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Bitcoin as an Alternative Financial Asset: Relations Between Geopolitical Risk, Global Economic Political Uncertainty, and Energy Consumption[1*]

Alternatif Bir Finansal Varlık Olarak Bitcoin: Jeopolitik Risk, Küresel Ekonomik Politik Belirsizlik ve Enerji Tüketimi Arasındaki İlişkiler

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Abstract

The aim of this research is to investigate the causality between Global Economic Political Uncertainty (GEPU) and Geopolitical Risk (GPRT) and Bitcoin Energy Consumption (BTCE). In order to test the stationarity of the variables, the Lee-Strazich unit root test, which takes into account the structural breaks, was used, and the causality relationship between the variables was analyzed with the Hatemi-J (2012) causality test. Monthly data between May 2011 and February 2022 were used in the research. According to the results obtained from the research, geopolitical risk and global economic policy uncertainity are effective on bitcoin energy consumption. In addition, it has been determined that the negative effects of geopolitical risk and global uncertainties are more dominant. The results show that the demand for bitcoin, which is considered an alternative financial asset class, and accordingly bitcoin energy consumption, increases in case of global risks and economic uncertainties.

Keywords: *Bitcoin, Financial Asset, Global Economic Policy Uncertainity, Geopolitical Risk, Energy Consumption.*

JEL codes: *C58; F37; G14; G15; Q31*

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[1]. Yazarlar bu çalışmanın tüm süreçlerinin araştırma ve yayın etiğine uygun olduğunu, etik kurallara ve bilimsel atıf gösterme ilkelerine uyduğunu beyan etmişlerdir. Aksi bir durumda Pamukkale Journal of Eurasian Socioeconomic Studies Dergisi sorumlu değildir. İntihal raporu alınmıştır.
The authors declared that all processes of this study comply with research and publication ethics, and comply with ethical rules and scientific citation principles. Otherwise, Pamukkale Journal of Eurasian Socioeconomic Studies is not responsible. A plagiarism report is received.

INTRODUCTION

Cryptocurrencies and their energy consumption have become an important matter of discussion in recent years. As of today, more than 2,500 types of cryptocurrencies are being traded in financial markets and this generates a new blockchain ecosystem (Huynh et al., 2022). Introduced as a new financial technology by Satoshi Nakamoto in 2009, Bitcoin continues to be the best-known and most valuable cryptocurrency as of today.

It is possible to categorize the studies conducted on the cryptocurrency market into two main groups. The first of these involves the studies that deal with the investment instrument aspect. In this regard, there is a large literature examining cryptocurrency markets in various different aspects such as risk management tools (Gurdgiev and O'Loughlin, 2020; Das et al., 2020), different asset classes, and investment tools (Corbet et al., 2019; Dyhrberg et al., 2018) effectiveness (Urquhart, 2016), its association with geopolitical uncertainty (Kyriazis, 2021). The second group of studies, however, deals with technologies supporting digital currencies and considers the subject within the framework of the internet of things and smart contracts (Khan and Salah, 2018; Huh et al., 2017). Nonetheless, the number of research studies examining the relationship between bitcoin energy consumption, geopolitical risk and threats (GPRT), and global economic political uncertainty (GEPU) is quite limited. Especially, the significant impact of increasing energy demand on climate change and intense energy requirement of Bitcoin mining both raises concerns and increases the interest in the subject (Küfeoğlu and Özkuran, 2019; Das and Dutta, 2020).

