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Research Article

The Relationship Between Bitcoin Trade Volume and Inflation Uncertainty: Evidence from Turkey

Bitcoin Ticaret Hacmi ile Enflasyon Belirsizliği Arasındaki İlişki: Türkiye Örneği

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Öz

Son yıllarda gelişmekte olan piyasalarda Bitcoin kullanımı artmış olsa da, literatürde Bitcoin kullanımını belirleyen unsurların ne olduğunu araştıran çalışma sayısı oldukça sınırlıdır. Türkiye, kripto para sahipliğinin oldukça yaygın olduğu ülkelerden biri haline gelmiştir. Bu makale, Türkiye'de enflasyon belirsizliği ile Bitcoin ticaret hacmi arasında bir eşbütünleşme ilişkisi olup olmadığını inceleyerek literatüre katkı yapmayı amaçlamaktadır. Enflasyon belirsizliği enflasyon serisindeki koşullu varyans ile temsil edilmektedir. Koşullu varyans, enflasyon serisine EGARCH modeli uygulanarak tahmin edilmektedir. Bu çalışma ile, liteatürde ilk kez, doğrusal olmayan bir eşbütünleşme yaklaşımı kullanılarak, Bitcoin ticaret hacminin enflasyon belirsizliğiyle birlikte uzun vadeli bir denge etrafında dalgalanarak hareket ettiğine kanıt sunulmaktadır.

Anahtar Kelimeler: *Bitcoin, Yerel ticaret hacmi, Doğrusal olmayan eşbütünleşme, Türkiye*

Abstract

Even though Bitcoin use has been increasing in emerging markets in recent years, the literature on the determinants of Bitcoin adoption is rather scarce. Turkey has become one of the countries in which cryptocurrency ownership is fairly common. This paper aims to contribute to the literature by examining whether inflation uncertainty and Bitcoin trade volume are cointegrated in Turkey. Inflation uncertainty is proxied by the conditional variance in inflation which is obtained by estimating the EGARCH model of the inflation series. By employing a nonlinear cointegration approach, the paper provides evidence for the first time that Bitcoin trade volume moves together with inflation uncertainty by fluctuating around a long-run equilibrium.

Key words: *Bitcoin, Local trade volume, Nonlinear cointegration, Turkey*

Jel codes: *E44, G10, G11, G12.*

1. Introduction

After its introduction in 2009, Bitcoin has attracted a great deal of attention in the finance literature. In recent years, it has been observed that the interest in Bitcoin has increased substantially in emerging markets. Turkey has become one of the countries in which cryptocurrency ownership is fairly common. Two different surveys conducted by ING (ING

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International Survey, 2019) and Statista Global Consumer Survey[1] find that nearly 20% of surveyed Turkish people do own cryptocurrency. Furthermore, according to Chainalysis' global cryptocurrency adoption index which ranks 154 countries, Turkey ranks the 29th country in terms of cryptocurrency adoption. It is surprising that Bitcoin trade volume kept increasing in Turkey during the Covid-19 pandemic despite the slump in the Bitcoin market.

What might be the reasons of the increasing Bitcoin adoption in Turkey? The obvious answer to this question is economic problems. In the face of inflation uncertainty and extremely volatile Turkish Lira, investors are desperately looking for a way to protect their wealth. In this study, we investigate whether inflation uncertainty is a reason for the increased use of Bitcoin in Turkey. High inflation rates have always become one of the most important economic problems in Turkey. Although the inflation rate dropped to single digit values after the implementation of inflation targeting policies, the inflation rate has been increasing in Turkey since August 2018 after a currency crisis. Since then, the rise in the inflation rate and inflation uncertainty has been among the main concerns of investors.

It is a well-documented fact that the residents turn to other currencies or commodities to protect the purchasing power of their income in the face of increasing inflation (Calvo and Veigh, 1992; Worthington and Pahlavani, 2007). The assets used for hedging have been usually dollar and gold in most of the countries experiencing high inflation problem. However, the investors now realized that Bitcoin can also be used as a long term store of value and began to increase the share of Bitcoin in their investment portfolios (Spade, 2018; Cifuentes, 2019; Henriques and Sadorsky, 2018). The inflationary fears caused by the expansion of the money supply contributed to the further increase in the use of Bitcoin in Turkey.

