



REPUBLIC OF TURKİYE
ANKARA YILDIRIM BEYAZIT UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES

ROLE OF CRYPTOCURRENCIES FOR EMERGING STOCK MARKETS

Ph.D. DISSERTATION

HASAN KURTAR

DEPARTMENT OF FINANCE AND BANKING

Ankara, 2024

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Prof. Dr. Ayhan Kapusuzoğlu

Ankara, 2024

APPROVAL PAGE

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DECLARATION

I hereby declare that this dissertation is my own work, that I have not had any unethical behaviour that violates patent and copyright rights in any stage, from the planning to the writing up of the thesis, that I have collected all the information by following academic and ethical rules and that I have cited all the information and comments used in this study.

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Dedication



To My Wife and Children

ÖZET

Kripto Paraların Gelişmekte Olan Ülke Borsaları için Rolü

Bu çalışma, kripto paraların gelişmekte olan ülke borsaları için çeşitlendirici, hedge veya güvenli liman olup olmadığını ortaya koymayı amaçlamaktadır. Bu çalışma, bütünsel ve ayrıntılı bir yaklaşımla, kripto paralar ile gelişmekte olan piyasalar arasındaki dinamik ilişkiyi analiz ederek ve kripto paralara çeşitlendirici, hedge veya güvenli liman gibi roller atfederek literatüre katkıda bulunmaktadır. Yüksek piyasa değeri, yüksek ticaret hacmi ve yüksek likiditesi nedeniyle beş kripto para, kripto para piyasasını temsil etmek üzere seçilmiştir. Kripto para birimleri ile 21 gelişmekte olan borsa arasındaki bağımlılık analiz edilmiştir. Örneklem dönemi, 01 Ekim 2017'den başlayıp 30 Haziran 2024'te sona ermektedir. Değişkenler arasındaki bağlantıyı araştırmak için DCC GARCH metodu kullanılmıştır. Ampirik kanıtlar, kripto para birimlerinin gelişmekte olan piyasalar için çeşitlendirici olduğunu ve bazı gelişmekte olan piyasalar için ise zayıf bir güvenli liman rolü üstlendiğini göstermiştir.

Anahtar Kelimeler: Kripto Para, Bitcoin, Ethereum, Binance Coin, Cardano, Ripple, DCC GARCH, Gelişmekte Olan Piyasalar, Gelişmekte Olan Ülke Borsaları, Çeşitlendirici, Hedge, Güvenli Liman

ABSTRACT

Role of Cryptocurrencies for Emerging Stock Markets

This study aims to reveal role of cryptocurrencies for emerging stock markets whether cryptocurrencies are diversifier, hedge or safe haven assets or not. This study enhances the literature through examining dynamic interrelation between cryptocurrencies and emerging markets by attributing role to cryptocurrencies such as diversifier, hedge or safe haven asset with a holistic and detailed approach. Five cryptocurrencies have been selected as proxy for cryptocurrency market due to high market cap, trade volume and liquidity. Dependency between cryptocurrencies and 21 emerging stock markets with overall MSCI Emerging Market Index have been analyzed. Sample period start from October 01, 2017 -due to availability of price data of cryptocurrencies- and ends at June 30, 2024. Dynamic Conditional Correlation GARCH method is used in order to investigate connectedness among variables. Empirical evidence indicated that cryptocurrencies are certain diversifier for emerging stock markets and they behave as weak safe haven for some developing markets.

Keywords: Cryptocurrency, Bitcoin, Ethereum, Binance Coin, Cardano, Ripple, DCC GARCH, Developing Markets, Emerging Stock Markets, Diversifier, Hedge, Safe Haven

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INDEX OF SYMBOLS AND ABBREVIATIONS

VIX	: Volatility Index
Value at risk	: (VaR)
(CVAR)	: Conditional Value at Risk
ARDL	: Autoregressive Distributed Lag
VAR	: Vector Autoregression
ADF	: Dickey-Fuller Augmented
PP	: Phillips-Perron
KPSS	: Kwiatkowski-Phillips-Schmidt-Shin
ACF	: Autocorrelation Function
ARCH	: Autoregressive Conditional Heteroscedasticity
ARCH LM	: ARCH Lagrange Multiplier
OLS	: Ordinary Least Square
GARCH	: Generalized Autoregressive Conditional Heteroscedasticity
GARCH CCC	: GARCH Constant Conditional Correlation
DCC GARCH	: Dynamic Conditional Correlation GARCH
AIC	: Akaike Information Criterion
BIC	: Bayesian Information Criterion
Std	: Student-t distribution
Ged	: Generalised Error Distribution
SNorm	: Skewed Normal Distribution (SNorm)
SStd	: Skewed Student-t Distribution (SStd)
SGed	: Skewed Generalised Error Distribution

Nig	: Normal Inverse Gaussian Distribution
Ghyp	: Generalised Hyperbolic Distribution
BRICS	: Brazil, Russia, India, China, South Africa
Gulf Countries Emirates	: Bahrain, Kuwait, Saudi Arabia, Jordan, Qatar, United Arab
BTC	: Bitcoin
ETH	: Ethereum
BNB	: Binance Coin
ADA	: Cardano
XRP	: Ripple
MSCI	: Morgan Stanley Capital International
UAE	: United Arab Emirates
EM	: Emerging Market

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INTRODUCTION

Risk and return are major topics in finance. Investors and professional portfolio managers are seeking and pursuing maximum yield corresponding to a particular risk. They try to find an asset portfolio providing optimal mix of risk and reward. The question arises here as which assets should be combined to create an optimum portfolio.

Although the concept of “not putting all the eggs in the same basket” has been known for hundreds of years, to invest in promising stocks rather than well-diversified portfolio was popular idea among investors. To create a diversified portfolio was not common thought even though it has become usual today. Markowitz (1952) theorised diversification by stating that what matters in a portfolio is gaining or losing value of stocks in relation to other stocks rather than individual treatment of stocks. Correlation among stocks should be considered. Markowitz emphasises that investor should choose to invest in asset or portfolio which have minimum variance for a specified level of return or the optimal return at a particular risk level (E-V rule). Statement above is never implication of superiority of diversification. If an asset with a return equal to return of portfolio has lower variance than portfolio variance, then the asset should be preferred over portfolio. However, to find such an asset is quite unusual in real life. Therefore, right diversification usually decreases risks without sacrificing return. The return of a portfolio is the mean return of its constituent assets, with the portfolio's risk being lower than the weighted average risk of the individual stocks. In simpler terms, standard deviation of portfolio will be lower than mean standard deviation of stocks in the portfolio in case of non-correlation or negative correlation among stocks. This is main advantage of diversification. Key for diversification is correlation and covariance among assets. Markowitz states that large number of stocks in portfolio does not always mean right diversification. For example, to hold stocks in the same industry could result in poor performance of portfolio. Diversification should be conducted across industries which different economic characteristics. To summarize, Markowitz revealed that risk can be reduced without sacrificing return. Markowitz's study created base for modern finance, portfolio management and diversification.

Cryptocurrencies are new type of assets and they are significantly Distinct from conventional assets such as commodity, gold, stock, bond. The emergence of cryptocurrencies started with creation of Bitcoin (Nakamoto, 2008). The cryptocurrencies make possible online payment without a third party, intermediary. This creates big difference

for cryptocurrencies because they do not have any link with higher authority in contrast to traditional assets. They are decentralized. They have no physical representation. They can be divided infinitely. Cryptocurrencies do not rely on any other asset, country, economy, firm etc. Cryptocurrencies which have low transaction cost, decentralized structure, peer-to-peer system attracted enormous attention from all over the world (Corbet, Lucey, Urquhart, & Yarovaya, 2019). Growth of cryptocurrencies become very fast in terms of value and number. Global cryptocurrency market cap is around 2.14 trillion US dollar as of today. It hit 2.6 trillion US dollar in the past. Price of Bitcoin exceeded 70,000 USD. More than 10,000 cryptocurrencies have been generated until today (Coinmarketcap, 2024). This created room for huge return on cryptocurrency investments. Therefore, a new type of asset as an investment tool has emerged for investors. Huge growth of cryptocurrencies has also attracted attention of the academia. Adding to cryptocurrencies to portfolios has been considered, performance of those portfolios have been examined in the literature based on modern portfolio theory of Markowitz. Diversification benefits of cryptocurrencies have been examined. The authors questioned whether risk of portfolios can be decreased without sacrificing return because investors put higher importance on losses than gains, they are risk-averse as Kahneman & Tversky (1979) have revealed in Prospect Theory. Although cryptocurrencies are also highly volatile and risky assets, correlation among assets in the portfolio does make sense rather than individual treatment of assets as Markowitz puts forward. The fact that they do not resemble traditional assets and have low correlation with them provided cryptocurrencies to be seen as potential hedge instrument and diversifiers in the eye of investors, portfolio managers and authors. Role of cryptocurrencies in investment portfolios have been researched. First of all, most of the studies scrutinize capability of cryptocurrencies as hedge instrument for developed markets such United States of America and European stock markets. To illustrate, Anne Haubo Dyhrberg (2016), Myriam Ben Osman et al. (2023), Stensås et al. (2019), Shahzad et al. (2019), Bouri et al. (2020), Będowska-Sójka & Kliber (2021), Mariana et al. (2021), Kliber (2022), Shahzad et al. (2020), Baur et al. (2018), Anyfantaki et al. (2018), Okoroafor & Leirvik (2023), Dutta et al. (2020), Belhassine & Karamti (2021), Brière et al. (2015), Jin & Tian (2024), Kayral et al. (2022), Kajtazi & Moro (2019), Corbet et al. (2018), Chan et al. (2019), Riahi et al. (2024), Tiwari et al. (2019), Xu & Kinkyo (2023), Chkili et al. (2021), Huang et al. (2021), Alana et al. (2020), and many other studies scrutinize association among cryptocurrencies and major stock exchanges. There are few studies concentrating on linkage between crypto assets and developing stock indices. To illustrate, Agata Kliber et al. (2019), Corbet et al. (2020), Ji et

al. (2020) analyze connection between cryptocurrencies and Chinese stock markets. Jeribi et al. (2021) delves into connection between crypto assets and BRICS stock markets (Brazil, Russia, India, China and South Africa). Some of studies observe correlation between cryptocurrencies and emerging markets through assigning overall emerging market indexes as representative of developing stock markets. For example, Stensås et al. (2019) uses MSCI BRIC as indicator of emerging markets in their studies. Shahzad et al. (2019), Guesmi et al. (2019) use MSCI Emerging Markets Index as representative of emerging markets in their analysis. Bouri et al. (2020), Jiang et al. (2021), Klein et al. (2018) Ji et al. (2020) assign MSCI Emerging Markets and MSCI China respectively as representatives for emerging markets in their studies. Okoroafor & Leirvik (2023) appoints Vanguard FTSE Emerging markets as proxy for emerging market in their studies. Similarly, some of studies investigate capacity of cryptocurrencies to serve as a safe haven for stock markets under extreme market conditions. To indicate, Bouri et al. (2020), Diniz-Maganini et al (2021), Będowska-Sójka & Kliber (2021), Mariana et al. (2021), Kliber (2022), Jeribi et al. (2021), Jin & Tian (2024) assess if cryptocurrencies could serve as a safe haven for equity markets. Other remaining studies that we reviewed in this study research hedging capability of cryptocurrencies. Lastly, most of the studies in the literature adopts only Bitcoin as proxy for cryptocurrencies. Anne Haubo Dyhrberg (2016), Stensås et al. (2019), Bouri et al. (2020), Diniz-Maganini et al (2021), Shahzad et al. (2020), Baur et al. (2018), Eisl et al. (2015), Okoroafor & Leirvik (2023), Belhassine & Karamti (2021), Brière et al. (2015), Jin & Tian (2024), Kayral et al. (2022), Chan et al. (2019), Akhtaruzzaman et al. (2020), Xu & Kinkyo (2023), Chkili et al. (2021), Mensi et al. (2020), Huang et al. (2021) and many other studies adopted only Bitcoin as proxy for cryptocurrencies market. Therefore, better representation of cryptocurrency market could be needed in analysis of cryptocurrency market in the literature.

In short, as it can be seen above, most research in the field is centred on connection between cryptocurrencies and developed stock markets. Few studies investigate correlation between cryptocurrencies and emerging markets. Those studies make their analysis by focusing on some countries or assigning overgeneralized indexes. In addition, some studies concentrate on safe haven properties of cryptocurrencies while others observe hedging capability of cryptocurrencies. To our best knowledge, there is no single study analysing correlation among crypto assets and developing stock indices with respect to hedging, diversification and safe-haven characteristics of cryptocurrencies by adopting holistic and detailed approach with including all emerging markets and better representation of

cryptocurrencies. First of all, this study will focus on emerging markets. Emerging markets exhibit greater volatility than developed markets. (Muguto & Muzindutsi, 2022). Similarly, cryptocurrencies are also highly volatile. Cryptocurrencies and traditional assets very different in their natures. Unlike the traditional assets, cryptocurrencies are decentralized, they can be divided indefinitely, and they do not have any link with higher authority. Therefore, low correlation is expected between cryptocurrencies and traditional assets. Cryptocurrencies have high volatility like emerging stock markets and correlation among them is expected to be low. This directs us on thinking to create portfolio by combining traditional emerging stock market instruments with cryptocurrencies in order to minimize risk of portfolio. In emerging markets, a volatile asset has a higher potential to function as a hedge than in developed markets. Therefore, correlation between cryptocurrencies and emerging markets will be investigated with holistic and detailed approach with including all emerging markets with respect to whether cryptocurrencies could be hedge, diversifier or safe haven instrument or not.