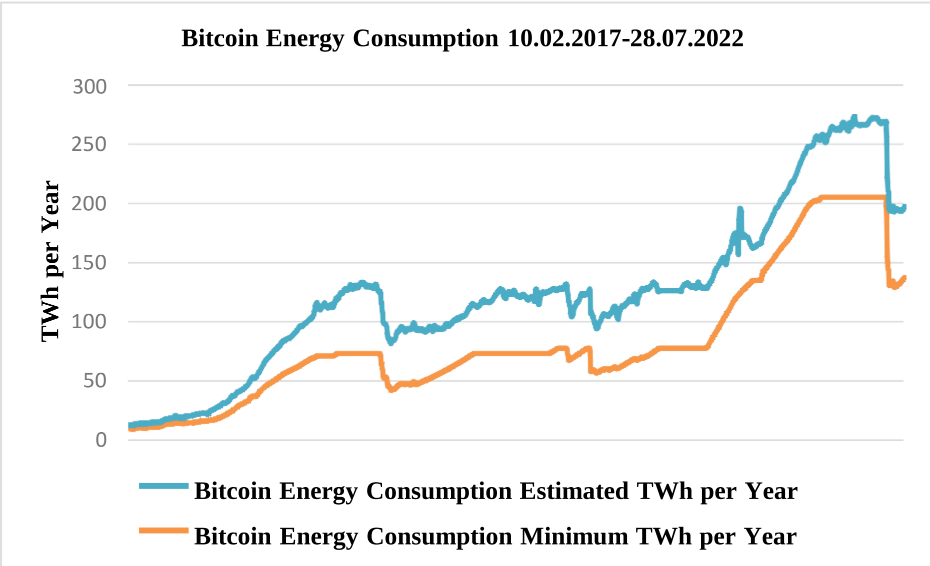


Figure 1: Bitcoin Energy Consumption
Source: https://digiconomist.net/bitcoin-energy-consumption/, 28.07.2022.

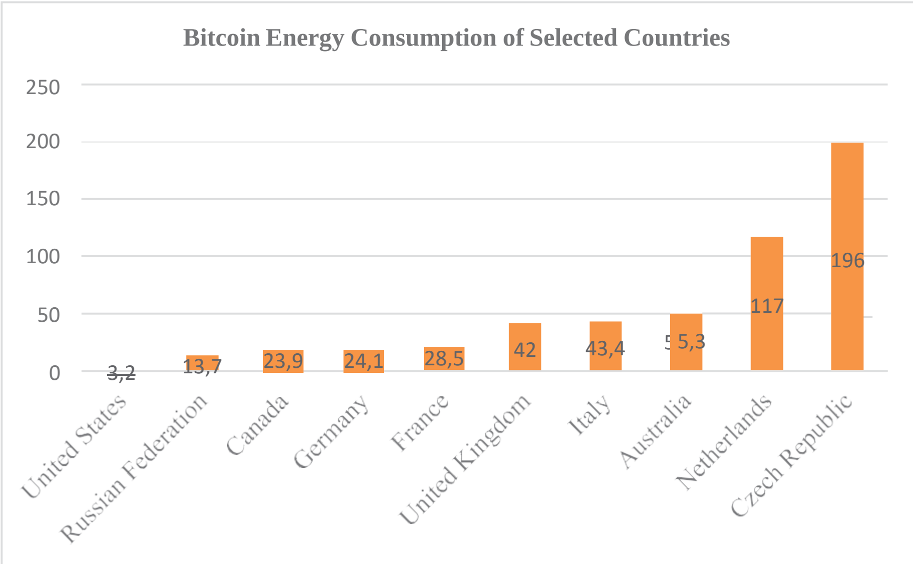


Figure 2. Bitcoin Energy Consumption for Selected Countries
Source: https://digiconomist.net/bitcoin-energy-consumption/, 28.07.2022.

Besides, the recessions in the world stock markets as of 2020, the impact of the COVID-19 pandemic on the global financial markets, as well as the uncertainty, low confidence that dominate the world economy, and high inflation expectation have significantly increased the demand for Bitcoin as an alternative investment tool (BinanceAcademy, 2021). Despite the high risk and volatility, cryptocurrencies have performed better than conventional investment instruments (Sarkodie et al., 2022). For instance, Bitcoin's price rose to $68,000 in November 2021, whereas its market cap was $1.2 trillion USD. In this context, the high performance of Bitcoin in an environment of uncertainty has increased the demand, and the miners who wish to gain a competitive advantage have begun to utilize more powerful computers and have caused higher levels of energy consumption (Sarkodie, 2022). Therefore, it is essential to investigate the relationships between Bitcoin energy consumption and the risk and uncertainty indexes, namely, GPRT and GEPU.

