Available online at www.alphanumericjournal.com

alphanumeric journal
The Journal of Operations Research, Statistics, Econometrics and Management Information Systems

Volume 9, Issue 1, 2021

Received: April 16, 2020
Accepted: January 27, 2021
Published Online: June 30, 2021

AJ ID: 2021.09.01.ECON.01
DOI: 10.17093/alphanumeric.720873
Research Article

The Impacts of Central Bank Indicators on Commodity Prices: An Application of ARDL Bounds Test

Çiğdem Yılmaz Özsoy, Ph.D.*

Assist. Prof., Department of Economics, Faculty of Economics, Administrative and Social Sciences, Istanbul Ayvansaray University, Istanbul, Turkey, cigdem_yilmazz@hotmail.com

* İstanbul Ayvansaray Üniversitesi İktisadi, İdari ve Sosyal Bilimler Fakültesi, Prof. Muammer Aksoy Cad. No: 10 Kazlıçeşme, Zeytinburnu, İstanbul, Türkiye

ABSTRACT

This paper investigates the impacts of Central Bank Indicators on Bitcoin/TL prices as a Commodity by using the ARDL Bounds Test. In the article, monthly data between 2017:09 – 2019:12 is used. The Central Bank Indicators are explained by M2 money supply, one-month interest rates of bank deposits, one-week repo interest rate, 10-year government bond. In the paper, Bitcoin's prices are considered as a Commodity in TL. The stationary behavior of variables is investigated by using the ADF test and it is found that all the variables are stationary in first differences for the trend and constant model. But the price of Bitcoin in TL is stationary in level for the constant model. Thus, to discover the long-run relationship between variables, the ARDL test is applied. As a result of the ARDL test, it is found that there is a long-run relationship between all the Central Bank indicators and Bitcoin/TL prices. According to obtained results, while the M2 money supply and Turkey's 10-year government bonds (%) move together with Bitcoin prices; the one-week repo interest rate as a political rate, and one-month interest rates of the deposit move in opposite directions with Bitcoin prices in a long-run.

Keywords: Central Bank, Commodity, ARDL, Unit root, Cointegration

1. Introduction

The monetary theory has been developed to understand the most appropriate approaches to monetary policy and how this should be carried out in an economy. Different monetary theories such as Fiat Debtless Money Reformers, Modern Money Theorists, Modern Monetary Realists, Post Keynesian Reformers, Islamic Banking Lawyers, Social Credit Reformers, Land Reformers, Hard Money Reformers, and Competitive Money Reformers; have been developed to benefit countries depending on their economies and resources. All these theories relate to the use of government-issued currencies, often referred to as fiat currencies, the size of the money supply, price levels, or the indicator of interest rates, and how all these factors affect the economy (Peters et al., 2015).

Over the past years, financial markets and institutions have undergone a sudden expansion period due to liberalization, globalization, and developments in computer technologies. In this period, the development of the financial sector was more than the real economy. This has led to numerous positive effects such as better capital allocation and lower costs. In line with these changes, the use of credit cards and debit cards has increased, and the form of payment has changed with the decrease of cash use (Fabris, 2019). As a result of these developments, a Bitcoin crypto-asset emerged as a new type of financial asset, using a peer-to-peer system (P2P) to complete and verify the transaction process. Some investors hope to use Bitcoin as electronic money in the future. This development led to a discussion of the factors that determine Bitcoin's price and the possibility of being a competitor to fiat money. However, to be used Bitcoin as money, it must provide the three functions of money: the exchange tool, the value store, and the unit of account. However, today the most distant of three different functions is that “Bitcoin is an accounting unit”. To accept and adopt Bitcoin, instead of converting the price of a good or service from Bitcoin to dollars, people need to start thinking from the kind of “Bitcoin currency” and should ask themselves how much it will cost in bitcoin currency. However, the Bitcoin price is too volatile (Yermack, 2013). Since money also serves as a store of value, the stability of this value is important. Since Bitcoin is priced entirely on-demand, the stability of how much a bitcoin is worth is limited, making things more complicated. The volatile price structure of Bitcoin may not appear as a threat to the store of value function of money when prices rise; but when prices drop, it reminds people that fixed value is an important aspect of the store of value. To be an effective exchange tool, money must be acceptable in exchange for goods and services. Bitcoin can be used as a medium of exchange for a limited number of goods (Wegdell, 2014; Wolla, 2018). Since Bitcoin is not controlled by any central bank or government, it also differs from the real economy. The supply and demand of Bitcoin stem from investors' speculative behaviour and there is no interest rate for this asset. Thus, profit can only be obtained from price changes (Kristoufek, 2013). Considering all this, it is seen that Bitcoin is a "speculative financial asset that can be used as a tool of exchange, a Commodity" (Prentis, 2015). Commodities are affected by general macroeconomic factors such as industrial production, exchange rate, inflation, and interest rate.