In the literature, there are many definitions and classifications for developing markets. Morgan Stanley Capital International (MSCI) country classification is widely used and it is acceptable in the literature (Shahzad et al. (2019), Bouri et al. (2020), Diniz-Maganini et al (2021), Guesmi et. al (2019), Corbet et. al (2018), Conlon et al. (2020), Ji et al. (2020), Jiang et al. (2021), Klein et al. (2018)). Therefore, MSCI country classification will be adopted in this study. According to MSCI country classification, there are 24 developing markets: Philippines, Egypt, Kuwait, Brazil, Hungary, South Africa, India, Colombia, China, Chile, Saudi Arabia, Thailand, Turkey, Greece, Poland, Peru, Indonesia, Malaysia, UAE, Mexico, Czech Republic, Taiwan, Korea, Qatar. There are 24 MSCI country indices as well. In addition to this, MSCI Emerging Market Index will take place in this study. Saudi Arabia will be excluded from the study due to unavailability of the data. There will be 24 emerging market indices in the study overall. Cryptocurrencies observed in this study will be Bitcoin, Ethereum and Binance Coin (BNB), Cardano (ADA) and Ripple (XRP). These five crypto assets will represent cryptocurrency market since they create 79.4% of total market cap in cryptocurrencies (Statista, 2024). In addition to market cap, they are highly traded in the market, their daily trade volume is high enough and this creates liquidity for those cryptocurrencies. In the literature, Bitcoin and/or Ethereum are mostly selected as proxies for cryptocurrency market. However, to choose only stable coins as proxies for cryptocurrencies will not represent cryptocurrency market and its volatility well because

cryptocurrency market is highly volatile. In addition, low volatility reduces hedging capability of crypto assets for developing stock markets as literature suggested (Conlon et al. (2020), Kliber (2022)). Therefore we do not only add stable coins but also we included volatile and mostly traded cryptocurrencies which are Binance Coin (BNB), Cardano (ADA) and Ripple (XRP) to study. Sample period start from October 01, 2017 -due to availability of price data of cryptocurrencies- and ends at June 30, 2024. We expanded analysis period as possible as much in order to obtain reliable and robust empirical evidence and inference. To summarize, this study will adopt large amount of sample for a big set of countries and big set of cryptocurrencies in order to obtain robust empirical evidence on the contrary to literature.

Today co-movements or dependencies are experienced across several financial markets and assets. In other words, relationships and interactions are observed among financial assets today. Therefore; multivariate models are needed to analyse correlation and volatility across financial markets and assets. Dynamic Conditional Correlation General Autoregressive Conditional Heteroscedasticity (DCC GARCH) has been selected as method of analysis in the study because it holds a computational benefit over other types of multivariate GARCH models. In addition, it does not have constant conditional correlation problem (Engle R. , 2002).

In our study, we scrutinize hedging capabilities of cryptocurrencies for emerging markets. To make this study, we need to clarify what we means by phrase “hedging”. In literature, nearly all of the studies adopt definition of Baur & Lucey (2010). To illustrate Conlon et al. (2020), Conlon & McGee (2020), Ji et al. (2020), Corbet et al. (2020), Chemka et al. (2021), Goodell & Goutte (2021), Wen et al. (2022), Maitra et al. (2022), Jiang et al. (2021), Choi & Shin (2022), Klein et all. (2018), and many other studies adopted definitions of Baur & Lucey (2010) in the literature. Baur & Lucey (2010) provided definitions for phrases which are diversifier, hedge and safe haven for the first time in the literature. In addition, these authors determined testable criteria for those definitions. By applying testable criteria to assets, it becomes possible to determine characteristics of an asset whether it is diversifier, hedge or safe haven with respect to another asset. The definitions are given below:

“**A diversifier** is defined as an asset that is positively (but not perfectly) correlated with another asset or portfolio on average.

A hedge is an asset that is uncorrelated or negatively correlated with another asset or portfolio on average. A strict hedge is (strictly) negatively correlated with another asset or a portfolio on average.

A safe haven is defined as an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil.”

Baur & McDermott (2010) improved those definitions by making a certain distinction between strong and weak form of hedge as followed:

“**A strong (weak) hedge** is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio on average.

A strong (weak) safe haven is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio in certain periods only, e.g. in times of falling stock markets.”

This study will stick to those definitions as it is common in literature.

To summarize, this research will enrich the literature by exploring the evolving relationship between cryptocurrencies and emerging markets by attributing role to cryptocurrencies such as safe-haven, diversifier and hedge with a holistic and detailed approach. The study will composed of five main parts. In the first part, development of cryptocurrencies will be explained with providing summary information on history of money. In the second part, general economic and financial characteristics of emerging markets will be clarified. In the third part, literature on hedging capabilities of cryptocurrencies will be summarized. Later on, explanations on research methodology and data will be given. In this part, econometric analysis will be conducted and empirical evidence will be obtained. In the final section of the study, empirical findings will be compared and contrasted with existing literature through discussion.

PART 1: HISTORY OF MONEY AND EMERGENCE OF CRYPTOCURRENCIES

Money, a human invention, is an artificial instrument that has emerged as a great invention of civilization. At the same time, money is recognized as a political, social and economic phenomenon. Although definitions of “money” can change depending on the economic and social structures of societies, money can be defined as “medium of exchange”. Actually, money has nearly no value physically, it is just a piece of paper or metal. Apart from its physical value, money can serve as a store of value, unit of account and medium of exchange (Arvidsson, 2019).

John K. Galbraith's definition of money is one of the most widely accepted definitions of money. Galbraith defined money as "Anything that people will accept for use as money." (Yüksel, 2015). This definition articulates the principle that the value considered as money must be acknowledged by society (Öztürk & Koç, 2006). The following traits are required for an instrument to be deemed money:

- Acceptance by everyone
- Portability
- Durability
- Divisibility
- Homogenous
- Not easily imitated

Money has to be accepted by everyone. Value not generally accepted by the society cannot remain in circulation. Portability and lightweight of money enables people to carry and transfer it easily. Since money will continue to exist in circulation in the economy for a long time, it should be made of a physically durable material in order to prevent easy tearing and aging. Money must be divisible. Money issued in different size and amount provide the user with ease of payment and exchange.

As stated above, money performs three essential functions: serving as a medium of exchange, a store of value, and a unit of account. In addition, it is a tool for economic policy. As a medium of exchange, money is utilized to enable the swapping of goods and services, which defines its primary function. The timeline of money stretches back 3,500 years. Before this date, barter system was used instead of money. Barter refers to the practice of trading goods and services directly. It has many difficulties such as lack of coincidence of wishes,

problems of storing goods and services, difficulty in specialization etc. Therefore, it was difficult to trade domestically and internationally in barter system. It is believed that Lydian invented money (currency) in the history around 687 BC because some sort of payment system was necessary in order to activate and improve trade and thereby enable specialization and prosperity (Arvidsson, 2019). In barter economies, transaction costs are high and it is up to the trading parties to decide on the rate or unit of exchange. In this context, role of currency as a medium of exchange lowers transaction costs and enhances economic efficiency while accelerating the division of labour and specialization in economy (Yıldırım K. , 2012). The function of money as a unit of account requires the value of money as a unit depending on the pricing of goods and services. Money facilitates the valuation of economic assets in the economy with a common unit of measurement. In this way, the accounting of goods and services, receivables and payables provides convenience to economic units. Money is a tool of accumulating value and wealth. People have started to keep and save the money they have obtained. In this way, people have always had the opportunity to keep money in liquid form and to use it when necessary. Lastly, money serves as a tool for economic policy. The function of money as an economic policy tool emerged with the economic paradigm of J.M. Keynes in the period following the World Economic Depression in 1929. This view argues that by overseeing the volume of money circulating in the economy, the government may be able to change national output and employment rates (Dinler, 2015).

There are different types of money in economies throughout the history and they have constantly changed and developed with the development of societies.

The value of commodity money comes from the product it is made. The most common forms of commodity money have been gold and silver throughout history. Even though they would not fulfil the exchange function of the money, they are considered to have their own value. Therefore, in times of economic crisis, some people may tend to prefer commodity currencies instead of the currencies issued by governments through emission (Altay, 2017).

Banknotes took place of commodity money due to the difficulty of using precious metals directly as money. Banks or merchants holding precious metals in their hands issued banknotes (money) that could be easily converted into commodity money on demand. These banknotes could be exchanged for the equivalent amount of silver or gold coins on demand.

These paper banknotes served as money similar to today's money, but in many countries, banks and private organizations rather than governments controlled them.

The United Nations Financial and Financial Conference (Bretton Woods Conference) was held in 1944 in Bretton Woods, a town in the state of New Hampshire in the United States of America, with the participation of 44 countries as the end of World War II approached. It was decided that the US dollar would be based on gold in the conference, paving the way for many other countries to create fiat money by indexing their currencies to the US dollar. Therefore, while other currencies were anchored to the dollar, the US dollar was the only currency that could be converted into gold. This model has been defined as gold standard. At the beginning, one ounce of gold was equivalent to the 35 US dollar. On 15 August 1971, US President Richard Nixon declared the termination of the gold standard, allowing the gold price to fluctuate freely in the market. Fiat currencies are not based on gold or silver. For fiat money, individuals and institutions, i.e. the users of the currency, have confidence the central authority that issued the fiat currency (Altay, 2017).

Digital money is a form of currency that exists in digital form and can be transferred electronically and it is a representation of paper money. With the development of e-commerce and internet, digital money usage increased, digital money has become widespread. Digital money has reduced the transaction costs of banks. Digital money has no physical existence but represents paper money. They are used for transactions (payment, transfer etc.) among accounts over the internet. Digital currencies, which are controlled by a central authority, are produced and protected in a virtual environment (Yıldırım, 2015).

Although virtual money or currency is a different from digital money, they are often confused with each other. Whereas digital money represents a fiat paper currency and has a control mechanism, virtual money does not. While all virtual currencies are a subset of digital currencies, not every digital currency falls under the category of virtual currencies. Virtual currency falls within the broader category of digital currency, which also covers cryptocurrencies. These assets are only kept and transacted via specific software, mobile or computer applications, and specialized digital wallets. Transactions take place through secure, private networks over the internet (Marian, 2016). European Central Bank defines virtual currency as following: “A virtual currency is a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community”. In other words, virtual currency denotes digital value that is not under the jurisdiction of a central bank or government entity, but recognized

by users for transactions and payments, and it may lack a direct equivalent value (European Central Bank, 2015).

Cryptocurrencies are alternative currencies that enable secure transactions due to their encrypted structure, enable additional virtual money supply and have digital values. Most prominent characteristics of cryptocurrencies is that they are decentralized. Central authorities cannot exert control over them. In conventional monetary systems, governments can generate money through the central bank whenever required, they cannot produce cryptocurrencies and cannot seize cryptocurrencies in the possession of other people. Decentralized encrypted networks create cryptocurrencies at designated rates. In cryptosystems, the parties do not need to trust each other, as the system itself is secure. It is claimed that cryptocurrencies will contribute to financial system as below:

- Contributes to shortening transaction time and decreasing transaction cost
- Increasing transaction security
- Ensures that financial records are kept instantly and appropriately

Major withdraw or disadvantage of cryptocurrencies is that it will be out of control of central banks and public authorities. Central banks cannot control supply of cryptocurrencies. On the other hand, this disadvantage is main motivation of cryptocurrency advocates. The valuation of cryptocurrencies is influenced by market supply and demand. Supply of cryptocurrency is determined at the beginning by the system itself. Therefore, no authority including governments can produce beyond the upper limit of cryptocurrencies and cannot control the cryptocurrencies in the market. System itself is reliable, there is no room for any third parties (Temelli, 2019).

Assets that emerged in the 9000s BC and characterized as money were first used for the exchange of various objects and goods. However, those assets were adapted to commercial life, became a permanent part of daily life and they were characterized as money after thousands of years. From the first appearance of money until 1871, money existed only in physical form. This period of money is called Money 1.0. With the first EFT (Electronic Funds Transfer) service of the Western Union Company, which started in 1871, money turned into a data as well as its physical existence. Later, credit cards and modern bank ATMs were included in our daily lives, different types of money were used, and they were diversified. This period of money is characterized as Money 2.0. After collapse of gold

standard, new era started for money. This period is called Money 3.0. Money has become a purely conceptual acceptance that no longer needs to have a physical equivalent (Usta, 2018).

With the rise of digital economy, information and communication technologies have kept pace with these changes, played vital role for transformation of financial services. Usage of the internet and smartphones has become widespread; many of the practices related to life are sustainable online via the internet. The supply and demand dynamics pertaining to goods and services, which is the basic element of the traditional economy, can also be realised on e-platforms. Those e-platforms made marketing and sales activities shift from local markets to global markets. Thus, money had digital and global characteristics. This new type of virtual money emerges as an alternative to traditional money. This new type of money does not involve any institution or intermediary such as a bank, and enables transactions between consumers without the need for commission costs (Çizmeçi & Göver, 2020).

With the increasing usage of electronic currency, problems such as high fees for transactions and information security came to agenda. After 2008 global crisis, credit rating agencies lost prestige, stock markets collapsed, financial institutions came to the point of bankruptcy, and large banks had to withdraw from the market. At this point, Bitcoin is emerged and it is started to be spoken as a substitute for traditional reserve currencies (Çalışır & Şanver, 2018).