Figure 3. BTC/USD price chart 01.01.2017-28.07.2022
Source: https://coinmarketcap.com/tr/currencies/bitcoin/, 29.07.2022.

In accordance with the literature mentioned above, the research model is developed as follows:

Figure 4. Model of the research
Source: Developed by the author.

Various studies have also been conducted in the literature on energy consumption (Soytaş et al. 2020; Kartal, 2022; Rahaman et al., 2022). A significant portion of these studies is pertinent to environmental degradation. For instance, Abbasi et al. (2021) for Pakistan, Bal et al. (2022) for India, stated that electricity consumption increased CO2 emissions, and all those studies indicated the significant impacts of energy consumption on environmental degradation. Moreover, according to Corbet et al. (2019), it is clear that due to its large market share, Bitcoin also demands a high amount of energy during the validation and mining processes. Krause and Tolaymat (2018) supported this view and stated that cryptocurrency mining was associated with environmental degradation.

Upon considering the gap in the literature, although the investment aspect of cryptocurrencies, particularly Bitcoin, and the environmental impacts of cryptocurrency mining are subject to country-specific research, the issue of the extent to which Bitcoin energy consumption is affected in the presence of uncertainty and risk situations that emerge as a question that needs to be answered. In this context, the research study examines the asymmetric causal relationship between Bitcoin energy consumption and GPRT and GEPU. To this end, the monthly data obtained over the period May 2011 - February 2022 are utilized by performing the Hatemi-J Asymmetric causality analysis. Unlike other tests, the Hatemi-J causality test considers the potential impacts of positive and negative components separately. Thus, the research study would be able to reveal the existence and direction of causality running from GPRT and GEPU independent variables to BTCE. Based on the method mentioned above, the research study investigated (i) the impact of GPRT and GEPU on Bitcoin energy consumption, (ii) if there is an impact, the direction of this impact, (iii) if there is causality, whether or not it is asymmetrical. Empirical findings indicate that GPRT and GEPU have both negative and positive impacts on BTCE, and a causal relationship exists between the variables.

The research study contributes to the literature in various aspects. Firstly, Hatemi-J examines the impact of GPRT and GEPU on BTCE by performing the causality test and expands the existing literature. Secondly, the monthly data are utilized in the empirical analyses, and thus, a dataset with high frequency is used. This is crucial since the high-frequency dataset enhances the predictive power of the econometric model. Although some of the studies such as Al Mamun et al. (2020) and Sarkodie et al. (2022) used daily data, these data were finalized in 2021 at the latest. In this regard, our dataset is quite new compared to other studies and includes the most recent data. Thirdly, unlike the classical tests such as the Toda-Yamamoto causality (1995) and Granger causality (1969) tests, which are frequently performed in previous studies, the research study prefers to perform the Hatemi-J (2012) causality test and examine the impacts of positive and negative components simultaneously.

The research study consists of five parts. In the second part, a literature review is presented. The third part introduces the methodology, and the findings are presented in the fourth part. The fifth and last part is comprised of the conclusion.

1. LITERATURE REVIEW

The GPRT and GEPU indexes, which are the variables that affect Bitcoin energy consumption in the research study, are widely accepted criteria in the literature that assess global economic uncertainties and geopolitical risks (Aysan, 2019; Antonakakis et al., 2017; Bouri et al., 2017). Early studies on economic and political uncertainty were conducted by Baker et al. (2013) who generated the economic policy uncertainty (EPU) index. The EPU index is developed by examining 10 major newspapers in the USA, in general, and the frequency of news containing keywords associated with economy, politics, and uncertainty.