There is a number of studies on the determinants of Bitcoin trade volume. Urquart (2018) and Aalborg et al. (2019) investigate the effect of returns and realized volatility on investors' interest in Bitcoin by utilizing the Google trends search queries and concluded that volatility and previous days' returns have an important effect on Bitcoin demand. Employing a multifractal detrended cross-correlations analysis, El Alaoui, Bouri, and Roubaud (2018) examine the relationship between the Bitcoin price and volume and obtained evidence for the existence of price–volume multifractal cross-correlations. Jerdack et al. (2019) analyze whether online search popularity, financial news, and volume of trade in stock markets affect Bitcoin trade volume. They conclude that the volume of trade in stock markets has a negative effect on trade volume while financial news does not affect Bitcoin trade volume significantly.

The aforementioned studies emphasize the importance of financial factors on Bitcoin trade volume. Economic variables may also influence Bitcoin volume dynamics. However, only a few studies are exploring the economic drivers of the Bitcoin trade volume. Vaddepalli and Antoney (2017) investigate the relationship between financial openness, inflation, and Bitcoin trade volume by using Pearson correlation analysis and reach the conclusion that there is no relation between inflation and Bitcoin trade volume. Parino et al. (2018) find that there is a correlation between Bitcoin trade volume and GDP per capita, freedom of trade, and internet penetration. In a recent study, Bouraoui (2019) examines the drivers of Bitcoin trading volume in selected emerging markets and concludes that Bitcoin trade volume is associated with banking system access and prices of altcoin prices.

The line of research on Bitcoin dynamics in Turkey focuses on financial aspects rather than the association between economic variables and Bitcoin trade volume. Vardar and Aydogan (2019) examine the return and volatility spillovers between Bitcoin and other traditional assets using a VAR-GARCH model and provides evidence for the existence of volatility spillover effects between Bitcoin and all other financial asset classes, except the US Dollar exchange rate. Koçoğlu et al. (2016) examine the efficiency of Bitcoin markets and conclude that Bitcoin does not have a

[1] https://www.statista.com/chart/18345/crypto-currency-adoption/

relation with other assets, making it a good portfolio diversifier. Öget and Kanat (2018) examine the relation between Bitcoin price and stock exchange markets in G7 countries and Turkey using a VECM model and find that there is no long run relation between Bitcoin price and stock exchange markets. In a similar study, Dirican and Canöz (2017) examine the relation between Bitcoin price and major stock markets and find that there is cointegration between them.

Despite the fact that inflation uncertainty can be one of the most important driving forces of Bitcoin trade volume, the relation between inflation uncertainty and Bitcoin trade volume is highly neglected in the literature. This is an important issue that is worth exploring especially for countries such as Turkey dealing with high inflation uncertainty. However, the existing literature related to the case of Turkey does not tackle this problem. To the best of our knowledge, there is no study examining the effect of inflation uncertainty on Bitcoin trade volume in the literature. We attempt to contribute to the literature by examining whether Bitcoin trade volume is cointegrated with inflation uncertainty. To this end, first, we apply an exponential generalized autoregressive conditional heteroskedastic (EGARCH) modeling approach to inflation series and estimate its conditional variance to proxy inflation uncertainty. The EGARCH model allows asymmetries on the responses of uncertainty to inflation shocks. Then, we employ the nonlinear cointegration approach developed by Kapetanios et al. (2006) (henceforth KSS). This approach, which is based on the linear smooth transition autoregression (STAR) framework, is more appropriate in the presence of nonlinearities that may arise as a result of transaction costs (Anderson, 1997). The results show that Bitcoin trade volume is cointegrated with inflation uncertainty in Turkey.

The remainder of the paper is structured as follows: Section 2 reviews the methodology used in the paper. Section 3 presents the data as well as the empirical results. Finally, Section 4 offers a conclusion.

2. Methodology

This study investigates whether inflation uncertainty and Bitcoin trade volume are cointegrated using a nonlinear cointegration approach proposed by Kapetanios et al. (2003, 2006). To measure inflation uncertainty, we apply an exponential generalized autoregressive conditional heteroskedastic (EGARCH) modeling approach to inflation series and estimate its conditional variance to proxy inflation uncertainty.