Interest rate is one of the important macroeconomic variables directly related to economic decisions. Interest rates are the reward that a borrower (borrower) pays to the lender (the creditor) for a certain period, expressed as a percentage on an annual

basis. Interest rates are often referred to as the price of money. There are many different interest rates; call deposit rates, time deposit rates, repo contract (repo) rates, base rates, policy rates, bank rates, government bond rates, corporate bond rates, negotiable paperwork (NCD) rates, treasury bond (TB) rates, corporate/commercial paper (CP) rates, fixed interest rates, variable interest rates, discount rates, coupon rates, real rates, nominal rates, effective rates, risk-free rates, etc. (Faure, 2014). Interest rates by maturity are analysed under two headings as short and long-term interest rates. Short-term rates controlled by the Central Bank are usually associated with treasury bills or comparable instruments with a quarterly maturity. However, there are a wide variety of instruments in the markets: those with a maturity of one month, three months, six months, and twelve months are normally classified as short-term. Long-term rates relate to bonds with a ten-year maturity. The longer the maturity of the investment, the higher the risk for the investor so the long-term interest rates are higher than the short-term rates. Good investors always want to invest in an efficient market (Uddin and Alam, 2010). In an inefficient market, increases in commodity prices generally meet the high inflation expectations, tighten monetary policy, and increase interest rates (Hammoudeh et al., 2009).

In this study, the impact of Central Bank monetary policy indicators on Bitcoin prices was analysed for the period of 2017:09 – 2019:12 by using the ARDL Bounds test. As Central Bank Monetary Policy Indicators: "M2 money supply", "One-month interest rates of bank deposit in TL", "10-year government bonds (%)" and "one-week repo interest rate" were used as monetary policy indicators. Bitcoin prices are considered in Bitcoin/TL. This paper aims to contribute to the formation of monetary policy, risk management practices, financial securities valuation, and government policies towards financial markets.

This article consists of five parts. In the second part, the literature review is given, in the third part, the ARDL Bounds test is examined, in the fourth part, both information about the data set is given, and the obtained empirical results are shown. In the last part, the findings were evaluated and interpreted in the Conclusion section.

2. Literature Review

2.1. Literature for Bitcoin

Baek and Elbeck (2015) established a regression model to determine whether Bitcoin is an investment tool or a speculative tool and included possible macroeconomic variables that could affect Bitcoin. According to the results obtained, Bitcoin was found to be largely speculative. Unlike many other studies, Bartos (2015) has revealed that Bitcoin prices act by the effective market hypothesis, in other words, there is no bubble in Bitcoin prices. Cheung, Roca, and Su (2015) used the GSADF test of Phillips, Wu, and Yu (2015) in their studies to investigate the presence of balloons in cryptocurrencies. According to the findings obtained, it is possible to mention the existence of three large bubbles from the data ranges examined. It was observed that these bubbles lasted between 66 and 106 days. In the study of Cheah and Fry (2015), they determined the existence of speculative bubbles in Bitcoin prices. Gunji (2016) found that Bitcoin prices contain a rational bubble in his study where he used the ADF and KPSS unit root tests and examined the Bitcoin prices in Yuan, Dollar, Euro, and Yen. Kristoufek (2015) discussed the existence of bubbles in Bitcoin with wavelet