The EPU index is categorized under 3 headings. Although the EPU index was calculated only for the USA at first, eventually it began to be calculated for various European countries. Baker et al. (2016) was conducted in a framework that included the USA and 11 European countries. The developed index was tested by employing the VAR method. The results indicated that EPU had impacts on financial markets, stock markets, construction, and healthcare sectors. Later on, the global economic policy uncertainty (GEPU) index was developed by Davis (2016) employing the same method. This is the GDP-weighted national EPU index, which accounts for 2/3 of global output for 16 countries. Each national EPU index reflects the relative frequency of country-specific newspaper articles, which include triad terms on economics, uncertainty, and policy-related topics. The GEPU index currently consists of the national EPU index of 21 countries. The 21 countries included in the GEPU Index account for approximately 71% of global output and an average of 80% of market exchange rates on a purchasing power parity-adjusted basis (Gürsoy, 2021: 121).

GPR is an index developed by Caldara and Iacoviello (2022) employing the calculation method and is being currently updated and published at www.policyuncertainty.com. Geopolitical risks, however, are described as the entire events that affect the normal and peaceful world order, such as political tension, war, or terrorism (Caldara and Iacoviello, 2016). According to Caldara and Iacoviello (2016), high levels of geopolitical risks lead to a decline in real sector activities, enhance volatility, and slow down the credit spread. Al Mamun et al. (2020) asserted that high geopolitical risk and global economic policy uncertainty generate a risk premium in unfavorable market conditions and that Bitcoin investors hedge their portfolios with merely gold investments in deteriorating market conditions and avoid investments in different financial assets. In this context, the demand for Bitcoin increases throughout the periods of high risk and uncertainty. Gürsoy et al. (2022) found a one-way causal relationship between cryptocurrency price uncertainty and cryptocurrency policy uncertainty indices and bitcoin energy consumption. According to this, in all crypto markets, it was determined that variations in bitcoin's energy consumption had an impact on both pricing and cryptocurrency money policies. There are also studies examining the relations between BTCE and the energy markets. For instance, according to Kılıç et al. (2021), there is unidirectional volatility spread between the S&P 500 and SSE energy indices and a bidirectional volatility spread between the CBECI index and the MOEX energy index. According to research, shocks from the S&P 500 energy index raise the CBECI index while those from the MOEX energy index lower it. Consequently, Bitcoin is a digital currency based on a cryptographically secured distributed ledger, representing the first and best known blockchain application. The computationally intensive verification process, called mining, requires specialized hardware and large amounts of energy, especially electricity, to attain consensus on ownership and transactions (Gallersdörfer et al., 2020).

Being consistent with the existing literature, the study considers geopolitical risk and global economic political risk as dependent variables. Also, Bitcoin energy consumption is the dependent variable of the research study. The causal relationship between the variables is crucial in terms of indicating the impact of uncertainties on energy consumption. Therefore, Table 1 presents the explanations of the indicators used in the research study.

Table 1. Variables Used in The Research

Type of variable	Abbreviation	Explanation
Dependent	BTCE	Bitcoin energy consumption
Independent	GEPU	Global economic politic risk
Independent	GPRT	Geopolitical risk

2. METHODOLOGY AND DATA

The methodology of the research is given in Figure-5 below.

