BITCOIN AND MACROECONOMIC DETERMINANTS: ANALYZING INDIVIDUAL FX DEPOSITS IN TÜRKİYE

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BITCOIN AND MACROECONOMIC DETERMINANTS: ANALYZING INDIVIDUAL FX DEPOSITS IN TÜRKİYE

İsmail Taşdemir
117620007

Prof. Dr. Serda Selin Öztürk
İstanbul Bilgi University

Assist. Prof. Dr. Umut Keskin
İstanbul Bilgi University

Assist. Prof. Dr. Gizem Turna Cebeci
İstanbul Bilgi University

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Name Surname: İsmail Taşdemir

Signature:

ABSTRACT

In this study, the potential relationship between individual FX deposits and Bitcoin price is analyzed by employing vector autoregression (VAR) and vector error correction (VEC) models. Individuals showed interest in cryptocurrencies as new investment instruments during COVID-19 outbreak between 2020 and 2021. Especially in countries with high inflation rates, cryptocurrencies are perceived as a hedging instrument against inflation in addition to their speculative returns. Türkiye was such a country due to high inflation rates. The demand for foreign currencies of the individuals, in other words dollarization in Türkiye increased in parallel to the historical experiences. This study approaches Bitcoin as an alternative currency for individuals to hedge against inflation and to potentially achieve high returns during 2020 and 2021. For this reason, the effect of Bitcoin price is analyzed together with the other determinants of individual FX deposits. Individual FX demand and time deposits are taken separately to distinguish the effects. The other variables in the models are selected as BIST 100 in USD terms, USDTRY parity, price of ounce gold, Nasdaq 100 index price, and Türkiye 2-years government bond yield. According to the results, Bitcoin price is not a significant instrument for individuals in comparison to other instruments. Therefore, it is hard to claim individuals in Türkiye consider cryptocurrencies as a powerful instrument in their portfolios.

Keywords: Bitcoin; Cryptocurrencies; Individual FX Deposit; VAR; VEC

ÖZ

Bu çalışmada, bireysel döviz mevduatları ve Bitcoin fiyatı arasındaki potansiyel ilişki, vektör otoregresyon ve vektör hata düzeltme modelleri kullanılarak analiz edildi. 2020 ve 2021'deki Covid-19 salgını boyunca bireyler kripto para birimlerine alternatif yatırım aracı olarak ilgi gösterdi. Özellikle yüksek enflasyona sahip ülkelerde kripto para birimleri spekülatif kazançların yanı sıra, enflasyona karşı bir finansal koruma olarak algılandı. Türkiye, yüksek enflasyon nedeniyle bu tür bir ülkeydi. Türkiye'deki bireylerin yabancı para birimlerine talebi, bir başka deyişle dolarizasyon da tarihsel deneyimlere paralel biçimde arttı. Bu çalışma, Bitcoin'e, 2020 ve 2021 yıllarında, bireyler için finansal koruma ve potansiyel yüksek getiri elde etmek amaçlarında alternatif bir para birimi olarak yaklaşmaktadır. Bu nedenle, Bitcoin fiyatının bireysel döviz mevduatına etkisi diğer belirleyicilerle birlikte analiz edildi. Etkilerin ayrıştırılması için bireysel döviz mevduatları, vadeli ve vadesiz olarak iki parçada ele alındı. Modellerdeki diğer değişkenler BIST 100 USD fiyatı, USDTRY paritesi, ons altın fiyatı, Nasdaq 100 endeks fiyatı ve Türkiye 2-yıllık tahvil getirisi olarak seçildi. Sonuçlara göre, Bitcoin diğer araçlara kıyasla önemli bir araç olmamaktadır. Bu nedenle Türkiye'deki bireylerin kripto para birimlerini portföylerinde güçlü bir enstrüman olarak gördüklerini iddia etmek zorlaşmaktadır.

Anahtar Kelimeler: Bitcoin; Kripto Para Birimleri; Bireysel DTH; VAR; VEC

To my daughter, Kumsal

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INTRODUCTION

As the COVID-19 pandemic isolated people and brought the world economy to a standstill starting in 2020, executives in the finance and investment sector eagerly anticipated the days of making record-high profits. During the early stages of the pandemic, it was difficult to foresee the acceleration in the number of retail financial investors and the subsequent boom in the global fintech industry. Nevertheless, this phenomenon unfolded as a reality.

The pandemic also catalyzed the rise of cryptocurrencies as potential future currency. Led by Bitcoin and Ether, the prices of cryptocurrencies surged by the end of 2020, prompting cautious investors to reconsider the nature of crypto and blockchain technologies. While some skeptics argue that cryptocurrencies are merely a result of marketing hype, their adoption rates increased worldwide.

During this period, economic discussions in Türkiye revolved around interest rate decisions, dollarization, and rising expected inflation rates. Economic conditions pushed Turkish Lira (TRY) savers and depositors to seek alternative investment instruments. While some opted for bank deposits in USD or Euro, others turned to traditional safe havens like gold or silver. Additionally, individuals inclined toward new technologies already considered cryptocurrencies as a non-traditional alternative.

Cryptocurrency investment in Türkiye did not commence with the pandemic but experienced a surge during this period. Macroeconomic conditions in Türkiye made cryptocurrency markets an attractive platform for trading, as their prices were influenced by global markets and directly correlated with changes in the USD/TRY parity and implicitly inflation. Consequently, as inflation rates increased in the Turkish economy, the demand for alternative financial investment products emerged as a widespread hedging method among individuals. Bitcoin emerged as a globally recognized alternative investment product, with its price soaring during 2020 and 2021. However, due to the lack of regulation in the crypto asset industry, measuring the total investment in crypto assets remained a challenging task.

This thesis aims to trace funds in crypto assets through foreign exchange deposits in individual bank accounts. The underlying assumption is that as the price of Bitcoin rises, Turkish individuals with foreign exchange deposits may sell their holdings to purchase Bitcoin on Turkish crypto exchanges, where assets are listed in TRY terms. The study employs a vector autoregression (VAR) model and a vector error correction model, divided into two parts: individual FX demand deposits and individual FX time deposits. Both models incorporate variables such as individual FX demand and time deposits, USD/TRY parity, BIST 100 index prices in USD terms, the price of an ounce of gold, the Nasdaq 100 index price, the yield of Turkish 2-year government bonds, and the price of Bitcoin. The data spans weekly frequencies during 2020 and 2021.

The first chapter revisits monetary theories, exploring how financial variables may impact money demand. It also covers the current definitions of money provided by the Central Bank of the Republic of Türkiye (CBRT) to establish a foundation for investigating dollarization in the Turkish economy. Traditional alternatives to holding FX deposits for individuals are presented to illustrate the increased demand for foreign financial products. In contrast, the second chapter delves into cryptocurrency investment in Türkiye, describing estimated figures for cryptocurrency investors and trading volumes, along with the motivating factors behind this investment. Additionally, it discusses the legal framework of cryptocurrencies and provides future predictions. The third chapter presents the empirical methodology and estimation results. VAR and VEC models for individual FX demand and time deposits are employed separately to discern their effects. Finally, the conclusion discusses the study's limitations and offers suggestions for further research.

LITERATURE REVIEW

As far as academic literature on Bitcoin and major financial indicators is considered, one might find a plenty of articles especially in the last five years. In other words, the impact of Bitcoin and other cryptocurrencies on the macroeconomic variables is attractive for many researchers as they are new and unknown from the perspective of economics. The other reason for the topic to be attractive is that millions of people from all over the world invested in these volatile instruments with different motivations and economists are trying to investigate the position of cryptocurrencies in the overall economy.

As this study focuses on the impact of Bitcoin prices on the individual FX deposits in with other major factors in the Turkish economy, below is presented some of the articles somehow related with it. From another point of view, the dollarization phenomenon is also analyzed by many researchers in the context of both its causes and impacts. On the other hand, the writer of the paper could not find any specific analysis on the impacts of Bitcoin prices to the individual FX deposits. Therefore, the articles below are the ones trying to investigate the relationships between similar variables.

Dirican and Canöz (2017) investigated potential relationship between Bitcoin prices and world major stock indices in the period from 2013 to 2017. The researchers aim to find if the changes in Bitcoin prices impact the decisions of the investors in DOW30, NASDAQ100, S&P500, FTSE100, NIKKEI225, CHINAA50. They also added BIST100 to the analysis. According to the findings, while, in the long term, Bitcoin prices affect investors in US and Chinese stock indices, there is no relationship between Bitcoin price changes and BIST100, FTSE100 and NIKKEI225.

In the study of Güleç et al. (2018), the relation between Bitcoin price in Turkish Lira term and some financial indicators was investigated in the period between 2012 and 2018. While researchers conducted a VAR analysis, the financial indicators in the model are USDTRY, gold in TL term, BIST100 index and 1-month interest rates. The researchers concluded that there is no relation between Bitcoin prices and financial indicators except

interest rate. According to the results, there is Granger causality between interest rate and Bitcoin price.

Oktar and Salihoğlu (2018) examined the relation between Bitcoin price in TL term, money supply figures (M1 and M2, separately), average funding cost, 10-year Turkish government bond returns, 1-month bank deposit returns. According to their findings, while there is a cointegration for Bitcoin TL price with other variables in the long run, the variables except 10-year government bond interest rate Granger cause Bitcoin TL price. As the data in the study includes the period from 2013 to 2018, they used vector autoregression method to analyze the relationship.

Sönmezer and Çelik (2019) studied factors affecting foreign exchange deposits in Türkiye. In order to do this, the researchers investigated the relation between sight FX deposits, USDTRY parity, CPI, confidence index, VIX, TL deposits, dollar index and foreign exchange deposits. The researchers did not make any separation for foreign exchange deposits, in other words, they take the total of real person and legal person FX deposits. They used VECM model as the research methodology. According to their findings, while sight FX deposits have a positive relation with FX deposits, confidence index and CPI have a negative relationship. Also, they concluded that high inflation leads to increase in FX deposit, and dollarization.

Kuzucu (2019) studied the relationship between Bitcoin price and US Dollar exchange rates for the period from 2010 to 2018. The researcher used the method of Granger causality analysis and ARDL Boundry test. According to the results, there is a positive relationship between Bitcoin price and US Dollar exchange rates in both long run and short run.

Akdag (2019) studied volatility spillovers in USDTRY conversion rate, BIST100 index and gold futures contracts by discussing the trading volume of Bitcoin in the large crypto exchanges operating in Türkiye. According to the results, between November 2017 and December 2017, individuals preferred to hold their savings in bitcoin even though the exchange rate of USDTRY is stable. Secondly, after the shock on USDTRY exchange rate in August 2018, individuals preferred bitcoin as a saving instrument. Thirdly, the decreases in the price of BIST 100 stock index resulted in the increase in bitcoin trading

volume. Lastly, it was argued that both gold and bitcoin can be categorized as a hedging tool because of the positive correlation between gold futures contracts and bitcoin trading volume.

Polat and Tuncel (2020) investigated the potential relationship between Bitcoin price and BIST100 index for the period of 2013-2019. According to the results of Johansen cointegration test, the researchers did not find any relationship between the two variables. However, the results of Hatemi-Irandoust test, the researchers found out that there is hidden cointegration between BIST 100 and Bitcoin prices.

Telek and Şit (2020) studied the potential relationship between the prices of Bitcoin, gold ounce and US Dollar index. The analysis covering the period from 2012 to 2019 was done by the method of ARDL Boundry test approach in order to determine cointegration relation. In the findings of the study, there is no short term cointegration between the variables. On the other hand, a long term cointegrated relationship between gold ounce, dollar index and Bitcoin price. As gold and dollar index increases, Bitcoin price increases, too.

Mişu et al. (2020), studied dollarization phenomenon in Turkish economy by analyzing the percentage of FX deposits of the residents over total deposits of the residents. In the study, they covered USDTRY exchange rate and interest rates of USD, EUR and TRY as independent variables. The researchers tested long run and short run effects with VECM in addition to Granger causality test. Interestingly, according to their findings, increase in TRY interest rate affects dollarization in a positive way in both long and short run. The researchers argue that the increases in interest rates by Central Bank of Republic of Türkiye are not enough to compensate for the loss of value in TRY. On the other hand, increase in USD and EUR interest rates decreases the dollarization.

Bakır (2021) studied the relationship between two major cryptocurrency prices (Bitcoin and Ethereum) and selected economic indicators. Among the economic indicators in the study, there are gold, silver and platin prices, VIX index, OFR financial stress index, Brent oil prices and G20 stock exchange indices. In addition to economic indicators, the study covers market shares, tweet counts, Google search counts, hash rates and on-chain transfer counts for both Bitcoin and Ethereum. While the study covers the period from

December 2019 to December 2020, two models were created to analyze Bitcoin and Ethereum prices, separately. The researchers used the methods of panel regression, Johansen cointegration and Granger causality. According to the findings, there are bi-directional causality relationships for Bitcoin and Ethereum prices from G20 stock exchanges indices, VIX, OFR financial stress, Bitcoin and Ethereum market shares and Brent oil prices.

Kaymak and Beybur (2022) studied long run relationship between Bitcoin trading volume and deposits in Turkish banking sector. The research is conducted for the period from 2017 to 2021 with a Engle-Granger cointegration analysis. According to the findings, there is a negative relationship between deposits and Bitcoin price. Therefore, the researchers argue that Bitcoin might be perceived as an alternative investment product to bank deposits.

Çatalçam (2022) studied the dollarization at both household and firm level. While he measures the dollarization as FX deposits to total deposits in the banking system, the period in the study is selected as 2003-2021 and he uses ARDL model. The explanatory variables in the model are exchange rate depreciation, inflation, USDTRY 3 months implied volatility, real deposit and lending rate, external debts to GDP, net exports to GDP and net international reserves to GDP. According to the findings, firm dollarization is affected by implied volatility and household dollarization is affected by inflation. Also, both household and firm dollarization are impacted by net international reserves.

Baş et al. (2022) searched for a potential substitution effect of Bitcoin trading volume on the individual term deposit in the banking system. Their study is conducted for the period from 2016 to 2021 and covers Mexico, Indonesia, Nigeria and Türkiye. According to their cointegration and error correction model results there is a negative relation between Bitcoin volume and term deposit amounts in three countries except Mexico. Therefore, they argue that Bitcoin is perceived as alternative investment instrument in the countries with unstable economy.

Shahzad et al. (2022) studied the weak and strong hedging abilities for bitcoin, gold and US VIX futures against the downside movement in BRICS stock market indices for the time period between July 19, 2010, and July 2, 2020. They firstly found out that bitcoin

and gold are weak hedges, in other words, they may not be taken as safe haven against stock indices. The second result they concluded is that a time-varying hedge strategy would be more efficient in the sense that three alternative assets provided efficient hedging probabilities during COVID-19 outbreak.

Regarding the relationship between BIST 100, Nasdaq 100, Dollar index (DXY) and Bitcoin price, Ulu (2022) performed autoregressive conditional variance model and dynamic conditional correlation test. According to his results, there is no significant dynamic conditional correlation between Bitcoin and BIST 100 and DXY. On the other hand, Bitcoin has significant and negative correlation with Nasdaq 100 index and significant. The period of the data used in the empirical study starts at 2017 and ends in 2022.

Kaya (2022) studied the causal relationship between the popularity and prices of investment instruments from the beginning of 2020 to the end of 2021. In this article, popularity was measured by Google search trends and the scope of investment instruments varied from traditional ones including gold, USD conversion rate, BIST 100 stock index and interest rate to more innovative ones covering Bitcoin, Ethereum and dogecoin. According to the results, while they found a causal relationship found between the popularity and traditional instrument prices, there are bidirectional causal relationships between the prices of selected cryptocurrencies and their popularity on Google search.

Mert and Timur (2023) investigated the relation between money supply and Bitcoin price from 2010 to 2023 for three developed economies: US, Eurozone and Japan. The researchers handle three central banks' money supply as independent variable and Bitcoin price as the dependent variable. Even though they did not find any relation in Bayesian-VAR and Granger causality tests for US and Eurozone, there is a causal relationship, especially after Covid-19 crisis, between Bitcoin price money supply for US and Japan as a result of sub-sample causality test. As they found out that Bitcoin price increases as money supply of central banks increases, Bitcoin can be handled as a hedge against inflationary impacts of money supply.

Karataşlıoğlu (2023) studied return and volatility spillover of Bitcoin prices with USDTRY parity, BIST100 index, gold prices in TL, silver prices in TL. The researcher used DCC-GARCH model and the study covers two separate periods, the first one is from 2018 to 2020 and the second one is between 2020 and 2021. According to the findings, Bitcoin price is affected by the shocks in the model more than its own volatility. Also, the shocks on Bitcoin's own price have more permanent impact compared to the shocks on other variables in the model.

Yilmaz and Akdag (2023) studied on the interaction between bitcoin as an alternative investment tool and other possible substitutive investment tools for the time period of 2014-2021. Among the other substitutive tools, they covered BIST 100 index, USDTRY, interest rate, and gold. Once the results are investigated, they found out that there is a trade-off between interest rate which is Türkiye 2-years bond yield and bitcoin trading volume in the long-run, but there is a short-run causality from BIST 100 stock index to bitcoin trading volume.

Aydogan (2023) studied volatility spillover between Bitcoin and other traditional financial instruments. She used DCC-GJR-GARCH method based on the VAR model and her data set includes the price Bitcoin, gold, BIST 100 index, USDTRY and EURTRY between 2015 and 2022. According to the results shown in the study, while there is no significant relationship between the price of Bitcoin and BIST 100 index, there is a low level of connectedness between Bitcoin price and gold, EURTRY and USDTRY.

DEMAND FOR FOREIGN EXCHANGE DEPOSIT IN TÜRKİYE

Local demand for foreign currencies is always a challenge in countries, especially those with trade deficits. Since neoliberal policies were implemented in the 1980s, governments started allowing citizens to hold their savings in foreign currency terms. This study will not discuss the pros and cons of the liberation of foreign currency trade by local people but rather focus on the dynamics and drivers behind the demand for foreign currency deposits.

The first part of this chapter reviews the literature on demand theories of foreign exchange in the context of monetary theory. The second part focuses on the history of the dollarization phenomenon in Türkiye, with specific milestones and breaking points. These milestones and breaking points will also be critical for determining factors affecting the demand for FX deposits. In the last part of this chapter, foreign investment instruments like stocks, bonds, and funds will be handled as an alternative to foreign currency. With the developments in financial technology, opportunities for retail investors to invest, especially in US and European markets, have expanded. Specifically speaking, new generation brokerage firms like Midas in Türkiye provide the opportunity to invest in partial stocks on foreign stock exchanges with low or even zero commission rates. That's why especially younger investors may prefer investing in foreign investment instruments not only for high returns but also for risk diversification.

3.1. Theoretical Background

The theory of money is always a hot topic in the economic thought because of inflation problems experienced by both developed and under-developed economies. The questions on the concept of money are still attractive for many economists. As a result of this, central banks in all economies are considered as both reason and solution of problems. In this part of study, money theory milestones in the history of economic thought will be reviewed and some outputs relevant with the empirical part will be revealed as a framework.

Even though there is any explicit theory on money demand in the classical economic thought, the following identity provides a basis for the conceptualization of money issue. Basically, when money supply (M), price level (P) and number of transactions (T) are given, velocity of circulation is derived from this identity:

$$M \times V \equiv P \times T \tag{3.1}$$

Together with neoclassical economic methodology, money demand (Md) was formulated by the following equation in which k=(1/V) and T is replaced by Y referring to real income:

$$\mathrm{M}^{d} = k \times P \times Y \tag{3.2}$$

According to this equation, money demand is function of real income, and this has the implicit assumption that when real income increases money demand also increases (Özatay, 2011). Even though this may not hold always, it provides critical clues to build money theory.

On the other hand, in the Keynesian approach, the conception of money was transformed into a more complex structure. In order to cover a broader sense of money demand, the economic theory has been melted in the same pot with human psychology. In this perspective, money demand is not just a function of income but also a function of tendencies in human behavior.

According to Keynesian economic thought, there are three reasons behind money demand: (1) real income as described above, (2) precaution against unforeseen contingencies and (3) speculation motive which is sensitive to bond interest rate (Keynes, 1936). Here, the conceptualization of speculation motive around interest rate opens a new field described as expectations. To put it explicitly, it is important to keep in mind the inverse relationship between the price of bond and the interest rate of bond. Also, as the interest rates of bonds increase, the demand for money or liquidity decrease due to the trade-off between holding bond with interest and money with no interest. For Keynes, if the interest rate of bonds decreases to a lower level than “normal”, people would sell their bonds by increasing demand for liquidity.

When digging this concept of "normal", expectations regarding the future play a decisive role because people who think the price (interest rate) of a bond is lower (higher) than their expectations, they would buy bonds. So, the demand for bonds increases and the demand for liquidity or money decreases.

Lastly, Friedman, as the best-known figure in monetarist school, adds expected returns of alternative instruments to the function of real money demand. While shares can be given as an example of alternative financial instruments, other products which protect against inflation might be considered as alternative to money. In other words, factors affecting money demand are real income (Y), bond interest rates (i), returns of shares (is) and inflation rate (π). So, the money demand function is:

$$\frac{M^d}{P} = f(Y, i, i_s, \pi) \tag{3.3}$$

In short, the demand for money is determined by the income and opportunity cost of holding money. In the scope of this study, the individuals' demand for FX deposit is analyzed in the light of the money demand theories. Therefore, before empirical study it is critical to revisit a short history of economic thought.