consistency analysis. The results obtained are not different in other studies, but also indicate the presence of bubbles in Bitcoin prices. In his study, Landgraf (2016) investigated the existence of bubbles in the Japanese core stock market NIKKEI 225 and Bitcoin. The GSADF test was determined to have bubbles for both markets. Lee (2017) investigated the effect of blockchain information and macroeconomic factors on Bitcoin price formation using Linear Regression, Bayesian Artificial Networks, and Support Vec. Regression methods. As a result, the predictive performance of the Bayesian artificial networks method was found to be better than other benchmarking methods. Corbet et al. (2018) aimed to test the basic principles of Bitcoin and Ethereum. There is no clear evidence that Bitcoin and Ethereum are a permanent price bubble on the market. Li, Naqvi, Rizvi, and Chang (2021) focused on portfolio optimization and evaluated how the financial sector can use Bitcoin to increase the efficiency and wealth of society. The study found that Bitcoin has a tremendous propensity to improve an investor's risk-return profile. Shynkevich (2021) examines the information efficiency of the Bitcoin spot market. Findings show that the launch of Bitcoin futures increases the information efficiency of the Bitcoin spot market. Sabalionis, Wang, and Park (2020) explain the price movements in Bitcoin and Ethereum cryptocurrencies by using the VAR-GARCH-BEKK model. As a result of the study, it was found that the impacts of Google searches and tweets were weaker than active addresses in terms of size and importance. In the study of Malladi and Dheeriya (2021), the link between the returns and volatility of Bitcoin and Ripple crypto assets was found by using ARMAX, GARCH, VAR, and Granger Causality tests. As a result of the study, it was seen that the Bitcoin collapse in 2018 can be explained by these time series methods, the returns of global stock markets and gold do not have a causal effect on Bitcoin returns, and Ripple's returns have a causal effect on Bitcoin prices.

2.2. Literature for ARDL Bounds Test

Qamruzzaman and Wei (2018) explained the relationship between the economic growth, financial innovation, and stock market development of Bangladesh in the period 1980-2016 using the ARDL boundary test approach. He determined the direction of causality between variables using Granger causality analysis. As a result of the ARDL boundary test, the existence of a long-term relationship between financial innovation, stock market development, and economic growth has been confirmed. Moreover, the findings from the Granger causality test support the bidirectional causality between financial innovation, economic growth, and stock market development and economic growth in both the long and short term. These findings support the theory that market-based financial development and financial innovation in the financial system can stimulate economic development.

In the study of Fuinhas and Marques (2012), they investigated the connection between primary energy consumption and growth in the countries of Portugal, Italy, Greece, Spain, and Turkey using the ARDL limit test. As a result of the study, bidirectional causality between energy and growth in both the long and short term was found.

Alhodiry, Rjoub, and Samoa (2021) researched the impact of oil prices and US interest rates on Turkey's real estate market using the newly developed bootstrap autoregressive distributed lag (ARDL) method and Khatami-J (2008) examined using

cointegration test. According to the findings, there is a significant impact on Turkey's real estate market over the interest rate in domestic oil prices.

Adebayo, Akinsola, Odugbesan, and Olanrewaju (2021) investigated the long-term and causal effects of financial development, real growth, urbanization, gross capital formation, and energy consumption on CO2 emissions in Thailand using the ARDL method. The robustness control of the ARDL long-term estimator was performed using FMOLS, DOLS, and CCR methods. As a result of the study, a negative and insignificant link was found between CO2 emissions and urbanization, while a positive link was found between CO2 emissions and energy use CO2 emissions and GDP.

Fernandes, Borges, and Caiado (2021) examined the contribution of digital financial services to the financial base in Mozambique using the ARDL method for the period from January 2011 to September 2019. The result of the study confirms the important role digital financial services play in spreading to the financial base. Onah, Ujunwa, and Ogundele (2021) examined the effects of four direct measures of financial technology (automated teller machine [ATM], internet banking, point of sale, and mobile banking) on cash holding in Nigeria using the ARDL method. As a result of the study, a long-term negative relationship was found between cash holding and four direct measures of financial technology.