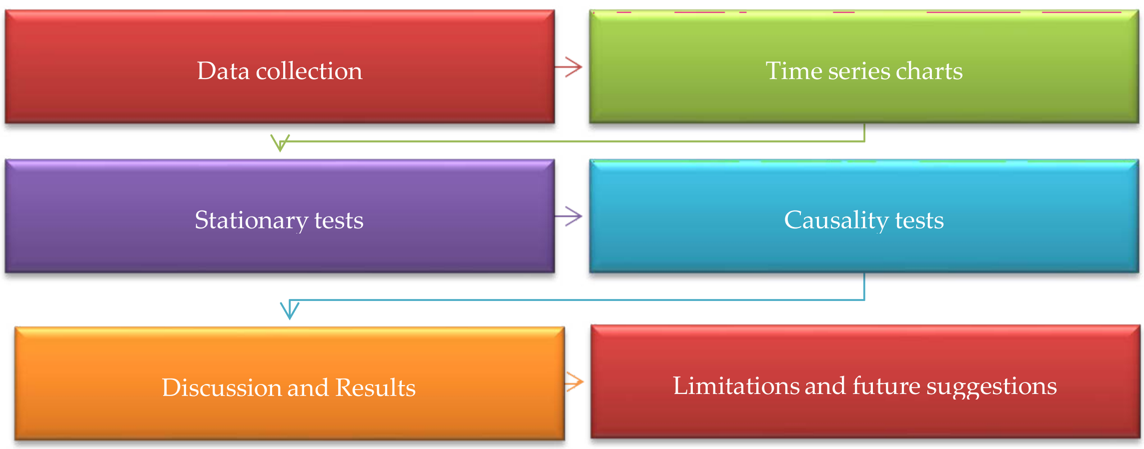


Figure 5. Research methodology

To examine the asymmetrical impact of global economic political uncertainties and geopolitical risks on Bitcoin energy consumption, a multi-stage methodology is employed as follows:

- Firstly, GEPU data are obtained from https://www.policyuncertainty.com/global_monthly.html, GPRT data from https://www.matteoiacoviello.com/gpr.htm, and Bitcoin energy consumption (BTCE) data from https://digiconomist.net/.
- In the second stage, using the monthly data obtained over the period May 2011 - February 2022 for three variables, the Hatemi-J (2012) Asymmetric causality test is performed.
- In the third stage, the degrees of stationarity of the series of variables are determined by performing Lee and Strazicich unit root tests, which also allows the structural breaks.
- In the fourth stage, the break dates of the series are presented simultaneously.

2.1. Lee-Strazicich Unit Root Test

In terms of the reliability of the stationarity results in the time-series, spurious regression should be avoided and the stationarity of the series of the variables should be ensured. In this context, some of these unit root tests such as the Augmented Dickey Fuller-ADF (1981), Phillips-Perron (1988), and Ng-Perron (2001) do not allow structural breaks. In this study, however, a unit root test developed by Lee and Strazicich (2003, 2004) is performed. The results regarding the structural breaks of the series are listed below.

2.2. Hatemi-J Asymmetric Causality Analysis

In asymmetric causality analyses, a probable relationship between the variables is investigated. In this context, the existence of a unit root should be revealed in order to select the most suitable model for the variables, and the degree of stationarity assumes importance. It is expected that the variables in the Granger causality test, a conventional causality test, would be stationary at the same level. Nevertheless, such a requirement is not sought in the Toda-Yamamoto (1995) causality test, however, this causality test yields symmetrical results. Developed by Hatemi-J (2012), causality is investigated by categorizing the variables into positive and negative components. This would help to monitor the dynamics of the series in asymmetric causality analysis and reveal the possible relationship in possible future predictions.
Suppose we wish to test the causality relationship between two integrated variables y_{1t} and y_{2t} as follows (Hatemi-J, 2012: 449-450);

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{10} + \sum_{i=1}^{t} \varepsilon_{1i} \quad and \quad y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{20} + \sum_{i=1}^{t} \varepsilon_{2i} \tag{1}$$

Here, t=1,2,…T represents the constant terms, y_{1t} and y_{2t} denote the initial values, whereas ε_{1i} and ε_{2i} stand for the error terms. Positive and negative shocks are expressed as shown in Equation (5);

$$\varepsilon_{1i}^{+} = \max(\varepsilon_{1i}, 0), \varepsilon_{2i}^{+} = \max(\varepsilon_{2i}, 0), \varepsilon_{1i}^{-} = \min(\varepsilon_{1i}, 0) \; and \; \varepsilon_{2i}^{-} = \min(\varepsilon_{2i}, 0) \tag{2}$$

where $\varepsilon_{1ii} = \varepsilon^+_{1ii} + \varepsilon^-_{1ii}$ and $\varepsilon_{2ii} = \varepsilon^+_{2ii} + \varepsilon^-_{2ii}$. In this context, Equations (1) and (2) are revised and rewritten as shown below.