On the other hand, the definition of money should also be handled for an alignment with the real world. In order to do this, the definitions and scopes of different money concepts will be reviewed based on the definitions of CBRT. The main reason behind it is the terminological convergence with remaining parts of the study. So, the definitions of monetary aggregates are as follow (CBRT, 2024):

Currency in Circulation= Coins and Banknotes in Circulation – Banks' Vaults

M1 = Currency in Circulation + TRY Demand Deposits + FX Demand Deposits

M2 = M1 + TRY Time Deposits + FX Time Deposits

M3 = M2 + Funds Received From Repo Transactions + Money Market Funds + Debt Securities Issued (maturity up to 2 years)

In order to relate these definitions with the theories of money demand, theories described above take basically M1 as the independent variable. However especially in economies

like Türkiye the scope of money includes time deposits in terms of both TRY and FX. This is simply because high inflation rates result in widespread use of foreign currencies.

3.2. Dollarization in Türkiye

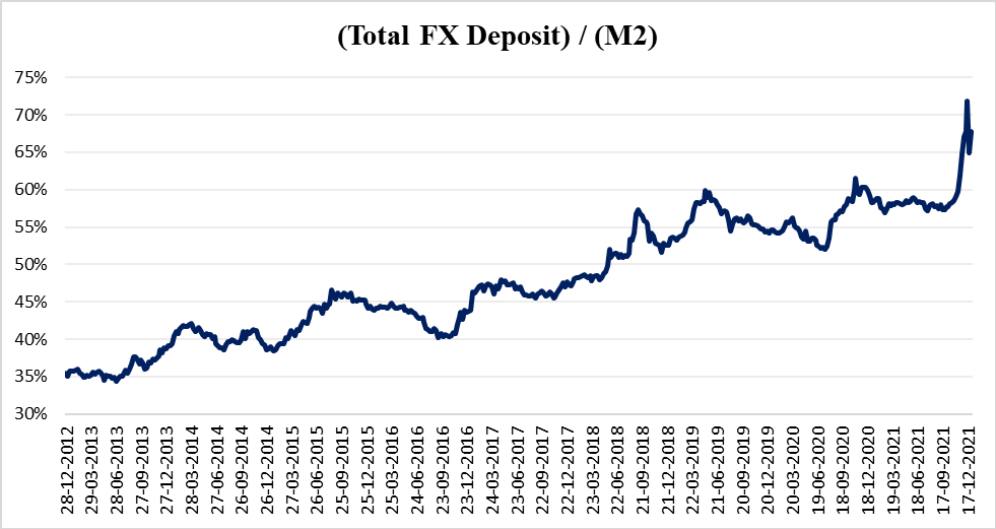
Before discussing dollarization phenomenon in Türkiye, a recall of the functions of money can provide the basis to understand why Turkish people demand USD instead of TRY. There are three main functions of money in an economy: (1) store of value, (2) unit of account, and (3) medium of exchange. These functions are also dependent on each other to make something money.

The first function, store of value, is critical in the sense that almost all economic agents hold money since money is able to keep the value for the future. In other words, people hold money as a method of saving to spend in the future also because money, especially fiat money, does not rot or deteriorate like commodities. Even though fiat money is a very efficient way to keep the value, things may not go as desired because of inflation. To speak explicitly, inflation harms the function of storing value of fiat money since it leads to decrease in the value of fiat money.

Shortly mentioning the second function, unit of value can be described as a common measure of value by providing economic agents simple and homogeneous calculation method. The last function, medium of exchange means that fiat money is accepted as payment methods across the economy. From another perspective, since the fiat money is backed by the government, people can confidently use fiat money in their buy and sell transactions.

Turkish Lira, as the fiat money used in Türkiye, naturally carries all three functions above. However, as the inflation rate in TRY increased in recent years, Turkish people did not prefer holding TRY as a store of value. The fewer people prefer TRY, the more TRY lost value. In other words, people preferred alternative instruments to keep their assets' value stable. Since historically the demand in USD increases in such periods, there has been a similar movement from TRY to USD. This phenomenon shows itself mainly in the TRY and USD deposits figures and called as dollarization.

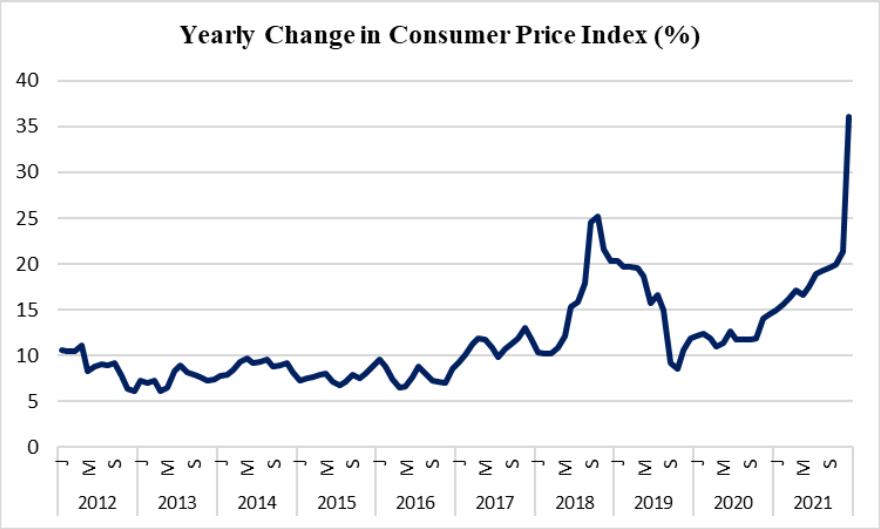
Figure 3.1. Dollarization in Türkiye: (Total FX Deposit) / (M2)



(Source: *Calculated by the author using CBRT, Statistical Data, EVDS*)

Since there is a direct relationship between real income and money demand which is seen in theoretical part, growth in Turkish economy increases the demand for both TRY and USD. So, instead of looking at the aggregate figures of TRY and FX deposits, their ratio would give a clearer picture for the level of dollarization. Since the ratio of FX deposits to M2 which was defined above is taken as a common measure, the Figure 2-1 provides insight into the dollarization rate in the Turkish economy. While the share of FX deposits in total deposits starts to increase after 2016, it accelerates towards the end of 2020.

Figure 3.2. Yearly Change in Consumer Price Index



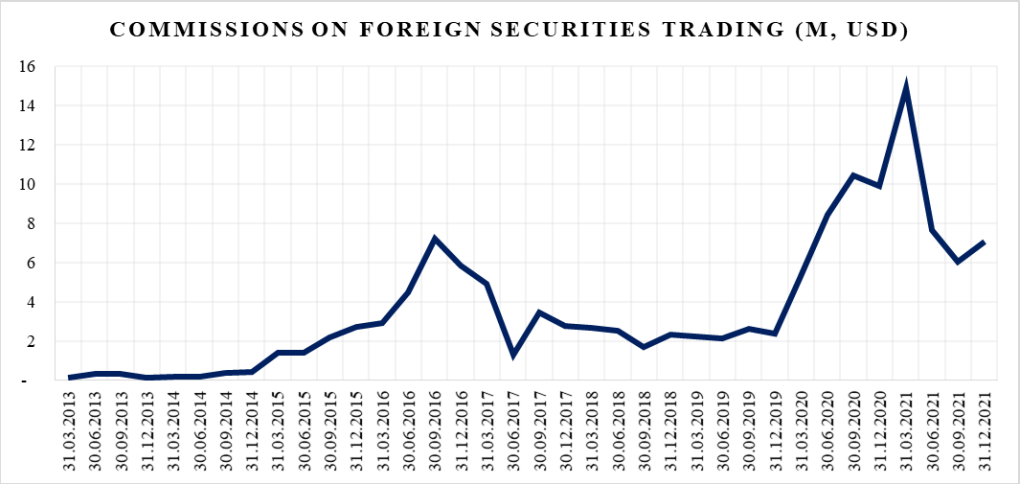
(Source: *Turkish Statistical Institute, Turkstat*)

On the other hand, in the Figure 2-2, yearly inflation rates is presented to show the direct relation with dollarization. Although the inflation rates between 2012 and 2017 are below 10%, after 2017 the inflation rates start going up. In a very descriptive analytical perspective, the dollarization rates and inflation rates show similar paths after 2017. In 2018 the dollarization rate even exceeds 50% and afterwards it does not go below 50%..

3.3. Retail Investment in Foreign Financial Instruments

The Figure 2-3 below shows quarterly total commission revenues earned by Turkish investment companies generated from foreign securities trading. These commissions include the commission collected from customers trading in the foreign stock, commodity or similar exchanges. As clearly seen in the graph, except for 2016, the commissions have a stable pattern until the end of 2019. Even though it is not a direct picture of the Türkiye-residents' investment in foreign financial instruments, it is still a demonstration of it. The graph shows a sharp increase in the beginning of 2020. This increase can be considered as an investment tendency towards foreign financial instruments. During 2020 and 2021, total commission from foreign securities trading is around 70 million USD and it is more than the total commissions between 2013 and 2019 which is around 61 million USD.

Figure 3.3. Brokerage Firms' Commission Revenue from Foreign Securities



(Source: *Turkish Capital Markets Association, TCMA*)

On the other hand, there are many fintech startups established in Türkiye in the last years. One of them deserves a special mention because of its well-known success: Midas. As an investment broker company established in 2020, Midas started to give trading services in US and Turkish stock exchanges. The registered customer numbers of more than 100,000 that Midas acquired in just 1 year were offering a good idea for how individuals are interested in investing in US stock exchanges. At the end of 2022, the number of customers in Midas exceeded 500,000 (Midas, 2022). This was a confirmation that its success is not a coincidence.

As the financial technologies provide easy access for the individuals to enter the foreign markets, individuals in Türkiye opted financial investment products in foreign markets. Midas, collaborating with a US broker to make transactions allowed its customers to trade in fractional shares listed in US stock exchanges. This innovation paved the way for democratization in financial instruments. Thanks to this, the liquidity in stock and derivative markets was affected in a positive way.

To sum up, the period after Covid-19 outbreak was extremely beneficial for both fintechs and retail investors to diversify their portfolios. While individuals were having difficulty

in access to foreign financial markets before pandemics, they found a way to re-allocate their investments. Even though there are many other local reasons behind this climate such as rising inflation in TL, this interest in foreign financial investment instruments is not expected to disappear in the future.

CRYPTO ADOPTION IN TÜRKİYE

Crypto adoption refers to the extent to which digital assets are embraced within the investment landscape by various economic players. In other words, the overall interest and sentiment of people in digital assets is referred to as crypto adoption. Although one of the best-known advantages is transparency in cryptocurrencies, it is also hard to monitor and report all activities on the networks due to their decentralized structures. The term “decentralized” here is that the data on the blockchain lacks the personal data of the cryptocurrency owners.

While in the traditional finance ecosystem, all institutions must conduct customer verification procedures according to regulations, there is no such obligation for cryptocurrency service providers, especially for the decentralized ones. Therefore, it is almost impossible to reach the personal data of crypto ownership but rather wallet distribution of cryptocurrencies without any personal information can be extracted with the help of blockchain analysis tools. Nevertheless, there are some crypto adoption rankings for countries.

There are many studies and articles based on the user surveys to measure the public interest in cryptocurrencies. Before handling public interest in Türkiye, it would bee useful to give some examples from other countries. Balutel et al. (2022) from Bank of Canada examined the trends in Bitcoin awareness and ownership in Canada between 2016 and 2021. Based on the Bitcoin Omnibus Survey conducted by Bank of Canada they argued that the share of Canadians holding Bitcoin increased from 5% to 13% between 2018 and 2021.

According to the results of a representative survey among 3,864 Germans, Steinmetz et al. (2021) reported an awareness ratio of 83%. Also, 9.2% of the respondents were holding cryptocurrency at the time of survey while another 9.1% had cryptocurrency in the past. Among their findings, the authors argued that cryptocurrencies are perceived as a long-run investment instrument among the Germans.

Akana (2023) presented important figures regarding the demographics and ownership of cryptocurrencies in the US between 2022 and 2023. According to the results of survey,

in July 2022, the 24.6% of the participants responded as “yes” to the question of “do you or anyone in your family currently own cryptocurrency?”. However, in October 2022, only 19.1% of the participants said “yes” to the same question. According to the author this difference gives a clear picture that people are less interested in cryptocurrencies after so-called crypto winter. However, for our own study, it is important to note that crypto adoption in US is also high.

4.1. Individual Investor Number and Volume Figures in Türkiye

Chainalysis as a blockchain analysis tool publishes one of the most well-established adoption indices. Based on mainly web traffic patterns, Chainalysis obtains an overall index score for all countries made up by five sub-indices. According to this index in both 2022 and 2023, Türkiye is ranked 12th in overall score among 155 countries. Also, retail centralized service value received ranking of 9th surpasses the other four sub-indices as individuals show significant interest (Chainalysis, 2023) (Chainalysis, 2022).

Similar to the Chainalysis report, Binance research team published a report on “Crypto Outlook in Türkiye” stressing the high adoption (Binance Research, 2023). Report claims that, in 2023, 40% of the population owns cryptocurrency while it was 16% in 2021. According to the survey results, 21% of the respondents said they invested in cryptocurrency and this ratio was higher than gold and precious metals (20%), stocks (15%), FX (13%) and real estate (11%) investors.

On the other hand, Paribu which is a local centralized cryptocurrency exchange in Türkiye published the research of “Cryptocurrency Awareness and Perception, 2023” conducted with FutureBright. In summary, the report asserting more than 6 million users of Paribu revealed that 99% of the respondents have heard the term of crypto or Bitcoin. Also, 25% of the respondents revealed that they made a crypto transaction at least once and this ratio was reported as 13% in 2022 (Paribu, 2022).

As far as cryptocurrency trading volume is concerned, the non-existence of a regulator which centrally collect all trading data from exchanges compels researchers to less-trustworthy data sources. Even though there are some critics of trading volume data in many sources including non-human or algorithmic transactions, Chainalysis report is

expected to be closer to the reality as it also analyses on-chain transactions. According to Chainalysis, Turkish citizens received $192B of crypto between July 2021 and June 2022 with a yearly increase of 10.5%. With this figure, Türkiye ranked in top 10 countries was also the 4th country from July 2022 to June 2023 (Chainalysis, 2023).

From a more traditional institutional perspective, The Banks Association of Türkiye published a report on digital assets in February 2022. As it is one of the few reports published by a traditional finance side, Digital Assets Report is critical to see how they perceive the cryptocurrency sector. As the report estimates around $15 billion of crypto asset in Türkiye based on trading volume. According to Coinmarketcap, daily global trading volume is $736 million, and Türkiye generates its 0.7% which is consistent with its 1% share in global trade (TBB, 2022).

In a working paper published by Bank for International Settlement, Auer et al. (2022) analyzed the drivers of crypto adoption by exploiting the figures of crypto exchange mobile apps. Their data set covers retail use of apps at daily frequency for 95 countries over 2015 and 2022. One of the main results in the study is summarized as an increase in the price of Bitcoin triggers the new entrants or users especially from risk-seeking population. One interesting finding from the study is that Türkiye has the highest crypto app adoption rate. This ratio is measured by the number of total downloads per 1,000,000 people.

4.2. Labyrinthian Way to Exchanges Abroad

A critical point that should be addressed in the analysis of cryptocurrency interest by individuals in Türkiye is their labyrinthian trading journey. Most of the time, a person who wants to invest in cryptocurrencies must follow a complex path. As there are many regulatory restrictions in Türkiye to prevent fiat money transfer to abroad, people who want to buy a cryptocurrency from a crypto exchange based in a different country complete the steps below:

(1) Transfer Turkish Lira (TRY) from a bank account to a crypto exchange based in Türkiye.

(2) Buy a stablecoin (mostly Tether known as USDT).

(3) On-chain transfer of USDT from exchange in Türkiye to the exchange abroad.

(4) Sell USDT for the cryptocurrency desired to invest in.

Similarly, when this person wants to bring the money back, they should follow the steps in reverse. The interesting point is there are many risks of losing all money on the way because of transferring wrong stablecoin by using wrong network. In other words, on-chain transfer operation has many risks for an ordinary person due to blockchain's irreversible nature.

The second thing that should be mentioned is that on-chain transfers are mostly charged for a percent of the transfer amount or a fixed amount. In other words, people have to waive the commission fees on the cryptocurrency transfer journey. Since these fees are mostly determined by the demand-supply conditions, they are fluctuating through time depending on the equilibrium between miners and transferrers.

The schemes below describe both investing and withdrawing steps one by one. In figure 4-1, an example process of a deposit to crypto exchange based in abroad is described. In figure 4-2, an example scenario of withdrawing funds from the crypto exchange based in abroad.

Figure 4.1. Depositing to a Crypto Exchange Based Abroad

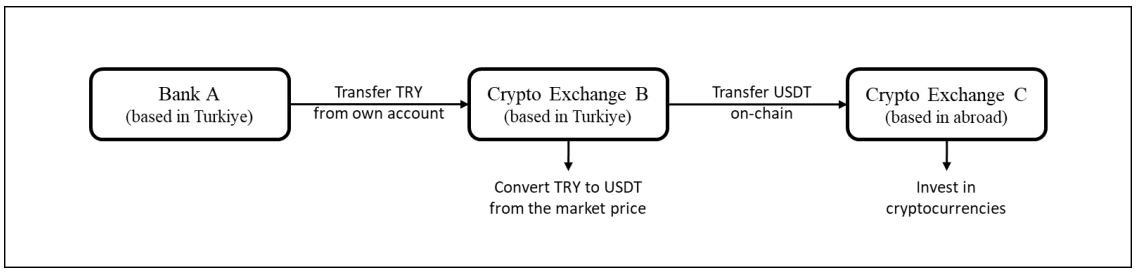
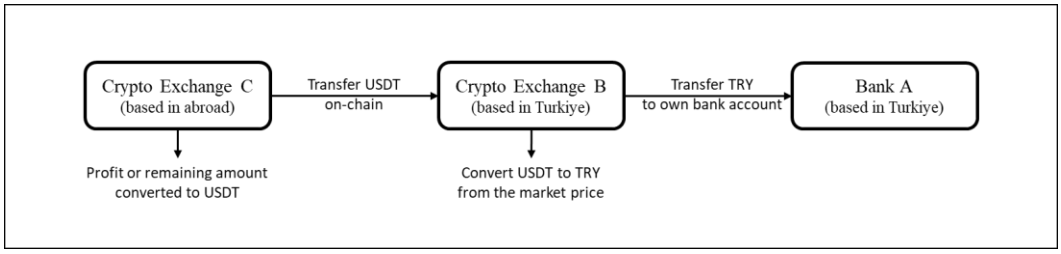


Figure 4.2. Withdrawing from a Crypto Exchange Based Abroad



In the light of the processes described above it is expected not to see much interest in exchanges based abroad. However a well-known crypto research platform, CoinGecko, reported the most impacted countries by the collapse of FTX which was one of the biggest crypto exchange across the world. According to this report, Türkiye is ranked at 6th among in country ranking based on the unique monthly average traffic to "ftx.com". Between January 2022 and October 2022, 186,636 visitors were found with a overall share of 3.8%. Even though there might be critics to this ranking methodology that assumes a positive relation between website traffic and investment amount, it still shows a significant share among the countries. Also, it is still a big secret how much fund was lost by individuals in Türkiye due to the collapse of FTX (CoinGecko, 2023).

In addition to CoinGecko's report, Chainalysis also estimated the international share of all cryptocurrency sent by sending country. Interestingly, Türkiye is the leader in this with 92% between July 2020 and June 2021 (Chainalysis, 2021). In other words, 92% of cryptocurrency transfers originated from wallets tagged in Türkiye go to abroad.

4.3. Motives Behind Demand: Hedging or Speculation

One of the common classification among cryptocurrencies is based on their stability: (1) stablecoins and (2) non-stablecoins. By stablecoin, it means that they are backed by fiat-money, precious metals such as gold, or a different cryptocurrency. As these stablecoins are actually private cryptocurrencies, the companies minting them periodically publish the reserves in order to prove there is a 1:1 collateral. For example, USDT and USDC cryptocurrencies are pegged to 1 USD despite some de-pegging cases. By nature, the buyers of these cryptocurrencies do not seek for any gain as a result of price increase simply because their prices are almost always equal to 1 USD. When looking at the evolution of stablecoin market capitalizations, their total market cap rose $30 billion in the beginning of 2021 to $180 billion in February 2022 (CoinGecko, 2022).

On the other hand non-stablecoins are always exposed to price fluctuations and therefore lead to profit or loss for their investors. In an environment that there is no conventional valuation method for cryptocurrencies, their prices may increase without any fundamental reasoning. Even social media effectsare taken into account, people might be manipulated

by many users, so-called influencers, by being directed to the cryptocurrencies with no value proposition. Therefore, it might be assumed that most of the non-stablecoin investors are categorized as risk lovers as their main motivation is speculation.

Regarding stablecoins, there is a reasonable fundamental behind buying them: hedging against inflation in local fiat-currency such as Turkish Lira. There might be several reasons in the demand of basically USD-backed stablecoins:

i. Alternative of storing USD meaning they are converted at the same rate with USD;
ii. Payment tool with advantages of speed and cost;
iii. Bridge between crypto exchanges;
iv. Illegal activities.

In spite of the fact that it is needed to conduct user surveys to differentiate the share of each reason, it can be assumed that the first motivation does not represent a small share in total demand.