3. ARDL Bounds Test

Economic time series usually have non-stationary processes (Johansen, and Juselius, 1990). Spurious regression problems may arise as a result of analysis using a non-stationary time series (Granger, 1974). To engage stationary, the difference in variables is taken. However, this process may cause loss of information in the series, while eliminating the existing relationship between the series (Tari, and Yıldırım, 2009). According to the article by Pesaran et al. (2001), the boundary test approach eliminates this problem and enables the investigation of the existence of the cointegration relationship between the series regardless of whether the series is I(0) or I(1) (Pesaran, and Smith, 2001). Besides, the bounds test approach yields convenient results with data containing a low number of observations (Narayan, and Narayan, 2005).

The ARDL bounds testing approach consists of three stages. In the first step, it is tested whether there is a long-term relationship between the variables included in the analysis. In case there is a cointegration relationship between these variables, long and short-term elasticities are obtained respectively in the following stages (Narayan, and Smyth, 2006).

The ARDL (1,1) model is the simplest version of the ARDL test. The ARDL (1,1) model equation is shown as follows:

$$Yt = a + \beta 1Xt + \beta 2Xt{-}1 + \beta 3Yt{-}1 + \varepsilon yt \quad (1)$$

The ARDL (1, 1) model has some important limitations:

- $\beta 2 = \beta 3 = 0$ Static regression,

- $\beta 1 = \beta 2 = 0$ First order autoregressive process,
- $\beta 3 = 1, \beta 1 = -\beta 2$ Equation in the first difference,
- $\beta 2 = 0$ Partial correction equation.

Since the ARDL test considers delay structure, it can give better results than other conventional cointegration tests. (Ahmed, 2018).

The model shown in Equation 1 is first estimated by the OLS method. Information criteria such as AIC, SIC, FPE, and HQ are used to determine the lag lengths. After determining the lag length in the ARDL boundary test approach, the basic hypothesis is tested using F- test to investigate the presence of the cointegration relationship between the variables included in the analysis (Narayan, 2005). The calculated F statistical value is compared with the lower and upper critical values given in Pesaran, Shin, and Smith's (2001) study. According to the variables I (0) and I (1), critical values were determined for upper and lower limits. If the calculated F statistical value is greater than the upper limit of the critical value, the basic hypothesis that there is no long-term relationship between the variables is rejected. The basic hypothesis cannot be rejected if the calculated F statistical value is lower than the lower limit of the critical value. If the calculated F statistical value is between the upper and lower limits, no decision can be made and other cointegration tests that take into account the stationarity of the variables are recommended. If there is a cointegration relationship between variables, long and short-term coefficients are obtained respectively. Once these coefficients have been determined, the diagnostic tests of the model are examined and it is decided whether the model is appropriate (Yılancı, 2012)

4. Data and Empirical Results

To examine the impacts of interest rates on Bitcoin; we use M2 money supply, one-month interest rates of deposit in TL, CBRT's one-week repo interest rate (%) as a political rate, Turkey's 10-year government bonds (%), and Bitcoin prices. The price of Bitcoin is in BTC/TL. In the paper, the monthly series over the period from 09.2017 through 12.2019 are used. The logarithmic forms of Bitcoin prices and M2 money supply are included in the model. The data for variables were obtained from https://evds2.tcmb.gov.tr/ and https://www.investing.com/.

In the first step of the empirical analysis, the ADF test was employed to investigate the stationarity behavior of variables. The null hypothesis of the ADF test is that a time series contains a unit root. The results of the ADF test are reported in Table 1. In the table, LNBTC, LNM, GOV BOND, REPO, and INTEREST represent Bitcoin/TL prices, M2 money supply, Turkey's 10-year government bonds (%), CBRT's one-week repo interest rate (%), and one-month interest rates of deposit in TL, respectively.