We prefer the generalized autoregressive conditional heteroskedastic (GARCH) modeling approach because of its advantages over the competent approaches. For example, in the literature, the uncertainty of a variable is commonly measured using the variability of that variable. However, in macroeconomic markets, existing knowledge may have a positive or a negative effect on uncertainty about a variable without any change in the computed volatility of that variable (Evans, 1991). Hence, while measuring uncertainty, one must take into account the existing information set. Introduced by Engle (1982) and Bollerslev et al. (1986), the autoregressive conditional heteroskedastic (ARCH) and generalized autoregressive conditional heteroskedastic (GARCH) models allow one to model a variable with volatile variance using the information set about them. In particular, according to the GARCH modeling approach, conditional variance in a series is expressed as a function of its lagged value and the error term obtained from the autoregressive model of the variable. The GARCH modeling approach has several other advantages in estimating uncertainty as well. In addition, the GARCH modeling approach is efficient since it allows one to simultaneously estimate the conditional mean and the conditional variance of variables, unlike a two-step approach. Furthermore, GARCH models enable one to test the significance of the dynamic aspect of the conditional variance (Hasanov and Omay, 2011).

Many studies have applied the GARCH modeling approach to obtain inflation uncertainty[2]. However, GARCH models impose symmetry on the response of uncertainty to inflation shocks. Fountas et al. (2004) and Wilson (2006) propose the EGARCH model, which allows positive and negative inflation shocks to have different effects on estimates of conditional variances in a variable. We model the inflation series using EGARCH(1,1) model and obtain the conditional variance in the inflation series by estimating the model. The conditional variance is the unpredictable part of the variance in inflation series, which comply with the notion of uncertainty.

Let I_t be the inflation rate. Univariate EGARCH(1,1) model for the inflation rate can be expressed as follows:

$$I_t = \beta_0 + \sum_{i=1}^{p} \beta_i I_{t-1} + \varepsilon_t \tag{1}$$

$$\ln \sigma_t^2 = \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \gamma_2 \ln \sigma_{t-1}^2 \tag{2}$$

where ln represents natural logarithm. $\beta_i, i = 0,1 \dots, p$ and $\gamma_j, j = 0,1,2$ are the parameters of the model. The residual ε_t is conditionally normal with mean zero and its conditional variance is σ_t^2. After estimating EGARCH model for inflation, the conditional variance series, σ_t^2, is obtained and used as the series for inflation uncertainty.

After creating a series for inflation uncertainty, to proceed the nonlinear cointegration approach, we first write the following long run relationship between two variables (Y_t and x_t) with a relaxed form:

$$Y_t = \gamma_0 + \gamma_1 x_t + \mu_t \qquad \mathrm{t} = 1, \dots, \mathrm{T} \tag{3}$$

where γ_0 is a constant and μ_t is the disturbance term. T is the total number of observations. In our study, Y_t is change in Bitcoin trade volume, x_t is change in inflation uncertainty.

As proposed by Kapetanios et al. (2003, 2006), the long run equilibrium process can be modelled using conditional exponential smooth transition regression error correction model STR ECM for ΔY_t as follows:

$$\Delta Y_t = \phi\mu_{t-1} + \gamma\mu_{t-1}\Theta(\theta;\ \mu_{t-1}) + \pi\Delta x_t + \sum_{i=1}^{p} \vartheta_i \Delta z_{t-i} + \epsilon_t \tag{4}$$

where $z_t = (Y_t, x_t)'$

where ϕ, γ, π, and ϑ_i for $i = 1..p$ denote the parameters and ϵ_t is independent and identically distributed white noise disturbance with zero mean and constant variance. It is assumed that $\theta \geq 0$. $\Theta(\theta;\ \mu_{t-1})$ is the transition function of the exponential form given by the following:

$$\Theta(\theta;\ \mu_{t-1}) = 1 - \exp[-\theta(\mu_{t-1} - c)^2] \tag{5}$$

Since the range of the transition function is $[0, 1]$, the extreme values of the transition function $\Theta(\theta;\ \mu_{t-1}) = 0$ and $\Theta(\theta;\ \mu_{t-1}) = 1$ generate two extreme regimes. However, while

[2] See, for example, Grier and Mark (1998), Fountas et al. (2004), Kontonikas (2004), Payne (2009), Keskek and Orhan (2010), Caporale et al. (2012), Hartmann and Herwartz (2012), Zivkov et al. (2014) , Jiang (2016), Lawton and Gallagher (2020).