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{1,0} + \sum_{ii=1}^{t} \varepsilon^+_{1ii} + \sum_{ii=1}^{t} \varepsilon^-_{1ii} \quad (3)$$

$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{2,0} + \sum_{ii=1}^{t} \varepsilon^+_{2ii} + \sum_{ii=1}^{t} \varepsilon^-_{2ii} \quad (4)$$

Finally, the positive and negative shocks in each variable are expressed in cumulative form as follows;

$$y^+_{1t} = \sum_{ii=1}^{t} \varepsilon^+_{1ii}, \quad y^-_{1t} = \sum_{ii=1}^{t} \varepsilon^-_{1ii}, \quad y^+_{2t} = \sum_{ii=1}^{t} \varepsilon^+_{2ii}, \quad y^-_{2t} = \sum_{ii=1}^{t} \varepsilon^-_{2ii}, \quad (5)$$

Afterward, assuming that $y^+_t = y^+_{1t}, y^+_{2t}$, the causality relationship between the positive components is tested with the help of the p -lagged vector autoregressive model (VAR). The $VAR\ (p)$ model is expressed as shown in Equation (6);

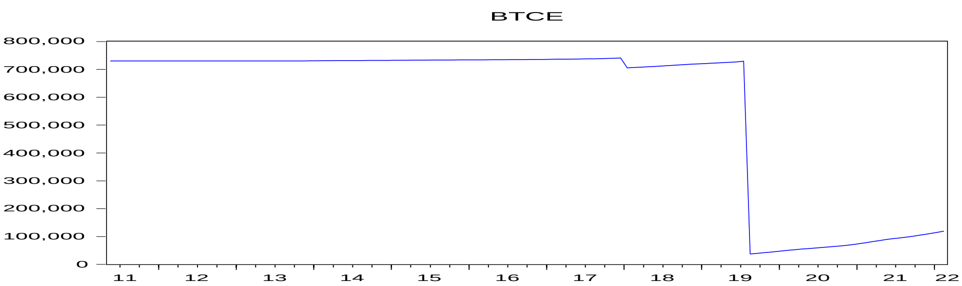
$$y^+_t = v + A_1 y^+_{t-1} + \cdots + A_p y^+_{t-1} + u^+_t \quad (6)$$

Here, y^+_t is expressed as a 2x1 variable vector, v is a 2x1 constant variable vector, u^+_t is a 2x1 error term, and A_r is a parameter matrix determined by using 2x2 lag length information criteria in the order "r".

3. RESEARCH FINDINGS

3.1. Time Series Graphs

The time series of BTCE, geopolitical risk and global economic policy uncertainity are presented below.