Variables	ADF Level		ADF First differences	
	Trend+Constant	Constant	Trend+Constant	Constant
LNBTC	-2.09143	-2.9911	-3.824875	-
	(0.5272)	(0.0495)	(0.0313)	
LNM	-2.47425	-0.37073	-4.5165	-4.60744
	(0.337)	(0.9009)	(0.007)	(0.0012)
GOVBOND	-1.1296	-1.75152	-4.528	-4.27647
	(0.9049)	(0.3953)	(0.0068)	(0.0026)
REPO	-0.136162	-1.255178	-5.22773	-4.62733
	(0.9913)	(0.6350)	(0.0014)	(0.0011)
INTEREST	-0.3415	-1.7231	-3.9081	-3.531102
	(0.9848)	(0.4084)	(0.0263)	(0.0151)

Table 1. Classical Unit Root Test

While Turkey's 10-year government bonds (%) one-month interest rate of deposit rate, M2 money supply, and one-week repo interest rate are stationary in I(1) for both trend and constant and constant model, the prices of Bitcoin in TL is stationary in level for the constant model. Therefore, to find out the long-run relationship between variables, the ARDL Bounds test is applied.

The first step of the ARDL model is to determine the appropriate lag length. At this step, the variables are tested with different lag combinations, and the model that gives the lowest value of the information criteria (AIC, SIC, or HQ) is selected as the best model. In this study, the optimal lag length was determined as 4 considering the Hannan-Quinn criteria. Thus, the ARDL (3,3,1,3,0) model is selected as the best model. To perform the ARDL test, the F statistical value must be determined.

I(0) Bound	I(1) Bound	Significant Level	F Statistics	k lag number
3.74	5.06	1%	13.7226	4
2.86	4.01	5%		
2.45	3.52	10%		

Table 2. ARDL Bounds Test Result

According to Table 2, the statistical value of the F test is greater than I(1) bound value at the 1%, 5%, and 10% significance level. Thus, we can't accept zero hypotheses. There is a cointegration relationship between variables.

Dependent Variable: Bitcoin/TL			
Variables	**Coefficient**	**t-stat.**	**Prob.**
LNBTC(-1)	0.2303	1.539	0.1547
LNBTC(-2)	-0.02845	-0.169	0.869
LNBTC(-3)	-0.301	-2.6464	0.0245
LNM	-0.89715	-0.4154	0.686
LNM(-1)	8.2946	2.8462	0.0174
LNM(-2)	-12.521	-3.3147	0.0078
LNM(-3)	12.625	4.8673	0.0007
GOVBOND	0.6778	0.259015	0.8009
GOVBOND (-1)	10.2061	3.15088	0.0103
INTEREST	-4.7078	-2.3892	0.038
INTEREST(-1)	4.9227	1.86214	0.0922
INTEREST(-2)	-2.3685	-0.8329	0.4243
INTEREST(-3)	-6.01758	-4.055103	0.0023
REPO	-3.21265	-2.6681	0.0236
C	-57.26461	-5.08306	0.0005
Selected Model			
R Square	0.974		
Adjusted R Square	0.937		
F stat.	26.591 (0.000)		
White Test	8.586 (0.8566)		

Table 3. Estimation Result of ARDL (3,3,1,3,0)

Table 3 includes the diagnostic test results of the estimated ARDL(3,3,1,3,0) model. It is understood that there is no heteroscedasticity problem in the predicted model and there is no error of model building. As a result of the ARDL model, long-term estimation results, or calculated elasticity coefficients are shown in Table 4.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNM	6.8257	0.9204	7.4159	0.000
REPO	-2.92298	1.0258	-2.84924	0.00173
INTEREST	-7.43445	1.79395	-4.14419	0.0020
GOVBOND	9.90256	2.3249	4.25924	0.0017
C	-52.1014	8.31003	-6.2697	0.0001

Table 4. ARDL Long Term Estimation Result

According to Table 4, long-term estimation results or the elasticity coefficients of the M2 money supply, one-week repo interest rate, Turkey's 10-year government bonds (%), and one-month interest rates of deposit rate in TL are 6.8257, -2.92293, -7.4344, and 9.90256, respectively. Based on the results in Table 4, while the M2 money supply and Turkey's 10-year government bonds (%) rise, Bitcoin/TL prices also increase. On the other hand, the one-week repo interest rate and one-month interest rates of the deposit rate in TL increase, Bitcoin/TL prices decrease. Short-term estimation results are also shown in Table 5.