Virtual money, which is a product of developing information and communication technologies, was created for the first time in 2008 by Satoshi Nakamoto and the world learned of it through the article's announcement "Bitcoin: Peer-to-Peer Electronic Cash System" (Nakamoto, 2008). In the article, it is stated that electronic trade or electronic financial transactions are depending on financial intermediaries that play role as trustworthy third party. Transaction making two parties actually trust to third party, which is almost exclusively financial institution. All transactions in the traditional system is reversible, because financial institutions must be intermediary to disagreements. Cost of being intermediary increases transaction costs, limiting effectiveness of daily practical transactions. If sellers do not use trusted third party, they should be careful and collect more information about their customers. In addition, some percentage of fraud must already be accepted since it is inevitable. Those costs and payment uncertainties cannot be prevented without a trusted third party or usage of physical currency. Instead of relying on trust, cryptocurrency offers an electronic payment system based on cryptographic validation. In this system, two parties directly trade electronically with each other without any

intermediary financial institution. Payment or transaction is irreversible. This protects merchants from fraud.

Although cryptocurrencies have many advantages, they have also drawbacks. First, cryptocurrencies have not become an alternative payment method yet. They are not widely accepted in the world. Irreversibility of cryptocurrency transactions made on the block chain is another disadvantage of those currencies. High volatility in the price of cryptocurrencies prevents their widely usage. Sharp rise and decline in price of cryptocurrencies can harm economic decision makers in the market. Lastly, the fact that the flow of money cannot be traced due to the anonymity of the cryptocurrency transfer can pave the way for many illegal actions such as tax evasion.

First cryptocurrency is Bitcoin. Cryptocurrencies aim to build a trustworthy financial system that facilitates transactions independent of central authorities and intermediaries. Bitcoin is a cryptocurrency that has no physical counterpart and is not issued and guaranteed by any official or private institution. Known as electronic money, Bitcoin is traded via a digital network infrastructure. It is widely known, most traded cryptocurrency and it has largest volume among cryptocurrencies. Bitcoin operates independently of a central authority and it has a limited supply (21 million). It is generated by cryptocurrency mining activity. Risk of inflation and problem of decreasing value of bitcoin was prevented by its creators in the following way: Bitcoin production becomes more difficult with increasing number of bitcoin in circulation. Furthermore, mining activities are organised to be cut off by every four years. Bitcoin is expected to reach upper limit 21 million at 2040. Thus, it is not a traditional monetary policy instrument. Bitcoin can be used for payment, saving and investment purposes like traditional currencies; however it is generated and managed electronically unlike traditional currencies. Its transfer is irreversible.

Bitcoin has no time and space limitations. Transactions are finalized without the involvement of traditional physical spaces such as banks or ATMs. While the transfer is extremely quick, storing it in a virtual wallet is quite straightforward. Transactions are available any place in the world. In addition, transactions are immune to the economic challenges of countries. They incur no additional costs such as fees or commissions, as they are executed directly without central authority or intermediaries. In addition, There is no minimum threshold for making payments. Its safety is provided by block chain technology (Yıldırım, 2018).

Table 1: Comparison of Physical Currency & Cryptocurrency

	Physical Currency	Cryptocurrency (Bitcoin)
Production	Central Banks	Cryptocurrency Mining
Control and Supervision	Central Authority	Users in the Network
Characteristics	National	International
Market Value	Apart from market supply and demand condition, credibility of governments determines	Number of users and transaction number determine
Transaction Fee & Commissions	Exist	Does not Exist
Function	Medium of Exchange, Unit of Account, Saving of Wealth, Monetary Instrument	Medium of Exchange, Saving of Wealth, Investment
Safety	Low	High

Bitcoin has more than 500 billion US dollars “market cap” today. Ethereum ranks second in terms of market cap which is around 210 billion US dollars in the market (CoinmarketCap, 2023). Ethereum is second in the ranking of cryptocurrencies by market volume, and it has many differences from Bitcoin and its other counterparts. Ethereum includes many innovations compared to the bitcoin. It is most preferred cryptocurrency after Bitcoin. Likely Bitcoin, Ethereum does not depend any central authority. However, it works faster than Bitcoin. Ethereum does not have any upper limit for supply but its production has been limited 18 million yearly. Most prominent and vital characteristics of Ethereum is support of “smart contracts”. Ethereum enables usage of smart contracts. With smart contracts, it becomes possible to trade real estate, goods and services, assets that do not necessitate the involvement of a third-party intermediary. Smart contracts explicitly define the terms and conditions of the agreement and are recorded on the block chain. Thus, it provides verifiability and transparency to the transaction sides. Smart contracts, excluding third parties, create an area of control and autonomy for the parties. Smart contracts allow transactions to be made faster and cheaper. In addition, it greatly reduces bureaucracy and stationery costs and enables the making of contracts with reasonable fees. Smart contracts provide a high level of privacy and security. The contract recorded in the system is encrypted end-to-end. In this way, data protection are provided and its modification and corruption are prevented (Ethereum, 2023).

There are more than 20 thousand cryptocurrencies today and nearly 10 thousand is active. There are around 300 million cryptocurrency users worldwide. Bitcoin (BTC) has the largest market cap. Ethereum (ETH), Binance Coin (BNB), Ripple (XRP) and Cardano

(ADA) are followings Bitcoin with respect to market cap in order. In this study, those coins stated above will be employed for statistical purposes because their market cap is high enough. 10 billion US dollars has been set as limit for market cap for cryptocurrencies which will be used in this study. Cardano has around 10 billion US dollars market cap. Ripple has 25 billion US dollars market cap. BNB has around 40 billion US dollars market cap. Ethereum has nearly 210 billion US dollars market cap. Finally, Bitcoin has over 500 billion US dollars market cap (CoinmarketCap, 2023). Cryptocurrencies having lower market cap and lower trade volume are open to manipulation in price and unhealthy and very volatile price movements could be seen on them. Employing cryptocurrencies, which have lower market cap and lower trade volume, could therefore cause unhealthy and suspicious results in our analysis. Thus, making econometric analysis with cryptocurrencies, which have higher market cap and trade volume (namely Bitcoin, Ethereum, BNB, Ripple, Cardano), is decided in this study.

Until now; history of money and emergence of cryptocurrencies are explained in details above. Three different frameworks of money are observable: value-based money, fiat money, and decentralized money (Arvidsson, 2019).

Value-based money is money that its value is depending on the value of the metal or object on which it is based. Example of value-based money is gold, silver, bronze coins. Value-based money was used intensely for thousand years. This value-based money system have many potential challenge and problems and it is open to manipulation. For example; content of the metal, size and the weight of the money can be modified secretly. This can bring unearned and unfair returns in transactions (Williams, 1997).

Fiat money is the second paradigm of money. Fiat money is produced and used with trustworthy authority. Value of the money is depending on the trust provided by central authority, printer of money. Advantage of fiat money (paper money which is invented by Chinese) over value-based money is that it is more suitable to carry and it is safer as well as it is easy to destroy (Williams, 1997). In addition, it is difficult to manipulate value of the paper money contrary to value-based money and the central authority guarantees its value. Therefore, trust is in the heart of the fiat money. People get ready to give their goods to someone else for a piece of paper in return. Because they trust governmental authority that that piece of paper, enable them to obtain goods they wanted in the markets (Arvidsson, 2019)

Third paradigm of money is decentralized money. There are many names of it i.e. Bitcoin, Cryptocurrency, Virtual Currency. All of them refer to the fact that control of the money and its authentication is decentralized. In other words; no one singularly can control or guarantee of the money in the third paradigm of money. Authentication, validity and control of this money is provided and guaranteed by the group of people who use that money rather than a central money authority. For example, Though Bitcoin can be physically represented, its digital form is controlled through a decentralized ledger that users of the coin can access. This implies that to protecting value of the money and maintaining confidence in money lies to shared responsibility by all users. Moreover, there is no longer need for intermediary, hegemonic central authority for any kind of transaction. There is also no need for intermediary getting a piece of pie from transactions. Block chain technology enables essence of decentralized money. Payment made by using Bitcoin or cryptocurrency create a block which have information about payment details. This process continues and collection of blocks are created and it is called block chain. This block chain is open to everyone in the system and people in the system poll controls it. Therefore, information about payments becomes decentralized. System itself guarantees transparency, prevents double-spend, hacking, forged transactions (Arvidsson, 2019).

In summary, authority who control and print money is known in fiat money system. However, anonymous system produces money with predetermined but self-regulatory process in decentralized money paradigm. Paradigm of money has shifted in 21th century. However, as stated above, Money fulfils three key roles: medium of exchange (payment system), unit of account, and store of value. These three roles are not fully met by cryptocurrencies yet since not all economic actors (householders, business actors etc.) have not adapted using cryptocurrencies in their transactions. It will take time. Therefore, we cannot fairly compare and contrast three paradigm of money with respect to main functions of money but we will do it for the time being (see Table 2). Lastly, if new, third paradigm of the money is fully adapted to societies, monetary policy tools of the governments will be taken out from their hands. Governments will no longer use monetary policy tools in order to affect their economies. Therefore, paradigm shift is relevant for both the evolution of money and the transformation of governmental power (Arvidsson, 2019).

Table 2: Three Paradigms of Money

	Value-Based Money	Fiat Money	Decentralized Money
Critical assumptions and underlying beliefs: means of payment	Is based on the liquidity in markets for the metal upon which the money is based and the ease with which the coin can be melted and sold as metal. Even bills have been directly connected to a certain amount of metal (gold) and thereby regarded as value-based money	Is based on the trust users have in the provider, i.e., a central bank backed by the government and the authenticity of the money. The provider backs the money and guarantees its usability. This is institutionalized in central bank law stating that cash is legal tender. Strong institutions safeguarding fiat money makes it possible to use in almost in all situations. The value of fiat money is connected to the trust users have in the state's monetary policies	This is based on the trust users have in the decentralized ledger that is underlying the money and liquidity of the virtual currency on the money markets. It is assumed that the technological system is guaranteeing the money.
Critical assumptions and underlying beliefs: unit of account	This is determined by the number of users that set prices in the currency and relate their idea of the value of a good or service in the metal underlying coins and bills	This is a de facto standard as a unit of account in the geographic area in which the currency is legal tender. Taxes, fees for public services, fines and other publically available services are priced in the currency. In the end, it is determined by the number of users that set prices in the fiat currency.	This is determined by the number of users that set their prices of a good or service in the virtual currency
Critical assumptions and underlying beliefs: store of value	Is based on the fluctuation of metal values. This implies that the store of value of the money is directly connected to the supply and demand of metal that the money is based on	First the trust that the central bank and the government create around the economic situation of the country in general and its money. Second, the economic policies governing the currency exchange rate. Third regulation and licenses around the companies providing services and consumer protection for deposits with these companies.	Is based on the currency fluctuation of the virtual currency, which in turn is based on supply and demand of the virtual currency

In the realm of risk management and portfolio analysis, cryptocurrencies present unique opportunities that differentiate them from other financial market assets. Due to the limited grasp of cryptocurrencies by investors, it is essential to analyze their potential across

various financial dimensions. To our best knowledge, there is no study observing comprehensively hedging capability of cryptocurrencies with respect to emerging stock markets. Thus, we will observe interaction between cryptocurrencies as a financial instrument and developing stock market indices in this study.

There is no certain definition of “emerging market or emerging stock market” which is accepted by everyone. In this study, we will use Morgan Stanley Capital International (MSCI) country classification, which is based on three main criteria: Economic Development, Size and Liquidity Requirements, Market Accessibility Criteria. MSCI classifies countries as “Developed”, “Emerging” and “Frontier” by using three main criteria above. By balancing a country's economic development with market conditions such as flexibility, accessibility, and stability, this classification provides a comprehensive view (Morgan Stanley Capital International, 2022).

First criteria of MSCI country classification is economic development. In the classification, sustainable economic development is needed in order to put a country into “developed country” status. However, there is no need to sustainable economic development in order to call a country emergent or frontier. Economic development criteria is not used for the distinction between emerging and frontier countries. In line with the minimum investability thresholds established for MSCI indexes, size and liquidity requirements are determined. Market Accessibility criteria mostly concentrates on determining how easy to reach and invest on that market for investors. Market accessibility is evaluated based on five factors: foreign ownership openness, the ease of capital flows, the efficiency of the operational framework, the availability of investment instruments, and the stability of the institutional framework. The majority of these criteria are qualitative. They are calculated per year for all countries (Morgan Stanley Capital International, 2022).

Criteria stated above are updated for certain periods and country classification is revised according to those updated criteria. Table 3 shows details for per status with respect to criteria stated above (Morgan Stanley Capital International, 2022).

Table 3: MSCI Country Classification Criteria

Criteria	Frontier	Emerging	Developed
A Economic Development			
A.1 Sustainability of economic development	No requirement	No requirement	Country GNI per capita 25% above the World Bank high income threshold* for 3 consecutive years
B Size and Liquidity Requirements			
B.1 Number of companies meeting the following Standard Index criteria Company size (full market cap) ** Security size (float market cap) ** Security liquidity	2 USD 1,070 mm USD 91 mm 2.5% ATVR	3 USD 2,139 mm USD 1,070 mm 15% ATVR	5 USD 4,278 mm USD 2,139 mm 20% ATVR
C Market Accessibility Criteria			
C.1 Openness to foreign ownership C.2 Ease of capital inflows / outflows C.3 Efficiency of operational framework C.4 Availability of Investment Instrument C.5 Stability of the institutional framework	At least some At least partial Modest High Modest	Significant Significant Good and tested High Modest	Very high Very high Very high Unrestricted Very high

* High income threshold: 2020 GNI per capita of USD 12,695 (World Bank, Atlas method)

** Minimum in use for the May 2022 Semi-Annual Index Review, updated on a semi-annual basis

According to the MSCI emerging stock market classification, there are 24 countries called emerging markets. American countries include Brazil, Mexico, Colombia, Chile, and Peru. EMEA countries are Saudi Arabia, Qatar, Egypt, Kuwait, South Africa, Greece, Hungary, Poland, Türkiye, United Arab Emirates (UAE), and Czech Republic. APAC countries include Malaysia, Taiwan, Philippines, India, China, Indonesia, Thailand, and Korea. In this study, hedging capabilities of cryptocurrencies against stocks in emerging markets will be investigated. However, **data on the historical performance of the Saudi Arabian stock market is not accessible**. As a result, this study will focus on the stock markets of the following 23 countries: Turkey, China, Indonesia, Greece, Malaysia, Brazil, Qatar, Poland, South Africa, India, Chile, Peru, Egypt, Korea, Thailand, Hungary, Taiwan, Colombia, Kuwait, Philippines, Czech Republic, and the MSCI Emerging Market Index (overall index). Before going into deep interrelation between cryptocurrencies and emerging stock markets, economic and financial analysis of emerging markets will be reviewed and summarized in the following section.