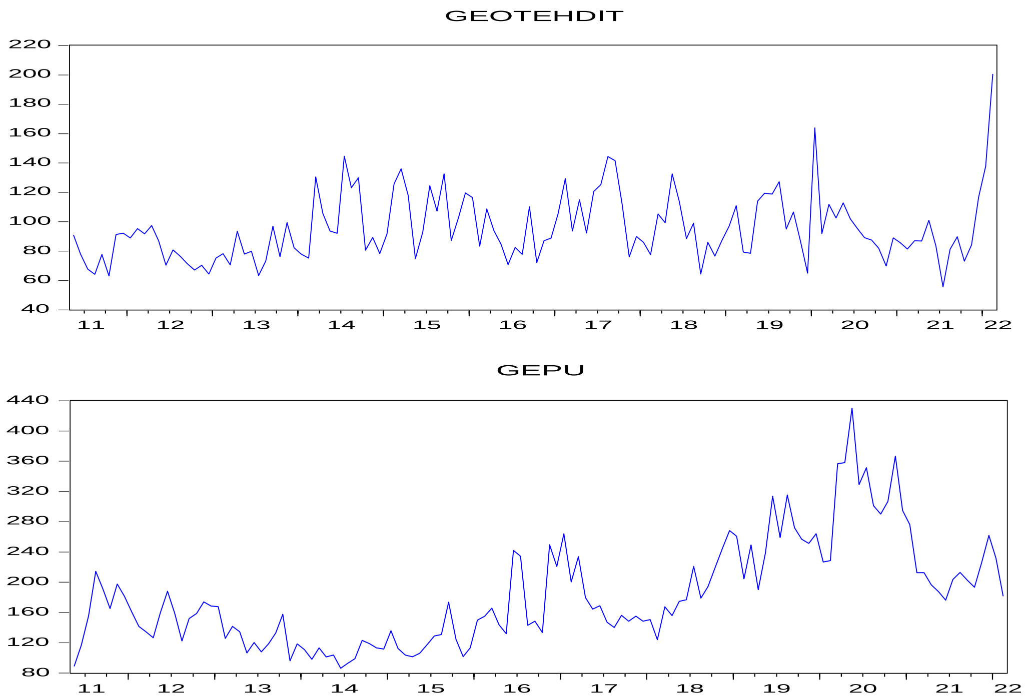


Figure 6. Time series graphs

3.2. Unit Root Test Results

Table 2. Lee- Strazicich Unit Root Test Results

Lee Strazicich (Model C)						
Variable	**Level Test Statistics**	**Level Break Date**	**Critical Value**	**1. Difference Test Statistics**	**Break Date of 1. Difference**	**Critical Value**
BTCE	-3.587320	November 2018	-4.143095	-11.70564*	May 2019	-4.106941
GPRT	-4.715553*	December 2019	-4.062468			
GEPU	-3.940684	March 2019	-4.124324	-9.190871*	November 2019	-4.063198

Upon considering the Lee- Strazicich Unit Root Test Results presented in Table 1, it is seen that GPRT becomes stationary at I(0) level, whereas BTCE and GEPU become stationary at I(1) level. Overall, it is observed that there is a break in the data as of the year 2019.

3.3. Hatemi-J Asymmetric Causality Test Results

In this part of the study, the causality between BTCE and GPRT, and GEPU is analyzed by performing the Hatemi-J (2012) asymmetric causality test. In Table 3, the causality relationship between the variables is analyzed separately for positive and negative shocks.

Table 3. Hatemi-J (2012) Asymmetric Causality Test Result

The direction of the causality	(T) Statistics	Bootstrap Critical Values		
		%1	%5	%10
GPRT (+) > BTCE (+)	22.982*	13.747	9.882	8.016
GPRT (-) > BTCE (-)	98.261*	14.543	10.107	8.142
GEPU (+) > BTCE (+)	15.267*	20.813	6.002	3.886
GEPU (-) > BTCE (-)	15.276*	27.632	5.877	3.637

Note: **: Significant at the 5% level.

Hatemi-J (2012) Asymmetric Causality Test Results of BTCE, GPRT, and GEPU are presented in Table 3 above. In the study, where BTCE is the only dependent variable, it is observed that statistically significant and strong causal relationships exist. Besides, both positive and negative causality relationships are found to exist between the GPRT and GEPU variables and the BTCE variable.

Upon considering the results of the analysis, in which a positive causal relationship running from GPRT to BTCE is tested, the T statistical value (22.982) is seen to exceed the Bootstrap Critical Value (9.882). Here, the equation proves that it is statistically significant at the 5% significance level. On the other hand, a negative causal relationship running from GPRT to BTCE is found to exist. This result is obtained when the T statistical value (98.261) exceeds the Bootstrap Critical Value (10.107). Also, the causality between GPRT and BTCE is more dominant in the negative direction. This result is obtained from the coefficient (98.261) of the equation by which the negative causality is tested.

