generate the short-run and long-run coefficient simultaneously. The ARDL has advantages and usefulness due to its incorporation of multiple integrated variables. Whether the variables are integrated of order zero, denoted by I(0), integrated of order one, denoted by I(1), or mutually cointegrated. Based on the model in section 2, we can express the model in ARDL form as follows;

$$lrgdp_t = \gamma_0 + \sum_{i=0}^{p} \delta_i \, lrgdp_{t-i} + \sum_{i=0}^{q} \beta_i' X_{t-i} + \mu_t \qquad (4)$$

where $X_t = (exvol_t, inf_t, oil_t)$ and $i$ = 1, 2, 3 … p or q represents the time lags expressed in quarters. As mention earlier, for the benefit of ARDL technique, all variables are allowed to be purely I(0), purely I(1), or cointegrated. We can further re-write equation (4) in re-parameterized form as follows:

$$\Delta lrgdp_t = \lambda - \theta(lrgdp_{t-1} - \varphi X_t) + \sum_{i=1}^{p} \beta_i \Delta lrgdp_{t-i} + \sum_{i=0}^{q} \psi_i' \Delta X_{t-i} + \mu_t \qquad (5)$$

In this study, we determine the optimal lags of variables using the Akaike information criterion (AIC). The variable of interest in this study is the nominal exchange rate volatility,

as previously mentioned. It is measured by the conditional variance of exchange rates obtained through fitting the GARCH (1, 1) model.

## 5. Results

This section is divided into three parts. Firstly, it presents the descriptive statistics of all variables that have been included in the study. Secondly, it conducts the unit root test, which serves the purpose of clarifying the stationarity of the variables before employing ARDL estimation. Finally, it reports the empirical results of the study.

### 5.1 Descriptive Statistics

Table 1 presents the descriptive statistics of the variables used in the study. These statistics include number of observations, mean, standard deviation, and minimum and maximum values. As seen from Table1, the maximum and minimum values of the exchange rates (*ex*) are 45.35 and 29.802, respectively, with a standard deviation of 4.324. The maximum and minimum values of the inflation rate (*inf*) are 4.233 and -3.446, respectively, while the maximum and minimum values for oil price (*oil*) are 121.477 and 19.409 USD/barrels, respectively. Regarding for the variable of interest, the exchange rate volatility (*inf_exvol*) ranges from a minimum of 0.689 to a maximum of 1.169.

*Table 1 Descriptive Statistics*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| *ex* | 92 | 35.264 | 4.324 | 29.802 | 45.350 |
| *inf* | 92 | .517 | .962 | -3.446 | 4.233 |
| *oil* | 92 | 65.476 | 29.412 | 19.409 | 121.477 |
| *rgdp* | 92 | 92341.308 | 19665.201 | 57792.488 | 121427.58 |
| *lrgdp* | 92 | 11.409 | .225 | 10.965 | 11.707 |
| *exvol* | 92 | .841 | .121 | .689 | 1.169 |
| *inf exvol* | 92 | .448 | .846 | -3.168 | 3.916 |

Source : Author's calculation

### 5.2 Unit Root Test

Prior to conducting ARDL estimation, it is crucial to verify the stationarity of all variables included in the study. To determine whether or not the variables used in the study exhibit stationary, we employed the Augmented Dickey-Fuller (ADF) test. The data can only be used for investigating the relationship using the ARDL methodology if it is stationary at either the I(0) or I(1) level, and not at the I(2) level.

Table 2 presents the results of testing stationary of variables at the level and at 1st difference. At level testing, the mixed results show a combination of accepting and rejecting the null hypothesis of non-stationarity as indicated by the p-values, suggesting that some variables are I(0) while others are not.

We also perform stationary test of variables at 1st difference and the results show that we can reject the null hypothesis of unit root (non-stationary) for all variables. Then we can conclude that the series are integrated of order one or I(1).

*Table 2 Unit Root Test*

| | AT Level | | | At 1st difference | | | summary |
|---|---|---|---|---|---|---|---|
| | obs | t-stat | p-value | obs | t-stat | p-value | |
| *ex* | 90 | -1.774 | 0.717 | 89 | -6.789 *** | 0.000 | I(1) |
| *inf* | 90 | -7.143*** | 0.000 | 89 | -11.113*** | 0.000 | I(1) |
| *oil* | 90 | -2.623 | 0.270 | 89 | -7.118*** | 0.000 | I(1) |
| *rgdp_sa* | 90 | -1.765 | 0.721 | 89 | -7.084*** | 0.000 | I(1) |
| *lrgdp_sa* | 90 | -1.206 | 0.909 | 89 | -7.183*** | 0.000 | I(1) |
| *exvol* | 90 | -2.559 | 0.299 | 89 | -5.895*** | 0.000 | I(1) |
| *inf_exvol* | 90 | -7.487*** | 0.000 | 89 | -11.324*** | 0.000 | I(1) |

Note: *** is denoted for the rejection of null hypothesis of unit root at 1% significant level

Source: Author's calculation

### 5.3 Estimated Results

The results are divided into two parts. The first part involves checking whether there is a long-run relationship among all variables using the Bound test for cointegration. The second part illustrates the relationship between all independent variables and economic growth.

