

*E-currency is a form of digital currency that employs encryption to safeguard transactions, limit the manufacture of new units, and verify asset transfers. Bitcoin exchange rates and returns are the primary subjects of this study. In order to measure volatility, the standard deviation of logarithmic returns is determined. This study used a special test to determine whether or not the data were normal. Findings of high volatility were also made using a plot, a statistical process control chart, and other methods. Normality test (casual test) has been investigated accordingly to approve and validate the results. The F-test has been considered as the main indicator for the validity of the results. It has been based on the F-value of 9.3. As well as the financial performance has been done using the time and currency with upper and lower limits. The maximum limit is 34 with a G-value of 0.34. Furthermore, market return-based e-currency has been investigated and analyzed using free and fixed limits for both main variables time and currency. According to these data, the greatest value is 23 in fixed limit circumstances, while it is 18.4 in broad trend cases. The financial performance-based ANP method has been examined using the ANP approach with return values for the currency. The upper limit reached 544 with 0.43 as a G-value. An increasing number of people are valuing volatility. Because of the present high level of volatility, investing in Bitcoin is seen as a high-risk endeavor. The purpose of this study is to assist investors in developing a strategy that maximizes returns while minimizing risk*

**Keywords:** ANP, finance, e-currency, information technology, financial performance, financial prediction

# ANALYSIS OF THE EFFECT OF E-CURRENCIES ON FINANCIAL PERFORMANCE BASED ON INFORMATION TECHNOLOGY

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## 1. Introduction

The way financial institutions do business has been completely transformed by new technological innovations. Internet technology has made it easier for financial institutions to offer a wide range of products and services to customers. Customers get an advantage by having easier access to the transactions. As conventional brick-and-mortar financial institutions are being replaced by networked and digital ones accessible via the internet, the adoption of developing technology provides banks a leg up on their competitors. As a result, various financial technology products and services had to be created in order to accommodate the entry of new technologies. Bitcoin, digital money, is one of a number of cutting-edge new technologies that have lately been adopted. All across the world, anyone may use the bitcoin money and digital payment system [1]. Direct transactions between participants are carried out through a P2P network, which eliminates the need for third intermediaries. Each transaction's details are verified and recorded in a public distributed ledger known as a blockchain before it can be completed by a network of nodes. The blockchain is a public record of all

Bitcoin transactions. Delegating all authority to the people is an innovative approach for achieving this goal [2].

In a blockchain, transactions between two parties are recorded in an open, distributed ledger that is verifiably and effectively recorded [3]. The mining process is verified in bitcoin networks to create confidence. Trust is built when the majority of miners have a financial motive to keep the network running. A majority of cryptocurrencies, including Bitcoin, have been designed to gradually restrict the amount of money that is issued into circulation, eventually capping the total amount of currency that will ever be in circulation, similar to precious metals [4]. Bitcoin's price climbed from \$6,415.28 to \$6,415.28 when it was first created. Transaction confirmation is extremely important in the bitcoin network because of this. Users of the bitcoin cryptocurrency network were concerned about escalating speculations because of this circumstance. Speculating refers to the extent to which a firm's financial holdings are constructed based on its projections of future market values [5]. Many digital objects, like bitcoin, may now be created thanks to current high-tech innovation. Shifting value makes it difficult for speculators to predict the currency's long-term worth,

though. Therefore, in order to effectively anticipate the Bitcoin exchange rate and return, we must first evaluate the volatility condition. For the first time, this study covers the following gaps in existing research, all of which are based on Bitcoin exchange rate estimates and return volatility forecasts. Changes to the financial system have been precipitated by both the development of the global economy and the increasing significance of new ideas and technology [6]. Because of all of the challenges that global exchanges face, new technology has had an influence on a wide range of investment decisions [7]. The bitcoin cryptocurrency is one of the most recent digital currencies to gain widespread adoption. There is a considerable surge in digital currency transactions as a result of this transaction. Open-source software and protocols are used to create a decentralized, private, and reversible payment network known as Bitcoins.

