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# EFFECT OF THE BITCOIN ON THE EXCHANGE RATE OF SRI LANKA: ARDL APPROACH

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**ABSTRACT**

This article examines the effect of the bitcoin cryptocurrency on the exchange rate in Sri Lanka. It attempts to identify the long-run and short-run relationship between bitcoin and the exchange rate and find the macroeconomic factors which determine the exchange rate. This study uses the exchange rate as a dependent variable while bitcoin, consumer price index, broad money, and remittance are independent variables. Monthly time series data set was used from January 2015 to August 2021. Outputs are carried from E-Views10. The Autoregressive-Distributed Lag model has been used to analyze the objectives. All variables transformed to the natural logarithm. According to the ADF test, the natural logarithm of remittance is stationary at level (I(0)), and other variables are stationary at the first difference (I(1)). ARDL (2 3 2 3 2) is the best lag model. The estimation findings expose that bitcoin price volatility has a long-run and short-run negative impact on the exchange rate. The consumer price index and broad money positively impact the exchange rate in the short run. The ECT (-1) coefficient is -0.265738, statistically significant at the 1% level. The estimated coefficient indicates that about 26% of this disequilibrium is corrected within 1 month. When price volatility rises, investors will move away from bitcoin investments to other ones. Due to the high level of risk associated with investing in virtual currency, people are more likely to invest in real money, which will increase the value of their local currency.

**Keywords:** Bitcoin, Cryptocurrency, Exchange Rate, ARDL, Sri Lanka

## 1. Introduction

A cryptocurrency is a form of digital currency that operates as a medium of exchange through a computer network and is not maintained by any central authority, such as a bank or government. It is also referred to as a crypto-currency or crypto. There will be over 10,000 digital currencies in 2022, compared to only a few in 2013. It's estimated that the top 20 cryptocurrencies make up almost 90% of the overall market. The most commonly mentioned cryptocurrency is still bitcoin when it comes to digital currency. The currency was first introduced in 2009 by its enigmatic creator, purportedly Satoshi Nakamoto and has been on a roller-coaster ride ever since (Bankrate.com, 2022).

The exchange rate is the most important macroeconomic variable which effect the bitcoin market. The Bitcoin market is extremely speculative, volatile, and prone to speculative bubbles linked to local currency exchange rates (Katsiampa, 2017). The researcher also identifies the potential for disruption in analyzing cryptocurrencies on exchange rates. The Central Bank of Sri Lanka press statements in 2018 and 2021 said that no organization or business has received a license or authorization from the bank to run any virtual currency, including cryptocurrency, related schemes. Virtual currencies are regarded as unregulated financial products under Sri Lanka's foreign exchange act and are not subject to any regulatory control or protections (CBSL, 2022).

In Sri Lanka, the exchange rate (Sri Lankan Rupees to US Dollar Spot Exchange Rate) decreased from January 2015 to August 2021, and bitcoin is commonly reduced but dramatically increased after September 2020. It reached a new all-time high in march 2021. Still, the relationship between the bitcoin and the exchange rate in Sri Lanka was not found. The main objective of this study, find the long-run and short-run relationship between the exchange rate and bitcoin. The sub-objective is to find the determinant of the factors of the exchange rate.

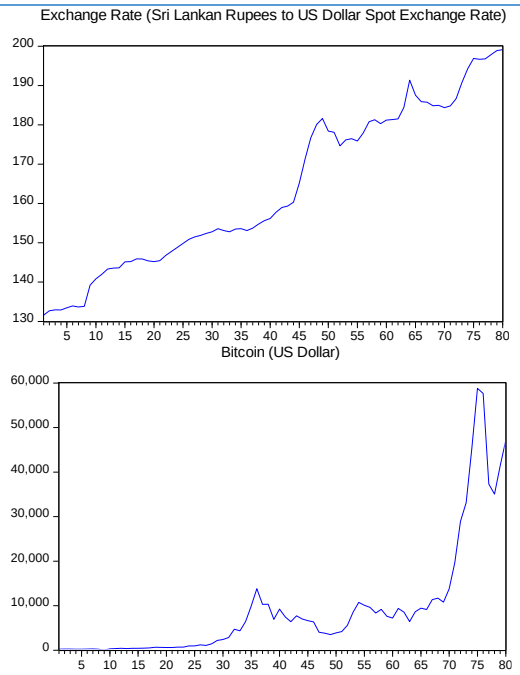


Figure 1: The Trend of Exchange rate and Bitcoin in Sri Lanka (January 2015 to August 2021)