From speculation perspective, the interest in cryptocurrencies with high volatility might be handled in comparison with the other countries. Cryptocurrency investors in Türkiye show more interest in so-called alt-coins. Nevertheless as more reliable reports are reachable, it will be possible to monitor investors' behavour in terms of speculation and hedging purposes.

4.4. Legal Frame: Support or Restriction

One of the most comprehensive regulations on cryptocurrencies was released by European Union in June 2023: The Markets in Crypto Assets (MiCA). As indicated by the name of the regulation, instead of cryptocurrencies, the term of crypto assets is used and defined as "a digital representation of a value or of a right that is able to be transferred and stored electronically using distributed ledger technology or similar technology" (European Securities and Markets Authority, 2023).

As far as the scope of the MiCA is considered, crypto asset issuance, offer to the public, and trading are the main points of the regulation among other crypto asset services. MiCA targets the development of distributed ledger technology with many different applications for regulating crypto asset markets. In other words, by regulating the crypto asset markets,

regulators aim to provide a legal framework for the crypto asset business for economic growth and new employment opportunities. Moreover, it is believed that the regulation helps to increase the confidence in the market for the crypto asset users. In short, MiCA was born into a chaotic legislative environment around the world. That's why it might be considered as a milestone for the crypto assets and blockchain as it first defines and classifies the concept and methodology. On the other hand, the crucial concern regarding crypto asset environment lies in the references to anti-money laundering (AML) issues as crypto assets are considered usual suspects in AML topic.

Another crucial milestone for cryptocurrency regulation is the approval of Bitcoin exchange-traded funds (ETFs) by US Securities and Exchange Commission (SEC) in the beginning of 2024 (US Securities and Exchange Commission, 2024). After a long period of neglect, SEC took a step forward by allowing the listing of ETFs in the US exchanges. Together with this approval, even the prices of Bitcoin and some other cryptocurrencies went up. However there is still room for a wholistic regulation for cryptocurrencies in the US.

When looking at Türkiye from a crypto asset regulatory perspective, there is no any specific legislative but there are some secondary legislatives introduced by public institutions like Central Bank of Republic of Türkiye (CBRT) and the Financial Crimes Investigation Board which is an organ of Ministry of Finance and Treasury. First, CBRT banned the use of cryptocurrencies in any payment activity on April 30, 2021 (CBRT, 2021). As one of the widespread benefits of cryptocurrencies, CBRT prevented both the natural and legal persons from utilizing crypto currencies in their payments. This might be seen as a hindrance of the development of DLT software.

The second major regulatory activity was done by Financial Crimes Investigation Board under the Republic of Türkiye Ministry of Treasury and Finance. This institution is responsible from prevention and detection of money laundering and terrorist financing. In its guide for crypto asset service providers (CASP), it referred to the definition of CBRT for crypto assets and listed the liabilities for CASPs. These liabilities range from know your customer methods to suspicious transaction reporting. Also, in case of not fulfilling the obligations, the enforcements may be imposed (MASAK, 2021).

Regarding money laundering and other terrorist financing problems, the international institution, Financial Action Task Force (FATF) is closely monitoring the technology of blockchain and therefore cryptocurrencies. FATF handled the cryptocurrencies first in 2012 and then continuously updated its recommendations in the business of cryptocurrencies. While cryptocurrencies are defined as virtual assets (VA), cryptocurrency service providers as virtual asset service providers (VASP). However, FATF clearly listed the actions that VASPs should take in recommendation 15. This recommendation states that in the transfer transactions of cryptocurrencies, VASPs should record the customer information of both sender and receiver (FATF, 2023). Even though the recommendations that FATF published are not mandatory to comply, most of the time, they are critical in the sense not to drop to grey list. Simply because the countries on the grey list are not able to attract foreign investment due to the rules defined in credit rating agencies.

Another important issue in the cryptocurrency business is the taxation. As far as the taxation issue is considered the categorization or classification of cryptocurrencies in terms of accounting is critical. Since cryptocurrencies cannot be defined like standard goods and services, most probably regulators in different countries may approach from various perspectives so that different taxation methods may arise. In Türkiye, there is not a comprehensive legislation defining and classifying the cryptocurrencies. Therefore this situation is interpreted as there is a risk of tax evasion if the government evaluates the cryptocurrencies not as a financial instrument and therefore they are subject to value added tax (VAT). In this framework, some of the crypto exchange founders prefer to establish their companies in tax heaven countries. At the end of the day, the governments are not able to tax the earnings of these crypto exchanges.

4.5. Future of Crypto: Promising or Worthless

Jamie Dimon, JPMorgan Chase & Co. CEO stated at a conference in 2021 that “I personally think Bitcoin is worthless” (Dimon, 2021). At that time, JPMorgan was already giving its wealth management clients access to cryptocurrency funds. Again, in 2021, the deputy governor of the Bank of England, stated in a speech that the price of

Bitcoin could theoretically or practically drop to zero (Bank of England, 2021). On the other hand he acknowledged that about 0.1% of the household savings of UK households are in cryptocurrencies and the number of cryptocurrency holders is around 2.3 million. Many other similar examples of cautious approach toward the price of Bitcoin and other cryptocurrencies can be found in press releases or even academic articles.

One of the common argumentation in suspicious approaches is that Bitcoin and other cryptocurrencies have risks of regulation and AML. There are many critics to Bitcoin in the sense that it provides an efficient channel for illegal transactions. Some even think that because of its nature it cannot be fully regulated and therefore one day its value may eventually reach zero due to this factor.

Another widespread criticism towards cryptocurrencies is that in fact cryptocurrencies do not carry inherent value but blockchain technology does. They argue that, even though blockchain can be handled as the new infrastructure for financial technologies, the cryptocurrencies prices are unreliable. For example, Bank for International Settlement said in its yearly report published in June, 2023 that crypto and decentralized finance (DeFi) have offered a glimpse of tokenization's promise, but crypto is flawed system that cannot take on the mantle of the future of money (BIS, 2023).

Another similar opinion was released by the managing director of Monetary Authority of Singapore's, Ravi Menon. In a seminar held in 2022, he stated that cryptocurrencies are unsuitable for the retail investors: "…cryptocurrencies have taken a life of their own outside of the distributed ledger – and this is the source of the crypto world's problems." On the other hand he still asserts that their vision is to build an innovative digital asset ecosystem with the transformative potential of tokenization of financial and real assets (Menon, 2022).

In short, regarding the price of cryptocurrencies there are many cautious views in the press. However regarding the blockchain technology, critics of cryptocurrenices are not as cautious and even many of them see it promising when it comes to tokenization of traditional financial products.

As described in the previous section, cryptocurrencies have many disadvantages in terms of regulation due to the their decentralized nature. However here it will be emphasized how financial technology may overcome this problem. The first way to help regulators in

their monitoring activities is the blockchain analysis tool. Across the world there are many software solutions which trace the on-chain activities on a network or blockchain. Thanks to these tools, it becomes possible to monitor the source of the transfers and tag the assets related with a wallet possibly illegal as risky. In other words, these tools give the central authorities to investigate on-chain transfers and if the incoming asset is messed with an money laundering wallet then they can prevent the transaction or transfer. Of course, in order to do that, all crypto service providers should report this kind of activities to central authorities.

The second solution for the central authorities to monitor the on-chain activities is provided by communication tools between different central cryptocurrency service providers. As described in the requirement of FATF in the previous part, the on-chain transfers do not include the personal information of neither sender nor receiver of a transfer. That is why, a smart solution to this problem is provided by software solution that helps transmitting the sender's information to the receiver's service provider and vice versa. By doing this, it becomes possible to record all on-chain transfer data by including the sender and receiver personal information.

The last point to be focused in this part is the other potential innovations that blockchain and cryptocurrency may offer to traditional finance. IT can be summarized as also the tokenization. But here the possible benefits of tokenization will be detailed.

According to a comprehensive report published by Kumar et al. (2022) from Boston Consulting Group more than 56% of the assets held by taxpayers were illiquid which means trading at discount compared to liquid assets. For the authors there are many reasons behind this illiquidity ranging from limited affordability due to high ticket sizes (between $250,000 and $5 million) to limited access only to some elites. However they arguing that tokenization of financial and real assets will provide a much more efficient environment for the retail investors who can trade at smaller sizes. This issue is, for example, solved in the stock market by the fractionalization of the shares. A similar innovation can be practiced by the tokenization of, for example government bonds which are traded mostly with high ticket sizes.

One of the reason why traditional finance could not overcome the issue of offering more liquidity in the markets is that the operation process from reconciliation to settlement of

the traded assets are manual, slow and so, open to operation risks. However by the blockchain, it is argued that distributed ledger technology is a very powerful candidate to solve this operations and therefore minimize risks. In other words, what is expected by the distributed ledger technology is minimizing transaction costs related with trading activities.

In summary, even though there is no consensus over the future of cryptocurrency stability, blockchain technology is mostly accepted as offering an innovative potential. However the finance professional should still solve many issues which arise with the use of blockchain.

EMPIRICAL ANALYSIS

5.1. Methodology

As this study covers the data of time series, it is very critical to test for non-stationarity. In time series models, non-stationarity tests are important due to the following reasons (Brooks, 2008):

i) The effect of shocks which are described as unexpected changes in variables may have bigger impacts for non-stationary series over time. In other words, the shocks are expected to have smaller effect in time t+1 compared to t, but for non-stationary series this might the vice versa and even the effect may be infinite.

ii) Non-stationary series tend to produce spurious regressions due to their trending characteristics. A spurious regression is the regression in which two variables are related to each other with standard regression techniques, but their relationship is valueless.

Therefore, it is critical to conduct a stationarity test before regression analysis. In this study, Augmented Dickey-Fuller test is used to test the stationarity of the variables. As most of the economic series are not stationary, this test is critical before conducting the regression analyses. In the ADF test, the model is written as follows:

$$\Delta y_t = \Psi y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + u_t \quad (5.1)$$

As seen in the equation, ADF test takes possible serial correlation in the error terms into account by adding lagged differences of dependent variable.

In the second step of empirical analysis, the optimal lag length will be chosen. As this study will cover vector autoregression (VAR) and vector error correction (VEC) models, it is critical to choose the optimal lag length. In the VAR model, all variables are taken as endogenous in order to conduct a multivariate regression. As a result of this, in VAR model, there are n-equations with (n×p)-variables. All variables are expressed as a linear function of (1) its past values, (2) past values of other variables and (3) a serially

uncorrelated error term. To state this wording mathematically, the equation below is a sample expression of a VAR model:

$$y_t = \sum_{k=1}^{p} \beta_{1k} y_{t-k} + \sum_{m=1}^{p} \beta_{2m} x_{t-m} + \sum_{s=1}^{p} \beta_{3s} r_{t-s} + u_t \quad (5.2)$$

In this example, there are three variables, so there are three equations. In the second equation, x would be the dependent variable while y and r are the independent variables. Similarly in the third equation, r will be the dependent variable as y and x are the independent variable. However, the problem arises in determining p which is the lag length. As described above, in VAR models, the lag values of both dependent and independent variables are estimated in the regression of dependent variable.

As the number of lags, p, determines the number of coefficients, it also affects the model itself. Here, the main aim is to reach a parsimonious regression model. In practice, there are three popular information criteria used for model selection: Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quin Information Criterion (HQ). All three criteria aim to find the maximized value of the log-likelihood which is ln $(\hat{\sigma}^2)$. While maximizing the log-likelihood, adding new parameters would be very helpful. However, it may not be a better regression model simply because new parameters could fit random noise, leading to overfitting (Ruppert & Matteson, 2015). Therefore, the criteria above approach this issue of choosing optimal lag length by adding a penalty term. The three methods can be summarized as follows:

$$AIC = -\ln(\hat{\sigma}^2) + \frac{2k}{T} \quad (5.3)$$

$$SC = -\ln(\hat{\sigma}^2) + \frac{k}{T} \times \ln T \quad (5.4)$$

$$HQ = -\ln(\hat{\sigma}^2) + \frac{2k}{T} \times \ln(\ln T) \quad (5.5)$$

where k=n+p+1 and T=sample size. As seen in the information criteria, while minimizing the result, the number of variables and lags works as a penalty term.

On the other hand, these information criteria should be used in accordance with the economic theory in order to provide a more parsimonious rationale. Therefore, the model selection can be slightly different from what information criteria offer (Ruppert &

Matteson, 2015). In this study, the results of information criteria are used as a guide in the determination of lag for VAR analysis.

Through the VAR system, impulse response functions give both the duration and direction of the shocks to each independent variable. In other words, impulse response functions in VAR measure the responsiveness of the dependent variables to innovations in the independent variables (Brooks, 2008). In this study, the impulse response functions in VAR systems are presented in order to see the effects of the shocks to each variable.

In order to search for causal relationships between the variables, firstly Johansen's cointegration test is conducted. Johansen's methodology provides a basis to check long-run relationships. If the result of Johansen's cointegration test tells whether there is cointegrating equation in the VAR system, or not. If there is at least one cointegrating equation, then it makes possible to search for long-run relationships between the variables. The analysis of long-run relationship is provided by vector error correction model (VECM). In this model, for each variable, it can be seen how short-run deviations from the long-run equilibrium are corrected thanks to the error correction term (Alexander, 2008).

When the variables of a VAR model are cointegrated, vector error correction (VEC) model is used to test cointegrating relations by including multiple error-correction terms to all equations. While conducting a VEC model, all variables are handled as endogenous like in VAR model but all variables should be in their level forms instead of log return. Mathematically, an example of regression equation looks as follows:

$$y_t = \sigma + \sum_{k=1}^{n-1} \theta_{1k} y_{t-k} + \sum_{m=1}^{n-1} \theta_{2m} x_{t-m} + \sum_{s=1}^{n-1} \theta_{3s} r_{t-s} + \lambda ECT_{t-1} + u_t \quad (5.6)$$

When comparing with VAR model, the main difference is the error correction term which is shown as ECT_{t-1} in the equation. ECT_{t-1} term explains previous period's deviation from long-run equilibrium affects short-run movement in the dependent variable. At this point, the new coefficient term, λ, is the speed of this adjustment. In other words, it shows the speed at which y returns to equilibrium after any change in independent variables, x and r. In the literature ECT_{t-1} is expressed as below:

$$ECT_{t-1} = y_{t-1} - \theta_{11} x_{t-1} - \theta_{21} r_{t-1} \quad (5.7)$$

The last point to be expressed in the equation is the lag value used in VEC model. While VAR model uses n-lags, VEC model uses (n-1) lags as seen in the equation above.

Finally, Granger causality tests are applied in order to see causality relations between variables. It would be very critical to note that Granger causality and causality different terms. More precisely, Granger causality refers to a limited causality in which, ceteris paribus, the time series of a variable is helpful in predicting another variable's time series (Wooldridge, 2013). Therefore, the results for causality will be presented in a careful way.

5.2. Data and Stationarity Test

In the scope of this paper, the selected variables represent specific roles based on the money theories explained in the first chapter. As a representative of a specific notion in the theory, they help with the regression analysis to be conducted.

To start with, individual FX deposits data shows the demand for foreign currencies by individual residents of Türkiye. As it is the bank deposit individuals hold in their accounts, this figure is closely monitored by market researchers since it is considered a kind sentiment. This study excluded non-individual FX deposits not to expose to other shocks on business entities as companies may demand FX to pay their debts or for similar activities. Nevertheless, individual FX deposits can be handled as a pure demand for foreign currencies.

On the other hand, FX deposits were separated into two parts as demand and time deposits and analyzed particularly. The aim behind it is to distinguish the temporal effects which are mostly related to FX demand deposits. In other words, it is assumed that while the demand for FX demand deposit is more sensitive to daily phenomena the demand for FX time deposit is stickier.

Regarding USTRY, while it can be taken as a nominal value of TRY against USD, it is also considered as a measure of inflation rate. The linear relation between USDTRY and inflation rate allows to use USDTRY data as a measure of inflation. Since the inflation

rates are published monthly and this paper studies weekly data, USDTRY was also included as a substitute of inflation rate since it reflects expectations regarding inflation.

Investing in stocks became very popular among individuals in Türkiye not only because of higher investment returns but also the motivation of keeping the TRY value of the savings against high inflation rates. Even though BIST100 index price increased in nominal terms in the last years, its value in USD did not experience a similar rise. That's why the study does not include nominal BIST100 index but rather the USD equivalent of BIST100, BIST100USD.

Another variable used in the paper is the price of ounce gold. In order to isolate the inflation rate in Türkiye, the gram gold price is not considered but ounce gold is included to monitor a more generic data. Gold as an investment tool, is always attractive for people in Türkiye, so gold price is taken into account in regressing individual FX deposits.

In this paper, to be able to measure the effect of foreign alternative investment products NASDAQ100 is selected as a representation mainly shares of technology companies. Although the other index prices like S&P500 or Dow Jones could be selected as they list important shares and other products it is assumed that NASDAQ would represent a more technology and innovation-oriented products.

In order to involve interest rates in the economy, Türkiye 2-years bond is preferred as a benchmark. Interest rates are usually effective in the investment decision of individuals. As government bonds in local currency is theoretically taken as risk-free, the yield of government bonds in investment decisions is included as a critical factor.

Finally, the price of Bitcoin is involved into the model in order to see if it creates an alternative to holding FX deposit. Since there is no regulatory requirement to publish the number of cryptocurrencies held by residents in Türkiye, the price of Bitcoin which is the most dominant asset compared to peers was selected because it may affect directly the demand for cryptocurrencies.

Aysan et al. (2021) searched for the inter-relations of nine cryptocurrencies with the highest market capitalization in the sense whether their prices have co-movement between 2017 and 2020. They found that there is cointegration among bitcoin other

chosen cryptocurrencies. Therefore, they conducted vector error correction model and concluded that even though there is no strong causality between their prices before Covid-19 pandemic, the inter-relationship exists between cryptocurrency prices after pandemic outbreak. The result found by Aysan et al. gives an important input also for the assumptions of this study. As the prices of cryptocurrencies start co-move after Covid-19 outbreak, it is not inappropriate to take only bitcoin prices for the period studied here.

All variables are used in weekly frequency and between 2020 and 2021. EViews was used in regression analyses. The summary of sources and descriptions of the variables is shown in the table 5.1.

Table 5.1. Data Sources and Descriptions

Variable	Source	Description
INDFXDD	CBRT	Only individual FX demand deposits in the banks
INDFXTD	CBRT	Only individual FX time deposits in the banks
USDTRY	investing.com.tr	Closing price of the parity of USDTRY
BIST100USD	investing.com.tr	(Closing price of BIST100 Index)/(Closing price of USDTRY)
OUNCEGOLD	investing.com.tr	Closing spot price of one ounce of gold
NAS100	investing.com.tr	Closing spot price of NASDAQ 100 Index
TR2Y	investing.com.tr	Türkiye 2 years bond yield
BTCUSD	investing.com.tr	Closing price of Bitcoin in USD terms

Before going on with descriptive analysis, stationarity test results are provided. The results of Augmented Dickey-Fuller (ADF) test for each variable are given in the table 5.2. For the simplicity of the analysis, it is firstly checked p-values for level which is the probability values in the table. If the p-value is above 0.05 which is the 5% significance level, then it is concluded that the variable has a unit root.

Table 5.2. Augmented Dickey-Fuller Test Results

Variables	Augmented Dickey Fuller			Order of Integration
		Level	First Difference	
LNINDFXDD	t-Stat	-2.031511	-7.916726	I(1)
	Prob.	0.2731	0.00***	
LNINDFXTD	t-Stat	-2.120732	-7.173220	I(1)
	Prob.	0.2371	0.00***	
LNUSDTRY	t-Stat	-0.828979	-11.94528	I(1)
	Prob.	0.8063	0.00***	
LNBIST100USD	t-Stat	-2.177261	-10.46066	I(1)
	Prob.	0.2158	0.00***	
LNOUNCEGOLD	t-Stat	-2.843648	-12.85020	I(1)
	Prob.	0.0557	0.00***	
LNNAS100	t-Stat	-0.879810	-10.53860	I(1)
	Prob.	0.7911	0.00***	
LNTR2Y	t-Stat	-0.285729	-8.637560	I(1)
	Prob.	0.9222	0.00***	
LNBTCUSD	t-Stat	-1.065407	-9.571995	I(1)
	Prob.	0.7271	0.00***	

Note. *, **, *** denote 10%, 5% and 1% significance respectively

As the p-values in the ADF test results of level values of all variables are above 0.05, the null hypothesis of having a unit root cannot be rejected. However, p-values at first difference are below 0.05 for all variables and this means that all variables are stationary at their first difference. So, all variables are integrated of order 1, i.e. $y_t \sim I(1)$.

On the other hand, the table 5.3 shows the descriptive analysis of the variables. There are 105 observations for all variables. Through the descriptive statistics of the variables, especially skewness, kurtosis, Jarque-Bera and probability values are to be interpreted to assess normality. While skewness measures the degree of the asymmetry of the series,

kurtosis helps measuring the peakness and flatness of the distribution of the series. The more the value of skewness is close to zero, it means the distribution is more symmetric. Also, the kurtosis value of a normal distribution is 3. In this framework of normality, the raw series leads the analysis to be done with the log values of the variables.