$\Theta(\theta;\ \mu_{t-1})$ changes from one extreme regime to the other, the parameter of μ_{t-1} of the model (4) changes smoothly. Regime changes are associated with small and big values of μ_{t-1} with respect to the threshold value c.

In order μ_t to follow a unit root process in the middle regime while being globally geometrically ergodic, Kapetanios et al. (2006) assume that $\phi = 0$. Then, they set the null hypothesis of no cointegration is as $\theta = 0$ in the model (2). The alternative hypothesis that μ_t is a nonlinear globally stationary process is $\theta > 0$.

Kapetanios et al. (2006) propose a two-step approach to test the null hypothesis. In the first step, the residuals $\hat{\mu}_t$ are obtained by ordinary least square method ($\hat{\mu}_t = Y_t - \hat{\gamma}_0 - \hat{\gamma}_1 x_t$ where $(\hat{\gamma}_0, \hat{\gamma}_1)$ are the ordinary least square estimates of the model parameters.) In the second step, the transition function $\Theta(\theta;\ \mu_{t-1})$ is approximated using a first order Taylor series approximation. As a result, we write the ESTAR model as follows:

$$\Delta Y_t = \delta_1 \hat{\mu}_{t-1} + \delta_2 \hat{\mu}_{t-1}^2 + \delta_3 \hat{\mu}_{t-1}^3 + \pi' \Delta x_t + \sum_{i=1}^{p} \vartheta_i' \Delta z_{t-i} + e_t \qquad (6)$$

The null hypothesis then can be tested using $F - type$ test for $\delta_1 = \delta_2 = \delta_3 = 0$ given as

$$F_{NEC} = \frac{(SSR_0 - SSR_1)/3}{SSR_0/(T-4-p)} \qquad (7)$$

where SSR_0 and SSR_1 are the sums of squared residuals obtained from models Eq. 8 and Eq. 6, respectively.

$$\Delta Y_t = \pi' \Delta x_t + \sum_{i=1}^{p} \vartheta_i' \Delta z_{t-i} + e_t \qquad (8)$$

By making the assumption that switching point is assumed to be zero ($c = 0$), we obtain the following auxiliary testing regression:

$$\Delta Y_t = \delta_1 \hat{\mu}_{t-1} + \delta_3 \hat{\mu}_{t-1}^3 + \pi' \Delta x_t + \sum_{i=1}^{p} \vartheta_i' \Delta z_{t-i} + e_t \qquad (9)$$

The null hypothesis of no cointegration then can be tested using $F - type$ test for $\delta_1 = \delta_3 = 0$ given as

$$F_{NEC}^{*} = \frac{(SSR_0 - SSR_1)/3}{SSR_0/(T-4-p)} \qquad (10)$$

where SSR_0 and SSR_1 are the sums of squared residuals obtained from models Eq. 8 and Eq. 9, respectively.

If the test statistic exceeds the related critical value tabulated by Kapetanios et al. (2006), the hypothesis of no cointegration can be rejected at the related significance level.

3. Data and Empirical Results

In order to investigate the cointegration relationship between local Bitcoin trade volume and inflation uncertainty for Turkey, we use data over the period between 2013:03 and 2019:12. Monthly trade volume is calculated using weekly data on local Bitcoin trading volume which is acquired from Coin Dance. The inflation rate is measured as the change in the Consumer Price Index (CPI) from the previous period. CPI series is obtained from the International Monetary Fund, Macroeconomic and Financial Data database. The series for inflation uncertainty is the conditional variance in inflation which is obtained by estimating the EGARCH model of inflation given by Eq. 1 and Eq. 2. The descriptive statistics of inflation, inflation uncertainty, and Bitcoin trade volume series are given in Table 1. The positive and negative values of skewness and kurtosis, and Jarque-Bera statistics suggest that the series are not normally distributed, thus, the relationship between the series might be nonlinear (Hamilton, 1994).