For the results of long-run cointegration, the estimated value of the F-statistic (Bound test for cointegration) is 6.103. According to the F-critical values criteria as reported by Pesaran et al. (2001) for 5 independent variables, as shown in Table 3, the null hypothesis of no long-run relationship is rejected when the calculated F value is greater than the upper critical bound

I(1), and it is accepted when it is lower than the lower critical bound I(0). However, the cointegration test is inconclusive if the computed F-statistic value falls between the upper and lower critical bounds. Since our calculated F-value (6.103) exceeds the upper critical bound at a 1% significance level, we reject the null hypothesis of no cointegration. Therefore, the Bounds test confirms the existence of a long-run relationship among all variables.

*Table 3 Critical value for Bound test*

| | I(0) | I(1) | I(0) | I(1) | I(0) | I(1) | I(0) | I(1) |
|---|---|---|---|---|---|---|---|---|
| | 10% | | 5% | | 2.50% | | 1% | |
| k_5 | 2.260 | 3.350 | 2.620 | 3.790 | 2.960 | 4.180 | 3.410 | 4.680 |

Note k=5 is number of independent variables in the estimation

Source : Author's calculation

The estimation results are presented in Table 4. Concerning the relationship between exchange rate volatility and economic growth, the findings reveal a statistically significant adverse influence of exchange rate volatility on economic growth at 1% confidence level with a coefficient of -1.489. One plausible explanation for this observed relationship is that nations characterized by heightened exchange rate volatility may create an unpredictable environment for businesses and investors. Such conditions can increase the costs associated with international transactions, particularly those incurred for safeguarding against exchange rate risks. Consequently, businesses and investors may choose to delay their trade and investments, potentially resulting in a prolonged decrease in economic growth.

Additionally, the results indicate a statistically significant positive relationship between inflation and economic growth, with a confidence level of 5%. An increase 1% in inflation lead to increase in economic growth 0.79%. There are at least two reasons for support this positive relationship. Firstly, the inflation may incentive investment and economic activity in the short run by increasing expected profits. Firms may invest more in production. This increase in investment can lead to higher economic growth. Secondly, the inflation can also help reduce unemployment by lowering real wages causing an increase in employment. The increase in employment can also contribute to higher economic growth. However, the empirical results reveal a noteworthy insight regarding the interaction between exchange rate volatility and the inflation (*inf_exvol).* This interaction term exhibits a statistically significant negative impact on economic growth at the 0.05 significance level. To be specific, an increase in *inf_exvol* is associated with a substantial decrease in economic growth, as indicated by the coefficient of -0.762. While the study is observed phenomenon that the inflation can stimulate economic growth, in situations characterized by a high level of

exchange rate volatility, the inflation appears to exert a counterproductive influence on economic growth. This phenomenon may be attributed to the higher risk environment faced by firms and investors in such circumstances, which, in turn, induces delays in investment decision-making processes, thereby resulting in a long-term reduction in economic growth.

The study also indicates a statistically significant negative relationship at a 20% significance level between oil prices and economic growth. This finding suggests that an increase in oil prices results in a reduction in economic growth. The rationale behind this result is that higher oil prices lead to increased production costs for firms operating in industries that heavily rely on oil, such as transportation and manufacturing. This, in turn, weakens economic growth.

For estimation, we add *dum* which cover periods of 2019q3 to 2021q4 to control the COVID19 situation. The COVID-19 pandemic has a negative effect on economic growth, with a statistically significant level of 20%.

Finally, as shown from the table the negative speed-of-adjustment coefficient is reported as -0.071. It measures how strongly the economic growth reacts to a deviation from the equilibrium relationship in one period or, in other words, how quickly such an equilibrium distortion is corrected.

*Table 4 Estimated Results*

| | Coef. | Std.Err. | t | P>t | sig |
|---|---|---|---|---|---|
| L.lrgdp (ADJ) | -0.071 | 0.026 | -2.690 | 0.009 | **** |
| Long Run | | | | | |
| exvol | -1.489 | 0.281 | -5.310 | 0.000 | **** |
| inf | 0.790 | 0.373 | 2.120 | 0.037 | *** |
| oil | -0.002 | 0.002 | -1.360 | 0.179 | * |
| inf_exvol | -0.762 | 0.384 | -1.980 | 0.051 | ** |
| dum | -0.189 | 0.139 | -1.350 | 0.179 | * |
| Short Run | | | | | |
| LD.lrgdp | -0.234 | 0.092 | -2.540 | 0.013 | *** |
| cons | 0.910 | 0.332 | 2.740 | 0.008 | **** |

Note ****,***,**,* are denoted for the rejection of the null hypothesis of coefficient is equal to 0 at the significant level at 1%, 5%, 10% and 20% respectively.

Source : Author's calculation

## 6. Conclusion

This study aimed to investigate the impact of exchange rate volatility on Thailand's economic growth, utilizing quarterly data from 2000-Q1 to 2022-Q4. The analytical framework employed the ARDL estimation method to explore the relationship between exchange rate volatility, inflation, and economic growth. Exchange rate volatilities were quantified using the GARCH (1,1) model. The findings of the study suggest that exchange rate volatility has a negative impact on Thailand's economic growth. Furthermore, our analysis reveals a positive relationship between inflation and economic growth, in contrast to a negative relationship observed between oil price and economic growth. Future research may investigate into the mechanisms through which exchange rate volatility impacts trade variables, facilitating a more comprehensive understanding of the factors influencing economic growth.

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