To ease cross-border payments of both big and small items, the protocol does not charge any transaction fees. Some experts believe that the bitcoin transaction system is anonymous, despite the fact that users have the ability to opt out of the system. The blockchain is the public record of all bitcoin transactions [8]. People may utilize this technology regardless of where they live, because cryptocurrencies can be used to execute transactions without identifying their sources of money or revealing their personal identities. A peer-to-peer (P2P) network has been referred to as Bitcoin. Many individuals connect to each other using P2P networks by running the proper software on their own computers and then connecting to one other. A publicly listed company, Google has staff and computer servers that house user data, unlike some internet organizations that have a single location where management and servers are housed. An entity other than the one that issued the currency accepts Bitcoin money as a form of payment. Digital and physical currencies are equivalent in terms of units of account [9].

There has been a rise in demand and speculation for bitcoin as a result of the growing number of individuals using the currency for transactions. This was a tumultuous situation. As a result of the widening of investment returns, volatility is calculated mathematically. Market players can bet on future volatility if they have a clear estimate of future volatility [10]. A wide range of academic disciplines analyze issues such as stock market volatility, home price fluctuations, and other aspects of national economies. According to this research report, implied volatility is compared to a stochastic volatility model for South Korea. Both higher market volatility and decreased return boost implied volatility projections. House price return volatility is time-varying, as seen by the time-varying volatility patterns in city and country-level price return volatility statistics. Throughout the research period, it appears that there were times of high and steady volatility. Another factor that may affect volatility is a significant economic event. Because the volatility of house price returns varies by area, you may see some correlation in the volatility series.

Therefore, studies devoted to the analysis of the effect of e-currencies on financial performance based on information technology are of scientific relevance.

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## 2. Literature review and problem statement

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For as long as humans have used money and finance to conduct commerce, financial innovation has existed. As a

result of rapid global economic growth and globalization, financial liberalization and deregulation (or in accordance with government regulation), the introduction of innovative legal tools and, most importantly, technological progress in the area of information and communication technologies (ICT), financial innovation has become more sophisticated and more rapid over the past half-century. There are both advantages and disadvantages to ICT innovation, just like with any other type of technology advancement. Both of these issues have to do with the integrity of financial markets, which can have far-reaching effects on financial intermediation, economic growth, and monetary policy. Accordingly, an overview of the most recent financial innovation developments is provided and their impact on the financial industry, the financial markets, as well as on the regulatory framework for micro and macro-prudential regulation is examined [11]. Recent financial innovations (particularly those related to the application of ICT) pose a serious challenge to the business model of financial institutions (both banks and non-banks) and may create new risks for financial stability if regulators do not respond promptly and adequately, but they will not necessarily revolutionize monetary policymaking and are unlikely to undermine it. This is our working hypothesis [12].

It is defined by the Financial Times Lexicon as the creation of new financial products and technologies as well as new financial institutions and markets. This comprises new sorts of financial enterprises, new types of derivatives and securitized assets, as well as new forms of internet banking, phone banking, and other forms of ICT applications [13]. Financial innovation is defined and categorized similarly. There are many ways in which financial innovation can take place, and the description and characteristics above clearly show that it can have both a technology and a legal and organizational base. Sometimes, all three are involved. Additionally, regulatory changes, changes in market conditions (e. g., changes in demand for financial services and real and potential competition), as well as changes in economic policy, are all variables that contribute to financial innovation. Other potential outcomes include a shift in the inflation rate and currency regime, or a rise in the demand for new kinds of goods [13]. Changes in the regulatory environment necessitate more investigation. There are two ways to foster financial innovation: first, deregulating the industry (since certain products, methods, regulations were previously not allowed to be implemented) and stricter control (to circumvent regulation). Regulations in the US economy in the 1970s led to financial innovation. Interest on demand deposits was prohibited, maximum or ceiling rates for time and savings deposits were set, and banks were compelled to maintain zero interest rates on their required reserves. There were also limits placed on borrowing and lending. The creation of new financial instruments to avoid or protect financial institutions and their clients from the negative effects of government policies, such as capital account controls and macroeconomic instability, can be cited as another example. This has always been the primary function of derivative instruments. Worse, though, is the fact that financial companies and regulators often engage in a "race to the bottom" to find loopholes in current regulations and to establish new ones to close them. Regulators are in a precarious position because of the ferocity of the competition [14]. According to the above, at least some of financial innovation does not assist to increase productivity

in the financial industry and the overall economy, but rather helps to bypass existing regulatory constraints (in a legal way). As well as being detrimental to the regulatory environment's ability to remain stable and transparent, it also raises financial risks for banks and the people who use them. Therefore, legislators and regulators must take into account the negative side effects of excessive, too-restrictive, and often non-transparent legislation [15].