Table 5.3. Descriptive Statistics of Variables

	Variables			
	INDFXDD	INDFXTD	USDTRY	BIST100USD
Mean	54,654	82,132	7.9381	168.27
Median	59,590	82,126	7.6699	165.77
Maximum	69,155	87,513	15.2118	224.42
Minimum	33,701	77,630	5.8684	131.68
Std. Dev.	10,358	2,601	1.6254	21.74
Skewness	-0.8373	0.1921	2.0622	0.6664
Jarque-Bera	2.1792	2.3273	8.6085	2.7160
Kurtosis	15.2151	2.6251	212.04	8.13
	OUNCEGOLD	NAS100	TR2Y	BTCUSD
Mean	1,788.03	12,382.66	0.1509	29,299
Median	1,792	12,738.2	0.148	29,406
Maximum	2,028	16,587.5	0.2309	64,156
Minimum	1,484.6	6,994.3	0.0869	5,625
Std. Dev.	107.31	2,525.46	0.0380	19,733
Skewness	-0.5708	-0.1981	0.0017	0.2677
Jarque-Bera	3.3761	1.9525	1.9968	1.4723
Kurtosis	6.32	5.49	4.40	11.46

When looking at the descriptive statistics of the variables, the first point to be discussed is the difference between INDFXDD and INDFXTD. The difference between maximum and minimum values of INDFXDD and the INDFXTD shows that INDFXDD time series move in a much wider range compared to INDFXTD. In other words, the gap between

maximum and minimum values of individual FX demand deposit is quite higher than individual FX time deposit. This might imply that the amount of demand deposit reacts faster and more massively. Similarly, standard deviation of INDFXDD is much higher than INDFXTD.

Moreover, the mean value of USDTRY is around 7.94 while its maximum and minimum values are 15.21 and 5.87, respectively. Despite rising trend in the price of USDTRY, it is mainly due to the sharp increase towards the end of 2021. This sharp rise in the last quarter of 2021 is also reflected in the standard deviation which is 1.63.

On the other hand, BIST100USD and NAS100 stock indices carry the impact of pandemics. While the stock prices suddenly decreased in global scale, they rallied after the shock effect. This is sometimes called as V-shaped graph. While NAS100 index has a rising trend after the shock, BIST100USD was not as lucky as NAS100. Due to the local reasons BIST100 displayed a more fluctuating trend. At the end of 2021, BIST100USD which rose to 224 at maximum was very close to the price in the beginning of 2020.

As a traditional investment product, gold prices were also closely monitored in 2020 and 2021. Although there is a rising period in the third quarter of 2020, gold prices follow more stable path from 2020 to 2021. From this perspective, it can be argued that gold kept its feature of being safe haven with low risk and low return. During the pandemics turmoil, gold prices (OUNCEGOLD) exceeded 2,000 USD while its minimum price was around 1,484 USD in these two years. Still, its standard deviation is lower than NAS100.

Regarding TR2Y, Türkiye 2-years bond yield, there are many factors affecting the interest rates to increase during 2020 and 2021. Firstly, rising inflation caused the price of bonds to decrease and therefore the interest rate to increase. In addition, other macroeconomic factors such as trade deficit, decreasing CBRT reserves and deteriorating government budget due to pandemics jointly contributed the interest rates to increase. Therefore, at the end of 2021 the interest rates rose to 23% which is the highest in this period.

Lastly, 2020 and 2021 represent a critical period for Bitcoin and other cryptocurrencies. Starting from the end of 2020, Bitcoin price around tripled in almost one quarter. Amid suspicious gazes, the performance of BTCUSD was impressive and drew all attention

towards itself. After so-called technical correction from 60,000 USD to 30,000 USD, BTCUSD regained its losses in the latter half of 2021. That's why the standard deviation of Bitcoin price which is almost 20,000 is quite high in this period.

In order to visualize the variables, the graphs both the raw and log transformations of time series are below. As seen also in the graphs, the normality condition is fulfilled with the log transformation of the time series.

Figure 5.1. Individual FX Demand Deposit & Log of Individual FX Demand Deposit

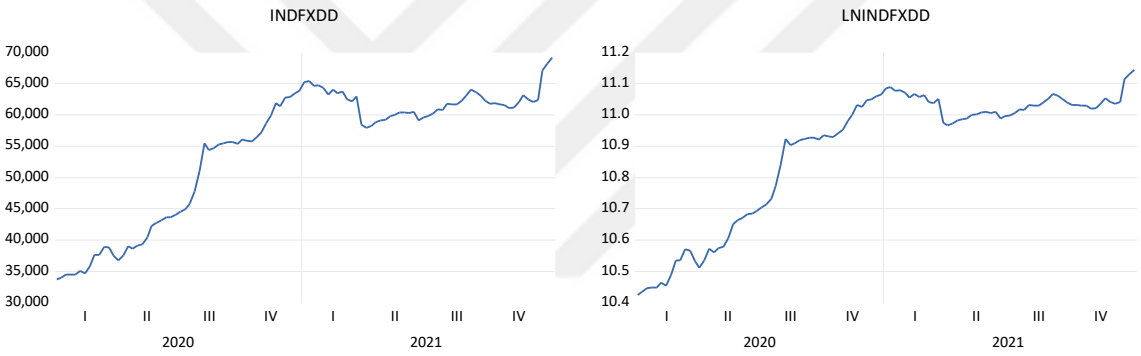


Figure 5.2. Individual FX Time Deposit & Log of Individual FX Time Deposit

Figure 5.3. USDTRY Parity & Log of USDTRY Parity

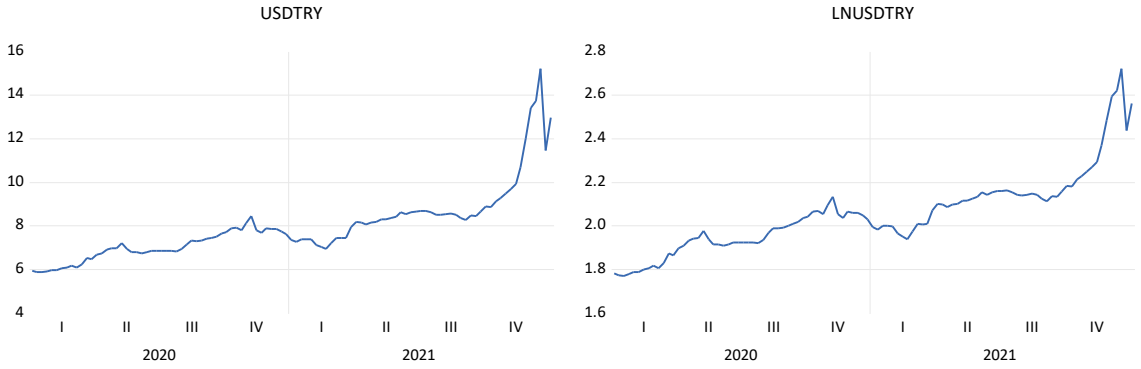


Figure 5.4. (BIST 100 Index / USDTRY) & Log of (BIST 100 Index /USDTRY)

Figure 5.5. Ounce Gold in USD & Log of Ounce Gold Price in USD

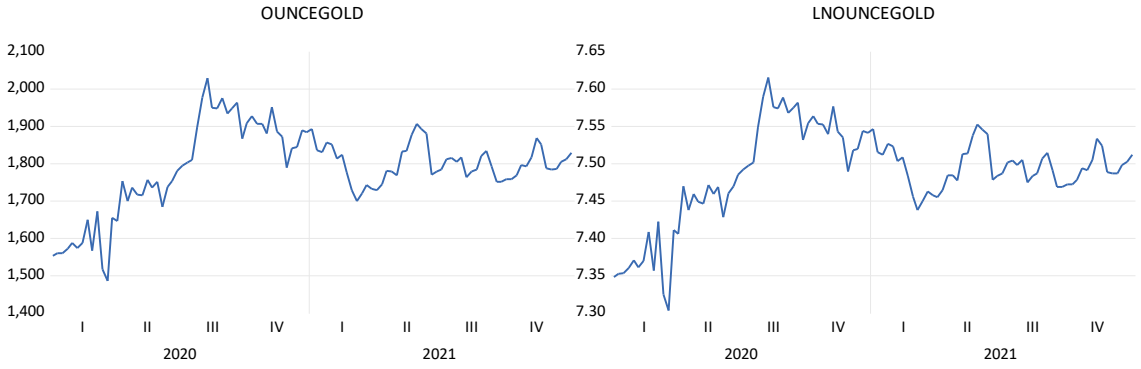


Figure 5.6. Nasdaq 100 Index Price & Log of Nasdaq 100 Index Price

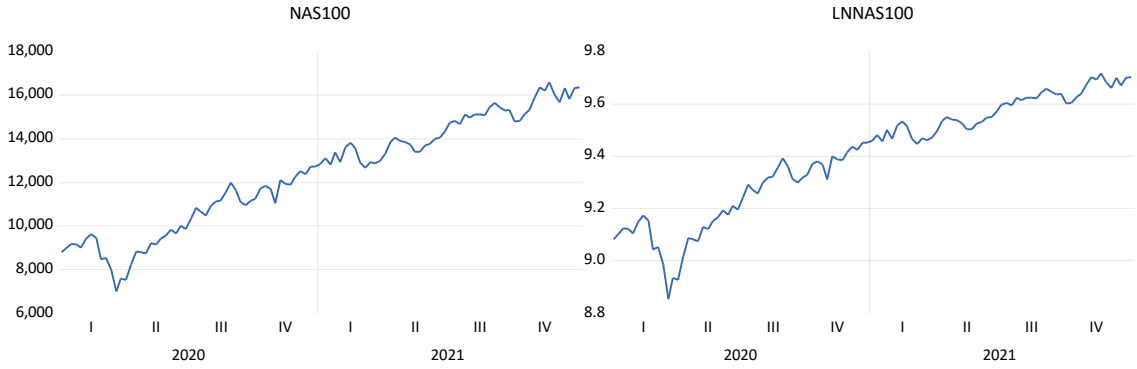


Figure 5.7. Türkiye 2 Years Bond Yield & Log of Türkiye 2 Years Bond Yield

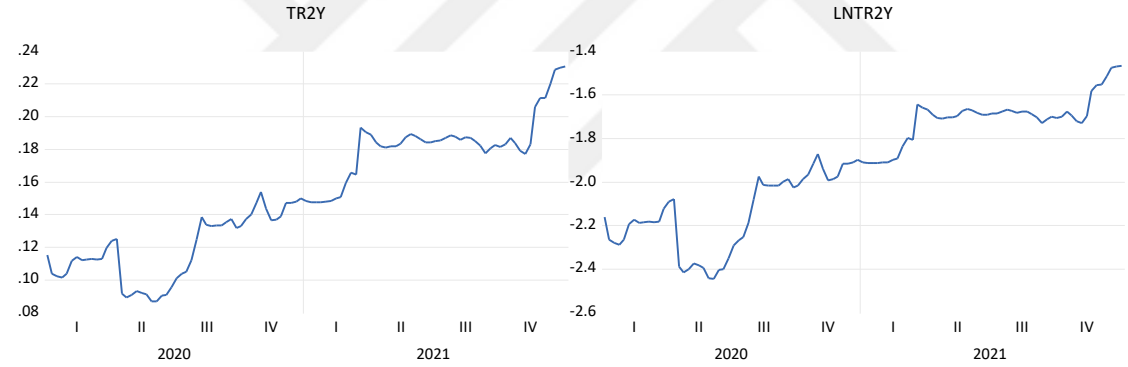
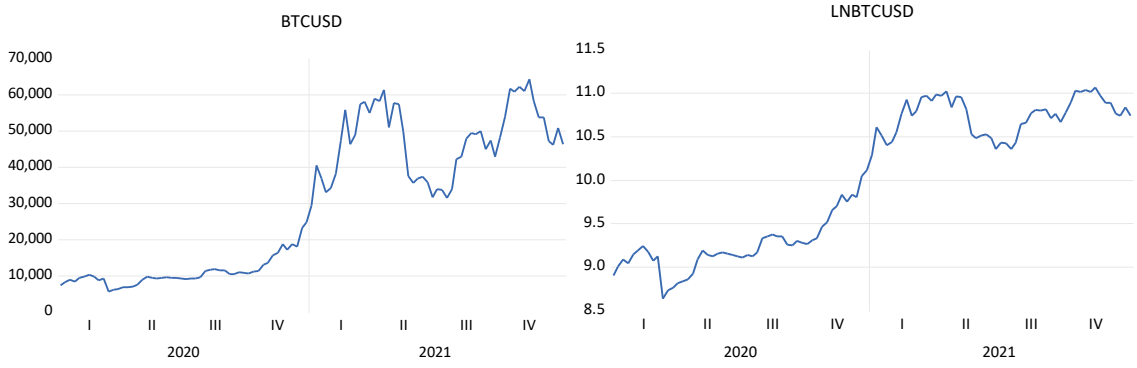


Figure 5.8. Bitcoin Price in USD & Log of Bitcoin Price in USD



When the individual FX demand deposit graph is evaluated, the tendency of rising from the beginning of 2020 to the end of 2021 is clearly observed. However individual FX time deposit graph does not present any trend but rather fluctuate in the same period. Also, the graph of USDTRY parity shows a very similar picture. The graphs of BIST 100, Nasdaq 100, the bond yield of Türkiye 2 years, and ounce gold show similar V-shape between the first and second quarter of 2020. The price of Bitcoin, lastly, experiences a sharp increase between the last quarter of 2020 and second quarter of 2021. After that period, its price tries stabilization in spite of high volatility.

5.3. Results for Individual FX Demand Deposit

First of all, the lag length is found with VAR model and with the first differenced variables. Endogenous variables in the VAR model are ΔLNINDFXDD, ΔLNUSDTRY, ΔLNBIST100USD, ΔLNOUNCEGOLD, ΔLNNAS100, ΔLNTR2Y, and ΔLNBTCUSD, in other words, log returns of the raw variables.

According to information criteria results given in the table 5.4, Akaike Information Criterion (AIC) gives a lower value. If the suggestion of information criteria is followed, the lag length should be chosen as 1. However lag length is chosen as 2 based on the economic theory. To put it more explicitly, it is assumed that the values of the variables can affect the variables in the VAR system for two weeks.

Table 5.4. VAR Lag Selection Criteria with INDFXDD

Lag	AIC	SC	HQ
0	-26.18628	-26.00613*	-26.11333*
1	-26.18757*	-24.74640	-25.60399
2	-25.67207	-22.96989	-24.57787
3	-25.22216	-21.21020	-23.59845
4	-25.18607	-19.89757	-23.04572

Note. * denotes to minimum value for each criterion

Since the choice of the lag length affects deeply both VAR and VECM models, it is critical to choose the optimum lag. There is a trade-off between choosing high and low

lag length: (1) If a high lag is chosen, there is a smaller risk of omitting important lags but the efficiency of the model decreases; (2) if a low lag length is chosen, there is a bigger risk of omitting important lags but the efficiency of the model increases.

Secondly, trace statistics of Johansen cointegration test is presented in order to see if there is cointegrating equation.

Table 5.5. Johansen Cointegration Test (Trace) with INDFXDD

	Trace Statistics	0.05 Critical Value	Prob.
None*	145.70	125.62	0.0017
At most 1*	96.89	95.75	0.0417
At most 2	65.41	69.82	0.1069
At most 3	40.67	47.86	0.1995
At most 4	23.31	29.80	0.2311
At most 5	9.81	15.49	0.2957
At most 6	2.58	3.84	0.1080

Note. * denotes to rejection of H_0

According to the table, the hypothesis that there is no co-integrating equation at the 0.05 level is rejected since p-value is 0.0017. Similarly, the hypothesis that there is at most 1 cointegrating equation is rejected since the probability value is 0.0417 which is lower than 0.05. However the hypothesis that there are 2 cointegrating equations cannot be rejected as the trace statistics (65.41) is lower than 0.05 critical value (69.82). As a result of trace test, it is appropriate to continue with both long-run and short-run models.

5.3.1. VAR Results with Individual FX Demand Deposit

In the scope of this study, all variables were estimated as independent variable in VAR model. As the lag length was chosen as 2 in the previous section, and there are 7 variables, VAR model estimates 105 coefficients for 7 equations. The equations covering individual FX demand deposit are expressed below:

$$\Delta(\mathrm{LNINDFXDD_t}) = \beta_1\Delta(\mathrm{LNINDFXDD_{t-1}}) + \beta_2\Delta(\mathrm{LNINDFXDD_{t-2}}) + \beta_3\Delta(\mathrm{LNUSDTRY_{t-1}}) + \beta_4\Delta(\mathrm{LNUSDTRY_{t-2}}) + \beta_5\Delta(\mathrm{LNBIST100USD_{t-1}}) + \beta_6\Delta(\mathrm{LNBIST100USD_{t-2}}) + \beta_7\Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \beta_8\Delta(\mathrm{LNOUNCEGOLD_{t-2}}) + \beta_9\Delta(\mathrm{LNNAS100_{t-1}}) + \beta_{10}\Delta(\mathrm{LNNAS100_{t-2}}) + \beta_{11}\Delta(\mathrm{LNTR2Y_{t-1}}) + \beta_{12}\Delta(\mathrm{LNTR2Y_{t-2}}) + \beta_{13}\Delta(\mathrm{LNBTCUSD_{t-1}}) + \beta_{14}\Delta(\mathrm{LNBTCUSD_{t-2}}) + \beta_{15} \quad (5.8)$$

$$\Delta(\mathrm{LNUSDTRY_t}) = \theta_1\Delta(\mathrm{LNINDFXDD_{t-1}}) + \theta_2\Delta(\mathrm{LNINDFXDD_{t-2}}) + \theta_3\Delta(\mathrm{LNUSDTRY_{t-1}}) + \theta_4\Delta(\mathrm{LNUSDTRY_{t-2}}) + \theta_5\Delta(\mathrm{LNBIST100USD_{t-1}}) + \theta_6\Delta(\mathrm{LNBIST100USD_{t-2}}) + \theta_7\Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \theta_8\Delta(\mathrm{LNOUNCEGOLD_{t-2}}) + \theta_9\Delta(\mathrm{LNNAS100_{t-1}}) + \theta_{10}\Delta(\mathrm{LNNAS100_{t-2}}) + \theta_{11}\Delta(\mathrm{LNTR2Y_{t-1}}) + \theta_{12}\Delta(\mathrm{LNTR2Y_{t-2}}) + \theta_{13}\Delta(\mathrm{LNBTCUSD_{t-1}}) + \theta_{14}\Delta(\mathrm{LNBTCUSD_{t-2}}) + \theta_{15} \quad (5.9)$$

$$\Delta(\mathrm{LNBIST100USD_t}) = \phi_1\Delta(\mathrm{LNINDFXDD_{t-1}}) + \phi_2\Delta(\mathrm{LNINDFXDD_{t-2}}) + \phi_3\Delta(\mathrm{LNUSDTRY_{t-1}}) + \phi_4\Delta(\mathrm{LNUSDTRY_{t-2}}) + \phi_5\Delta(\mathrm{LNBIST100USD_{t-1}}) + \phi_6\Delta(\mathrm{LNBIST100USD_{t-2}}) + \phi_7\Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \phi_8\Delta(\mathrm{LNOUNCEGOLD_{t-2}}) + \phi_9\Delta(\mathrm{LNNAS100_{t-1}}) + \phi_{10}\Delta(\mathrm{LNNAS100_{t-2}}) + \phi_{11}\Delta(\mathrm{LNTR2Y_{t-1}}) + \phi_{12}\Delta(\mathrm{LNTR2Y_{t-2}}) + \phi_{13}\Delta(\mathrm{LNBTCUSD_{t-1}}) + \phi_{14}\Delta(\mathrm{LNBTCUSD_{t-2}}) + \phi_{15} \quad (5.10)$$

$$\Delta(\mathrm{LNOUNCEGOLD}_t) = \delta_1\Delta(\mathrm{LNINDFXDD}_{t-1}) + \delta_2\Delta(\mathrm{LNINDFXDD}_{t-2}) + \delta_3\Delta(\mathrm{LNUSDTRY}_{t-1}) + \delta_4\Delta(\mathrm{LNUSDTRY}_{t-2}) + \delta_5\Delta(\mathrm{LNBIST100USD}_{t-1}) + \delta_6\Delta(\mathrm{LNBIST100USD}_{t-2}) + \delta_7\Delta(\mathrm{LNOUNCEGOLD}_{t-1}) + \delta_8\Delta(\mathrm{LNOUNCEGOLD}_{t-2}) + \delta_9\Delta(\mathrm{LNNAS100}_{t-1}) + \delta_{10}\Delta(\mathrm{LNNAS100}_{t-2}) + \delta_{11}\Delta(\mathrm{LNTR2Y}_{t-1}) + \delta_{12}\Delta(\mathrm{LNTR2Y}_{t-2}) + \delta_{13}\Delta(\mathrm{LNBTCUSD}_{t-1}) + \delta_{14}\Delta(\mathrm{LNBTCUSD}_{t-2}) + \delta_{15} \quad (5.11)$$

$$\Delta(\mathrm{LNNAS100}_t) = \vartheta_1\Delta(\mathrm{LNINDFXDD}_{t-1}) + \vartheta_2\Delta(\mathrm{LNINDFXDD}_{t-2}) + \vartheta_3\Delta(\mathrm{LNUSDTRY}_{t-1}) + \vartheta_4\Delta(\mathrm{LNUSDTRY}_{t-2}) + \vartheta_5\Delta(\mathrm{LNBIST100USD}_{t-1}) + \vartheta_6\Delta(\mathrm{LNBIST100USD}_{t-2}) + \vartheta_7\Delta(\mathrm{LNOUNCEGOLD}_{t-1}) + \vartheta_8\Delta(\mathrm{LNOUNCEGOLD}_{t-2}) + \vartheta_9\Delta(\mathrm{LNNAS100}_{t-1}) + \vartheta_{10}\Delta(\mathrm{LNNAS100}_{t-2}) + \vartheta_{11}\Delta(\mathrm{LNTR2Y}_{t-1}) + \vartheta_{12}\Delta(\mathrm{LNTR2Y}_{t-2}) + \vartheta_{13}\Delta(\mathrm{LNBTCUSD}_{t-1}) + \vartheta_{14}\Delta(\mathrm{LNBTCUSD}_{t-2}) + \vartheta_{15} \quad (5.12)$$

$$\Delta(\mathrm{LNTR2Y}_t) = \varphi_1\Delta(\mathrm{LNINDFXDD}_{t-1}) + \varphi_2\Delta(\mathrm{LNINDFXDD}_{t-2}) + \varphi_3\Delta(\mathrm{LNUSDTRY}_{t-1}) + \varphi_4\Delta(\mathrm{LNUSDTRY}_{t-2}) + \varphi_5\Delta(\mathrm{LNBIST100USD}_{t-1}) + \varphi_6\Delta(\mathrm{LNBIST100USD}_{t-2}) + \varphi_7\Delta(\mathrm{LNOUNCEGOLD}_{t-1}) + \varphi_8\Delta(\mathrm{LNOUNCEGOLD}_{t-2}) + \varphi_9\Delta(\mathrm{LNNAS100}_{t-1}) + \varphi_{10}\Delta(\mathrm{LNNAS100}_{t-2}) + \varphi_{11}\Delta(\mathrm{LNTR2Y}_{t-1}) + \varphi_{12}\Delta(\mathrm{LNTR2Y}_{t-2}) + \varphi_{13}\Delta(\mathrm{LNBTCUSD}_{t-1}) + \varphi_{14}\Delta(\mathrm{LNBTCUSD}_{t-2}) + \varphi_{15} \quad (5.13)$$

$$\Delta(\mathrm{LNBTCUSD_t}) = \eta_1\Delta(\mathrm{LNINDFXDD_{t-1}}) + \eta_2\Delta(\mathrm{LNINDFXDD_{t-2}}) + \eta_3\Delta(\mathrm{LNUSDTRY_{t-1}}) + \eta_4\Delta(\mathrm{LNUSDTRY_{t-2}}) + \eta_5\Delta(\mathrm{LNBIST100USD_{t-1}}) + \eta_6\Delta(\mathrm{LNBIST100USD_{t-2}}) + \eta_7\Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \eta_8\Delta(\mathrm{LNOUNCEGOLD_{t-2}}) + \eta_9\Delta(\mathrm{LNNAS100_{t-1}}) + \eta_{10}\Delta(\mathrm{LNNAS100_{t-2}}) + \eta_{11}\Delta(\mathrm{LNTR2Y_{t-1}}) + \eta_{12}\Delta(\mathrm{LNTR2Y_{t-2}}) + \eta_{13}\Delta(\mathrm{LNBTCUSD_{t-1}}) + \eta_{14}\Delta(\mathrm{LNBTCUSD_{t-2}}) + \eta_{15} \quad (5.14)$$