Cointegrating Form				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LNBTC(-1))	0.32928	0.0985	3.34329	0.0074
D(LNBTC(-2))	0.30093	0.1137	2.64637	0.0245
D(LNM)	-0.89715	2.15978	-0.4154	0.6866
D(LNM(-1))	12.5207	3.7773	3.31472	0.0078
D(LNM(-2))	-12.62547	2.59393	-4.867305	0.0007
D(GOVBOND)	0.67779	2.6168	0.259015	0.8009
D(INTEREST)	-4.70786	1.9705	-2.3892	0.038
D(INTEREST(-1))	2.3685	2.84343	0.8329	0.4243
D(INTEREST(-2))	6.0176	1.4839	4.055103	0.0023
D(REPO)	-3.21265	1.20411	-2.6681	0.0236
CointEq(-1)	-0.9991	0.11731	-9.36952	0.0000

Table 5. ARDL Short Term Estimation Result

The variable ECt-1 in Table 5 is a period-delayed value of the series of error terms obtained from the long-term relationship. The coefficient of the ECt-1 variable shows how much of the imbalance in the short term will be corrected in the long term. According to Table 5, the error correction term is negative, less than 1, and statistically significant, as expected. Therefore, short-term deviations between long-run series disappear and the series converge again to the long-run equilibrium value.

5. Conclusion

All the goods and products that are subject to trade are generally called commodities. As an exciting technology, Bitcoin must also be considered a commodity to be consistent with the historical understanding of what money is and accurately reflect the fluctuations in the Bitcoin economy. Classifying Bitcoin as a commodity ensures that Bitcoin exchanges can be regulated and any Bitcoin derivative that can be developed is auditable. Organized and regulated commodity exchanges promote price stability in the market and enable investors to enter the "hedging" process to limit investment risk. Such an arrangement will be very beneficial for Bitcoin users because it will create increased trust in the Bitcoin economy and ecosystem. In this study, the determinants of fluctuations in Bitcoin/TL prices, which are considered as a commodity, were investigated in terms of central banking. For the period of 09.2017 – 12.2019, the stationary behaviours of variables are investigated by using the ADF test. The results of the unit root tests indicate that the variables under study were both I(0) and I(1) processes. The long-term relationships between variables were investigated by using the ARDL bounds test approach, and the error correction model was used to obtain short-term relationships between variables. The ARDL (3,3,1,3,0) model is selected as an appropriate model. According to the ARDL bounds test results, it is found a long-run relationship between all explanatory variables and Bitcoin prices as a Commodity. However, while the M2 money supply and Turkey's 10-year government bonds (%) move together with Bitcoin prices; the one-week repo interest rate as a political rate, and one-month interest rates of the deposit move in opposite directions with Bitcoin prices in a long-run.

References

Adebayo, T.S., Akinsola, G.D., Odugbesan, J.A., Olanrewaju, V.O. (2020). Determinants of Environmental Degradation in Thailand: Empirical Evidence from ARDL and Wavelet Coherence Approaches. Pollution, 7(1), 181-196. Doi: 10.22059/poll.2020.309083.88.