PART 2: REVIEW OF EMERGING STOCK MARKETS

According to the MSCI market classification, there are 24 emerging markets namely Chile, Colombia, Mexico, Peru, Czech Republic, Egypt, Greece, Hungary, Kuwait, Poland, Qatar, Saudi Arabia, South Africa, Turkey, UAE, China, India, Indonesia, Korea, Malaysia, Philippines, Taiwan, Thailand, and Brazil. We will exclude Saudi Arabia due to unavailability of historical stock market data. Remaining countries' stock markets will be analysed economically and financially in summary.

Part 2.1: Brazil

Brazil's GDP is the largest in South America, making it the 10th largest economy on a global scale and it has huge population which is 213 million. South-eastern Brazil is heart of the economy and economic activity and competitive industries driving economic growth and prosperity such as manufacturing, agriculture, mining, energy takes place over that part of the country. Sao Paulo serves as the financial capital of the country and is a central hub for international business operations (U.S. International Trade Administration, 2023).

Brazil is among the global giants with respect to mining, agriculture and manufacturing. To begin with mining industry, it is main producer of niobium, iron ore, tin, bauxite, manganese, gold, quartz and gems in the world. Mining industry accounts for nearly 4% of Brazil GDP. Brazil is also main producer and exporter of agricultural products such as coffee, sugar, cacao, soya bean, maize, cotton etc. Agriculture sector is responsible for creating nearly one-twelfth of GDP and approximately 20% of labour force is employed in agriculture sector. In addition, agriculture sector is contributing to produce energy supply of the country. Sugarcane biomass, hydraulic energy and firewood is responsible for creating roughly 50% of total energy supply. Manufacturing industry creates 20% of GDP and 10% of labour force is employed in manufacturing sector. Exports are composed of automobiles, electronics and consumer goods in the sector. However, deterioration is seen in manufacturing sector due to China's rapid growth in industrial production and increasing trade in last years. Lastly, 70% labour force is employed in service sector. Apart from public sector, private sector is formed by different sub sectors such as tourism, transportation, financial services, travel, retail sales etc. (see (European Parliamentary Research Service, 2022)).

Energy sector is vitally important for Brazil. Brazil's economy one of the main and largest producers of oil worldwide. Furthermore, renewable energy production capacity is high (84 %, whereas the world average is 38 %). Hydropower, solar and wind are main sources of the renewable energy (European Parliamentary Research Service, 2022).

Brazil's economic has unstable economic growth, inflation and unemployment rate. Although presence of those instabilities, Brazil is one of the main trade partners of The United States and European Union. Brazil's 15% of the trade (which is around 28 billion US\$) is made by European Union (EU) countries. United States trade volume with Brazil is around 21 billion US\$. Apart from oil exports, machinery, chemical products and transportation equipment are main elements of the trade between Brazil and United States / EU. Lastly, EU countries are main foreign investors in Brazil. Foreign direct investment stock in 2020 is around 330 billion US\$ (European Parliamentary Research Service, 2022). After Covid 19 pandemic crisis, many free market reforms and Covid 19 recovery packages have been implemented. Those steps taken caused sharp increase in GDP and sharp decrease in unemployment rate until the last year. However, unemployment rate is still high which around 10% is. Due to free-market reforms and Covid 19 pandemic recovery packages, monetary and fiscal easing policies led to hike in inflation in last years.

Brazilian equity market had many boom and bust cycles in the past years. Depending on this, market capitalization has changed significantly over times (see Figure 1). In other words, many expansions and contractions have been seen in the capital market of Brazil. However, characteristics of this market has not changed too much. One of the most prominent and distinguished feature of Brazil equity market is high level of ownership concentration. This situation has changed a bit in recent years. Ownership structure of publicly held companies has changed into more distributed or dispersed structure (OECD, 2019)

Capital markets are important for companies as a source of corporate fund. Corporate investment needs are provided by capital markets. In Brazil, capital market comes in second place as a source of fund. In Brazil, National Development Bank (BNDES) was main source of finance for corporate investments. After 2008 financial crisis, to shield against the adverse effects of the global financial crisis, the BNDES significantly increased its balance sheet. However, government fiscal policy approach changed dramatically in 2016. Credit amount given by BNDES decreased significantly. This radical change created room for capital markets. Volumes increased with the contribution of equity market variety instruments. In

addition, private banks faced with many credit defaults which came across corruption investigations influencing whole economy. This made Brazilian banks being selective and careful when providing loan. This situation also contributed development of the stock market. The corporate credit market's demand side dynamics, Brazilian companies turned into looking alternative sources of fund for their investments in the capital market. Covid 19 pandemic created room for monetary easing policies and interest rates decreased. This prevented high guarantee yields obtained from Brazilian government bonds for investor. All of those factors contributed development of Brazilian capital market since demand and supply side of fund market turned their face to capital markets (OECD, 2019).

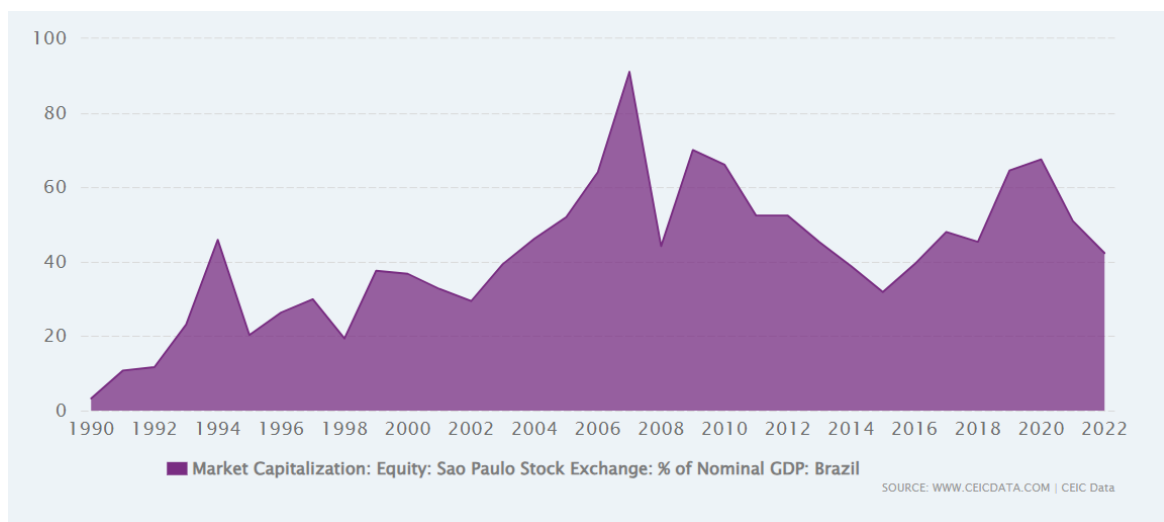


Figure 1: Brazil Market Capitalization

Brazilian equity market is composed of different economic sectors. Listed companies in the market is in consumer goods, finance, industrial goods, public utilities, basic materials, healthcare, oil, gas and biofuels, information technology and communications sectors. Those sectors' share in the market changes according to the economic conjuncture.

Another important characteristic of Brazilian equity market is about company size. Most of the companies listed in Brazilian stock market is large size. Small or medium companies (SMEs) listed are less compared to the large size companies. SMEs' capital market access is low. This problem is dealt by policy makers in recent years. It is allowed for SMEs to wait until 7 years for holding Initial Public Offering (IPO) after they have been

listed. Although those efforts contributed to the problem solution, large sized companies are still dominating the market.

Part 2.2: Chile

Chile is stable country with respect to economic development for decades until the two last major shocks which are social protests and Covid 19 pandemic. It has highest per capita income in Latin America and it has doubled over the past two decades. Chile have strong institutions, stable macroeconomic framework that enables and encourages investment. Prudent fiscal policy combined with loose monetary policy, well applied inflation-targeting program with an independent central bank, healthy financial sector created room for economic recovery and development through investments and innovation (OECD, 2021).

Covid 19 pandemic really affected negatively the Chile economy. Economy contracted deeply. GDP growth, consumption, investment growth declined. Terms of trade worked against the economy. Unemployment rate increased, employment rate declined and real wages hiked after the pandemic outbreak. However, economic stimulus packages cured this problem and the economy recovered. GDP growth increased significantly in 2021 and slowed and stabilized in remaining years. Inflation has decreased but it is still high and persistent over there. Unemployment rate decreased and stabilized but it is still high. Current account balance improved and central government financial balance stabilized around 2% of GDP. In addition, although country faced two major crisis, financial sectors and banking sector remained stable and strong due to solid institutional structure and independent central bank.

As it is stated above, although there are deteriorations in shocks, Chile economy has strong fundamentals. Country has strong and sustainable economic growth, central government has low gross debt which is 32% of GDP, and investment grades are high and stable. In addition; pension funds enables deepening and diversification in financial system. Financial sector is mainly composed of eight conglomerates. Financial assets are around three times of GDP. Size of pension funds is nearly 75% of GDP. Most of the financial sources are provided through banks (see Figure 2). Top 6 banks dominates the sector and holds nearly 70% of total assets (International Monetary Fund, 2021).

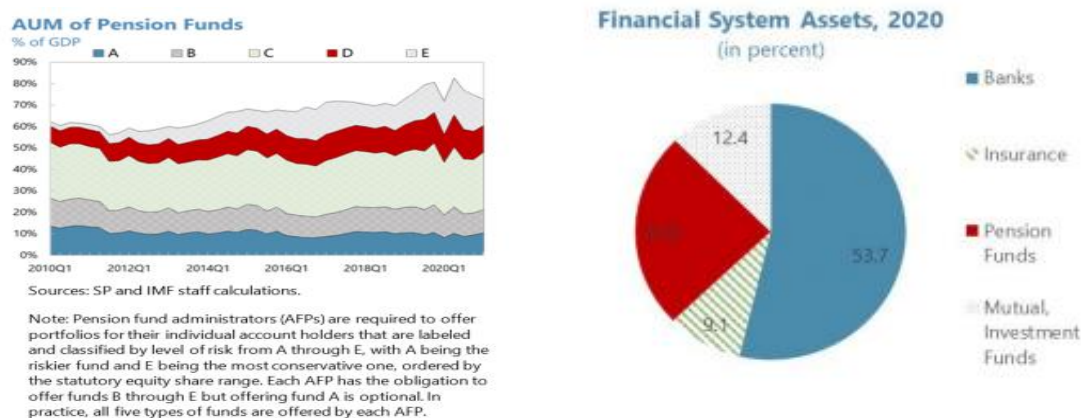


Figure 2: Pension Funds and Financial System Assets of Chile

When we look at the economic history of Chile, we see that Chile economy has come a long way. 50 years ago, International trade and capital flows in Chile were constrained by the country's closed economic policies and strict limits. However, Chile has open economy, flexible exchange rate regime, prudent fiscal policy, robust financial system and monetary policy today. All those structural changes created strong regulatory framework with economic and financial stability in Chile. In last decades, financial development is provided and financial institutions and financial markets indexes got better off according to the International Monetary Fund (IMF) (see Figure 3). Growing capital inflow from foreigners and international institutional agents paved way for capital and derivatives market development. This makes corporate investment and credit funds available to private non-financial sector. In return, economic and financial development are increased (Banco Central Chile, 2022).

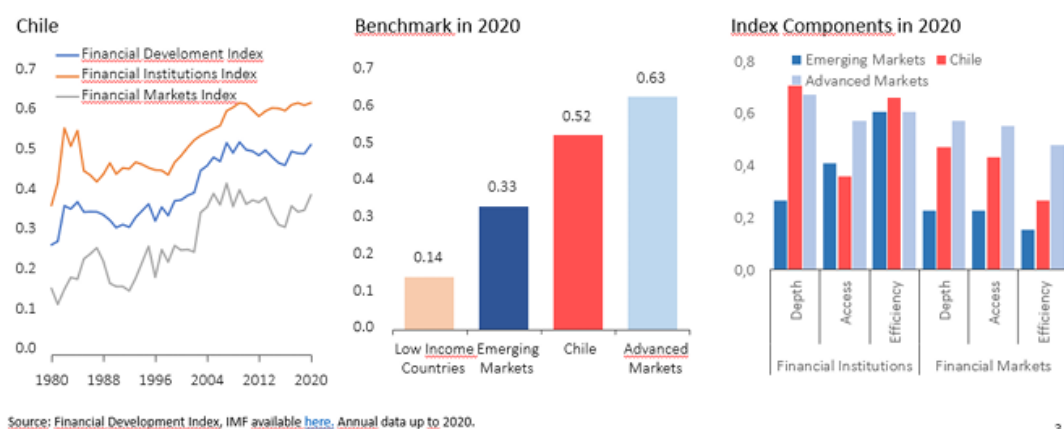


Figure 3: Financial Development Indicators of Chile

Although major external economic shocks due to pandemic outbreak and social protests, financial stability has been preserved. Short-term interest rates held steady, exhibiting a low spread. The rise in long-term sovereign rates caused by external shocks was followed by a subsequent decrease. Direct investment from different trade partners of Chile increased as years passed. In addition; many stress tests show that banks' foreign exchange and domestic currency capital is high enough. (OECD, 2021).