In order for simplicity, OLS estimation results of the 105 coefficients are presented below. The first column of the table shows the related number of equations above. Regarding each coefficient, coefficient value and its p-value are shown in the table.

Table 5.6. OLS Estimation Results of VAR Model Coefficients with INDFXDD

	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	β_{10}	β_{11}	β_{12}	β_{13}	β_{14}	β_{15}
Coef.	.17	.1	.02	.20	.06	.08	.14	.1	.01	-.0	-.0	.0	-.0	.0	.0
Prob.	.1	.5	.77	.06**	.3	.2	.1	.4	.9	.9	.6	.4	.9	.9	.2
	θ_1	θ_2	θ_3	θ_4	θ_5	θ_6	θ_7	θ_8	θ_9	θ_{10}	θ_{11}	θ_{12}	θ_{13}	θ_{14}	θ_{15}
Coef.	-.6	.2	-.3	.54	-.1	.20	-.1	.2	.05	-.2	.2	-.0	-.0	.0	.0
Prob.	.01**	.4	.04	.01**	.5	.11	.6	.3	.7	.2	.02**	.7	.48	.6	.1
	ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5	ϕ_6	ϕ_7	ϕ_8	ϕ_9	ϕ_{10}	ϕ_{11}	ϕ_{12}	ϕ_{13}	ϕ_{14}	ϕ_{15}
Coef.	.07	.07	.58	-.3	.2	-.1	.1	-.2	-.1	.4	-.3	.1	.1	.0	-.0
Prob.	.8	.8	.0***	.2	.3	.4	.7	.5	.7	.05*	.03**	.4	.2	.8	.3
	δ_1	δ_2	δ_3	δ_4	δ_5	δ_6	δ_7	δ_8	δ_9	δ_{10}	δ_{11}	δ_{12}	δ_{13}	δ_{14}	δ_{15}
Coef.	-.1	-.1	-.1	.1	-.1	-.0	-.2	.1	-.1	.1	.0	-.0	.0	-.0	.0
Prob.	.5	.5	.4	.4	.2	.9	.1	.4	.5	.5	.7	.9	.3	.1	.5
	ϑ_1	ϑ_2	ϑ_3	ϑ_4	ϑ_5	ϑ_6	ϑ_7	ϑ_8	ϑ_9	ϑ_{10}	ϑ_{11}	ϑ_{12}	ϑ_{13}	ϑ_{14}	ϑ_{15}
Coef.	-.2	-.1	.1	.0	.0	.0	.1	.0	-.1	.1	.0	.1	.08	-.0	.0
Prob.	.3	.8	.6	.9	.9	.9	.4	.9	.4	.5	.6	.5	.02**	.3	.2

	φ_1	φ_2	φ_3	φ_4	φ_5	φ_6	φ_7	φ_8	φ_9	φ_{10}	φ_{11}	φ_{12}	φ_{13}	φ_{14}	φ_{15}
Coef.	-.3	.2	-.0	.4	-.1	.27	-.0	.1	-.3	-.1	.2	-.1	.1	-.0	.0
Prob.	.2	.4	.8	.1	.7	.07*	.9	.6	.08*	.5	.09*	.4	.2	.4	.2
	η_1	η_2	η_3	η_4	η_5	η_6	η_7	η_8	η_9	η_{10}	η_{11}	η_{12}	η_{13}	η_{14}	η_{15}
Coef.	.3	-.9	-.2	-.4	-.2	-.2	-.6	.3	.1	.3	-.0	-.0	.1	.0	.0
Prob.	.6	.2	.7	.5	.6	.6	.2	.6	.9	.5	.9	.9	.4	.9	.2

Note. *, **, *** denote 10%, 5% and 1% significance respectively

Based on this table, only the coefficients which have p-value lower than 0.10 are taken in the equations below to comply with 10% significance level.

$$\Delta(\text{LNINDFXDD}_t) = 0.1964 \times \Delta(\text{LNUSDTRY}_{t-2}) \quad (5.15)$$

$$\Delta(\text{LNUSDTRY}_t) = -0.588673 \times \Delta(\text{LNINDFXDD}_{t-1}) - 0.298508 \times \Delta(\text{LNUSDTRY}_{t-1}) + 0.538363 \times \Delta(\text{LNUSDTRY}_{t-2}) + 0.212447 \times \Delta(\text{LNTR2Y}_{t-1}) \quad (5.16)$$

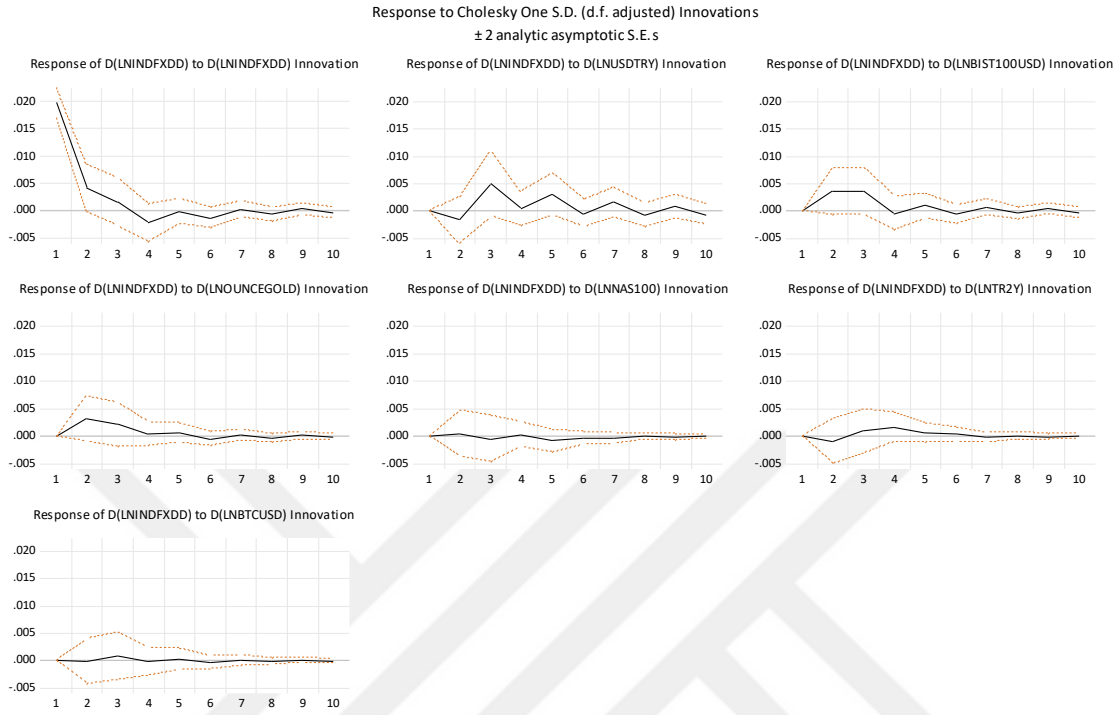
$$\Delta(\text{LNBIST100USD}_t) = 0.577088 \times \Delta(\text{LNUSDTRY}_{t-1}) + 0.365153 \times \Delta(\text{LNNAS100}_{t-2}) - 0.278827 \times \Delta(\text{LNTR2Y}_{t-1}) \quad (5.17)$$

$$\Delta(\text{LNNAS100}_t) = 0.083998 \times \Delta(\text{LNBTCUSD}_{t-1}) \quad (5.18)$$

$$\Delta(\text{LNTR2Y}_t) = 0.270974 \times \Delta(\text{LNBIST100USD}_{t-2}) - 0.304767 \times \Delta(\text{LNNAS100}_{t-1}) + 0.191875 \times \Delta(\text{LNTR2Y}_t) \quad (5.19)$$

As seen from the table, none of the variables are explanatory when ΔLNOUNCEGOLD and ΔLNBTCUSD are dependent variables. Therefore, only 5 equations are listed above. After estimating VAR equations, impulse-response functions are graphed in order to visualize the response of each variable to a shock to other variables.

Figure 5.9. Response of ΔLNINDFXDD to Shocks on Variables



In the figure 5-9 it is shown the response of ΔLNINDFXDD to shocks on other variables. The only statistically significant response occurs after a shock to ΔLNINDFXDD, itself, and in the first period and positive way. The shocks on other variables do not have a significant impact on ΔLNINDFXDD

Figure 5.10. Response of ΔLNUSDTRY to Shocks on Variables

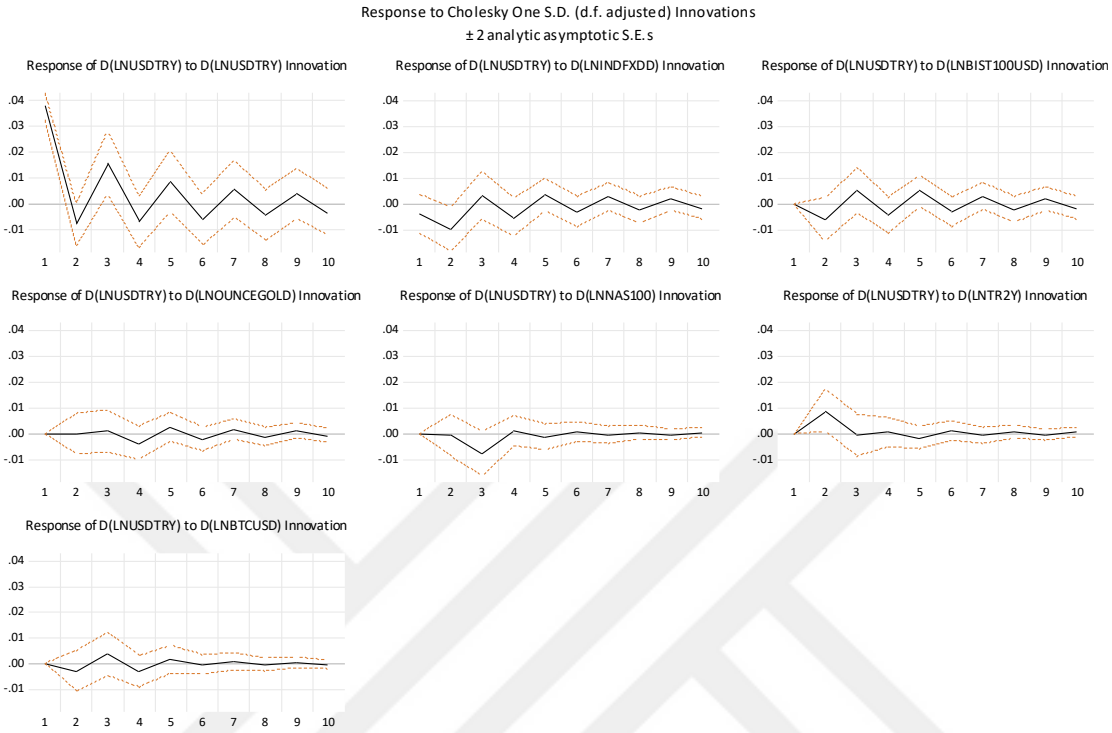


Figure 5-10 shows the response of ΔLNUSDTRY after the shocks on other variables. When there is a shock on ΔLNUSDTRY, the first and third periods implies significant impact on ΔLNUSDTRY, itself. Also, ΔLNUSDTRY is negatively impacted by a shock on ΔLNINDFXDD in the second period. However the other variables does not display any significant shock impulse on ΔLNUSDTRY.

Figure 5.11. Response of ΔLNBIST100USD to Shocks on Variables

The responses of ΔLNBIST100USD to the shocks on variables are in the figure 5.11. ΔLNBIST100USD has a positive response when there is shock on itself in the first period. Also, it responds negatively to a shock on ΔLNUSDTRY in the first period, but positively in the second period. Interestingly, a positive and significant impact occurs in the third period after a shock on ΔLNNAS100. This impact stabilizes after fifth period. However, shocks on other variables do not have any significant impact on ΔLNBIST100USD.

Figure 5.12. Response of ΔLNOUNCEGOLD to Shocks on Variables

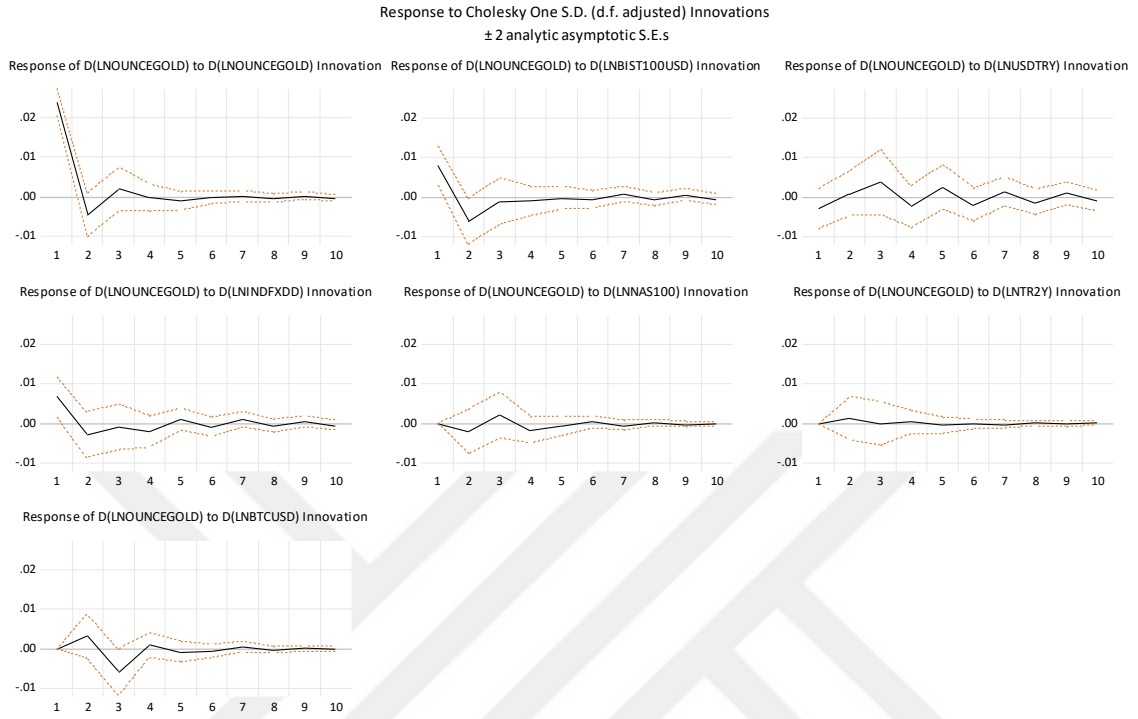
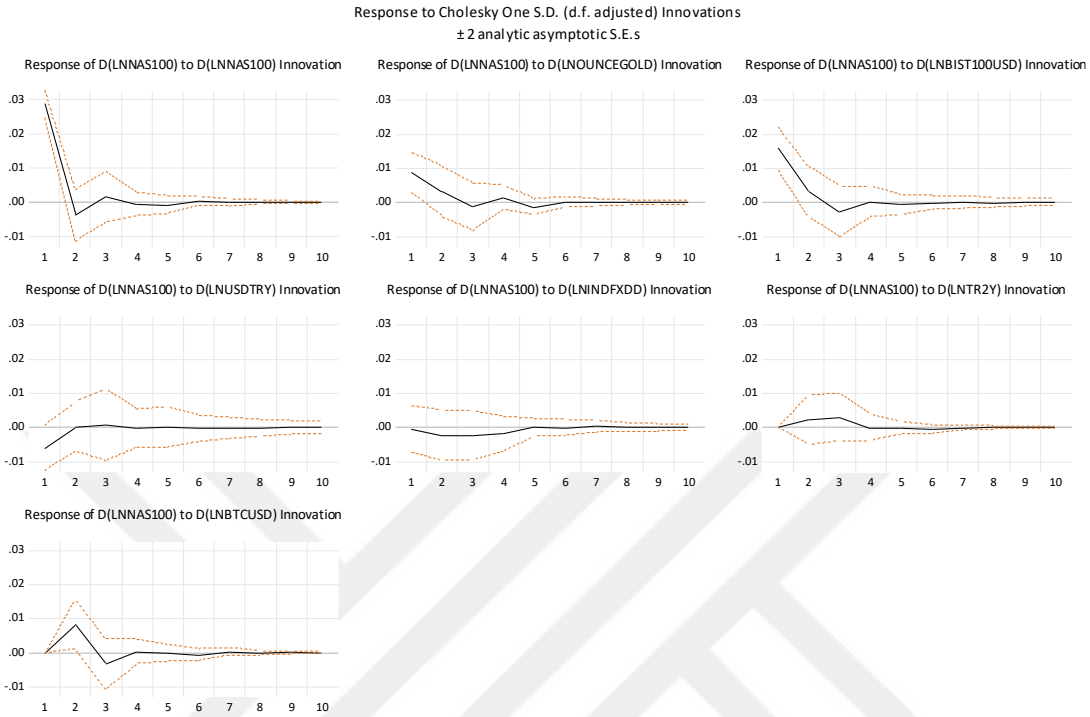


Figure 5.12 shows responses of ΔLNOUNCEGOLD to shocks on variables. While there is a positive response to a shock on itself in the first period, this impact stabilizes after fourth period. On the other hand, ΔLNOUNCEGOLD shows negative response to shocks on ΔLNBIST100USD and ΔLNBTCUSD in the second and third periods, separately.

Figure 5.13. Response of ΔLNNAS100 to Shocks on Variables



ΔLNNAS100 responds positively to shocks on itself, ΔLNOUNCEGOLD and ΔLNBIST100 in the first period. However these impacts stabilizes after fourth period for each shock. Interestingly, ΔLNNAS100 does not display any response to a shock on ΔLNBTCUSD in the first period but a positive response in the second period.