Technological advancement was significant, but it didn't appear to be playing a major role at this point (for example, adding ATMs or debit payment cards, or increasing the use of computers for internal operations within financial institutions, such as data collection or accounting). However, since the mid-1990s, when the internet, personal computers, international data transmission, mobile telephony, and other digital services began to gain prominence, this has altered dramatically. Technology applications have helped to minimize transaction costs, promote transparency in transactions, as well as diminish the importance of boundaries between jurisdictions. Globalization and increased competition in the financial markets were the inevitable outcomes of this development. Legal and organizational innovation played an important role, and this hasn't gone away. The mortgage-backed securities, collateralized debt obligations, and credit default swaps of the 2000s should be mentioned. Expansion of specialized bonds, such as green or development bonds, is also included in this group of activities [16]. To be sure, many new financial products and institutions have been made available by new technical options, such as crowdfunding and peer-to-peer lending platforms (see Section 2. 3). Because of this, clients now have easier access to a wider range of monetary services, including online banking, personal computers, and mobile phones, as well as innovative new products and financial institutions that were previously unimaginable before ICT.

All or possibly most of the financial sector's ICT applications aren't covered in this paper. Since these instances could have a significant impact on the way financial services are supplied and the business model of banks, we will focus our attention on them. The dominating business model in the financial industry is the online provision of financial services via personal computers, tablets, or mobile telephony devices. More and more people will be able to take advantage of electronic services and payments in the future thanks to a variety of factors, including the development of new e-payment gadgets, increased processing power in ICT devices and data transmission channels, improved cybersecurity (including a broader application of blockchain technology), and more widespread use of digital valets [17]. Peer-to-peer lending and equity financing (crowdfunding) can be popularized outside the bounds of traditional financial institutions thanks to the development of digital platforms that allow for wider distribution of financial services. This has the potential to lower the cost of financial services while also making them more widely available to the general public and companies. New threats to financial stability may arise as a result. With the rapid expansion of business-related crowdfunding, originally developed to collect donations for non-commercial purposes, small and medium-sized businesses that do not have easy access to bank credit and capital markets can now take advantage of this new funding opportunity. As of this year, crowdsourcing is predicted to raise more money than venture capital firms, totaling about US\$30 billion. Financial regulation, as in the case of many other innovative

institutions and businesses, has a significant impact on their future expansion [18].

It is possible that financial innovation will have a far greater impact on the financial industry compared to what has already occurred. Compared to how they were 20 or 30 years ago, banks and non-banking financial firms operate considerably differently now. In order to make a deposit, obtain a loan, pay a bill, send money, or purchase insurance or other financial goods, customers no longer have to go to a bank branch (or the branch of another type of financial institution). Additionally, the rate at which transactions are completed has increased significantly in recent years. Some of the more classic financial instruments are no longer available or have seen a significant reduction in their importance. Debit cards and e-transfers, for example, have supplanted checks in several nations. If current trends continue, it's easy to envision a world in which all financial services are provided solely online in the next decade or two, with bank offices becoming increasingly obsolete as electronic payment and transfer methods proliferate [19]. Traditional company models, internal organizational structures, and the employment of all participants in the financial sector will all face substantial changes and problems as a result of this. Another question is whether the current sorts of financial institutions will be able to withstand the growing competition from other market actors. Competing with traditional financial institutions on the basis of their technological advantages may be possible for non-financial enterprises in the ICT or retail sectors, for example. Existing digital platforms or new payment methods are examples of this, and they have the potential for significant expansion in the future as well. However, the regulatory environment will have a large impact on how far this technology progresses [20].