Lastly; although Chile exports many different products, copper export has the largest share among other products. Manufacturing products comes in the second place while agriculture, forestry and fisheries takes third place among exported products in terms of trade volume. On the other hand, trade partners are more diversified than exported products. China is the main export market for Chile. Rest of Asian countries are the second export market. Therefore, we see concentration of exports with respect to market place and product (OECD, 2021).

Part 2.3: Colombia

Colombia is a large country with 51 million population and it has huge trade potential. It has ports on two oceans which provide opportunity to become a trade hub. In addition, Colombia is rich with respect to natural resources such as coffee, oil, gas, coal, gold etc. Moreover, tourism potential of the country is also high. All of those factors stated above make Colombia centre of attraction for foreign direct investment. However, infrastructure of the country is not on the level expected and demanded due to low level of investment and difficult geographic features Colombia poses. In addition, structural unemployment, poverty and inequality are risks that discourages investors. Long lasting twin deficits will also continue to keep the country vulnerable to external events and shocks (International Monetary Fund, 2022).

As most of the emerging countries experienced, Colombia faced significant contraction during Covid pandemic. Economic activity reduced. However, GDP growth is sustained after the pandemic outbreak. Inflation is still high. Colombia's economy is predominantly challenged by its budget deficit and current account deficit. Public debt is around 60% of the GDP which is decent for Maastricht criteria (International Monetary Fund, 2022).

Colombia's economy is still to open and vulnerable to external shocks. Terms of trade shocks are especially great risk for the economy because nearly half of the total exports are commodity exports.

Table 4: Colombia Financial Sector Structure

Colombia: Financial Sector Structure (At end-2020)				
Type of Financial Institution	Assets (billion, COP)	Assets (% of GDP)	Percent of total financial sector assets	No. of entities
Credit institutions	768,724	76.2	34.9	46
Commercial banks	701,990	69.6	31.9	24
State-owned bank	27,851	2.8	1.3	1
Other	38,883	3.9	1.8	21
Pension funds	383,761	38.1	17.4	5
Pension funds	325,138	32.2	14.8	
Other retirement funds	47,927	4.8	2.2	
Prima media	10,696	1.1	0.5	
Mutual funds	135,027	13.4	6.1	279
Collective investment funds	76,039	7.5	3.5	
Private equity funds	19,412	1.9	0.9	
Other	39,577	3.9	1.8	
Insurance	94,820	9.4	4.3	45
Life	58,358	5.8	2.7	20
General	33,137	3.3	1.5	25
Other	3,326	0.3	0.2	
State-owned Financial Institutions¹	88,120	8.7	4.0	11
Other	69,191	6.9	3.1	
Trust services	660,546	65.5	30.0	23,680
Management and Payment	179,000	17.8	8.1	11,986
Social Security Resources	88,000	8.7	4.0	103
Real Estate Development	76,000	7.5	3.5	8,572
Secured Finance and Collateral Mgmt	72,000	7.1	3.3	3,010
Investment	15,000	1.5	0.7	404
Securities custody	222,173	22.0	10.1	
Other	8,373	0.8	0.4	
TOTAL FINANCIAL SYSTEM	2,200,188	218	100	
Source: SFC.				
¹ This category includes only nonbanks and does not include the state-owned bank (Banco Agrario), which is reflected under credit institutions.				

Colombia has huge financial system and it is complex. Assets in the financial system (assets of credit institutions) are nearly 76% of GDP. There are many trust companies, insurance companies, pension funds and especially trust companies and pension funds increased their share in the financial sector over the past few years. In the financial sector, conglomerates serve a pivotal function. They hold 60% of total assets in the financial sector

and hold nearly 80% of assets in the banking system. Rather than capital markets, banks are main source of funding for all parties in the economy. For investors, main investment alternative bank and government securities due to shallow capital markets. Colombia financial sector's structure depicted in table above (International Monetary Fund, 2022).

Colombian financial conglomerates actively service in 14 countries with different business lines such as banking asset management services, insurance etc. They play vital role in Central American markets. Number of financial entities servicing abroad increased from 46 to 288 in last decade. The assets managed by these entities experienced a substantial increase, growing from US\$ 11 billion to US\$ 93 billion during the same timeframe.

Part 2.4: Mexico

Mexico has around 130 million population and it is ranked as the second-largest economy across Latin America. Mexico economy is 15th largest economy in the world. Extensive natural resources are available in the country and it is open to international trade. Mexico is powerful with respect to having strong and trustworthy macroeconomic institutions and manufacturing in the economy which is linked to global value chains is assorted. Despite its progress, the country lags in growth, inclusion, and poverty reduction relative to other emerging economies. Economic growth on average is around 2% between years 1980 and 2023. As most of the countries in the world, Mexico economy experienced contraction during Covid-19 pandemic but it recovered after the outbreak. Employment level and GDP reached pre-pandemic period. Mexico's strong institutional capacity in economy, being economic and trade partner with United States and diversified and strong manufacturing capacity will continue to support economic activity (World Bank, 2023).

As stated above, economic output in Mexico declined during Covid-19 pandemic but it has recovered after the outbreak. GDP decreased around 8% but it has increased around after 5% after the pandemic. However, cumulative output growth and credit growth right after the outbreak underperformed compared to the other developing countries (International Monetary Fund, 2022).

Nonperforming loans over two decades declined and it is stable. Credit boom-bust cycle has not happened since the Peso devaluation. Private sector leverage stayed stable and low as debt service burden did compared to other emerging markets. Mexico economy

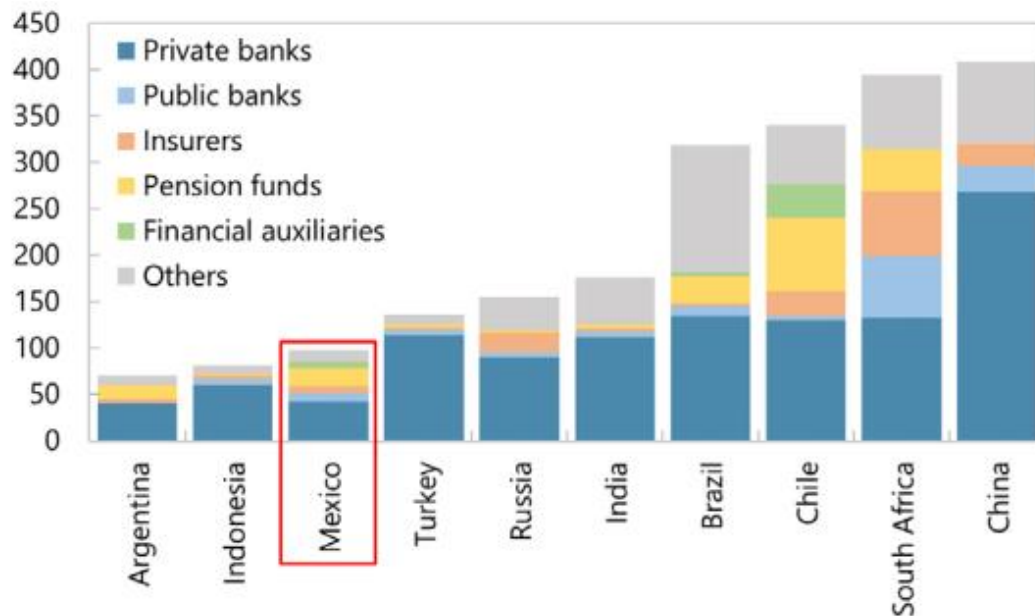
experienced relatively high inflation due to rise in commodity prices even though the country exposed to limited influence of external shocks such as Russia-Ukraine conflict. The Mexico Central Bank, Banxico, reacted by increasing interest rate. This caused decline in economic growth. Therefore country is experiencing relatively high inflation and low economic growth and it sounds stagflation.

Efforts in Mexico are directed at using digital financial services to provide more accessible financial solutions. This is the first transition the country trying to succeed. Another transition the economy trying to realize is low carbon economy. This can create risks for carbon intensive sectors and banks providing loan to those sectors (International Monetary Fund, 2022).

The unemployment rate increased during Covid-19 pandemic times but it recovered and normalized after the outbreak. Inflation is still out of Banxico targets and it persists. Current account is close to break-even point but it is in deficit situation in recent years. Although the country is trying to attract foreign direct investments, portfolio outflow continues. As most of the emerging market experienced, Mexico peso depreciated during the outbreak but it has returned their pre-pandemic level and high volatility seen during the Covid-19 pandemic a bit stabilized. Sovereign credit spreads increased but it is still acceptable when compared to the emerging market peers. Corporate risk spread is in line with sovereign risk spreads and it is still low when compared to the similar countries. Government bonds' yield curve shifted up and flattened in the face of inflation concerns. In overall, financial conditions are stable nearly for more than ten years. Steps taken by macroeconomic institutions provided stable financial conditions. Debt service costs are stable and it is low according to the international standards. Due to tightening monetary policies, credit developments and house prices are suppressed (International Monetary Fund, 2022).

Although Mexico is a big country with respect to economic volume, its financial system is relatively small. The banks are major players in the financial sector. Assets in the financial system which is as much as GDP does not show significant growth. More than half of the assets in the system are controlled by banks while pension funds and insurance companies hold nearly 30% of the assets (see Figure 4). Foreign entities hold a significant share of ownership in the banking sector. Commercial banks hold big share of assets. (see Figure 5). Non-bank financial institutions are usually making long term investments on

pension funds, insurance and investment funds. Most of the long term investments are placed on government sovereign debt securities (International Monetary Fund, 2022)



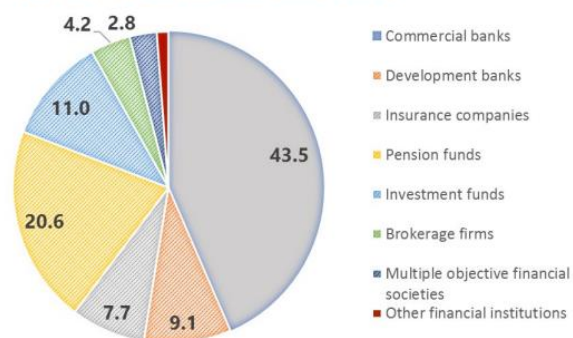
Sources: FSB; and IMF staff calculation.

Figure 4: Structure and Size of Financial System of Selected Emerging Markets (Percent of GDP, 2020)

The banking sector dominates the financial system...

Share of Financial Sector Assets

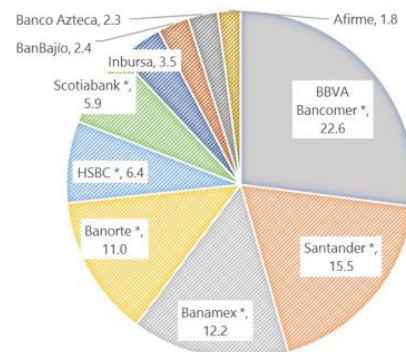
(In percent of total financial sector assets)



... and is dominated by D-SIBs.

Share of Banking Sector Assets

(In percent of top 10 commercial bank assets)



Sources: Banxico; CNBV; and IMF staff calculation.

Note: "*" in the right chart indicates the six D-SIBs in Mexico.

Figure 5: Financial and Banking Sector Assets of Mexico

Integration of Mexico financial markets with international markets is high enough. Approximately 20% of government debt securities in local currency are owned by foreign investors, though this proportion has been decreasing in past few years. Mexican peso is one of the main representatives for emerging market foreign exchanges and it is highly traded in emerging countries' foreign exchange markets. In other words; Mexican peso is a good proxy for developing countries' currencies. Therefore, it shows high correlation with global risk shocks. Mexico's capital markets are of middle size comparing to the other emerging market peers. Domestic debt securities are 46% of GDP while stock market capitalization is around 30% of GDP. Usage of financing by firms from capital market in Mexico is limited (International Monetary Fund, 2022)

Part 2.5: Peru

Peru has distinctive geography which makes possible diversified economic sectoral activity. Due to various climate areas the country poses, agricultural activity is enormous in the economy. The country has abundant natural mineral resources which drives mining industry in the economy. Having coast of Pacific Ocean makes commercial fishery an important economic sector. In addition, natural resources and beauties with different climate zones make country attractive to tourists. Therefore, tourism is another important sector for the economy (International Monetary Fund, 2023).

In last two decades, Peru experienced high and sustainable GDP growth. Main reason behind this successful economic improvement is favourable macroeconomic policy environment, openness to international trade, encouragement of foreign direct investments, stable currency exchange rate and low and stable inflation. Exports of commodities plays critical role for Peru's economy. Nearly 30% of GDP is created by exports. This situation makes Peru's economy vulnerable to external shocks (International Monetary Fund, 2023).

Parallel to the economic growth, export growth has remained high for last decades. The main exports consist of precious metals, copper, ores, zinc, fruits, animal feed, mineral oils and fuels, and nuts. The Peru also has big trading partners such as China, US, Japan, South Korea, Canada etc. Inflation in Peru was low especially compared to emerging market peers until recent years. Although it is not very high, it remains moderately high after the Covid-19 pandemic (International Monetary Fund, 2023).