Figure 5.14. Response of ΔLNTR2Y to Shocks on Variables

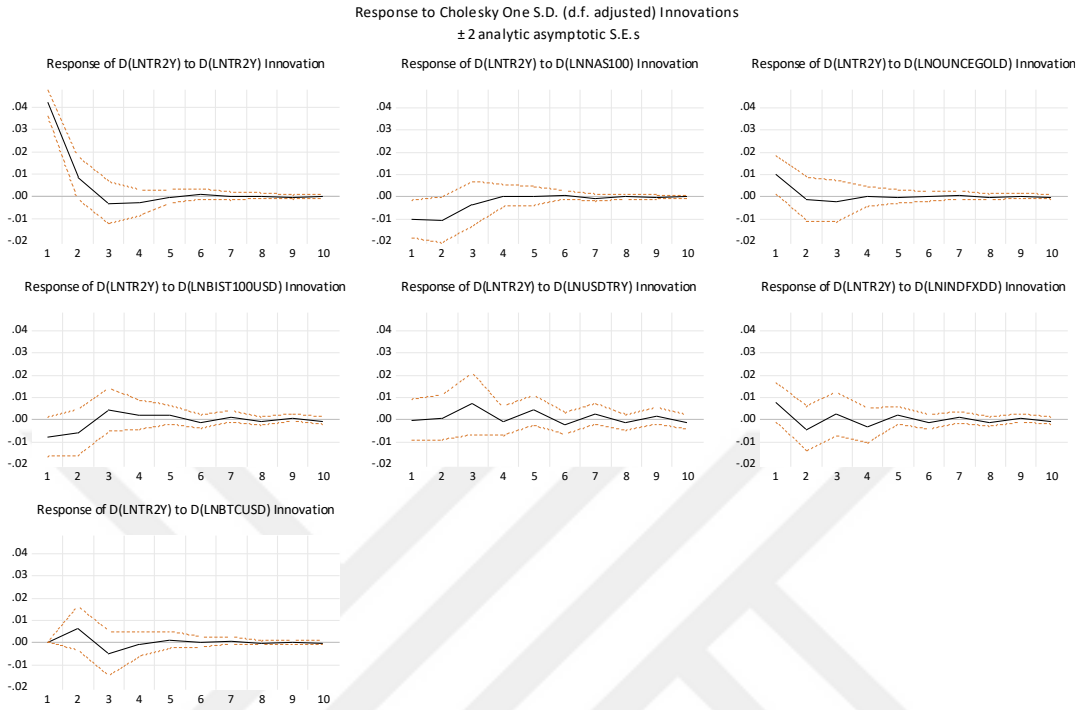
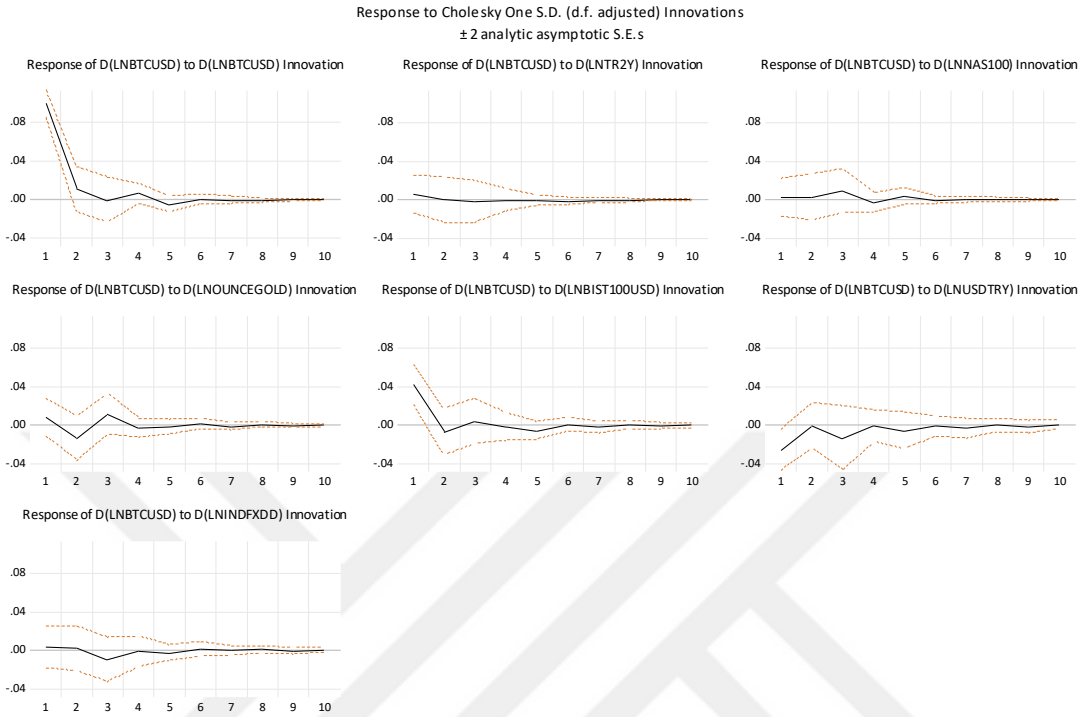


Figure 5.14 describes responses of ΔLNTR2Y to shocks on each variable. According to the graphs, ΔLNTR2Y shows a positive response to the shocks on itself and ΔLNOUNCEGOLD in the first period. However, a negative response seems to a shock on ΔLNNAS100 in the first period.

Figure 5.15. Response of ΔLNBTCUSD to Shocks on Variables



Finally, responses of ΔLNBTCUSD is displayed in the graph 5.15 below. While it responds positively to shock on itself and ΔLNBIST100USD in the first period, there is a negative response to a shock on ΔLNUSDTRY. Economic interpretations of these response-impulse functions are studied in the upcoming parts of the study.

5.3.2. VECM Results with Individual FX Demand Deposit

In the scope of this study, VEC model is conducted with the endogenous variables of LNINDFXDD, LNUSDTRY, LNBIST100USD, LNOUNCEGOLD, LNNAS100, LNTR2Y and LNBTCUSD. The estimated equations can be seen below:

$$\begin{aligned} \mathrm{ECT}_{t-1} = {} & \mathrm{LNINDFXDD}_{t-1} - 1.22 \times \mathrm{LNUSDTRY}_{t-1} \\ & - 0.68 \times \mathrm{LNBIST100USD}_{t-1} + 2.93 \times \mathrm{LNOUNCEGOLD}_{t-1} \\ & - 0.42 \times \mathrm{LNNAS100}_{t-1} + 0.78 \times \mathrm{LNTR2Y}_{t-1} \\ & - 0.05 \times \mathrm{LNBTCUSD}_{t-1} + 22.91 \end{aligned} \tag{5.20}$$

$$\Delta(\mathrm{LNINDFXDD_t}) = \lambda_1 \mathrm{ECT_{t-1}} + \beta_1 \Delta(\mathrm{LNINDFXDD_{t-1}}) + \beta_2 \Delta(\mathrm{LNUSDTRY_{t-1}}) + \beta_3 \Delta(\mathrm{LNBIST100USD_{t-1}}) + \beta_4 \Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \beta_5 \Delta(\mathrm{LNNAS100_{t-1}}) + \beta_6 \Delta(\mathrm{LNTR2Y_{t-1}}) + \beta_7 \Delta(\mathrm{LNBTCUSD_{t-1}}) + \beta_8 \quad (5.21)$$

$$\Delta(\mathrm{LNUSDTRY_t}) = \lambda_2 \mathrm{ECT_{t-1}} + \theta_1 \Delta(\mathrm{LNINDFXDD_{t-1}}) + \theta_2 \Delta(\mathrm{LNUSDTRY_{t-1}}) + \theta_3 \Delta(\mathrm{LNBIST100USD_{t-1}}) + \theta_4 \Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \theta_5 \Delta(\mathrm{LNNAS100_{t-1}}) + \theta_6 \Delta(\mathrm{LNTR2Y_{t-1}}) + \theta_7 \Delta(\mathrm{LNBTCUSD_{t-1}}) + \theta_8 \quad (5.22)$$

$$\Delta(\mathrm{LNBIST100USD_t}) = \lambda_3 \mathrm{ECT_{t-1}} + \phi_1 \Delta(\mathrm{LNINDFXDD_{t-1}}) + \phi_2 \Delta(\mathrm{LNUSDTRY_{t-1}}) + \phi_3 \Delta(\mathrm{LNBIST100USD_{t-1}}) + \phi_4 \Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \phi_5 \Delta(\mathrm{LNNAS100_{t-1}}) + \phi_6 \Delta(\mathrm{LNTR2Y_{t-1}}) + \phi_7 \Delta(\mathrm{LNBTCUSD_{t-1}}) + \phi_8 \quad (5.23)$$

$$\Delta(\mathrm{LNOUNCEGOLD_t}) = \lambda_4 \mathrm{ECT_{t-1}} + \delta_1 \Delta(\mathrm{LNINDFXDD_{t-1}}) + \delta_2 \Delta(\mathrm{LNUSDTRY_{t-1}}) + \delta_3 \Delta(\mathrm{LNBIST100USD_{t-1}}) + \delta_4 \Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \delta_5 \Delta(\mathrm{LNNAS100_{t-1}}) + \delta_6 \Delta(\mathrm{LNTR2Y_{t-1}}) + \delta_7 \Delta(\mathrm{LNBTCUSD_{t-1}}) + \delta_8 \quad (5.24)$$

$$\Delta(\mathrm{LNNAS100_t}) = \lambda_5 \mathrm{ECT_{t-1}} + \vartheta_1 \Delta(\mathrm{LNINDFXDD_{t-1}}) + \vartheta_2 \Delta(\mathrm{LNUSDTRY_{t-1}}) + \vartheta_3 \Delta(\mathrm{LNBIST100USD_{t-1}}) + \vartheta_4 \Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \vartheta_5 \Delta(\mathrm{LNNAS100_{t-1}}) + \vartheta_6 \Delta(\mathrm{LNTR2Y_{t-1}}) + \vartheta_7 \Delta(\mathrm{LNBTCUSD_{t-1}}) + \vartheta_8 \quad (5.25)$$

$$\Delta(\mathrm{LNTR2Y_t}) = \lambda_6 \mathrm{ECT_{t-1}} + \varphi_1 \Delta(\mathrm{LNINDFXDD_{t-1}}) + \varphi_2 \Delta(\mathrm{LNUSDTRY_{t-1}}) + \varphi_3 \Delta(\mathrm{LNBIST100USD_{t-1}}) + \varphi_4 \Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \varphi_5 \Delta(\mathrm{LNNAS100_{t-1}}) + \varphi_6 \Delta(\mathrm{LNTR2Y_{t-1}}) + \varphi_7 \Delta(\mathrm{LNBTCUSD_{t-1}}) + \varphi_8 \quad (5.26)$$

$$\Delta(\mathrm{LNBTCUSD_t}) = \lambda_7 \mathrm{ECT_{t-1}} + \eta_1 \Delta(\mathrm{LNINDFXDD_{t-1}}) + \eta_2 \Delta(\mathrm{LNUSDTRY_{t-1}}) + \eta_3 \Delta(\mathrm{LNBIST100USD_{t-1}}) + \eta_4 \Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \eta_5 \Delta(\mathrm{LNNAS100_{t-1}}) + \eta_6 \Delta(\mathrm{LNTR2Y_{t-1}}) + \eta_7 \Delta(\mathrm{LNBTCUSD_{t-1}}) + \eta_8 \quad (5.27)$$

To evaluate the vector error correction model, the coefficient statistics should be checked.

Table 5.7. VEC Model Coefficient Statistics

	λ_1	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8
Coef.	-.05	.09	-.06	-.01	.09	.00	-.03	-.01	.01
Prob.	.00***	.38	.42	.82	.27	.97	.52	.75	.00***
	λ_2	θ_1	θ_2	θ_3	θ_4	θ_5	θ_6	θ_7	θ_8
Coef.	-.01	-.57	-.32	-.03	-.15	.09	.22	-.05	.01
Prob.	.66	.00***	.02**	.79	.35	.49	.00***	.17	.00***
	λ_3	ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5	ϕ_6	ϕ_7	ϕ_8
Coef.	-.03	.03	.49	.04	.07	-.15	-.32	.10	.00
Prob.	.34	.89	.00***	.79	.74	.40	.00***	.04**	.32
	λ_4	δ_1	δ_2	δ_3	δ_4	δ_5	δ_6	δ_7	δ_8
Coef.	.01	-.05	-.02	-.07	-.16	-.07	.00	.02	.00
Prob.	.44	.67	.79	.40	.15	.40	.93	.42	.43
	λ_5	ϑ_1	ϑ_2	ϑ_3	ϑ_4	ϑ_5	ϑ_6	ϑ_7	ϑ_8
Coef.	.00	-.19	.08	.00	.12	-.14	.01	.08	.00
Prob.	.72	.27	.52	.98	.38	.23	.83	.01**	.13
	λ_6	φ_1	φ_2	φ_3	φ_4	φ_5	φ_6	φ_7	φ_8
Coef.	-.09	-.46	-.21	-.17	-.11	-.41	.15	.05	.01
Prob.	.00***	.04**	.18	.23	.53	.00***	.11	.22	.00***
	λ_7	η_1	η_2	η_3	η_4	η_5	η_6	η_7	η_8
Coef.	.04	.41	.05	-.06	-.71	.15	-.04	.10	.01
Prob.	.59	.48	.88	.85	.13	.69	.84	.36	.33

Note. *, **, *** denote 10%, 5% and 1% significance respectively

Based on the results in the table above, the estimated equation could be written as follows in the 10% significance level:

$$\Delta(\text{LNINDFXDD}_t) = -0.0457 \times \text{ECT}_{t-1} + 0.0067 \quad (5.28)$$

$$\begin{aligned}\Delta(\text{LNUSDTRY}_t) &= -0.5686 \times \Delta(\text{LNINDFXDD}_{t-1}) \\ &- 0.3213 \times \Delta(\text{LNUSDTRY}_{t-1}) + 0.2264 \times \Delta(\text{LNTR2Y}_{t-1}) \\ &+ 0.0127\end{aligned} \quad (5.29)$$

$$\begin{aligned}\Delta(\text{LNBIST100USD}_t) &= 0.4945 \times \Delta(\text{LNUSDTRY}_{t-1}) - 0.3267 \times \Delta(\text{LNTR2Y}_{t-1}) \\ &+ 0.1037 \times \Delta(\text{LNBTCUSD}_{t-1})\end{aligned} \quad (5.30)$$

$$\Delta(\text{LNNAS100}_t) = 0.0843 \times \Delta(\text{LNBTCUSD}_{t-1}) \quad (5.31)$$

$$\begin{aligned}\Delta(\text{LNTR2Y}_t) &= -0.0994 \times \text{ECT}_{t-1} - 0.4666 \times \Delta(\text{LNINDFXDD}_{t-1}) \\ &- 0.4105 \times \Delta(\text{LNNAS100}_{t-1}) + 0.0126\end{aligned} \quad (5.32)$$

In the equation 5.28, it is seen that ECT_{t-1} is statistically significant and therefore included in the equation. Since the sign of error correction term is negative and the p-value of cointegrating equation is 0.0009 which is lower than 0.10, it is seen that a deviation from the long-run relationship would be corrected at the speed of 4.57% in the present period. However, there is not any causal relationship from the level forms of other variables to ΔLNINDFXDD.

In the equation 5.29, it is seen that there is no long-run causality when ΔLNTR2Y is the dependent variable because λ_2 is higher than 0.10. On the other hand, it is seen that ΔLNTR2Y has short-run causality with the variables of $\Delta LNUSDTRY_{t-1}$, $\Delta LNINDFXDD_{t-1}$, and $\Delta LNTR2Y_{t-1}$. Here, t-1 refers to 1 lag of the variables.

In the equation 5.30, as the coefficient of error correction term, λ_3, is higher than 0.10, it is concluded that there is no long-run causal relationship from the level forms of the variables to ΔLNBIST100USD. Still, since the values of coefficients of θ_{18}, θ_{22}, and θ_{23} are lower than 0.01, 0.01 and 0.05, respectively, it is said that there is short-run causality between ΔLNBIST100USD, $\Delta LNUSDTRY_{t-1}$, $\Delta LNTR2Y_{t-1}$ and $\Delta LNBTCUSD_{t-1}$.

In the equation 5.31, since the p-value of error correction term, λ_5, is higher than 0.01, it is excluded. Therefore, it can be said that there is no long-run causal relationship from the level forms of other variables to ΔLNNAS100. However, it is seen that there is statistically significant short-run causal relationship from ΔLNBTCUSD to ΔLNNAS100 since the p-value of θ_{39} is lower than 0.05.

In the equation 5.32, for ΔLNTR2Y, ECT term is significant at 1% level. It means the variables in level form have a long-run causal relationship with ΔLNTR2Y. Moreover, the value of ECT coefficient is -0.0994 and it means that a deviation from the long-run relationship would be corrected at the speed of 9.94% in the present period. Also, the equations show that there is a short-run causality from $\Delta LNINDFXDD_{t-1}$ and $\Delta LNNAS100_{t-1}$ to ΔLNTR2Y since p-values of the coefficients of θ_{41} and θ_{45} are significant at 1% and 5% levels, respectively.

Lastly, there is no equation in which ΔLNOUNCEGOLD and ΔLNBTCUSD are dependent variable because none of the p-values of the coefficients are lower than 0.10. In other words, there is not any short-run or long-run causal relationship from ΔLNOUNCEGOLD and ΔLNBTCUSD to any other variable. This can be seen also in the table 5.8. Since the prices of gold and Bitcoin is determined in global markets, this is not surprising result as most of the variables in the model is local variable which have very limited impact in the dynamics of global market.

The results of Granger causality are listed in the table 5.8 below. These results show the short-run causalities between the variables. The figures in the table are the probability values of the variables with 1 lag. If the probability value is lower 0.01, it means there is short-run Granger causality from the independent variable to dependent variable at the 1% significance level. If the p-value is lower than 0.05 and 0.10, then it is concluded there is causal relationship at the significance levels of 5% and 10%, accordingly.

On the other hand, the p-values of ECT terms show long-run causality relations. Similar to short-run test results, if the p-value is lower than 0.01, 0.05 and 0.10 then it is concluded that there is a long-run relationship at the significance level of 1%, 5% and 10%, accordingly.

Table 5.8. VEC Granger causality test results with INDFXDD

Dependent Variables	Independent Variables		
	ΔLNINDFXDD	ΔLNUSDTRY	ΔLNBIST100USD
ΔLNINDFXDD	-	.41	.81
ΔLNUSDTRY	.00***	-	.79
ΔLNBIST100USD	.89	.00***	-
ΔLNOUNCEGOLD	.67	.79	.40
ΔLNNAS100	.27	.52	.98
ΔLNTR2Y	.04**	.18	.23
ΔLNBTCUSD	.48	.88	.85

Dependent Variables	Independent Variables			
	ΔLNOUNCEGOLD	ΔLNNAS100	ΔLNTR2Y	ΔLNBTCUSD
ΔLNINDFXDD	.26	.96	.51	.75
ΔLNUSDTRY	.35	.49	.00***	.16
ΔLNBIST100USD	.74	.39	.00***	.04**
ΔLNOUNCEGOLD	-	.40	.93	.42
ΔLNNAS100	.38	-	.83	.01**
ΔLNTR2Y	.53	.00***	-	.22
ΔLNBTCUSD	.13	.69	.84	-

Note. *,**,*** denote 10%, 5% and 1% significance respectively

The summary of short-run and long-run causality test results are described in the table 5-9 below. In this table, the arrows show the direction of causality. Right arrow means that there is causal relationship from the first variable in the pair column to the second one. Left arrow means there is a causal relationship from the second variable in the pair column to the first one. Left-right arrow means both variables have a causal relationship on each other. Lastly, if there is no causal relationship, it is written as “no” in the in the table. The results are also interpreted by considering the implications of economic theory.

In the table 5-9, 21 possible causality results are shared. In order to interpret the results an important not should be mentioned: If a variable pair has both short-run and long-run

causality, then it is said that they have a strong Granger causality. Otherwise, if there is only short-run or long-run causality then it is said that there is a weak causality between the variables.

Table 5.9. Causality Relationships Between Variables

Variable Pairs	Causality Results	
	Short-run	Long-run
ΔLNINDFXDD - ΔLNUSDTRY	→	←
ΔLNINDFXDD - ΔLNBIST100USD	No	←
ΔLNINDFXDD - ΔLNOUNCEGOLD	No	←
ΔLNINDFXDD - ΔLNNAS100	No	←
ΔLNINDFXDD - ΔLNTR2Y	→	↔
ΔLNINDFXDD - ΔLNBTCUSD	No	←
ΔLNUSDTRY - ΔLNBIST100USD	→	No
ΔLNUSDTRY - ΔLNOUNCEGOLD	No	No
ΔLNUSDTRY - ΔLNNAS100	No	No
ΔLNUSDTRY - ΔLNTR2Y	←	→
ΔLNUSDTRY - ΔLNBTCUSD	No	No
ΔLNBIST100USD - ΔLNOUNCEGOLD	No	No
ΔLNBIST100USD - ΔLNNAS100	No	No
ΔLNBIST100USD - ΔLNTR2Y	←	→
ΔLNBIST100USD - ΔLNBTCUSD	←	No
ΔLNOUNCEGOLD - ΔLNNAS100	No	No
ΔLNOUNCEGOLD - ΔLNTR2Y	No	→
ΔLNOUNCEGOLD - ΔLNBTCUSD	No	No
ΔLNNAS100 - ΔLNTR2Y	→	→
ΔLNNAS100 - ΔLNBTCUSD	←	No
ΔLNTR2Y - ΔLNBTCUSD	No	←

5.4. Results for Individual FX Time Deposit

First of all, the lag length is found with the vector autoregressive (VAR) model and with the first differenced variables. Endogenous variables in the VAR model are ΔLNINDFXTD ΔLNUSDTRY ΔLNBIST100USD ΔLNOUNCEGOLD ΔLNNAS100 ΔLNTR2Y ΔLNBTCUSD, in other words, log returns of the raw variables.