Table 1 Descriptive Statistics of the Series

	Inflation	Inflation Uncertainty	Bitcoin Trade Volume
Mean	0.870	0.595	982998.8
Median	0.723	0.417	140313.0
Maximum	6.305	2.021	6561925.0
Minimum	-1.443	0.154	0.000
Std. Dev.	0.981	0.458	1234989.
Skewness	2.094	1.836	1.632
Kurtosis	12.963	5.447	7.001
Jarque-Bera	399.087	65.693	92.200
Probability	0.000	0.000	0.000000

The empirical procedure to apply the nonlinear cointegration approach KSS, proposed by Kapetanios et al. (2006), begins with an examination of the stationarity of the series under investigation. To this end, we apply Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests to inflation uncertainty and Bitcoin trade volume ant their first difference series. Table 2 reports the unit root test results, which indicate that the null hypothesis of a unit root can be rejected for both series in first difference. Since they are stationary, KSS can be employed.

Table 2 The unit root test results

	ADF		PP	
Variables	**Level**	**The first difference**	**Level**	**The first difference**
Inflation Uncertainty	-2.539	-4.212***	-2.079	-7.599***
Bitcoin Trade Volume	-2.121	-9.322***	-2.126	-9.385***

Notes: Only intercepts are used in unit root tests in levels since the series do not display a trending behavior over the period considered. The lag lengths of each variable in each equation for ADF test are determined by applying Schwarz Criteria. *** denotes significance at 1% level.

However, before adopting KSS, to show that the dynamic relationship between inflation uncertainty and Bitcoin trade volume is inherently nonlinear, we apply the LM-type linearity tests proposed by Teräsvirta (1994). To this end, we first estimate the model (3) where Y_t is the first difference of Bitcoin trade volume and x_t is the first difference in inflation uncertainty. Then, we use its residuals to form a smooth transition autoregressive model with the lags of the residuals as candidate transition variables. The autoregressive structure of the STAR model is specified by eliminating the autocorrelation in its benchmark linear model given by Eq. 3. We test the model against linearity using F-tests. The test results are given in Table 3. For the majority of the candidate transition variables, the null hypothesis of linearity can be rejected. These results indicate the existence of nonlinearity in the relationship between inflation and Bitcoin trade volume.

Table 3 The LM-type linearity test results

Candidate Trans. Var.	F-value	Candidate Trans. Var.	F-value
$\hat{\mu}_{t-1}$	8.662***	$\hat{\mu}_{t-7}$	6.787**
$\hat{\mu}_{t-2}$	14.016***	$\hat{\mu}_{t-8}$	4.453***
$\hat{\mu}_{t-3}$	5.095***	$\hat{\mu}_{t-9}$	4.968 ***
$\hat{\mu}_{t-4}$	4.622***	$\hat{\mu}_{t-10}$	1.932**
$\hat{\mu}_{t-5}$	1.552	$\hat{\mu}_{t-11}$	6.245***
$\hat{\mu}_{t-6}$	4.472***	$\hat{\mu}_{t-12}$	3.950**

Notes: $\hat{\mu}_{t-i}$, for $i = 1..12$ represent the residual obtained by applying by ordinary least square method to the model given by Eq. 3 ($\hat{\mu}_t = Y_t - \hat{\gamma}_0 - \hat{\gamma}_1 x_t$ where $(\hat{\gamma}_0, \hat{\gamma}_1)$ are the ordinary least square estimates of the model parameters) ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively.

After justifying that the nonlinearity between the series, we proceed to apply KSS. We estimate the auxiliary models (6), (8), and (9) and calculate F_{NEC} and F^*_{NEC} statistics, which are reported in Table 4. OAT stands for the order of the autoregressive terms. The critical values of the F_{NEC} and F^*_{NEC} tests at 10%, 5% and 1% significance levels for one regressor are 11.79, 13.73, 17.38 and 10.13, 12.17, and 16.36, respectively. Since F_{NEC} and F^*_{NEC} statistics exceed the critical value of KSS tests, the hypothesis of no cointegration can be rejected for both models.