On the other hand, upon examining the analysis results through which a positive causality from GEPU to BTCE is tested, the T statistical value (15.267) is seen to exceed the Bootstrap Critical Value (6.002). Here, the equation proves the statistical significance at the 5% significance level. On the other hand, it is found that a negative causality running from GEPU to BTCE exists. This result is obtained when the T statistical value (15.276) exceeds the Bootstrap Critical Value (5.877). As for the entire study, the negative impacts of the GPRT and GEPU variables are found to be more dominant on BTCE.

CONCLUSION

Empirical results obtained with the Hatemi-J causality test indicate the existence and direction of the relationships between GPRT and GEPU and BTCE. The causality test results indicate that both positive and negative relationships running from GPRT, that is, geopolitical risk, to BTCE, that is, Bitcoin energy consumption exist. Nevertheless, the negative impact of GPRTon BTCE is more prominent. Similarly, although both positive and negative relationships running from GEPU to BTCE exist, the negative impact is seen higher here as well.

In general, the research results reveal the existence of relationships between risk anduncertainty and Bitcoin energy consumption. Accordingly, risk and uncertainty factors in theglobal context are effective on Bitcoin energy consumption. Accordingly, the research results support the opinion that Bitcoin is a different asset class and hedging instrument in case of risk and uncertainty. Risk and uncertainty factors increase the demand for Bitcoin, as well as mining activities and energy consumption. Accordingly, the following policy practices are recommended within the framework of the obtained results and the relevant literature:

Firstly, policymakers should plan alternative new energy resources, taking into account the changes in Bitcoin energy consumption due to risk and uncertainty factors. Therefore, it is crucial for converting electricity generation resources from fossil fuel resources to renewable resources in both industrial and commercial fields.
Secondly, the expansion of renewable energy resources and investments in these areas may contribute to environmental quality by preventing the damage and degradation of the environment due to Bitcoin energy consumption.

Both global and country-specific risks and uncertainties incurred are perceived as important problems by investors, therefore, they accelerate their pursuit of alternatives. Accordingly, global institutions and organizations should take measures to eliminate risk and uncertainty factors. Otherwise, the demand for Bitcoin would persist unabated, and it would cause an increase in energy consumption.

In this research study, the monthly data are utilized and the obtained data are more robust since the monthly data have a high frequency. Therefore, the obtained results are reliable in terms of policymakers and researchers. It is recommended that both researchers and policymakers utilize high-frequency data in order to provide greater benefit in practical analyses.
The main contributions of the research study may be listed as follows: (i) The most recent data are utilized in the research study, (ii) Hatemi-J causality test, which considers both positive and negative shocks, is used. In this context, it differs from research studies that perform Toda-Yamamoto and Granger causality tests, (iii) analyze the asymmetrical relationships between GPRT and GEPU and BTCE.

The research study has several limitations. In the study, only the causality is analyzed and the relationship of BTCE with merely GPRT and GEPU is examined. Nonetheless, there are many macro factors that affect BTCE. In future research studies, other factors affecting BTCE can beincluded in different econometric models and relationships can be investigated. In this context, a combination of different techniques, including machine learning algorithms, can be employed in future studies.

Author Contributions / Yazar Katkıları:
The author declared that he has contributed to this article alone.
Yazar bu çalışmaya tek başına katkı sağladığını beyan etmiştir.

Conflict of Interest /Çıkar Beyanı:
There is no conflict of interest among the authors and/or any institution.
Yazarlar ya da herhangi bir kurum/kuruluş arasında çıkar çatışması yoktur.

Ethics Statement / Etik Beyanı:
The author(s) declared that the ethical rules are followed in all preparation processes of this study. In the event of a contrary situation, Pamukkale Journal of Eurasian Socioeconomic Studies has no responsibility, and all responsibility belongs to the author(s) of the study.

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