Globalization, unrestricted financial market growth, total computerization, and the development of information technology (IT) have resulted in a great number of new institutes, financial instruments, and new ways for individuals in our society to communicate. Electronic money, often known as cryptocurrency, is one of these modern-day institutions. E-currency is a technology that allows for the electronic exchange of resources [21]. The premise behind this technology is that it eliminates the need for a regulating party to support the infrastructure (for example, a bank) and so allows for the safe exchange of resources. Accounting operations are transferred from centralized institutions to a network of autonomous computers, producing a decentralized system that works independently of any managerial institution's influence. The majority of the time, cryptocurrencies are floating in relation to national currencies and between themselves. Any asset's rate, including E-currency [22], fluctuates frequently. It is influenced by the demand and supply of ordinary customers, investors, traders, the economic-political environment, the information field, and other events that are common to not only the crypto-sphere, but the entire economy. The aforementioned could have a favorable or negative impact on cryptocurrency. Positive and negative factors frequently occur with a small difference in time, resulting in outcome rate fluctuations [23]. They're amplified by trade games, in which players strive to boost or drop it on purpose. As a result, analyzing and developing methods for forecasting e-currency prices is a critical undertaking that necessitates extensive research. The scientific literature [24] contains a large number of mathematical models and approaches for understanding and forecasting financial markets. The process of forecasting

entails determining specificity, goals, and various methods of use, as well as selecting a forecasting method. As a result, technical and fundamental analyses are common ways to forecast price changes in financial markets. Technical analysis is based only on the study of the dynamics of market characteristics. The creation of various graphs, as well as the study of changes in market price in the dynamics, helps an investor to make the best decision possible. Constructing diagrams, reviewing recently concluded contracts, and so on are examples of traditional technical analysis [25]. It is focused on researching the dynamics of pricing for a concrete financial instrument in order to forecast a price movement for a short period of time in the first turn. Analysts hunt for re-repeating typical outlines, figures on graphs of price behavior, and make recommendations for continued movement of a price along this figure with this goal in mind. A trend indicator is a technical analysis auxiliary mechanism that aids in determining the unique direction of a trend: ascending or declining movement of a price for a trade instrument. Trend-type indicators moderate price fluctuations while creating a signal via data averaging. It allows a trader to visually determine which trend will be present at one or more time intervals [26].

In this study, the effect of e-currencies on financial performance based on information technology will be investigated and analyzed using the ANP approach along with the mathematical model to assess the financial performance.

### 3. The aim and objectives of the study

The aim of the study is to investigate the impact of e-currencies on financial performance based on information technology.

To achieve this aim, the following objectives are accomplished:

- to investigate the normality test (casual test );
- to analyze financial performance;
- to investigate the market return based e-currency;
- to examine the financial performance based ANP method.

## 4. Materials and methods

### 4. 1. Modeling of predicting fluctuations

Consider a scenario in which the market is subjected to a sudden and unexpected change. It is presumed that the timing of the shock is absolutely random. Exogenous shocks have just a transient effect on the body. The consequences of an endogenous shock, on the other hand, might endure for a significantly longer period of time. The shock happens at  $t_0$  and causes a drop in drift of  $t_0$  and an increase in volatility of  $t_0$  to occur immediately after the shock. The market recovers at random time  $t_0$  – the drift grows by 0 and volatility reduces by 0–2 – because an arbitrage opportunity has to be eliminated. There is no way to predict the market’s recovery period  $t_0$  ( $t$ ). Exogenous shocks have a short-term effect, hence in this instance  $h'(t)$   $N_0$  is the correct answer, because as

time passes, a market recovery becomes more plausible. As a result of the shock, it’s important to note.

$$I(y)=C(y)dt +\Delta(t)dy, \tag{1}$$

where  $y$  – independent variable,  $C$  – constant,  $I$  – dependent variable,  $t$  – considered time series.