## 2. Literature

Some of the researchers found an association between the bitcoin and the exchange rate. Long-run volatility in bitcoin prices has a significant detrimental impact on the exchange rate (RiskaDwi et al., 2018). Bitcoin is so liquid that anybody may trade it for any currency. In comparison to other currencies maintained by banks, this enables foreign transactions a lot of freedom and speed (Dyhrberg, 2016). Bitcoin can influence the future of international currencies such as the US dollar, The growth of crypto-currencies will make a new path to the US dollar's challenges (Seetharaman, A. et al. 2017).
Using weekly data between November 2013 and July 2018, Erdas and Caglar (2018) use an asymmetric causality test to examine the correlations between bitcoin and currency rates, commodities, and global indices. In the short term, there is an asymmetric link between bitcoin's optimistic views and the USD exchange rate. Over time, the price of bitcoin is negatively asymmetrical concerning the USD (Rajput, 2020).

Ciaian et al. (2016) revealed that the value of bitcoin depends on investor attitudes along with the demand, supply, and market price of the cryptocurrency, using the ARDL model. Additionally, they demonstrated that macro-financial changes (such as those in the price of oil, the Dow Jones index and the exchange rate) only have a short-term impact on the price of bitcoin.

Using daily data from 17-Dec-2019 to 17-Jun-2, Mallick and Mallik (2021) analyze the correlation between cryptocurrency rates (Bitcoin, Ethereum, Binance Coin, Litecoin) and official Indian currency foreign exchange rates (YEN, GBP, USD, EURO). According to the research, there is no substantial correlation between ICX and the exchange rate of cryptocurrencies, except for YEN with Ethereum and USD with Binance Coin & Litecoin.

The research by Corelli (2018) extensively examines the data, their characteristics, and their connections to examine this link for the first time. Given how concentrated the causation effect is on a few particular cryptocurrencies and fiat currencies, the results are intriguing. As a result, there is a noticeable and perhaps explicable connection between cryptocurrencies and Asian markets, along with a suggestion of an Asian influence. According to the literature, there is a connectivity between the exchange rate and BTC. Above the contexts clearly explained the relationship.

## 3. Data, model, and methodology

### 3.1. Data

This study used monthly time series data from January 2015 to August 2021. The response variable Exchange rate (Sri Lankan Rupees to US Dollar Spot Exchange Rate) was gathered from the trading economics website. The explanatory variables, bitcoin (US Dollar) obtained from the website of investing, the proxy variable of inflation (Consumer Price Index) and remittances (USD Million) obtained from the website of trading economics, broad money (LKR million) obtained from Central Bank of Sri Lanka.

## 3.2. Model

The following is the model specification for this study:

$$LNEXR_t = \beta_0 + \beta_1 LNBTC_t + \beta_2 LNCPI_t + \beta_3 LNM2b_t + \beta_4 LNREM_t + \varepsilon_t \quad (1)$$

Where:

| | |
|---|---|
| $LNEXR_t$ | - Natural logarithm of exchange rate |
| $LNBTC_t$ | - Natural logarithm of bitcoin |
| $LNCPI_t$ | - Natural logarithm of consumer price index |
| $LNM2b_t$ | - Natural logarithm broad money |
| $LNREM_t$ | - Natural logarithm remittance |
| $\beta_0$ | - Intercept |
| $\beta_1, \beta_2, \beta_3$ and $\beta_4$ | - Slope / Coefficient |
| $\varepsilon_t$ | - Error Term |

## 3.3. Methodology

The study uses the Autoregressive Distributed Lag (ARDL) model and the Error Correction Model (ECM) to reach the objective. Which required data to be assessed for the cointegration of long-run relationships, short-run relationships, and the monthly adjustment speed of the variable. The study uses residual diagnostics (Jarque-Bera normality test, Serial correlation, and Heteroscedasticity) and stability diagnostics tests to ensure the study's reliability (RAMSEY and CUSUM). All outputs were carried out from the E-views 10.