Table 5.10. VAR Lag Selection Criteria with INDFXTD

Lag	AIC	SC	HQ
0	-28.48007	-28.29308*	-28.40449*
1	-28.86800*	-27.37213	-28.26334
2	-28.34708	-25.54232	-27.21335
3	-28.02022	-23.90658	-26.35742
4	-27.95679	-22.53426	-25.76491

Note. * denotes to minimum value for each criterion

Based on the information criteria in the table above, AIC with the lowest value among others, says 1 lag to be chosen. However from the economic theory the selected lag length is 2 for this study.

Secondly, trace statistics of Johansen cointegration test is presented in order to see if there is cointegrating equation. According to the results of Johansen Cointegration Trace test, there are two cointegrating equations. That's why it is appropriate to conduct both VAR and VEC models to see causality relations.

Table 5.11. Johansen Cointegration Test (Trace) with INDFXTD

	Trace Statistics	0.05 Critical Value	Prob.
None*	150.55	125.62	0.0006
At most 1*	97.58	95.75	0.0372
At most 2	65.52	69.82	0.1050
At most 3	40.16	47.86	0.2167
At most 4	18.65	29.80	0.5181

At most 5	5.92	15.49	0.7047
At most 6	0.34	3.84	0.5621

Note. * denotes to rejection of H_0

5.4.1. VAR Results with Individual FX Time Deposit

In the scope of this study, all variables were estimated as independent variable in VAR model. As the lag length was chosen as 2, and there are 7 variables, VAR model estimates 105 coefficients for 7 equations. Al estimated equations in VAR system are expressed below:

$$\Delta(\mathrm{LNINDFXTD_t}) = \beta_1\Delta(\mathrm{LNINDFXTD_{t-1}}) + \beta_2\Delta(\mathrm{LNINDFXTD_{t-2}}) + \beta_3\Delta(\mathrm{LNUSDTRY_{t-1}}) + \beta_4\Delta(\mathrm{LNUSDTRY_{t-2}}) + \beta_5\Delta(\mathrm{LNBIST100USD_{t-1}}) + \beta_6\Delta(\mathrm{LNBIST100USD_{t-2}}) + \beta_7\Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \beta_8\Delta(\mathrm{LNOUNCEGOLD_{t-2}}) + \beta_9\Delta(\mathrm{LNNAS100_{t-1}}) + \beta_{10}\Delta(\mathrm{LNNAS100_{t-2}}) + \beta_{11}\Delta(\mathrm{LNTR2Y_{t-1}}) + \beta_{12}\Delta(\mathrm{LNTR2Y_{t-2}}) + \beta_{13}\Delta(\mathrm{LNBTCUSD_{t-1}}) + \beta_{14}\Delta(\mathrm{LNBTCUSD_{t-2}}) + \beta_{15} \quad (5.33)$$

$$\Delta(\mathrm{LNUSDTRY_t}) = \theta_1\Delta(\mathrm{LNINDFXTD_{t-1}}) + \theta_2\Delta(\mathrm{LNINDFXTD_{t-2}}) + \theta_3\Delta(\mathrm{LNUSDTRY_{t-1}}) + \theta_4\Delta(\mathrm{LNUSDTRY_{t-2}}) + \theta_5\Delta(\mathrm{LNBIST100USD_{t-1}}) + \theta_6\Delta(\mathrm{LNBIST100USD_{t-2}}) + \theta_7\Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \theta_8\Delta(\mathrm{LNOUNCEGOLD_{t-2}}) + \theta_9\Delta(\mathrm{LNNAS100_{t-1}}) + \theta_{10}\Delta(\mathrm{LNNAS100_{t-2}}) + \theta_{11}\Delta(\mathrm{LNTR2Y_{t-1}}) + \theta_{12}\Delta(\mathrm{LNTR2Y_{t-2}}) + \theta_{13}\Delta(\mathrm{LNBTCUSD_{t-1}}) + \theta_{14}\Delta(\mathrm{LNBTCUSD_{t-2}}) + \theta_{15}$$

(5.34)

$$\Delta(\text{LNBIST100USD}_t) = \phi_1\Delta(\text{LNINDFXTD}_{t-1}) + \phi_2\Delta(\text{LNINDFXTD}_{t-2}) + \phi_3\Delta(\text{LNUSDTRY}_{t-1}) + \phi_4\Delta(\text{LNUSDTRY}_{t-2}) + \phi_5\Delta(\text{LNBIST100USD}_{t-1}) + \phi_6\Delta(\text{LNBIST100USD}_{t-2}) + \phi_7\Delta(\text{LNOUNCEGOLD}_{t-1}) + \phi_8\Delta(\text{LNOUNCEGOLD}_{t-2}) + \phi_9\Delta(\text{LNNAS100}_{t-1}) + \phi_{10}\Delta(\text{LNNAS100}_{t-2}) + \phi_{11}\Delta(\text{LNTR2Y}_{t-1}) + \phi_{12}\Delta(\text{LNTR2Y}_{t-2}) + \phi_{13}\Delta(\text{LNBTCUSD}_{t-1}) + \phi_{14}\Delta(\text{LNBTCUSD}_{t-2}) + \phi_{15} \quad (5.35)$$

$$\Delta(\text{LNOUNCEGOLD}_t) = \delta_1\Delta(\text{LNINDFXTD}_{t-1}) + \delta_2\Delta(\text{LNINDFXTD}_{t-2}) + \delta_3\Delta(\text{LNUSDTRY}_{t-1}) + \delta_4\Delta(\text{LNUSDTRY}_{t-2}) + \delta_5\Delta(\text{LNBIST100USD}_{t-1}) + \delta_6\Delta(\text{LNBIST100USD}_{t-2}) + \delta_7\Delta(\text{LNOUNCEGOLD}_{t-1}) + \delta_8\Delta(\text{LNOUNCEGOLD}_{t-2}) + \delta_9\Delta(\text{LNNAS100}_{t-1}) + \delta_{10}\Delta(\text{LNNAS100}_{t-2}) + \delta_{11}\Delta(\text{LNTR2Y}_{t-1}) + \delta_{12}\Delta(\text{LNTR2Y}_{t-2}) + \delta_{13}\Delta(\text{LNBTCUSD}_{t-1}) + \delta_{14}\Delta(\text{LNBTCUSD}_{t-2}) + \delta_{15} \quad (5.36)$$

$$\Delta(\text{LNNAS100}_t) = \vartheta_1\Delta(\text{LNINDFXTD}_{t-1}) + \vartheta_1\Delta(\text{LNINDFXTD}_{t-2}) + \vartheta_1\Delta(\text{LNUSDTRY}_{t-1}) + \vartheta_1\Delta(\text{LNUSDTRY}_{t-2}) + \vartheta_1\Delta(\text{LNBIST100USD}_{t-1}) + \vartheta_1\Delta(\text{LNBIST100USD}_{t-2}) + \vartheta_1\Delta(\text{LNOUNCEGOLD}_{t-1}) + \vartheta_1\Delta(\text{LNOUNCEGOLD}_{t-2}) + \vartheta_1\Delta(\text{LNNAS100}_{t-1}) + \vartheta_1\Delta(\text{LNNAS100}_{t-2}) + \vartheta_1\Delta(\text{LNTR2Y}_{t-1}) + \vartheta_1\Delta(\text{LNTR2Y}_{t-2}) + \vartheta_1\Delta(\text{LNBTCUSD}_{t-1}) + \vartheta_1\Delta(\text{LNBTCUSD}_{t-2}) + \vartheta_1 \quad (5.37)$$

$$\Delta(\mathrm{LNTR2Y_t}) = \varphi_1\Delta(\mathrm{LNINDFXTD_{t-1}}) + \varphi_2\Delta(\mathrm{LNINDFXTD_{t-2}}) + \varphi_3\Delta(\mathrm{LNUSDTRY_{t-1}}) + \varphi_4\Delta(\mathrm{LNUSDTRY_{t-2}}) + \varphi_5\Delta(\mathrm{LNBIST100USD_{t-1}}) + \varphi_6\Delta(\mathrm{LNBIST100USD_{t-2}}) + \varphi_7\Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \varphi_8\Delta(\mathrm{LNOUNCEGOLD_{t-2}}) + \varphi_9\Delta(\mathrm{LNNAS100_{t-1}}) + \varphi_{10}\Delta(\mathrm{LNNAS100_{t-2}}) + \varphi_{11}\Delta(\mathrm{LNTR2Y_{t-1}}) + \varphi_{12}\Delta(\mathrm{LNTR2Y_{t-2}}) + \varphi_{13}\Delta(\mathrm{LNBTCUSD_{t-1}}) + \varphi_{14}\Delta(\mathrm{LNBTCUSD_{t-2}}) + \varphi_{15} \quad (5.38)$$

$$\Delta(\mathrm{LNBTCUSD_t}) = \eta_1\Delta(\mathrm{LNINDFXTD_{t-1}}) + \eta_2\Delta(\mathrm{LNINDFXTD_{t-2}}) + \eta_3\Delta(\mathrm{LNUSDTRY_{t-1}}) + \eta_4\Delta(\mathrm{LNUSDTRY_{t-2}}) + \eta_5\Delta(\mathrm{LNBIST100USD_{t-1}}) + \eta_6\Delta(\mathrm{LNBIST100USD_{t-2}}) + \eta_7\Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \eta_8\Delta(\mathrm{LNOUNCEGOLD_{t-2}}) + \eta_9\Delta(\mathrm{LNNAS100_{t-1}}) + \eta_{10}\Delta(\mathrm{LNNAS100_{t-2}}) + \eta_{11}\Delta(\mathrm{LNTR2Y_{t-1}}) + \eta_{12}\Delta(\mathrm{LNTR2Y_{t-2}}) + \eta_{13}\Delta(\mathrm{LNBTCUSD_{t-1}}) + \eta_{14}\Delta(\mathrm{LNBTCUSD_{t-2}}) + \eta_{15} \quad (5.39)$$

In order for simplicity, OLS estimation results of the 105 coefficients are presented below. Regarding each coefficient both coefficient value and its p-value are shown in the table.

Table 5.12. OLS Estimation Results of VAR Model Coefficients with INDFXTD

	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	β_{10}	β_{11}	β_{12}	β_{13}	β_{14}	β_{15}
Coef.	.34	.12	-.02	-.00	.01	-.00	-.02	-.06	-.02	.04	-.02	.02	.00	-.0	.00
Prob.	.00***	.34	.25	.82	.37	.88	.47	.03**	.33	.06*	.07*	.06*	.58	.30	.72
	θ_1	θ_2	θ_3	θ_4	θ_5	θ_6	θ_7	θ_8	θ_9	θ_{10}	θ_{11}	θ_{12}	θ_{13}	θ_{14}	θ_{15}
Coef.	-1.2	.39	-.24	.42	-.0	.15	-.11	.09	.08	-.26	.20	-.04	-.02	.03	.00
Prob.	.14	.63	.10	.05*	.85	.22	.58	.61	.57	.06*	.04**	.63	.52	.46	.31
	ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5	ϕ_6	ϕ_7	ϕ_8	ϕ_9	ϕ_{10}	ϕ_{11}	ϕ_{12}	ϕ_{13}	ϕ_{14}	ϕ_{15}
Coef.	.56	-.06	.52	-.26	.13	-.14	.05	-.15	-.09	.37	-.29	.10	.07	-.01	-.00

Prob.	.58	.94	.00***	.34	.45	.37	.82	.51	.62	.04**	.02**	.42	.13	.79	.37
	δ_1	δ_2	δ_3	δ_4	δ_5	δ_6	δ_7	δ_8	δ_9	δ_{10}	δ_{11}	δ_{12}	δ_{13}	δ_{14}	δ_{15}
Coef.	-.45	-.55	-.05	.03	-.07	.00	-.19	.09	-.06	.06	.05	.00	.02	-.04	.00
Prob.	.39	.30	.60	.81	.43	.92	.14	.41	.52	.47	.43	.97	.30	.11	.90
	ϑ_1	ϑ_2	ϑ_3	ϑ_4	ϑ_5	ϑ_6	ϑ_7	ϑ_8	ϑ_9	ϑ_{10}	ϑ_{11}	ϑ_{12}	ϑ_{13}	ϑ_{14}	ϑ_{15}
Coef.	-.75	-1.0	.11	-.11	.09	.04	.10	.03	-.12	.08	.07	.08	.07	-.03	.00
Prob.	.28	.14	.37	.54	.41	.68	.56	.79	.31	.51	.36	.33	.02**	.33	.50
	φ_1	φ_2	φ_3	φ_4	φ_5	φ_6	φ_7	φ_8	φ_9	φ_{10}	φ_{11}	φ_{12}	φ_{13}	φ_{14}	φ_{15}
Coef.	1.1	.51	-.10	.51	-.15	.2	-.16	.05	-.28	-.14	.13	-.09	.06	-.03	.00
Prob.	.23	.59	.53	.04**	.35	.16	.48	.78	.10	.37	.24	.42	.15	.46	.14
	η_1	η_2	η_3	η_4	η_5	η_6	η_7	η_8	η_9	η_{10}	η_{11}	η_{12}	η_{13}	η_{14}	η_{15}
Coef.	.31	-1.1	-.03	-.36	-.14	-.12	-.64	.31	.07	.34	-.05	.05	.09	.01	.01
Prob.	.89	.64	.94	.57	.72	.73	.26	.54	.85	.40	.84	.85	.42	.92	.28

Note: *, **, *** denote 10%, 5% and 1% significance respectively.

Based on this table, only the coefficients which have p-value lower than 0.10 are taken in the equations below to comply with 10% significance level.

$$\Delta(\text{LNINDFXTD}_t) = 0.34 \times \Delta(\text{LNINDFXTD}_{t-1}) - 0.06 \times \Delta(\text{LNOUNCEGOLD}_{t-2}) + 0.04 \times \Delta(\text{LNNAS100}_{t-2}) - 0.02 \times \Delta(\text{LNTR2Y}_{t-1}) + 0.02 \times \Delta(\text{LNTR2Y}_{t-2}) \quad (54.40)$$

$$\Delta(\text{LNUSDTRY}_t) = 0.42 \times \Delta(\text{LNUSDTRY}_{t-2}) - 0.26 \times \Delta(\text{LNNAS100}_{t-2}) + 0.2 \times \Delta(\text{LNTR2Y}_{t-1}) \quad (5.41)$$

$$\Delta(\text{LNBIST100USD}_t) = 0.52 \times \Delta(\text{LNUSDTRY}_{t-1}) + 0.37 \times \Delta(\text{LNNAS100}_{t-2}) - 0.29 \times \Delta(\text{LNTR2Y}_{t-1}) \quad (5.42)$$

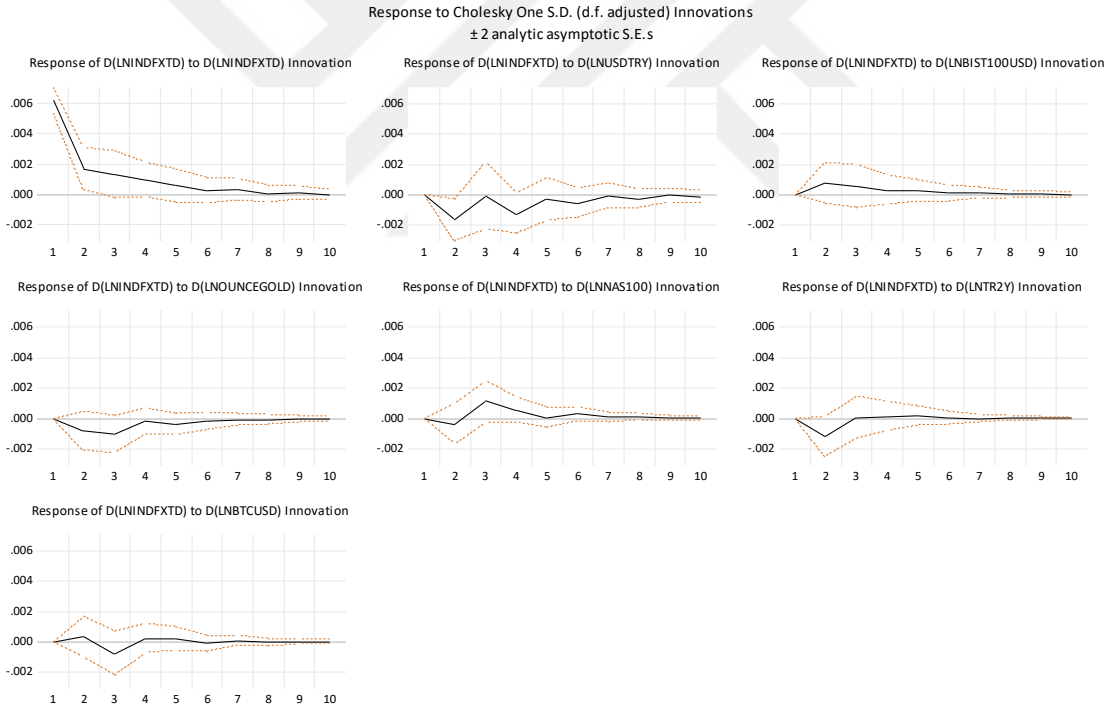
$$\Delta(\text{LNNAS100}_t) = 0.08 \times \Delta(\text{LNBTCUSD}_{t-1}) \quad (5.43)$$

$$\Delta(\text{LNTR2Y}_t) = 0.51 \times \Delta(\text{LNUSDTRY}_{t-2}) \quad (5.44)$$

As seen from the table, none of the variables are explanatory when $\Delta LNOUNCEGOLD_t$ and $\Delta LNBTCUSD_t$ are dependent variables. Therefore, only 5 equations are listed above.

After estimating VAR models, impulse-response functions are graphed in order to visualize the response of each variable to a shock to other variables. In order to measure the total impact, the responses are shown in accumulated way. The only statistically response realizes when there is shock to ΔLNUSDTRY which is the log return of USDTRY. On the other hand, the response to shock to ΔLNOUNCEGOLD is almost significant. However, the other variables do not show any impulse-response relationship with ΔLNINDFXDD.

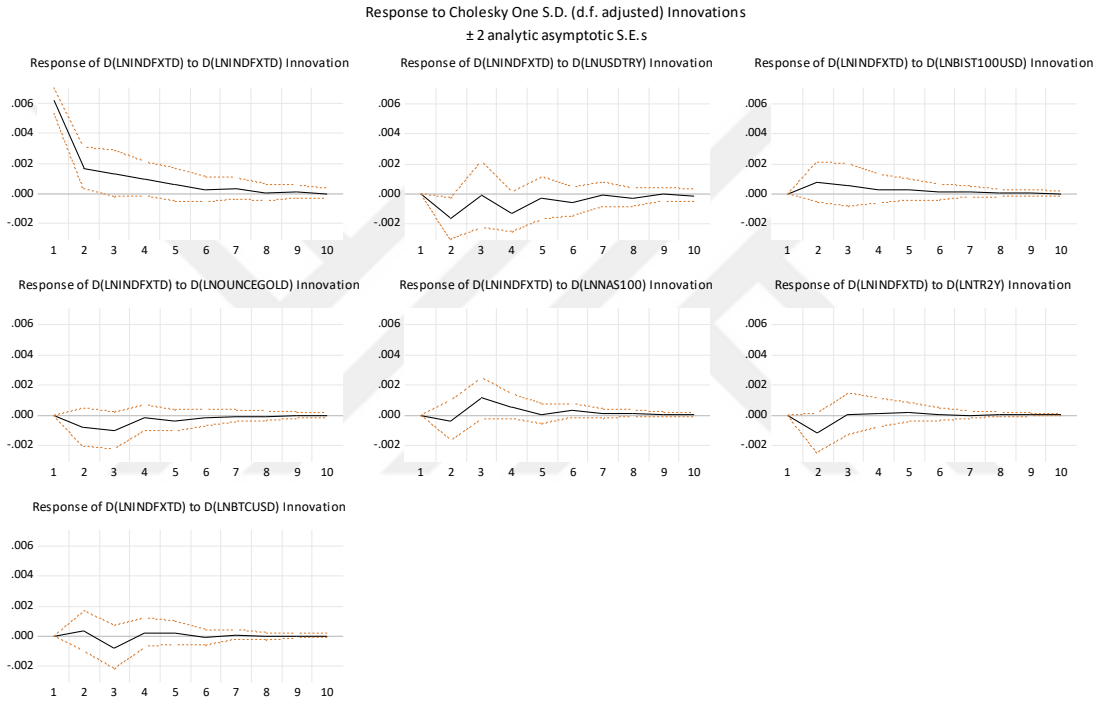
Figure 5.16. Response Functions of Individual FX Time Deposit ΔLNINDFXTD



Comparing with individual FX demand deposit impulse-response functions, individual FX time deposit does not have a statistically significant relation with ΔLNBIST100USD, however instead of it, ΔLNUSDTRY is statistically significant here. Within economic theory considerations this might be a logical relation since people may respond to changes in BIST100USD to adjust their returns more easily. In other words, people may choose to invest in stocks instead of FX demand deposit. However, USDTRY is not significant

because other factors such as household earning. For example, there were factors like tax on USD conversion charged around 0.2% from the volume of the investment. On the other hand, the price of ounce gold seems still affective in the individual preference for both FX demand deposit and FX time deposit. It might be possible to say gold was a good alternative between 2020 and 2021 as always.

Figure 5.17. Response Functions of Individual FX Time Deposit ΔLNINDFXTD



When the impulses of ΔLNINDFXTD on other variables were analyzed ΔLNBIST100USD, ΔLNOUNCEGOLD, ΔLNNAS100 and ΔLNBTCUSD show positive response in the first period. But this impact disappears after fifth period.