Table 4 The nonlinear cointegration test results

Models	F_{NEC}	F^*_{NEC}
F-statistics	18.302***	27.663***
OAT	3	3
LB-Q(1)	0.002	0.049
LB-Q(4)	0.544	0.561
ARCH(1)	9.012***	14.683***

Note: *** denote significance at 1% level.

Lastly, we test for the existence of autocorrelation and heteroscedasticity to examine if there are potential threats to affect the test results. To examine the presence of autocorrelation, the Ljung-Box Q (LB-Q(j)) test is applied. As it is seen in Table 3, there is no autocorrelation in both cases.

To examine the issue of heteroscedasticity, first order autoregressive conditional heteroscedasticity test (ARCH(1)) proposed by Engel (1982) is used. The test statistics presented in Table 4 indicate that ARCH effects are not detected in both cases.

4. Conclusion

Bitcoin adoption has been increasing in Turkey in recent years. Meanwhile, inflation uncertainty has also been on the rise. Understanding the effect of inflation uncertainty on Bitcoin trade volume in Turkey in recent years is important to identify the determinants of Bitcoin trade volume. Nevertheless, the literature on the Bitcoin market has ignored the effect of inflation uncertainty on trade volume. In the current paper, we investigate whether Bitcoin trade volume is cointegrated with inflation uncertainty by applying the nonlinear cointegration approach developed by Kapetanios et al. (2006). We conclude that there is nonlinear cointegration between inflation uncertainty and local Bitcoin trade volume in Turkey indicating that investors consider inflationary expectations in their investment decisions.

The findings of the paper have several implications. First of all, because Bitcoin trade volume is cointegrated with inflation uncertainty, Bitcoin trade volume in Turkey may decrease if the inflation rate is stabilized at low levels. Nowadays, because we see a lot of interest coming from international finance companies and banks for investing in Turkey's Bitcoin market, these firms should also consider the likely changes in the inflation rate.

Furthermore, although the Bitcoin market provides certain opportunities to investors, it also brings about certain risks. The Bitcoin market is known to be very volatile, not regulated, open to speculation, and open to large losses as well as gains. Hence, it is possible that financial stability may be threatened with the increasing use of Bitcoin. Therefore, reducing inflation uncertainty should be one of the priorities of monetary authorities to decrease Bitcoin adoption.

This study has certain limitations. First of all, we analyze the cointegration between Bitcoin trade volume and inflation uncertainty. However, various cryptocurrencies exist and this study may be repeated for other cryptocurrencies. Moreover, the same analysis can be undertaken for other countries experiencing high inflation uncertainty to see if our results can be generalized to other countries as well. Especially, extending the analysis to the countries such as Argentina and Venezuela may provide helpful insights regarding the inflation uncertainty and trade volume nexus.

The literature on the economic determinants of Bitcoin dynamicss is very limited and there is much to be done to further explore the relationship between various economic factors and Bitcoin trade volume for specific country cases by employing different econometric techniques and different variables.

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<u>Araştırma Makalesi</u>

The Relationship Between Bitcoin Trade Volume and Inflation Uncertainty: Evidence from Turkey

Bitcoin Ticaret Hacmi ile Enflasyon Belirsizliği Arasındaki İlişki: Türkiye Örneği

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Genişletilmiş Özet

Giriş

Son yıllarda gelişmekte olan piyasalarda Bitcoin kullanımı artmış olsa da, literatürde Bitcoin kullanımını belirleyen unsurların ne olduğunu araştıran çalışma sayısı oldukça sınırlıdır. Türkiye, kripto para sahipliğinin oldukça yaygın olduğu ülkelerden biri haline gelmiştir. Türkiye'de artan Bitcoin kullanımının nedenleri neler olabilir? Bu sorunun en net cevabı ekonomik problemlerdir. Enflasyon belirsizliği ve son derece değişken Türk Lirası karşısında, yatırımcılar çaresizce servetlerini korumanın bir yolunu aramaktadır. Bu çalışmada, enflasyon belirsizliğinin Türkiye'de Bitcoin kullanımının artmasının bir nedeni olup olmadığı araştırılmaktadır.