Long-run relationship estimation: Once cointegration between the variables has been determined, the ARDL model can be specified for long-run estimates.

$$\Delta LNEXR = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta LNEXR_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta LNBTC_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta LNCPI_{t-i} + \sum_{i=0}^{n} \beta_{4i} \Delta LNM2b_{t-i} + \sum_{i=0}^{n} \beta_{5i} \Delta LNREM_{t-i} + \gamma_1 LNEXR_{t-1} + \gamma_2 LNBTC_{t-1} + \gamma_3 LNCPI_{t-1} + \gamma_4 LNM2b_{t-1} + \gamma_5 LNREM_{t-1} + \varepsilon_t \quad (2)$$

Where:

| | | |
|---|---|---|
| $n$ | - | Optimum lag |
| $\Delta$ | - | 1st difference |
| $\gamma_1 - \gamma_5$ | - | Explain the coefficient of long run relationship |
| $\beta_{1i} - \beta_{5i}$ | - | Explain coefficshort-runhort run relationship |

In the cointegration test, the null hypothesis is $H_0 = \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = 0$ whereas the alternative hypothesis is $H_0 \neq \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq 0$.

## 4. Empirical results

Table 1 shows the outputs obtained from the Augmented Dickey-Fuller Test (ADF). The findings show that variables LNEXR, LNBTC, LNCPI, and LNM2b are stationary at 1st difference (I(1)) in the 1% significant level and LNREM is stationary at level (I(0)) in the 1% significant level respectively.

Table 1: Augmented Dickey-Fuller (ADF)

| Variables | ADF unit root test Constant – P Value | | Stationary |
|---|---|---|---|
| | **Level** | Δ | |
| **LNEXR** | 0.8637 | 0.0000*** | I(1) |
| **LNBTC** | 0.7006 | 0.0001*** | I(1) |
| **LNCPI** | 0.9700 | 0.0000*** | I(1) |
| **LNM2b** | 0.9333 | 0.0000*** | I(1) |
| **LNREM** | 0.0000*** | - | I(0) |

(*), (**), (***), significant at 10%, 5% and 1% respectively

The study, therefore, performed a lag length test, as shown in table 2. According to the findings, the optimal lags to include in the survey is three lags as selected by the LR, FPE, and AIC criterion.

Table 2: Lag length criteria

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| **0** | 737.5305 | NA | 1.00e-15 | -20.34807 | -20.18997* | -20.28513* |
| **1** | 773.7218 | 66.35072 | 7.35e-16 | -20.65894 | -19.71033 | -20.28129 |
| **2** | 798.2776 | 41.60845 | 7.52e-16 | -20.64660 | -18.90748 | -19.95425 |
| **3** | **828.5286** | **47.05704*** | **6.67e-16*** | **-20.79246*** | **-18.26283** | **-19.78541** |
| **4** | 845.6676 | 24.28035 | 8.72e-16 | -20.57410 | -17.25396 | -19.25234 |
| **5** | 861.6415 | 20.41106 | 1.22e-15 | -20.32338 | -16.21273 | -18.68691 |
| **6** | 881.7091 | 22.85478 | 1.59e-15 | -20.18636 | -15.28521 | -18.23520 |
| **7** | 908.3159 | 26.60677 | 1.84e-15 | -20.23100 | -14.53933 | -17.96513 |

(*) denoted optimum lag length

The graph of inverse roots of the characteristic AR polynomial is used to verify the stability of the model, as illustrated in Figure 2. The calculated VAR model is stable since every last root has a modulus below one and is located inside the unit circle.

For this study, the most optimal lag is 2 3 2 3 2. It was obtained from E-views output (Figure 3). Table 3 reveals the outcomes from the bounds test for cointegration. According to the calculated F-statistics is higher than the upper critical value at the 5% level, as a result, the alternative hypothesis that there is cointegration is accepted, suggesting that the variables have a stable long-run cointegrating relationship.