Since the impulse-response functions for the variables of ΔLNUSDTRY, ΔLNBIST100USD, ΔLNOUNCEGOLD, ΔLNNAS100, ΔLNTR2Y and ΔLNBTCUSD were shared in the previous part, they are not shown to prevent duplication.

5.4.2. VECM Results with Individual FX Time Deposit

In the scope of this study, VEC model is conducted with the endogenous variables of LNINDFXTD, LNUSDTRY, LNBIST100USD, LNOUNCEGOLD, LNNAS100, LNTR2Y and LNBTCUSD. The estimated equation can be seen below:

$$\begin{aligned}\mathrm{ECT}_{t-1} &= \mathrm{LNINDFXTD}_{t-1} - 1.22 \times \mathrm{LNUSDTRY}_{t-1} \\ &\quad - 0.68 \times \mathrm{LNBIST100USD}_{t-1} + 2.93 \times \mathrm{LNOUNCEGOLD}_{t-1} \\ &\quad - 0.42 \times \mathrm{LNNAS100}_{t-1} + 0.78 \times \mathrm{LNTR2Y}_{t-1} \\ &\quad - 0.05 \times \mathrm{LNBTCUSD}_{t-1} + 22.91 \end{aligned} \tag{5.45}$$

$$\begin{aligned}\Delta(\mathrm{LNINDFXTD}_t) &= \lambda_1 \mathrm{ECT}_{t-1} + \beta_1 \Delta(\mathrm{LNINDFXTD}_{t-1}) + \beta_2 \Delta(\mathrm{LNUSDTRY}_{t-1}) \\ &\quad + \beta_3 \Delta(\mathrm{LNBIST100USD}_{t-1}) + \beta_4 \Delta(\mathrm{LNOUNCEGOLD}_{t-1}) \\ &\quad + \beta_5 \Delta(\mathrm{LNNAS100}_{t-1}) + \beta_6 \Delta(\mathrm{LNTR2Y}_{t-1}) \\ &\quad + \beta_7 \Delta(\mathrm{LNBTCUSD}_{t-1}) + \beta_8 \end{aligned} \tag{5.46}$$

$$\begin{aligned}\Delta(\mathrm{LNUSDTRY}_t) &= \lambda_2 \mathrm{ECT}_{t-1} + \theta_1 \Delta(\mathrm{LNINDFXTD}_{t-1}) + \theta_2 \Delta(\mathrm{LNUSDTRY}_{t-1}) \\ &\quad + \theta_3 \Delta(\mathrm{LNBIST100USD}_{t-1}) + \theta_4 \Delta(\mathrm{LNOUNCEGOLD}_{t-1}) \\ &\quad + \theta_5 \Delta(\mathrm{LNNAS100}_{t-1}) + \theta_6 \Delta(\mathrm{LNTR2Y}_{t-1}) \\ &\quad + \theta_7 \Delta(\mathrm{LNBTCUSD}_{t-1}) + \theta_8 \end{aligned} \tag{5.47}$$

$$\begin{aligned}\Delta(\mathrm{LNBIST100USD}_t) &= \lambda_3 \mathrm{ECT}_{t-1} + \phi_1 \Delta(\mathrm{LNINDFXTD}_{t-1}) + \phi_2 \Delta(\mathrm{LNUSDTRY}_{t-1}) \\ &\quad + \phi_3 \Delta(\mathrm{LNBIST100USD}_{t-1}) + \phi_4 \Delta(\mathrm{LNOUNCEGOLD}_{t-1}) \\ &\quad + \phi_5 \Delta(\mathrm{LNNAS100}_{t-1}) + \phi_6 \Delta(\mathrm{LNTR2Y}_{t-1}) \\ &\quad + \phi_7 \Delta(\mathrm{LNBTCUSD}_{t-1}) + \phi_8 \end{aligned} \tag{5.48}$$

$$\begin{aligned}\Delta(\mathrm{LNOUNCEGOLD}_t) &= \lambda_4 \mathrm{ECT}_{t-1} + \delta_1 \Delta(\mathrm{LNINDFXTD}_{t-1}) + \delta_2 \Delta(\mathrm{LNUSDTRY}_{t-1}) \\ &\quad + \delta_3 \Delta(\mathrm{LNBIST100USD}_{t-1}) + \delta_4 \Delta(\mathrm{LNOUNCEGOLD}_{t-1}) \\ &\quad + \delta_5 \Delta(\mathrm{LNNAS100}_{t-1}) + \delta_6 \Delta(\mathrm{LNTR2Y}_{t-1}) \\ &\quad + \delta_7 \Delta(\mathrm{LNBTCUSD}_{t-1}) + \delta_8 \end{aligned} \tag{5.49}$$

$$\Delta(\mathrm{LNNAS100_t}) = \lambda_5 \mathrm{ECT_{t-1}} + \vartheta_1 \Delta(\mathrm{LNINDFXTD_{t-1}}) + \vartheta_2 \Delta(\mathrm{LNUSDTRY_{t-1}}) + \vartheta_3 \Delta(\mathrm{LNBIST100USD_{t-1}}) + \vartheta_4 \Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \vartheta_5 \Delta(\mathrm{LNNAS100_{t-1}}) + \vartheta_6 \Delta(\mathrm{LNTR2Y_{t-1}}) + \vartheta_7 \Delta(\mathrm{LNBTCUSD_{t-1}}) + \vartheta_8 \quad (5.50)$$

$$\Delta(\mathrm{LNTR2Y_t}) = \lambda_6 \mathrm{ECT_{t-1}} + \varphi_1 \Delta(\mathrm{LNINDFXTD_{t-1}}) + \varphi_2 \Delta(\mathrm{LNUSDTRY_{t-1}}) + \varphi_3 \Delta(\mathrm{LNBIST100USD_{t-1}}) + \varphi_4 \Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \varphi_5 \Delta(\mathrm{LNNAS100_{t-1}}) + \varphi_6 \Delta(\mathrm{LNTR2Y_{t-1}}) + \varphi_7 \Delta(\mathrm{LNBTCUSD_{t-1}}) + \varphi_8 \quad (5.51)$$

$$\Delta(\mathrm{LNBTCUSD_t}) = \lambda_7 \mathrm{ECT_{t-1}} + \eta_1 \Delta(\mathrm{LNINDFXTD_{t-1}}) + \eta_2 \Delta(\mathrm{LNUSDTRY_{t-1}}) + \eta_3 \Delta(\mathrm{LNBIST100USD_{t-1}}) + \eta_4 \Delta(\mathrm{LNOUNCEGOLD_{t-1}}) + \eta_5 \Delta(\mathrm{LNNAS100_{t-1}}) + \eta_6 \Delta(\mathrm{LNTR2Y_{t-1}}) + \eta_7 \Delta(\mathrm{LNBTCUSD_{t-1}}) + \eta_8 \quad (5.52)$$

To evaluate the VEC model, the coefficient statistics should be checked. So, the results can be seen in the table below.

Table 5.13. VEC Model Coefficient Statistics with INDFXTD

	λ_1	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8
Coef.	-.02	.06	-.01	.01	.02	-.05	-.04	.01	-.00
Prob.	.00***	.60	.74	.65	.52	.01**	.00***	.25	.35
	λ_2	θ_1	θ_2	θ_3	θ_4	θ_5	θ_6	θ_7	θ_8
Coef.	-.0	-1.5	-.2	.06	-.11	.12	.24	-.04	.00
Prob.	.74	.05*	.14	.60	.53	.39	.00***	.22	.15
	λ_3	ϕ_1	ϕ_2	ϕ_3	ϕ_4	ϕ_5	ϕ_6	ϕ_7	ϕ_8
Coef.	-.0	.48	.53	.07	.07	-.13	-.33	.09	-.00
Prob.	.83	.63	.00***	.65	.75	.45	.00***	.05*	.35
	λ_4	δ_1	δ_2	δ_3	δ_4	δ_5	δ_6	δ_7	δ_8
Coef.	.02	-.38	-.04	-.05	-.19	-.05	.03	.02	.00

Prob.	.17	.46	.64	.54	.11	.54	.58	.35	.64
	λ_5	ϑ_1	ϑ_2	ϑ_3	ϑ_4	ϑ_5	ϑ_6	ϑ_7	ϑ_8
Coef.	.01	-72	.12	.07	.12	-.10	.04	.08	.00
Prob.	.47	.28	.29	.48	.44	.38	.54	.01**	.42
	λ_6	φ_1	φ_2	φ_3	φ_4	φ_5	φ_6	φ_7	φ_8
Coef.	-.05	-.04	-.00	-.04	-.04	-.37	.12	.04	.00
Prob.	.09*	.96	.99	.75	.83	.01**	.24	.32	.08*
	λ_7	η_1	η_2	η_3	η_4	η_5	η_6	η_7	η_8
Coef.	-.10	-1.2	.04	-.19	-.45	-.01	-.11	.10	.01
Prob.	.20	.57	.90	.58	.38	.96	.65	.33	.22

Note. *, **, *** denote 10%, 5% and 1% significance respectively

Based on the results in the table above, the estimated equations could be written as follows in the 10% significance level:

$$\Delta(\mathrm{LNINDFXTD_t}) = -0.017\mathrm{ECT_{t-1}} - 0.052 \times \Delta(\mathrm{LNNAS100_{t-1}}) - 0.036 \times \Delta(\mathrm{LNTR2Y_{t-1}}) \quad (5.53)$$

$$\Delta(\mathrm{LNUSDTRY_t}) = -1.5351 \times \Delta(\mathrm{LNINDFXTD_{t-1}}) + 0.2448 \times \Delta(\mathrm{LNTR2Y_{t-1}}) \quad (5.54)$$

$$\Delta(\mathrm{LNBIST100USD_t}) = 0.5364 \times \Delta(\mathrm{LNUSDTRY_{t-1}}) - 0.3354 \times \Delta(\mathrm{LNTR2Y_{t-1}}) + 0.0983 \times \Delta(\mathrm{LNBTCUSD_{t-1}}) \quad (5.55)$$

$$\Delta(\mathrm{LNNAS100_t}) = 0.0863 \times \Delta(\mathrm{LNBTCUSD_{t-1}}) \quad (5.56)$$

$$\Delta(\mathrm{LNTR2Y_t}) = -0.0552 \times \mathrm{ECT_{t-1}} - 0.3784 \times \Delta(\mathrm{LNNAS100_{t-1}}) + 0.0083 \quad (5.57)$$

In the equation 5.46 where ΔINDFXTD is dependent variable, the sign of error correction term is negative and the p-value of cointegrating equation is 0.0001 which is lower than 0.10. So it is said that a deviation from the long-run relationship would be corrected at the speed of 1.7% in the present period. Also, $\Delta LNNAS100_{t-1}$ and $\Delta LNTR2Y_{t-1}$ have

significant short-run causal relationship with ΔLNINDFXTD as p-values of β_5 and β_5 are below within the 10% significance level.

Equation 5.47 where ΔLNUSDTRY is the dependent variable shows only the 1 lag values of ΔLNUSDTRY and ΔLNTR2Y have short-run causal relationship. However, since the p-value of λ_2 is not lower than 0.10 it is said that there is no long-run causal relationship from other variables to the dependent one.

Equation 5.48 presents the short-run causal relationships from $\Delta LNUSDTRY_{t-1}$, $\Delta LNTR2Y_{t-1}$ and $\Delta LNBTCUSD_{t-1}$ to $\Delta LNBIST100USD_t$. While $\Delta LNUSDTRY_{t-1}$ and $\Delta LNTR2Y_{t-1}$ have short-run causal relation at 1% significance level $\Delta LNBTCUSD_{t-1}$, has short-run causal relationship at 5% significance level. However, there is no significant long-run causality as the value of error correction term, λ_3, is not lower than 0.10.

In the equation 5.49, it is seen that there is no long-run causal relationship between ΔLNNAS100 and other independent variables. However, the only causal relationship occurs between ΔLNNAS100 and $\Delta LNBTCUSD_{t-1}$ in the short-run.

Lastly, equation 5.52 presents short-run and long-run causal relationships when ΔLNTR2Y is the independent variable. It seems that there is a significant long-run relationship between ΔLNTR2Y and other variables since p-value the error correction term, λ_6, is lower than 0.10.

Table 5.14. VEC Granger Causality Test Results With Individual FX Demand Deposit

Dependent Variables	Independent Variables		
	ΔLNINDFXTD	ΔLNUSDTRY	ΔLNBIST100USD
ΔLNINDFXTD	-	.73	.64
ΔLNUSDTRY	.05*	-	.60
ΔLNBIST100USD	.63	.00***	-
ΔLNOUNCEGOLD	.45	.64	.54
ΔLNNAS100	.28	.29	.48
ΔLNTR2Y	.96	.99	.75

ΔLNBTCUSD	.57	.90	.58

Dependent Variables	Independent Variables			
	ΔLNOUNCEGOLD	ΔLNNAS100	ΔLNTR2Y	ΔLNBTCUSD
ΔLNINDFXTD	.51	.01**	.00***	.25
ΔLNUSDTRY	.53	.39	.00***	.22
ΔLNBIST100USD	.75	.45	.00***	.05*
ΔLNOUNCEGOLD	-	.54	.58	.35
ΔLNNAS100	.44	-	.54	.01**
ΔLNTR2Y	.83	.01**	-	.32
ΔLNBTCUSD	.38	.96	.65	-

Note. *, **, *** denote 10%, 5% and 1% significance respectively

The scheme below shows the overall causality relationship when other test results included.

Table 5.15. Causality Relationships Between Variables

Variable Pairs	Causality Results	
	Short-run	Long-run
ΔLNINDFXTD - ΔLNUSDTRY	←	←
ΔLNINDFXTD - ΔLNBIST100USD	No	←
ΔLNINDFXTD - ΔLNOUNCEGOLD	No	←
ΔLNINDFXTD - ΔLNNAS100	←	←
ΔLNINDFXTD - ΔLNTR2Y	←	↔
ΔLNINDFXTD - ΔLNBTCUSD	No	←
ΔLNUSDTRY - ΔLNBIST100USD	→	No
ΔLNUSDTRY - ΔLNOUNCEGOLD	No	No
ΔLNUSDTRY - ΔLNNAS100	No	No
ΔLNUSDTRY - ΔLNTR2Y	←	→
ΔLNUSDTRY - ΔLNBTCUSD	No	No
ΔLNBIST100USD - ΔLNOUNCEGOLD	No	No

ΔLNBIST100USD - ΔLNNAS100	No	No
ΔLNBIST100USD - ΔLNTR2Y	←	→
ΔLNBIST100USD - ΔLNBTCUSD	←	No
ΔLNOUNCEGOLD - ΔLNNAS100	No	No
ΔLNOUNCEGOLD - ΔLNTR2Y	No	→
ΔLNOUNCEGOLD - ΔLNBTCUSD	No	No
ΔLNNAS100 - ΔLNTR2Y	→	→
ΔLNNAS100 - ΔLNBTCUSD	←	No
ΔLNTR2Y - ΔLNBTCUSD	No	←

5.5. Economic Implications and Intuitions of the Results

First of all, in the context of economic theories discussed in the first chapter, this study could not cover the income effect in the empirical analysis due to the data frequency. As the other variables can be collected in weekly periods, the data of household income is not possible to collect weekly. Therefore, the absence of income data may affect the power of the results. However, the other variables still give important results and deserve to be analyzed through theoretical approaches.

According to the VAR results including demand deposit, USDTRY seems the only variable affecting individual FX demand deposit. On the other hand, VAR system with time deposit says that individual FX time deposit is related with its own previous value, ounce gold, NAS100 and the yield of 2-years TRY government bond. It looks like there is a structural difference in the individual demand for FX demand deposit and time deposit. When this analysis is considered together with the money demand theories in the first chapter, it is consistent with the reasons behind money demand. Since the individual demand for FX demand deposit can be handled as a type of hedging against the inflation, when the USDTRY parity goes up, individuals may expect increase in inflation and therefore converting their TRY savings into USD deposit. In other words, the individuals would buy USD and sell TRY as USDTRY parity rises simply because they do not want

to make any loss due to the inflation. The main logic behind it is that rise in USDTRY parity results in a similar rate of increase in inflation rate.

The second interesting result is that individual demand for FX time deposit is not a function of USDTRY parity which is the case in demand deposit. Instead of it, individuals follow ounce gold, NAS100 index and the yield of 2-years government bond in TRY. In other words, individuals do not consider USDTRY, thus inflation rate but they take other the returns alternative investment instruments while deciding to increase or decrease their time deposits. In the context of money demand motives in Keynesian economic thought, people approach from a more speculative perspective towards FX time deposit as they compare alternative investment opportunities.

After analyzing the VAR results, VECM and Granger causality results tell a similar story regarding FX time and demand deposit. While there is a long-run Granger causality from USDTRY parity to both individual FX demand and time deposit, in the short-run there is such a causality. However, differently from individual FX demand deposit, individual FX time deposit has a short-run Granger causality with ounce gold and the yield of 2-years government bond. Therefore, it can be concluded that individuals do not look at the yields of alternative instruments in their FX demand deposit decisions, but they do in their FX time deposit decisions. This result might be helpful in further studies on the determinants of individual FX deposit.

When the VAR results are analyzed for USDTRY, there seems to be a relation between USDTRY parity and individual FX demand and time deposit, NAS 100 index, the yield of 2-years government bond. According to VECM results, similar results are reached out except NAS 100 index. Since the parity of USDTRY is not the focus in this study and it requires a much deeper analysis, the only interpretation regarding the results would be individual FX demand and time deposit have Granger causal relationship with USDTRY. Therefore, it can be argued that the change in individual demand for FX deposit can be handled as the cause behind the change in USDTRY but not the effect of it. For example, when the individuals expect an increase in USDTRY parity and therefore prefer FX deposit in the banks, this might cause USDTRY parity to decrease. Simply, if people

expect increase in USDTRY then it decreases. This is interesting because it might be argued that people respond late to the changes in USDTRY.

When it comes to BIST 100 index price in USD terms, VAR results tell that as the interest rate of 2-years government bond increases BIST100 in USD terms decreases. This result is consistent with the theory that there is a trade-off between risk-free rate of return and investment in shares. Also, the BIST 100 in USD terms is positively related with both NAS 100 index and USDTRY parity. The result of positive relation with NAS 100 would be expected because they are both affected by the global risk perception and similar political factors. However, the case of USDTRY deserves to be analyzed deeper. Similarly, VECM results propose that BIST 100 index has a short-run relationship with bond yield and USDTRY parity except NAS 100. In both VECM results, it seems that BIST 100 has a Granger causality with Bitcoin price. This might be due to the fact that BIST 100 and Bitcoin are considered as risky instruments and therefore they are affected by the similar factors. Otherwise, the economic theories covered in this study did not assume such a significant relationship.

For ounce gold, government bond yield and NAS100 index, the determinants of them are not part of this study. Therefore, the VAR and VECM results for these two variables will not be interpreted except the case for Bitcoin price. In both VAR and VECM results it is said that NAS 100 price is related with Bitcoin price. Even Granger causality results say that NAS 100 price has Granger causality with Bitcoin price. This can be interpreted as there is a link between traditional financial asset class and non-traditional asset class of cryptocurrencies. In the global extent, Bitcoin is effective even to have a Granger causality with NAS 100 index whose market capitalization is really high not to be affected by one class of asset.

Lastly, none of the models suggest any relationship for the price of Bitcoin. Since this study does not search for the determinants of Bitcoin price, it is not deeply analyzed. However, this study focuses on a special way towards Bitcoin price in the context of individual FX deposits.

One of the main arguments in this study was the search of any data-based relation between Bitcoin price and individual FX deposit can be traced through the channel that individuals

sold their USD deposit to buy Bitcoin or other cryptocurrencies. As seen from all models and causality relationships, no such a channel was detected. Therefore, it can be concluded that people did not perceive Bitcoin as a powerful alternative to USD or similar major fiat currency

CONCLUSION

This study tried to find relationships between the variables of individual FX demand and time deposit, separately, USDTRY parity, ounce gold, BIST 100 index price in USD terms, NAS 100 stock index, the yield of 2-years government bond and Bitcoin price. Through the years of Coin-19 outbreak which is between 2020 and 2021, the weekly frequency data was used in VAR system and vector error correction models. Impulse-response functions were given together with VAR results and Granger causalities were provided in the context of VEC model.

According to the models, there are important results for economy policy. First of all, even though Bitcoin and other cryptocurrencies are shown as a thread to traditional instruments, the data studied does not argue it. In contrast, it tells that people still approach cryptocurrencies cautiously and invest in them in a very limited proportion. In order to defend this result, it can be propounded that individuals are affected by the Bitcoin price to change their preferences from USD to Bitcoin. This shows that analyses claiming Bitcoin or other cryptocurrency adoption is quite high in Türkiye might be exaggerated. On the other hand, it can be maintained that there is a high interest in Bitcoin and others as they are very popular across the world. People try to learn the dynamics of cryptocurrency markets and of course high volatility might become attractive for many people to make speculative trading profit.

For the further studies regarding cryptocurrency or Bitcoin investment, the reliable data sources will be very important. For this reason, the expected regulation in Türkiye will be very helpful for pushing the cryptocurrency service providers to publish or give realized trading volumes and asset under management. As the data can be collected at regular periods, the comparisons with traditional asset classes will be giving more precise results. In that case economic theories might be subject to change in accordance with the new technologies of blockchain.

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