As it is stated above, Peru has taken great steps in the direction of economic growth. It takes higher notes from credit rating agencies for a long time compared to other emerging markets due to economic stability, strong macroeconomic conditions, low or moderate public debt with stable policy regimes (see Table 5).

Table 5: Peru's Credit Rating, 2011-2022

Agency	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fitch	BBB	BBB	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB	BBB
S&P	BBB	BBB	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB+	BBB
Moody's	Baa3	Baa2	Baa2	A3	A3	A3	A3	A3	A3	A3	Baa1	Baa1

Data Source: Fitch, S&P, Moody's

Peru's financial system resembles other emerging markets. It is dominated by top four banks two of which are foreign. Another big players in the financial system are two large holding companies with pension system. The pension system is composed of four fund managements which controls nearly 25% of the assets in the financial area.

In recent years, number of listed companies has risen in Peru's stock market. Market capitalization as a proportion of GDP has experienced stagnation. Turnover ratio in the capital market is still persisting around 3.5%. Although national government of Peru is putting efforts in order to increase liquidity of government and private sector bonds, there are not largely traded or seeing enough demand. Domestic currency market are shallow and most of the securities have very short maturity. In overall, capital market of Peru remains shallow and illiquid

On the other hand, banks preserve their profitability. They are well-capitalized and they have low level of nonperforming loans. Their lending is has good diversification with high profitability and consistent return on assets (International Monetary Fund, 2018).

Peru's economy recovered after Covid-19 pandemic but economic growth declined last year. Due to social unrests and protests, real GDP declined as well at the beginning of this year around 1%. Driving sectors of the economy which are tourism, agriculture and mining are influenced in a negative way from recent developments. Unemployment rate still remains high even though economic growth is experienced. It is around 7.5% in March 2023.

Nominal income increases stay under the inflation while job creation is not on the level required.

Headline inflation has significantly risen after the outbreak and it has not declined to demanded level although it has been reduced in recent months (see Figure below). Public debt stock is hovering 35% of GDP in recent years while budget deficit of national government is around 2% of GDP. Foreign investors significantly decreased their government bond holdings this year. Foreign government bond holding decreased from 50% to 41% in 2023. Banking turmoil in the US and Europe has not influenced and spilled over to the economy. Total liabilities in the financial system is mostly relying on the public deposits and it stays stable (see Figure below). Amount of the public deposits is around 70% of the total liabilities in the financial system and nearly 40% of those total deposits is insured. Exposure to interest rate risk of financial institutions remain low. (International Monetary Fund, 2023).

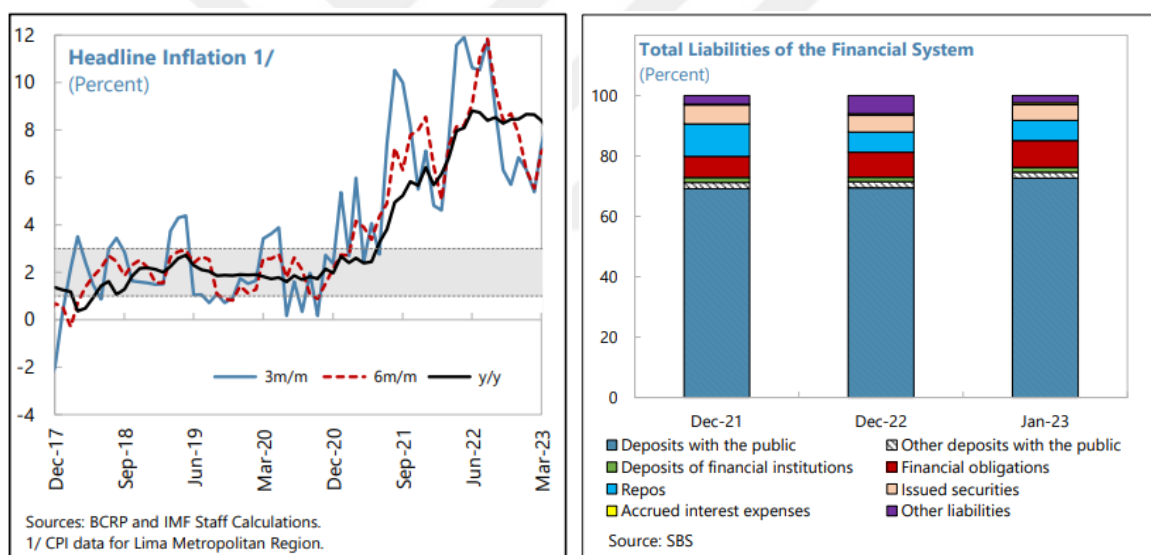


Figure 6: Peru, Headline Inflation and Distribution of Total Liabilities

Although there is banking sector turmoil in the US and Europe, Peru's banking system stayed strong. Volatility in the financial market, monetary tightening existence for fighting high inflation become stress tests for banking sector and the sector achieved staying strong. Performance of banking sector has returned pre-pandemic level. Lastly, current account deficit has worsened in the last year due to unfavourable terms of trade but exchange rate remained stable compared to the other emerging markets (International Monetary Fund, 2023).

Part 2.6: Czech Republic

Czech Republic is medium sized country with around 10 million population. GDP per capita is around 26000 US\$ and it is in the middle of the Europe. The country has huge industrial potential with a robust and strong financial and banking system. Automotive and engineering industries play key role for Czech Republic economy. Main trading partner of the country is Germany and exports of industrial goods has the largest share which is around 72% in formation of GDP. 26.3% of total exports are made to Germany while other European countries and the US are coming in second and third place respectively in terms of export volume. Sharp rise in energy prices and Russia-Ukraine conflict are major challenges for Czech Republic economy which caused decline in GDP while resulted in highest inflation rate since 1993 which is around 15% (Department of State, 2023).

One significant vulnerability in the Czechia economy is dependency on a few sectors especially on automotive industry. Less diversification problem in the economy is trying to be dealt by the government by encouraging investments and research and development activities on new fields and innovative technologies. European Union funding supported to the country for founding world-class scientific and high-tech centres. However, the problem still persists. In addition; demand to exported goods are mainly coming from Europe especially from Germany which makes economy highly dependent on European demand. Moreover, high foreign intermediate inputs employed in exports is another risk and challenge the country face. Aging population and shortage of skilled labour are seen another structural problems for the economy (Department of State, 2023).

Prague Stock Exchange is nearly small compared to other emerging markets while it has around 6-7 billion US\$ overall trade volume yearly and 25 million US\$ trade volume daily. Prague Stock Exchange created Power Exchange Central Europe in order to provide and facilitate energy trading in electricity market in Czech Republic, Slovakia, Hungary, Poland and Romania. In 2016, German power exchange, EEX, has bought 66% share of Power Exchange Central Europe. In return, liquidity and trade volume has risen significantly in Power Exchange Central Europe (Department of State, 2023).

As it is stated above, Covid-19 pandemic and Russia-Ukraine conflict were and are two major challenges for the Czechia. GDP growth was not on the demanded level in the recent years. Unemployment rate is lowest of the Europe and it is still stable. However, nominal wages stagnated. Higher inflation caused real wages to decline even though

employment rate is stable. Labour participation rate has risen a little bit but it is stable in the long run compared to other similar European countries (International Monetary Fund, 2023).

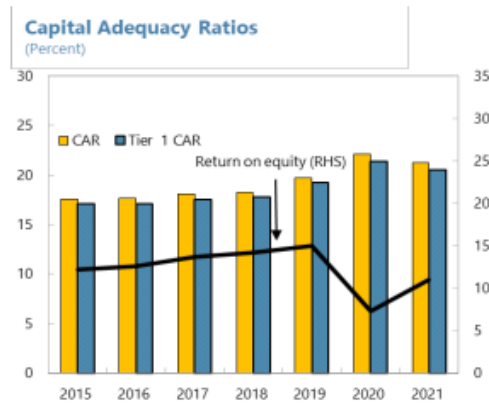
The country is experiencing trade surplus for a long time which is seven years. However, trade deficit occurred in 2021 due to significantly increasing import bills. The real effective exchange rate, which is based on the consumer price index, remains on an appreciating path. Although exports have recovered after the outbreak due to higher import input prices, trade deficit occurred after a long time. The country has attracting foreign direct investment for many years and it is net recipient. Net international investment position is negative which means the country taking more investments than it invested rest of the world. External debt amount is also increasing for the 7-8 years (International Monetary Fund, 2023).

Government sector was doing fairly well until the Covid-19 pandemic. However, deterioration was seen after the outbreak in order to activate economy. The public debt is around 40% of GDP. Sovereign bond yields has increased due to tight monetary policy in order to fight inflation even though CDS spreads continue decline and to stay low.

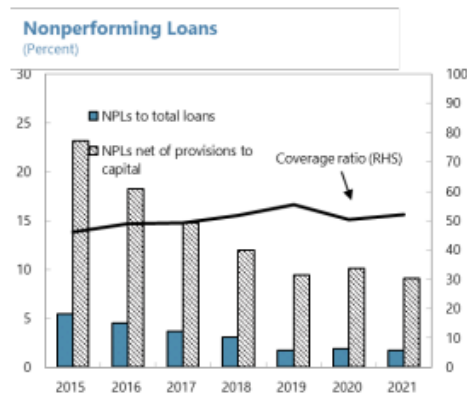
The banking sector is healthy and resilient, maintaining strong return on equity and return on asset ratios although deterioration was seen in the outbreak. Capital adequacy ratio recovered after the pandemic. Nonperforming loans declined significantly after the outbreak. Liquidity in the banking sector is high enough and loan-to-deposit ratios are still stables (see Figure below).

One of the main risk for the Czechia economy is pension system. Old-age dependency ratio is rising and transfer payments to the pension system is increasing as well. The country faces a significant challenge in securing the long-term sustainability of its pension system. Therefore the country is prioritizing health, smart-inclusive-sustainable growth, social and territorial cohesion, with hope of taking contribution of digital transformation and green transition (International Monetary Fund, 2023).

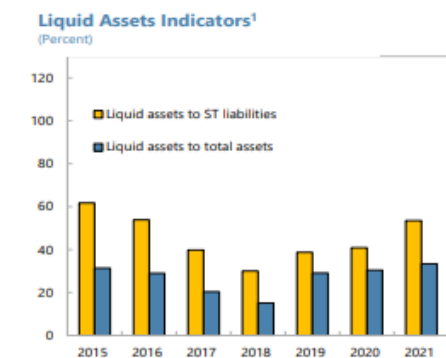
Capital adequacy ratios are solid...



Non-performing loans decreased while the coverage ratio increased.



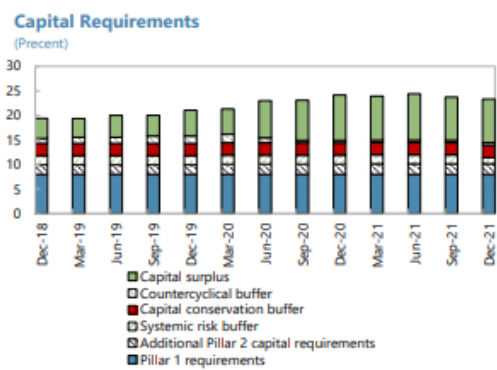
System liquidity coverage has improved.



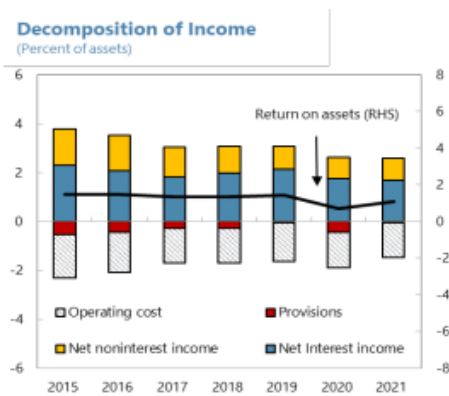
Sources: IMF, FSI database; and Czech National Bank.

¹ Czech banks increasingly preserve additional liquidity in the form of 2-week securities repurchase agreements (repo) with the Czech National Bank. These repo loans, although highly liquid, are not included in the definition of liquid assets used above, which explains the fall in the ratio in 2017 and 2018.

...and capital surpluses remained high.



Banks' profitability rebounded in 2021 from the year before.



Loan-to-deposit ratios have remained broadly stable.

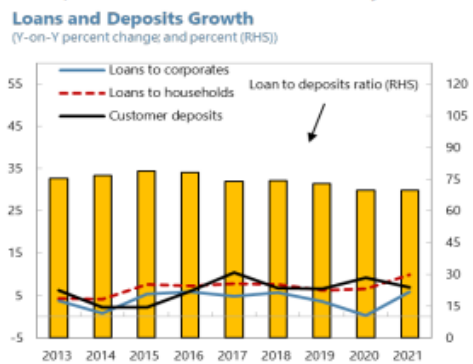


Figure 7: Czechia Financial Sector Developments

Part 2.7: Egypt

Arab Republic of Egypt is a big country with its 106.225 million population and its economic potential. Egypt is an important economy with respect to international trade. Geographical location it has is valuable and it is bridge between Europe and Asia with Suez Canal. Therefore, it has a great economic potential. Egypt is mainly exporting petroleum products such as crude oil, refined products and gold. Main trading partners with respect to exports are United Arab Emirates, Saudi Arabia and Italy. However, the country has some economic structural programs. High inflation, current account deficit, budget deficit, vulnerability to sudden alterations in capital flows and currency fluctuations (OECD, 2023)

Conflict between Russia and Ukraine influenced Egypt's economy negatively due to significantly rising food prices. Egypt economy is depending on food imports. The conflict resulted in high inflation Egypt economy. Later on, this inflationary pressures spread and deteriorated with currency depreciation. Therefore, Covid-19 pandemic and Russia-Ukraine conflict hit Egypt economy hard. In addition; public debt is close to the total of GDP (85.3% of GDP) which really remains high compared to the similar countries (OECD, 2023). In addition to the high inflation and public debt problems, the country has faced large amount of capital outflows which is around 20 billion US\$ (4.7% of GDP) after the Russia-Ukraine conflict. Moreover, currency depreciation, chronic current account deficit problem has deteriorated in this process (OECD, 2023). Due to high inflation, it is better to use real GDP growth in order to understand improving economic activity. Egypt economy is experiencing unstable GDP growth for many years due to changing economic and political conditions

Although unemployment rate is declining in recent years, the country has high and persistent unemployment problem historically.