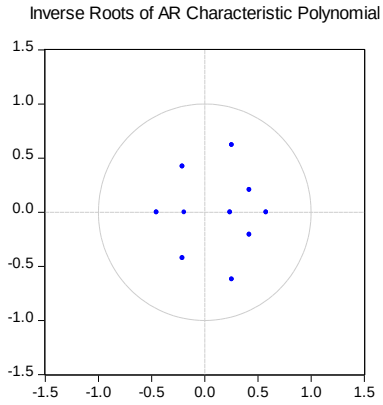

Figure 2: Inverse Roots of AR Characteristic Polynomial

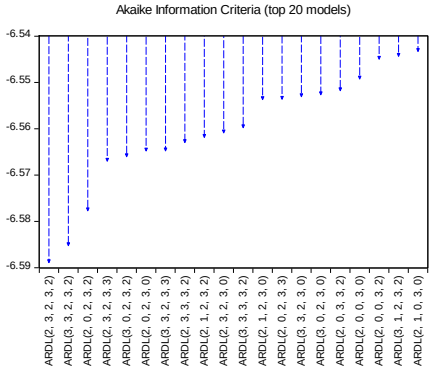


Figure 3: Optimum lags based on Akaike Information Criteria (AIC)

Table 3: ARDL Bound Test

| **F- Bounds Test -Test Statistic** | **Value** | **Significance** | **I(0)** | **I(1)** |
|---|---|---|---|---|
| F-statistic | 3.685435 | 10% | 2.2 | 3.09 |
| | | 5% | 2.56 | 3.49 |
| k | 4 | 2.5% | 2.88 | 3.87 |
| | | 1% | 3.29 | 4.37 |

Table 4: ARDL and Long-Run Relationship

| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
|---|---|---|---|---|
| LNBTC | -0.048201 | 0.008604 | -5.602063 | 0.0000*** |
| LNCPI | 0.887240 | 0.404981 | 2.190817 | 0.0324** |
| LNM2B | 0.430058 | 0.147714 | 2.911426 | 0.0050*** |
| LNREM | 0.013607 | 0.045178 | 0.301187 | 0.7643 |
| C | -5.569015 | 0.884949 | -6.293034 | 0.0000*** |

(*), (**), (***), significant at 10%, 5% and 1% respectively

Table 4 shows the ARDL model's long-run estimated coefficients. According to the results, bitcoin has a negative impact on the exchange rate and it was statistically significant at 1% level. The coefficient of bitcoin is -0.048201, indicating 1% increase in bitcoin decreases the exchange rate by 0.05%. The coefficient of the consumer price index is statistically significant at 5% (P-value $< 0.05$) and broad money is statistically significant at 1% (P-value $< 0.01$). These two variables have a positive impact on the exchange rate. Thus, a 1% increase in the consumer price index increases the exchange rate by 0.89% and 1% increase in broad money increases the exchange rate by 0.43%. The results of this investigation are consistent with Astuti and Fazira (2018) findings.

Table 5: ECM and Short-Run Relationship

**ECM Regression**

**Case 2: Restricted Constant and No Trend**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LNEXR(-1)) | 0.583167 | 0.099333 | 5.870819 | 0.0000*** |
| D(LNBTC) | -0.011157 | 0.002348 | -4.751023 | 0.0000*** |

| | | | | |
|---|---|---|---|---|
| D(LNBTC(-1)) | 0.004559 | 0.003001 | 1.519212 | 0.1340 |
| D(LNBTC(-2)) | 0.006536 | 0.002627 | 2.487745 | 0.0157** |
| D(LNCPI) | 0.292509 | 0.141249 | 2.070869 | 0.0427** |
| D(LNCPI(-1)) | -0.522136 | 0.152784 | -3.417479 | 0.0011*** |
| D(LNM2B) | -0.055602 | 0.137764 | -0.403606 | 0.6879 |
| D(LNM2B(-1)) | -0.008752 | 0.144658 | -0.060502 | 0.9520 |
| D(LNM2B(-2)) | -0.643002 | 0.139670 | -4.603719 | 0.0000*** |
| D(LNREM) | -0.006101 | 0.007960 | -0.766477 | 0.4464 |
| D(LNREM(-1)) | -0.020670 | 0.007971 | -2.593091 | 0.0119** |
| ECT(-1)* | **-0.265738** | 0.054294 | -4.894418 | 0.0000*** |