Ahmed, S. (2018). ARDL Model as A Remedy for Spurious Regression: Problems, Performance, and Prospectus. Munich Personal RePEc Archive, 1–31. https://mpra.ub.uni-muenchen.de/83973/1/MPRA_paper_83973.pdf

Alhodiry, A., Rjoub, H., Samoa, A. (2021). Impact of Oil Prices, The U.S. Interest Rates on Turkey's Real Estate Market. New Evidence from Combined Co-Integration and Bootstrap ARDL Tests. PLoS ONE, 16(1). https://doi.org/10.1371/journal.pone.0242672

Baek,C., and Elbeck, M. (2015). Bitcoins As An Investment Or Speculative Vehicle? A First Look, Applied Economics Letters, 22(1), 30-34. https://www.tandfonline.com/doi/abs/10.1080/13504851.2014.916379

Bartos, J. (2015). Does Bitcoin Follow the Hypothesis of Efficient Market, International Journal of Economic Sciences, 4/2, 10-23. https://www.iises.net/international-journal-of-economic-sciences/publication-detail-189

Cheah, E. and Fry, J. (2015). Speculative bubbles in Bitcoin markets? An empirical investigation into the fundamental value of Bitcoin. Economics Letters, 130. 32-36. https://doi.org/10.1016/j.econlet.2015.02.029

Cheung, A., Roca, E, Su, J.J. (2013). Crypto-Currency Bubbles: An Application of the Phillips-Shi-Yu Methodology on Mt.Gox Bitcoin Prices", Applied Economics, 47/23, 2348-2358. https://www.tandfonline.com/doi/abs/10.1080/00036846.2015.1005827

Corbet, S., Lucey, B., and Yarovya, L. (2018). Datestamping the Bitcoin and Ethereum Bubbles", Finance Research Letters, 26, 81-88. https://www.sciencedirect.com/science/article/abs/pii/S1544612317307419

Fabris, N. (2019). "Cashless Society - The Future of Money or a Utopia?", Journal of Central Banking Theory and Practice, 8(1), 53–66. https://doi.org/10.2478/jcbtp-2019-0003

Faure, A.P. (2014). Interest Rates 1: What are Interest Rates? SSRN Electronic Journal. DOI: 10.2139/ssrn.2542083

Fernandes, C., Borges, M.R., Caiado, J. (2021). The Contribution of Digital Financial Services to Financial Inclusion in Mozambique: An ARDL Model Approach. Applied Economics, 53(3), 400-409. https://doi.org/10.1080/00036846.2020.1808177

Fuinhas, J.A., and Marques, A.G. (2012). Energy Consumption and Economic Growth Nexus in Portugal, Italy, Greece, Spain and Turkey: An ARDL Bounds Test Approach (1965-2009). Energy Economics, 34(2), 511-517. https://doi.org/10.1016/j.eneco.2011.10.003

Granger, C. W. J. (1974). Spurious Regressions in Econometrics. A Companion to Theoretical Econometrics, 2(2), 111–120. https://doi.org/10.1002/9780470996249.ch27

Gunji, H. (2016). Are Bitcoin Prices Rational Bubbles. The Empirical Economics Letters, 15(9), 819-824.

Hammoudeh, S., Sarı, R., and Ewing, B.T. (2009). Relationships among strategic commodities and with Financial Variables: A New Look, Contemporary Economic Policy, 27(2), 251-264.

Johansen, S., and Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration — With Applications to the Demand for Money. Oxford Bulletin of Economics and Statistics, 52(2), 169–210. https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x

Kristoufek, L. (2013). Bitcoin Meets Google Trends and Wikipedia: Quantifying the Relationship Between Phenomena of the Internet Era, Scientific Reports, 3(3415), 1–7. https://doi.org/10.1038/srep03415

Kristoufek, L. (2015). What are the Main Drivers of the Bitcoin Price? Evidence from Wavelet Coherence Analysis, Plos One, 10/4, 1–15. https://doi.org/10.1371/journal.pone.0123923

Li, J.P., Naqvi, B., Rizvi, S.K.A, Chang, H.L. (2021). Bitcoin: The Biggest Financial Innovation of Fourth Industrial Revolution and A Portfolio's Efficiency Booster, Technological Forecasting and Social Change, 162(January), 1-10. https://doi.org/10.1016/j.techfore.2020.120383