Compared to the main macroeconomic developments and indicators, banking sector and financial markets are showing quite well performances. Although high amount of depreciations and limited foreign currency and capital buffers create risk for financial markets and banks, this sector has ability to withstand to those pressures. Capital adequacy ratio is increasing year by year while to share of nonperforming loans in total loans is decreasing. While foreign currency liquidity is rising, local currency liquidity is declining in banks (see Table below) (International Monetary Fund, 2023).

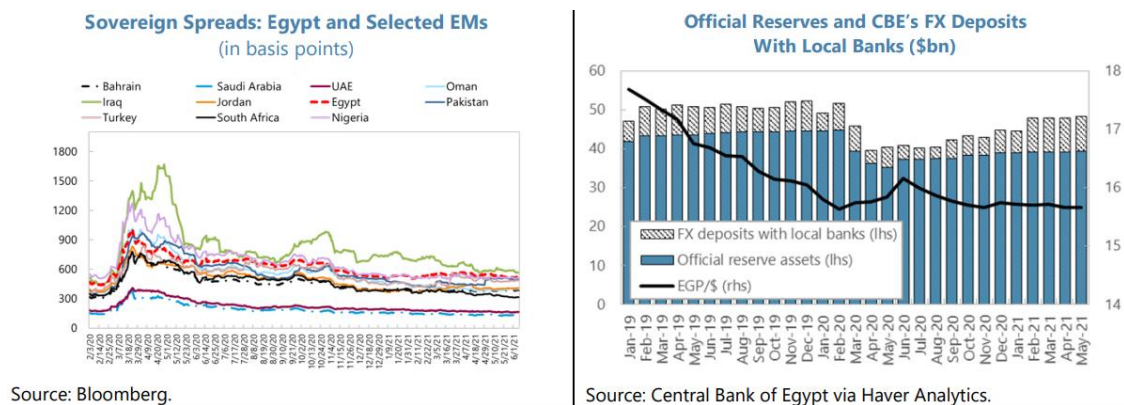
Table 6: Egypt Financial Soundness Indicators of the Banking System

	2014	2015	2016	2017	2018	2019	2020	2021	end-Jun 2022
<i>Capital adequacy</i>									
Regulatory capital to RWA	13.9	14.5	14.0	14.7	15.7	17.7	20.1	22.2	20.9
Common equity to RWA	11.4	12.1	11.7	9.2	10.4	12.7	14.6	13.4	12.2
<i>Asset quality</i>									
NPLs to total loans	8.5	7.1	6.0	4.9	4.1	4.2	4.0	3.4	3.2
Loan provisions to non-performing loans	98.9	99.0	99.1	98.3	98.0	97.6	95.2	92.3	92.1
<i>Profitability</i>									
Return on assets	1.3	1.5	2.0	1.5	1.4	1.8	1.2	1.2	1.2
Return on average equity	18.9	24.4	30.9	21.5	19.2	23.4	14.9	16.1	16.1
<i>Liquidity</i>									
Average liquidity ratio									
Local currency	62.7	59.7	55.4	47.1	40.3	44.4	53.8	45.4	44.3
Foreign currency	57.4	52.0	60.2	66.4	67.7	67.7	71.5	67.9	78.4
Loans to deposits	40.8	40.9	47.0	46.0	46.2	46.7	46.4	48.3	48.6

Source: Central Bank of Egypt.

1/ Starting in 2021, the fiscal year ends on December 31 for the banking sector. Prior to that, the fiscal year ended on June 30 for public sector banks and December 31 for the rest of the banks.

The sovereign spreads are stable in recent years especially compared to other emerging markets. In recent years, foreign exchanges deposits are also increasing which contribute financial stability in the country (see Figure below). Most of the portfolio investments are made by non-residents in Egypt capital markets. Source of foreign exchanges is tourism sector other than IMF fund and foreign investments.

**Figure 8: Egypt Financial Market Indicators**

Part 2.8: Greece

Greece economy is based on service sector, industry and agriculture. The highest share is taken by the services sector while industry is following it. The prominent industries are tourism and merchant shipping in the economy. Greece is a member of European Union, International Monetary Fund (IMF), World Trade Organization (WTO) and Organization for Economic Co-Operation and Development (OECD).

Greece with 10.7 million population has more than 20 thousand US\$ per capita GDP. Unemployment in Greece remains high for many years while public debt is 200% of GDP. The high unemployment rates and high amount of public debt chronicle problems of Greece economy. Increasing energy and food prices due to conflict between Russia and Ukraine affects negatively inflation and Covid-19 pandemic recovery process. Trade volume and exports of the country is rising but current account deficit is still increasing in last years. Current account deficits are usually financed by European Central Bank asset purchases, foreign direct investments and European Union funds (OECD, 2023).

Greece's net exports of goods are negative while the service exports are positive. Main trading partners of European Union countries while service sector exports are more diversified with respect to destination country and type of services. Greece has prepared and plan to implement Greece 2.0 Recovery and Resilience Plan. This plan is trying to make many structural reforms implement over hundred investment projects. Investment priorities in the plan cover private investment & transformation of the economy, skills, digital transition, social cohesion (health, education, and social protection), green transition, and employment. (OECD, 2023).

Investment credit rating is still under the level investment grade but it is improving after 2019. It is on the verge of investment level. 10-year government bonds yield increased and remains high comparing to the other EU countries. One of the main financial problem in the economy and banking system is non-performing loans. The government started program named The Hercules in order to securitisation of non-performing loans (NPLs). Volume of NPLS declined in recent years but it still remains high especially compared to other EU countries.

Commercial banks' assets are dominating the financial sector with around 90% of share in Greece. Insurance companies, investment companies, and other financial institutions hold remaining shares in financial sector. Total assets of the banking sector doubled GDP.

Banking sector loans is nearly equal to the Greece GDP. Four main banks are dominating the banking and financial sector. Capital adequacy is still high while quality of the capital worsened in recent years in banking sector.

In summary, rich European Union financial resource (which is around 20% of 2019 GDP) is primary advantage for Greece economy. Marine transportation and tourism sector are also main drivers of the economy. Decreasing NPLs and improving business climate are positives for Greece economy. On the other hand; very high amount of public debt, high dependency on imports of energy and food, less diversified economy and geopolitical risks are weaknesses of the economy.

Part 2.9: Hungary

Hungary has nearly 10 million population. It is a European Union country and it is also member of OECD and Schengen Zone. Therefore, it has easy access EU markets. It is located in Central Europe. Being member of EU and its strategic location makes Hungary becoming hub of industrial production and manufacturing for many big companies such as Coca-Cola, IBM, and Microsoft etc. Core economic sectors consist of wholesale and retail trade, transport, accommodation, industry, and food services. Since Hungary is located in the centre of Europe, major trading partners are European countries.

As it is common nearly for many economies, Hungary economy was hit by Covid-19 pandemic. However, recovery from outbreak was successful until the Russia-Ukraine war. Rising commodity and energy prices after the conflict and distortions in supply chain resulted in inflation and current account deficit in Hungary economy. The exchange rate and yields on government bonds are being pressured by a large trade deficit and the constriction of global financial conditions. Before the outbreak, yearly GDP growth was around 5%. However, Covid-19 pandemic distorted this economic growth. After the recovery process, it reached pre-outbreak level. Unemployment rate is stable and it is around 4%. Inflation has significantly risen due to external shocks. Public debt is around 75% of GDP which relatively high than recommended level by Maastricht criteria which is 60% (International Monetary Fund, 2023). Current account deficit magnified recent years.

Due to the external shock and deterioration in trade balance significant depreciation has been seen in exchange rate. In order to provide inflow of funds and control inflation

central bank policy rates and real interest rates have increased. The banking system is well enough with respect to capitalization, profitability and liquidity. Capital adequacy ratio was close to 20% in last year (International Monetary Fund, 2023). However, asset quality declined in recent years because share of NPLs increased over total assets. In addition, although liquidity in the banking system is adequate, it decreased in last years (see Table below). International net investment position of the country is negative for many years and main financial source is EU funds for the economy. Main share of external debt is hold by government sector. It is followed by financial and non-financial sectors and central bank comes in the last place (International Monetary Fund, 2023).

International reserves of the country is well enough although it is open to improvement because due to higher need of financial resources in recent years create vulnerability. Most of the public debt is in local currency denominated while major amount of public debt has medium and long term (International Monetary Fund, 2023).

Budapest Stock Exchange is one of the main stock markets in Central and Eastern Europe with respect to capitalization and liquidity. Capitalization of the listed companies in Budapest Stock Exchange was around 20% of Hungary GDP in 2020. Bank, energy and pharma companies dominate Blue-Chip-Stock market index (BUX) (Tonny Lybek, 2023).

Table 7: Financial Health Metrics for Hungary's Banking Sector 2018-2022

	2018	2019	2020	2021	2022		
					Q1	Q2	Q3
Capital							
Regulatory capital to risk-weighted assets	18.5	18.0	18.3	18.6	18.7	18.2	17.6
Regulatory Tier 1 capital to risk-weighted assets	16.7	15.9	16.2	17.1	17.2	16.7	16.1
Asset Quality							
NPLs (90 days overdue) net of provisions to capital	3.2	2.2	10.1	11.5	10.9	11.2	...
NPLs (90 days overdue) to gross loans	2.5	1.5	4.0	3.7	3.4	3.7	...
New NPL definition 1/	5.4	4.1	3.5	3.2	3.2	3.5	3.4
FX loans	23.4	23.4	21.7	19.6	20.4	21.5	...
Profitability							
ROA	1.9	2.0	0.9	1.2	0.4	0.6	0.9
ROE	19.4	19.5	9.7	12.7	4.6	6.5	10.1
Net interest income to gross income	47.7	46.8	52.1	53.4	54.7	57.4	...
Noninterest expenses to gross income	70.1	68.1	64.7	64.4	65.5	69.6	...
Liquidity							
Liquid assets to total assets	27.0	24.9	27.7	15.6	15.5	14.4	...
Liquid assets to short term liabilities	41.6	39.7	34.4	17.9	17.7	16.7	...
Sensitivity to Market risk							
Net open FX position to Regulatory capital	-1.0	-0.8	-1.4	...	...	...	...

Sources: IMF's *Financial Soundness Indicators Database*, while more current data from the Magyar Nemzeti Bank (MNB) are indicated in italics.

1/ New definition to better reflect the EBA methodology and the introduction of IFRS 9.

Part 2.10: Kuwait

Kuwait is Middle East country with 4.3 million population. Its main source of external finance is oil and oil based products exports because country has abundant oil resources. Highest share in GDP is coming from oil and oil products exports. This results in high per capita income in the country. Kuwait is a growing and stable country with stable sovereign credit rating which is given by reliable international institutions such as S&P, Fitch, and Moody's (DEİK, 2021).

Kuwait is global player in oil industry and it has vast oil resources. It is estimated that it is in 6th order with globally with respect to having largest oil resources. It has seats on Gulf Cooperation Council and Organization of Petroleum Exporting Countries. With inflow of fund due to the exports, Kuwait Investment Authority (KIA) created Kuwait's sovereign wealth fund. Nearly USD 600 Billion worth of assets is under the management of KIA. According to the report prepared by World Economic Forum, Kuwait is in the 2nd place with respect to size of Gross National Savings globally. This shows how strong financial position Kuwait has. In addition, tempting tax regime (which enables %0 personal income tax, low corporate income tax which is %15), free flow of capital nationally and internationally, free trade with stable and reliable currency and the central bank's monetary policy makes Kuwait a perfect place for international investments according to the World Economic Forum (DEİK, 2021). Kuwait economy is highly dependent on oil and oil based products' income. Diversification of the economy remains low level for many years (see Figure below). Nearly %90 of government revenue is obtained from energy industry which is basically dependent on oil and related goods production (U.S. Department of State, 2023)

Kuwait stock exchange is controlled and managed by a private sector. Kuwaiti Boursa is the only stock market which is owned by private companies in the Middle East. In addition, it has met inclusion criteria of MSCI Emerging Markets Indexes and it has entered MSCI Emerging Market Indexes in 2020.

Banking sector of Kuwait manages more than worth of USD 250 billion assets. 22 banks operate in Kuwait. Eleven of them is foreign bank while remaining include Islamic banks, local banks and specialized bank. Value of Kuwait dinar is dependent or pegged on basket of foreign currencies and it is anchor for monetary policy. Dinar's value changes through changes in the basket. It is claimed that US dollar has highest weight in the basket (U.S. International Trade Administration, 2023).