Artan enflasyon karşısında, gelirlerinin satın alma gücünü korumak için ülke vatandaşlarının başka ülke para birimlerine veya emtialara yöneldiği iyi belgelenmiş bir gerçektir (Calvo ve Veigh, 1992; Worthington ve Pahlavani, 2007). Yüksek enflasyon sorunu yaşayan ülkelerin çoğunda riskten korunma için kullanılan varlıklar genellikle dolar ve altın olmuştur. Ancak yatırımcılar artık Bitcoin'in uzun vadeli bir değer deposu olarak da kullanılabileceğini fark etmiş ve Bitcoin'in yatırım portföylerindeki payını artırmaya başlamıştır. Para arzının genişlemesinin neden olduğu enflasyonist korkular, Türkiye'de Bitcoin kullanımının daha da artmasına katkıda bulunmaktadır.

Yazarların bilgisi dahilinde, literatürde enflasyon belirsizliğinin Bitcoin ticaret hacmi üzerindeki etkisini inceleyen bir çalışma bulunmamaktadır. Bu, özellikle Türkiye gibi yüksek enflasyon belirsizliği ile başa çıkmak zorunda kalan ülkeler için araştırmaya değer önemli bir konudur. Ancak, Türkiye ile ilgili mevcut literatür bu sorunu ele almamaktadır. Bu çalışma, Bitcoin ticaret hacminin enflasyon belirsizliği ile uzun dönemde birlikte hareket edip etmediğini analiz ederek literatüre katkıda bulunmaktadır.

Yöntem

Bu çalışmada, enflasyon serilerine üstel bir genelleştirilmiş otoregresif koşullu heteroskedastik (EGARCH) modelleme yaklaşımı uygulanmakta ve enflasyon serisindeki varyansın öngörülemeyen parçası belirsizlik kavramıyla uyumlu olduğundan, enflasyon belirsizliğini temsil etmek üzere koşullu varyans tahmin edilmektedir. Bu çalışma benzer yaklaşımlara göre avantajları olması nedeniyle GARCH modelleme yaklaşımını tercih etmektedir. Literatürde, bir değişkenin belirsizliği genellikle o değişkenin değişkenliği kullanılarak ölçülmektedir. Bununla birlikte, makroekonomik piyasalarda, mevcut bilgi, o değişkenin hesaplanan oynaklığında herhangi bir değişiklik olmaksızın, bir değişken hakkındaki belirsizlik üzerinde etkili olabilmektedir (Evans, 1991). Bu nedenle, belirsizlik ölçülürken mevcut bilgi setinin hesaba katılması gerekmektedir. Engle (1982) tarafından oluşturulan ve Bollerslev vd. (1986) tarafından geliştirilen otoregresif koşullu heteroskedastik (ARCH) ve genelleştirilmiş otoregresif koşullu heteroskedastik (GARCH) modelleri, değişken varyanslı bir değişkenin ilgili bilgi kümesini kullanarak modellenmesine izin vermektedir.

Bununla birlikte, GARCH modelleri belirsizliğin pozitif ve negatif enflasyon şoklarına tepkisinin simetrik olduğunu varsaymaktadır. Fountas vd. (2004) ve Wilson (2006), pozitif ve negatif enflasyon şoklarının bir değişkendeki koşullu varyans tahminleri üzerinde farklı etkilere sahip olmasına izin veren EGARCH modelini önermiştir. Bu çalışmada, enflasyon serisi EGARCH (1,1) modeline göre modellenmekte ve bu model tahmin edilerek, enflasyon serisindeki koşullu varyans elde edilmektedir.

Enflasyon belirsizliği için bir seri oluşturduktan sonra, Kapetanios vd. (2006) (bundan böyle KSS) tarafından geliştirilen doğrusal olmayan eşbütünleşme yaklaşımı kullanılmaktadır. Doğrusal yumuşak geçişli otoregresyon (STAR) modellemesine dayanan bu yaklaşım, ele alınan değişkenler arasında işlem maliyetlerinin bir sonucu olarak ortaya çıkabilecek doğrusal olmayan yapıların varlığında daha uygundur (Anderson, 1997).