(*), (**), (***), significant at 10%, 5% and 1% respective

Table 6: Residual Diagnostic Test

| **Test** | **P-value** | **Conclusion** | **Test** | **Probability Value** |
|---|---|---|---|---|
| Normality Test - Jarque-Bera | 0.485860 | Accept The Null Hypothesis | Normality Test - Jarque-Bera | 0.485860 |
| Serial Correlation LM Test | 0.9852 | Accept The Null Hypothesis | Serial Correlation LM Test | 0.9852 |
| Heteroskedasticity Test Breusch – Pagan Godfrey | 0.0643 | Accept The Null Hypothesis | Heteroskedasticity Test Breusch – Pagan Godfrey | 0.0643 |
| Ramsey Reset Test | 0.5678 | Accept The Null Hypothesis | Ramsey Reset Test | 0.5678 |

Table 5 shows the Error correction model's short-run estimated coefficients. The ECT (-1) indicates the predicted negative sign and is significant. This indicates that the speed of adjustment from the short-term out-of-equilibrium to the long-term equilibrium is increasing. The ECT (-1) coefficient value is found to be -0.265738. It shows that about 26% of the deviation from long-run equilibrium is adjusted every month. One period lagged value of the exchange rate has a positive significant relationship with the exchange rate at the 1% level. The current period value of bitcoin has a negative significant relationship with the exchange rate at the 1% level. Two period-lagged value of bitcoin and the current period value of the consumer price index have a positive significant relationship with the exchange rate at the 5% level. Two period lagged value of broad money and one period value of remittance have a negative significant relationship with the exchange rate at 1% level.

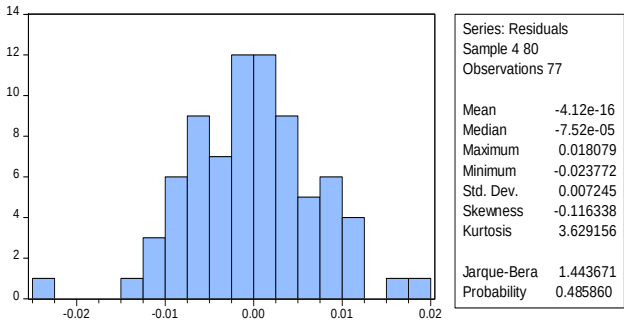


Figure 4: Residual Diagnostic Test - Histogram Normality Test

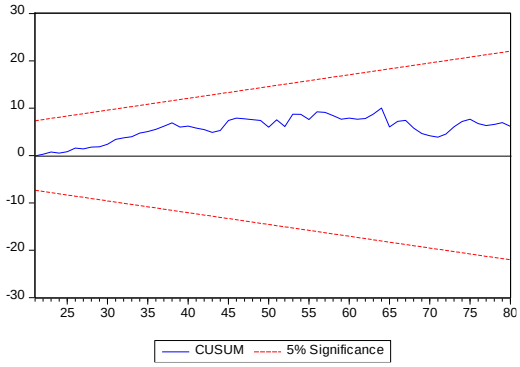


Figure 5: Stability Diagnostic recursive estimate – CUSUM TEST

According to the result, the residual is normally distributed, there is no serially correlated error, and there is no evidence of misspecification and heteroskedasticity. Also, the model specification is accurate. According to the CUSUM test in Figure 5, the dependent variable is stable since the CUSUM plot is within the two straight lines' 5% range of significance. Thus, the error correction model is stable.

## 5. Conclusion

The objective of this paper is to identify the long-run and short-run relationships between bitcoin and the exchange rate as well as macroeconomic variables that determine the exchange rate. The results reveal that volatility of the Bitcoin price has a long-run and short-run negative impact on the exchange rate. This outcome is drawn from the ARDL model. Therefore, it would be better for future research to adopt different approaches and examine the relationship between bitcoin volatility and other macroeconomic variables. Bitcoin was legal in developed countries such as U.S., U.K. and Japan. So, central bank of sri Lanka has to investigate very deeply the benefits of cryptocurrency in Sri Lanka. It may help to privilege our economy in the future. If the Sri Lankan Government agree with the transaction of cryptocurrency, they can also collect the tax from the transaction. It will be needful to the economic development.

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