### 4. 2. ANP approach

Some of the literature review shows the use of the Analytic Network Process. The method of ANP with the reliability of the model represents reality better than the AHP model [11]. Some researchers showed that ANP is useful in dealing with complex decisions involving dependence and feedback analyzed in the context of benefits, opportunity, cost and risk. It has been applied literally in the hundreds. ANP is a multi-criteria assessment method for structuring and decision analysis that can measure the consistency of assessment and flexibility in the choice of the level subcriteria of examples of both real and hypothetical. ANP also has been validated in several instances. People often argue the subjective assessment that one should not expect the results to correspond to objective data. It is important in decision-making how a decision produces a valid answer in practical terms. But it was put in the framework of garbage in garbage out without ensuring the validity of the long-term outcome. On the other side, the decision-making is normative. For this, the ANP describes the approach to science rather than the normative approach and perspective. Produces the best result not simply in accordance with the values of decision-makers, but also with risks and dangers faced by the decision. [12] explains that the application of AHP/ANP in the banking sector is still less than three percent of the total research applications in banking. More intense research has been carried out since 2000. After the global financial crisis, research and application of AHP/ANP were more specifically triggered by the banking sector to meet the needs of integration with traditional credit information systems. It is also shown that after the Asian financial crisis, research and application of AHP/ANP have grown in countries such as Thailand, Indonesia, Vietnam and Taiwan. For this, China is relatively more advanced in the use of AHP/ANP. There is a growing need for a decision support system based on AHP/ANP in the banking sector. AHP, ANP characters above describe the real-world representation of the problem under consideration. Therefore, ANP is an interesting decision tool, and has been used in various fields in recent years. Particularly, ANP has been applied to supplier selection [13] as shown in Fig. 1.

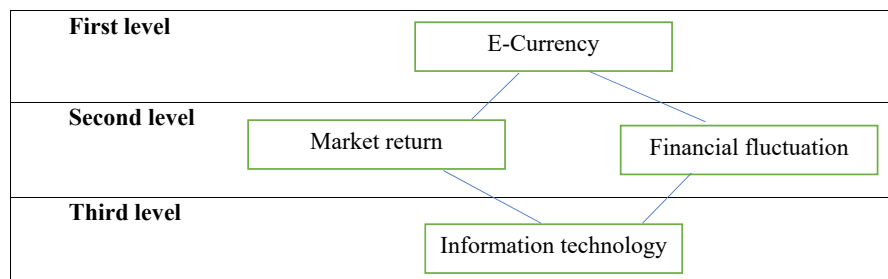


Fig. 1. ANP tree



ANP approach has been applied in this study with three levels. The first level is E-currency, the second level contains Market return and financial fluctuation, and the third level contains Information technology.

**5. Results of research of the impact of e-currencies on the financial performance based on the information technology**

**5.1. Normality test (casual test)**

A major focus of this study is on international factors and how to adjust to meet the difficulties and threats that they pose. With a p-value (sig) of zero, we may conclude that *F*test is 15.2 and *F*table is 6.4. This led to the conclusion that the proposed assumption might be accepted as shown in Table 1.

Table 1

Details of the tested assumption

No.	Function	Value
1	Sum of $R^2$	12.4
2	<i>Df</i>	5
3	Mean of Squares	11.5
4	<i>F</i> value	9.3
5	SIG	0.00

Five main functions have been considered for the analyzing process, Sum of R square with mean square with 000 value of SIG.

**5.2. Analyzing financial performance**

The box plot and statistical process control chart are used to detect volatility, as described in the next section. It is possible to identify Bitcoin return anomalies using the box-whisker plot analysis. It is clear from the results that there are several outliers in the data. Bitcoin return data is highly volatile because of these anomalies. Then, the statistical method was carried out in this investigation. This is the statistical process control chart for the return on Bitcoin. There is a single data point that exceeds the top limit of the control. Data points that fall below the lower limit of control also exist. Table 2 also shows the data dispersion based on the G-value.

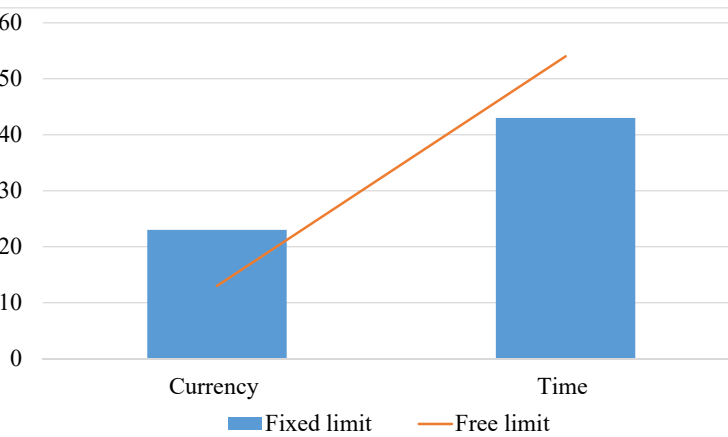


Fig. 2. Primary parameters are fixed and freely limited

**5.4. Financial performance based ANP method**

As discussed in the next section, the box plot and statistical process control chart are utilized to detect volatility. The box-whisker plot analysis can be used to spot Bitcoin return abnormalities. There are multiple outliers in the data, as shown by the results. Because of these abnormalities, Bitcoin return data is extremely volatile. After that, in this inquiry, the statistical method was used. This is the return on Bitcoin statistical process control chart. There is a single data point that exceeds the control's upper limit. There are additional data points that are below the lower limit of control. Table 3 also shows the data dispersion based on the G value.