Veri

Bu çalışmada kullanılan verileri 2013: 03 ve 2019: 12 arasındaki dönemi kapsamaktadır. Aylık Bitcoin işlem hacmi, Coin Dance'tan alınan yerel Bitcoin işlem hacmine ilişkin haftalık veriler kullanılarak hesaplanmıştır. Enflasyon oranı, Tüketici Fiyat Endeksi'nde bir önceki döneme göre değişim olarak ölçülmüştür. TÜFE serisi Uluslararası Para Fonu, Makroekonomik ve Finansal Veri tabanından alınmıştır.

Ampirik Bulgular

Kapetanios ve ark. (2006) tarafından geliştirilen doğrusal olmayan eşbütünleşme yaklaşımını (KSS) uygulamak için ampirik prosedür, ele alınan serilerin durağan olup olmadıklarını analiz etmekle başlamaktadır. Bu amaçla, enflasyon belirsizliği serisine ve Bitcoin ticaret hacmindeki ilk fark alınarak elde edilen seriye Augmented Dickey-Fuller (ADF) ve Phillips-Perron (PP) birim kök testleri uygulanmaktadır. Birim kök testlerinin sonuçları, her iki serinin de durağan olduğunu göstermektedir.

Enflasyon belirsizliği ile Bitcoin ticaret hacmi arasındaki dinamik ilişkinin doğası gereği doğrusal olmadığını göstermek için Teräsvirta (1994) tarafından önerilen LM-tipi doğrusallık testleri uygulanmıştır. Model tahminleri ve yapılan testler, söz konusu iki değişken arasındaki ilişkinin doğrusal olmadığına ilişkin güçlü kanıtlar sunmuştur.

Seriler arasındaki ilişkinin doğrusal olmadığı gerekçelendirildikten sonra, KSS uygulamasına geçilmiştir. KSS'nin için model tahminleri yapıldıktan sonra, F_{NEC} ve F_{NEC}^{*} istatistikleri hesaplanmıştır. Tablo 1'de görüldüğü gibi, F_{NEC} ve F_{NEC}^{*} istatistikleri KSS testlerinin kritik değerlerini aşmaktadır. Bu nedenle eşbütünleşme yok sıfır hipotezi her iki model için de reddedilebilmektedir.

Tablo 1 Doğrusal Olmayan Eşbütünleşme Test Sonuçları

Modeller	$\mathbf{F_{NEC}}$	$\mathbf{F^{*}_{NEC}}$
F-statistics	18.302***	27.663***

Not: Bir açıklayıcı değişkenli modelde % 10, % 5 ve % 1 anlamlılık seviyelerinde F_{NEC} and F^{*}_{NEC} testlerinin kritik değerleri sırasıyla 11.79, 13.73, 17.38 ve 10.13, 12.17 ve 16.36'dır. *** % 1 düzeyinde anlamlılığı göstermektedir.

Sonuç

Bu çalışma, Kapetanios vd. (2006) tarafından geliştirilen doğrusal olmayan eşbütünleşme yaklaşımını uygulayarak Bitcoin ticaret hacminin enflasyon belirsizliği ile eş-bütünleşip bütünleşmediğini araştırmaktadır. Çalışma, Türkiye'de söz konusu değişkenlerin aralarında doğrusal olmayan eşbütünleşme ilişkisi olduğu sonucuna varmıştır. Sonuçlar, yatırımcıların yatırım kararlarında enflasyonist beklentileri dikkate aldıklarını göstermektedir.

Makalenin bulgularının çeşitli çıkarımları bulunmaktadır. Öncelikle Bitcoin ticaret hacmi enflasyon belirsizliği ile eşbütünleşik olduğundan, enflasyon oranının düşük seviyelerde tutulabilmesi halinde Türkiye'deki Bitcoin ticaret hacmi düşebilecektir. Ayrıca Bitcoin piyasası yatırımcılara belirli fırsatlar sunmasına rağmen, belirli riskleri de beraberinde getirmektedir. Bitcoin piyasasının çok değişken olduğu, düzenlenemediği, spekülasyonlara açık olduğu ve kazançların yanı sıra büyük kayıplara açık olduğu bilinmektedir. Dolayısıyla, artan Bitcoin kullanımı finansal istikrar için bir tehdit oluşturabilir. Bu nedenle, Bitcoin kullanımını azaltmak için enflasyon belirsizliğini azaltmaya çalışmak para otoritelerinin önceliklerinden biri olmalıdır.