Malladi, R.K, and Dheeriya, P. (2021). Time Series Analysis of Cryptocurrency Returns and Volatilities. Journal of Economics and Finance, 45, 75-94. https://doi.org/10.1007/s12197-020-09526-4

Narayan, P. K., and Narayan, S. (2005). Estimating Income and Price Elasticities of Imports for Fiji In a Cointegration Framework. Economic Modelling, 22(3), 423–438. https://doi.org/10.1016/j.econmod.2004.06.004

Narayan, P. K., and Smyth, R. (2006). What Determines Migration Flows from Low-Income to High-Income Countries? An empirical investigation of Fiji-U.S. migration 1972-2001. Contemporary Economic Policy, 24(2), 332–342. https://doi.org/10.1093/cep/byj019

Onah, E.O., Ujunwa, A.I., Ogundele, O.S. (2021). Effect of Financial Technology on Cash Holding in Nigeria. African Journal of Economic and Management Studies. https://doi.org/10.1108/AJEMS-04-2020-0190

Pesaran, M. H., Shin, Y., and Smith, R. J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. Journal of Applied Econometrics, 16(3), 289–326. https://doi.org/10.1002/jae.616

Peters, G., Panayi, E., and Chapelle, A. (2015). Trends in cryptocurrencies and blockchain technologies: a monetary theory and regulation perspective. The Journal of Financial Perspectives: FinTech, 3(3), 1-43. https://www.ey.com/Publication/vwLUAssets/ey-trends-in-cryptocurrencies-and-blockchain-technologies-a-monetary-theory-and-regulation-perspective/$FILE/ey-trends-in-cryptocurrencies-and-blockchain-technologies-a-monetary-theory-and-regulation-perspective.pdf

Prentis, M. (2015). Digital Metal: Regulating Bitcoin as a Commodity. Case Western Reserve Law Review, 66(2), 609-638. https://scholarlycommons.law.case.edu/cgi/viewcontent.cgi?article=2654&context=caselrev

Qamruzzaman, M., and Wei, J. (2018). Financial Innovation, Stock Market Development, and Economic Growth: An Application of ARDL Model. International Journal of Financial Studies, 6(3), 1-30. http://dx.doi.org/10.3390/ijfs6030069

Sabalionis, A., Wang, W., Park, H. (2020). What Affects the Price Movements in Bitcoin and Ethereum?. The Manchester School, 1-26. https://doi.org/10.1111/manc.12352

Shynkevich, A. (2020). Impact of Bitcoin Futures on the Informational Efficiency of Bitcoin Sport Market. Journal of Futures Markets, 1-20. https://doi.org/10.1002/fut.22164

Tari, R., and Yıldırım, Ç. (2009). Döviz Kuru Belirsizliğinin İhracata Etkisi: Türkiye İçin Bir Uygulama. Yönetim ve Ekonomi: Celal Bayar Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 16(2), 95–105. https://doi.org/10.18657/yecbu.22783

Uddin, M.G.S., and Alam, M.M. (2010). The Impacts of Interest Rate on Stock Market: Empirical Evidence from Dhaka Stock Exchange, South Asian Journal of Management Sciences, 4(1), 21-30.

Wegdell, A.A.G. (2014). Prospects of Bitcoin - An Evalutation Of Its Future. Lund University. http://lup.lub.lu.se/student-papers/record/4462711

Wolla, S.A. (2018). Bitcoin: Money or Financial Investment?, Federal Reserve Bank of St. Louis, 1-6. https://files.stlouisfed.org/files/htdocs/publications/page1-econ/2018/03/01/bitcoin-money-or-financial-investment_SE.pdf

Yermak, D. (2013). Is Bitcoin A Real Currency? An Economic Appraisal, Cambridge, National Bureau of Economic Research. https://www.nber.org/papers/w19747.pdf

Yılancı, V. (2012). Türkiye'de Para Talebi İstikrarsızlığının Testi: Kayan Pencerelerde Sınır Testi Yaklaşımı. Dumlupınar Üniversitesi Sosyal Bilimler Dergisi, (33), 67–74. https://dergipark.org.tr/en/download/article-file/55789