Table 2

Detection of the high fluctuation

Model	Return value	Upper control limit	Lower control limit	G-value
Currency	-	34	22	0.21
Time	-	33	21	0.34

Detection of the fluctuation based on the suggested model was considered for the lower and upper values. G values were considered as well to be investigated. The currency reached 34 as an upper limit whereas time reached 33. The maximum lower lime for the currency is 22 while 21 for the time.

**5.3. Market return based e-currency**

Fig. 2 shows the first form with a fixed limit and a free limit. According to these data, the greatest value is 23 in fixed limit circumstances, while it is 18.4 in broad trend cases. Other indicators, such as the manufacturing-to-to-

Table 3

Prediction of the high fluctuation

Model	Return value	Upper Control Limit	Lower Control Limit	G-value
Currency	454	544	323	0.43
ANP method	000	434	237	0.32

The currency along with the ANP approach considering G-value. Upper and lower limits were taken with return values. The results showed that the maximum is 544 and the lower limit is 232. Currency achieved the maximum G-value of 0.43.

**6. Discussion of the impact of e-currencies on the financial performance based on the information technology**

The results explain the Normality test (casual test). Where international factors have been adjusted to meet the

difficulties and threats that they pose. With a p-value (sig) of zero. Furthermore, financial performance was analyzed. In this case, the box plot and statistical process control chart were used to detect volatility. It is possible to identify e-currency return anomalies using the box-whisker plot analysis. It is clear from the results that there are several outliers in the data. They were calculated by using the lower and upper limits of returns. Moreover, the investigation of the market return based e-currency considered free and fixed limits. The first form with a fixed limit and a free limit. According to these data, the greatest value is 23 in fixed limit circumstances, while it is 18.4 in broad trend cases. As well as the financial performance based ANP method. The box-whisker plot analysis can be used to spot e-currency return abnormalities. There are multiple outliers in the data, as shown by the results. Because of these abnormalities, Bitcoin return data is extremely volatile. After that, in this inquiry, the statistical method was used. This is the return on e-currency statistical process control chart.

The ANP methodology is used in conjunction with the present method to estimate the returns. In order to examine the data in the proper manner, a current model was utilized. This model, which is stated in equation (1), was used to achieve the results obtained. The results, as indicated in Table 1, have been validated by other means. According to Table 2, financial performance has been evaluated using the upper and lower return values based on the two primary components of time and currency. Furthermore, as indicated in Table 3 and Fig. 1, the returns on the market according to the e-currency and ANP approaches have been examined in the appropriate manner.

This study's findings have a significant benefit over previous studies in that they are based on the ANP technique and make a significant contribution to the analysis of finan-

cial performance, as opposed to [27], where the findings were examined using a different method. There were some gaps left by using a different way to measure financial performance based on time and money, as shown by the results.

Limitations of the study are return-based time and fluctuation of the currency. Fixed and free limits were considered as well.

This method has several advantages such as can be applied on the long series of the time of the returns. As well as hardly applied with more than their variables.

Mathematical difficulties were encountered while applying the proposed model where it is hard to be calculated. Moreover, it has hardly to apply the ANP approach to predict the return over time and fluctuation in currency.

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## 7. Conclusions

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1. Normality test (casual test) has been investigated accordingly to approve and validate the results. It has been based on the F-value of 9.3.

2. Financial performance has been done using the time and currency with upper and lower limits. The maximum limit is 34 with a G-value of 0.34.

3. Market return-based e-currency has been investigated and analyzed using free and fixed limits for both main variables time and currency. According to these data, the greatest value is 23 in fixed limit circumstances, while it is 18.4 in broad trend cases.

4. The financial performance-based ANP method has been examined using the ANP approach with return values for the currency. The upper limit reached 544 with 0.43 as a G-value.

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