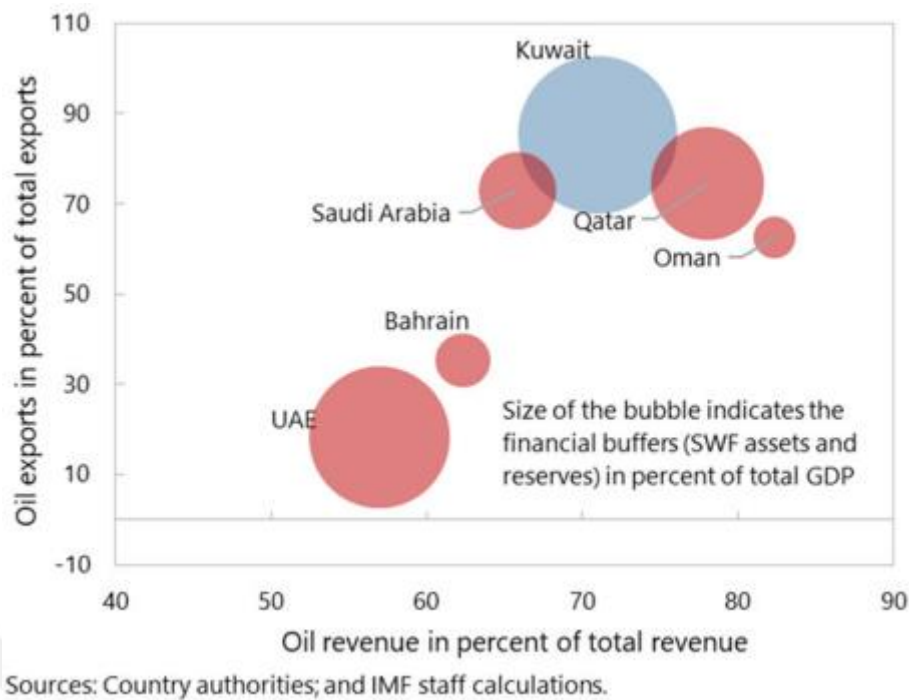


Figure 9: Dependence on Oil: Kuwait and GCC, 2022

The COVID-19 outbreak and the geopolitical tensions between Russia and Ukraine hit Kuwait hard as it happened many countries over world. However, recovery process of the economy is successful. Non-oil GDP growth reached %4 in 2022. GDP growth became %8.2 in 2022. Inflation is around %4. Kuwait economy is giving current account surplus for a long time due to oil exports. Fiscal balance is positive for many years except external or internal shocks occurrence. Lastly, government debt is around %10 of GDP and it is expected to stay at that level.

Liquidity in the banking sector is high enough which is around %25. Capital adequacy ratio is near %20. It is already above Basel III Criteria. Amount and rate of Non-Performing Loans are declining after the outbreak while return on assets ration are is improving in recent years (International Monetary Fund, 2023).

Part 2.11: Poland

Poland has nearly 38 million population and per capita GDP is around 18.000 USD. GDP of Poland nearly reached 700 billion USD. Poland is close to Western European markets and this creates many investment opportunities for the country. Proximity to

European markets and cheap labour force makes Poland attractive for investors. In addition, Poland's industrial production is highly integrated to production chain of Germany which is an industrial giant in Europe.

Poland has a well-diversified economy in which many sector and industries such agriculture, services etc. play substantial role in the economic activity. Moreover, this diversified economic activity is supported by resilient financial sector. Much of foreign direct investments is attracted from Netherland, Germany and France which are economic giants in Europe.

Excluding pandemic outbreak and Russia-Ukraine conflict, Poland GDP growth and inflation were stable for many years. However, those events stated above made GDP growth and inflation unstable. Inflation hiked significantly and it nearly reached 20% due to Covid-19 pandemic and energy crisis caused by Russia-Ukraine conflict. Budget balance of central government is giving deficit in recent years while public debt is under 60% of GDP and it is at acceptable level. Lastly, current account deficit has been given due to increasing imported energy prices in recent years.

Although Poland has many structural and geographical economic advantages, main withdraw or weakness of Polish economy is structural unemployment which is very hard to overcome. In addition, low level of female employment is another disadvantage of the economy. Even though country is in a good position with respect to attracting foreign investment, investment level in the economy is not enough and domestic savings which is source for investments are remaining very low for many years. Another structural problem in Poland economy is high amount of import ingredients in exports. Increasing exports means rising imports. This structural problem harms current account.

The Polish stock market is recognized for its considerable size and liquidity in Central Europe. Stocks, bonds, futures, derivatives are easily traded. Polish stock market is in "developed" status according to the FTSE Russell's country classification report. Warsaw Stock Exchange's market capitalization is nearly 40% of Poland GDP (U.S. Department of State, 2023)

Poland banking sector hold dominance in financial sector. Nearly 70% of total assets in financial system is controlled by banks. There are many private banks but share of public banks are high enough. Nearly 40% of banking sector is controlled by public authorities. The biggest insurance company is owned by state. Poland is European Union member but its

central bank still has sovereignty. In other words, Poland uses its own local currency in domestic market and it is not member of Eurozone and banking union. Monetary policy is independent from European Central Bank's monetary policy. Capital adequacy ratio is around 17% while asset quality has deteriorated in recent years. Liquidity is well enough for banking sector. In general, banking sector is still resilient in Poland.

At it is stated above, Polish economy is well-diversified. Mining, manufacturing and electricity industry are dominant sectors in the economy while trade, travel, accommodation and food sectors have significant shares. Construction, agriculture, forestry and financial intermediation and real estate have lower shares in the economy compared to other sectors.

In short, Poland economy has many strengths and it has the largest stock market in Central Europe. Due to the COVID-19 crisis and the geopolitical conflict between Russia and Ukraine, economic growth has slowed while inflation increased. Unfavourable terms of trade conditions harmed current account deficit. Due to the expansionary monetary policy during external shocks, real interest rates turned into negative. Unemployment rate increased significantly after the outbreak. Current account deficits has been financed by flow of funds. Most of financial inflow is coming as foreign direct investment and portfolio investment in very volatile in last years. Although international investment position is negative, it is improving in recent years. Polish currency, Zloty is highly volatile in recent years due to external shocks.

Part 2.12: Qatar

Qatar is a small and rich Arab country. It has enormous natural gas and oil reserves which are main source of their wealth. Qatar is a stable country economically. In addition, social and domestic political stability makes Qatar suitable place for portfolio investment. The citizens of the country has high per capita income. Monetary and fiscal policies are predictable and economic and social stability creates business friendly environment. Inflation is usually under 5% and it is stable. Government budget balance gives surplus most of the time. Since country has rich natural resources which are exported to whole world, current account creates surplus for a long time. In addition; public debt is under 60% of GDP in recent years.

Manufacturing industry is mainly concentrated on petrochemical sectors. Therefore, Qatar economy is not diversified. This is main weakness of the economy. Country is vulnerable to moving energy prices. Due to infertile soils and unfavourable climate conditions, food and live animals are mostly imported from rest of the world. In addition, machinery, transportation equipment, and manufactured goods are also other imports of the country. In order to provide diversification of the economy, government is trying to increase tourism revenues through investment on developing tourism activities (COFACE, 2023).

As it is stated above, Qatar has enormous natural oil and gas resources. Revenues in the government budget is mainly provided through exports of petrochemical goods. Qatar is the 3rd largest natural gas and oil producer in the world. Main export destination for Qatar natural gas and oil products are Japan, South Korea, Singapore. Qatar government created a sovereign wealth fund for its next generations. This fund is managed by Qatar Investment Authority (QIA). With this fund, Qatar makes investment in all over the world.

Table 8: Financial Soundness Indicators of Qatar

	(in percent)					
	2016	2017	2018	2019	2020	2021
Capital Adequacy						
Regulatory Tier 1 capital to risk-weighted assets	15.7	16.5	17.0	17.5	17.6	18.0
Regulatory Tier 1 capital to total assets	10.7	10.7	10.1	9.9	9.6	9.3
Regulatory capital to risk weighted assets	16.1	16.8	18.0	18.6	18.8	19.1
Asset Quality						
Nonperforming loans to total loans	1.3	1.6	1.9	1.8	2.0	2.4
Nonperforming loans net of provisions to capital	1.7	1.7	3.0	2.2	2.3	
Bank provisions to nonperforming loans	79.9	83.2	75.8	81.9	83.8	85.0
Bank provisions to total loans	1.3	1.5	2.3	2.5	2.8	
Total provisions to total assets	0.9	1.1	1.6	1.7	1.9	
Earnings and Profitability						
Return on assets	1.7	1.5	1.6	1.6	1.4	1.4
Return on equity	14.5	13.9	15.3	15.8	13.7	14.7
Net interest to gross income	75.1	78.1	77.0	77.0	79.5	80.5
Net Interest to average total assets	1.9	1.9	1.9	1.9	2.0	
Non-interest expenses to gross income	28.8	26.8	25.9	24.4	21.2	21.1
Wages and salaries to other non-interest expenses	49.8	49.4	49.7	50.0	49.5	
Liquidity						
Liquid assets to total assets	29.6	28.2	29.1	30.2	28.1	28.2
Liquid assets to short-term liabilities	54.7	54.2	62.7	69.7	67.0	66.9
Domestic credit-to-deposits ratio	136.8	119.6	134.1	150.4	159.5	165.3
Loans as a percentage of customers deposits	115.5	110.7	116.1	122.4	124.6	124.9

Sources: Qatar Central Bank, and Haver Analytics.

Financial stability is still hold in Qatar economics. Capital adequacy is high and liquidity is also well enough in Qatar banks. Ratio of nonperforming loans to total loans is around 2%. Capital adequacy ratios are nearly 20%. Ratio of liquid assets to total assets is around 30%. Earnings and profitability in banking system is also stable and high for many years. Stock market index increased significantly in last years (see Figure above). Qatar obtains high investment grades from international credit rating agencies such as Moody's and Standard and Poor's. Those data and information shows how banking system works well and how it is stable in Qatar. (International Monetary Fund, 2022).

Part 2:13 South Africa

South Africa is an another developing country which has abundant natural resources (gold, coal, rare metals) and it has youth population that is around 60 million. GDP per capita in the country is nearly 7,000 USD. South Africa experienced significant economic growth after 1990s through liberalization and institutionalization of the economy. Free floating exchange rate regime, independent central bank, healthy banking system makes South Africa suitable for foreign direct investment and portfolio investment.

After last external shocks such as Covid-19 pandemic, GDP growth has slowed down and inflation increased. For many years, budget balance is in a deficit position although percentage of budget deficit is declining in recent years. South Africa is experiencing current account surplus due to natural resource exports in general. Public debt is usually around 70% of GDP.

In 1980-90s, South African economy experienced transformation through privatization, liberalization and institutionalization of the economy. This resulted in significant growth process in the economy. However, there are still few weaknesses in the economy. Power companies are controlled by public authority and energy crisis is seen in the economy. Dependence on foreign capital and lack of foreign direct investment are another weaknesses of the economy. Lastly, high unemployment rate is another obstacle for the economy reaching full potential.

Agriculture is important sector for South Africa because low fertility of soil and limited water resources makes agricultural production harder. However, mining sector is main driver of South African economy. The country is very rich with respect having natural

resources from diamond and gold to other metals such as Titanium, uranium, chromium, copper, iron ore, beryllium, silver, platinum, and manganese. South Africa is the largest manufacturer of gold globally. Precious metal trade have critical importance for the economy. South Africa mainly imports motor vehicles chemicals and chemical products. While South Africa makes exports to all over the world, major export destinations are China, United States, Germany, Japan, United Kingdom and Netherlands. It is mostly importing from China, India, Germany, and United States.

Most of the public debt is in South Africa Rand (domestic currency) and high share of public debt has long term maturity. In other words; domestic bonds prevails foreign bond in total marketable debt. After Covid 19 pandemic, as it is common in most of the countries, stock market experienced a significant fall. Although Johannesburg Stock Exchange (JSE) All-Share Index appreciated after 2022, low valuation is existing in JSE according to the price-earnings ratio because it has not reached long term average yet (South African Reserve Bank, 2023).

Banking sector is trying to push economic growth through expanding loans. Leverage ratio is relatively high in the banking sector and it is highly depending on short-term wholesale sources. Loan-deposit ratio is around 90% and non-performing loan ratios are increasing which is sign of decline in quality of banks' loans. Non-Bank Financial Institutions (NBFI) play critical role in South Africa financial markets. NBFI also finance government spending through purchase of government bonds. Amount of government bonds are more than double of the banks holding. More than 50% of assets are government bonds in total assets of NBFI. Another industry in financial markets is insurance. Value of total assets in insurance industry passed R4 trillion which surpassed the pre-pandemic level that is R3.5 trillion (South African Reserve Bank, 2023).

Part 2:14 Türkiye

Türkiye is a big country with over 85 million population and around 906 billion USD GDP. Per capita GDP is around 10.661 USD. With respect to GDP, Turkey is positioned as the 19th largest economy worldwide. Türkiye has membership to OECD and G20.

After the economic crisis in 2001-2002 in Türkiye, it has experienced significant economic transformation, followed economic and social reforms. This provided stable,

continuous and high amount of economic growth. Türkiye is classified as upper-middle-income status after a period of uninterrupted growth. Poverty declined. Percentage of people below poverty line declined significantly between years 2006 and 2020. However, ambitious efforts towards making economic reforms has slowed in last decade. Especially after 2018, Expansionary fiscal and monetary measures have been implemented to bolster growth. This resulted in credit booms, external and internal vulnerabilities, high inflation and high current account deficits. Covid-19 pandemic and two devastating earthquake have put extensive pressure on Türkiye economy (World Bank, 2023).

Türkiye economy has experienced 5.6% of economic growth last year. The Turkish lira depreciated 30% in 2022. Inflation reached the highest level in last 24 years. Unemployment rate is around 10% for many years. Yearly inflation is above 70%. Although banking sector's stance is solid and it has adequate liquidity, risks upon them are increasing through interventions of government on banking and financial sector. Government's cost of borrowing was still high at the beginning of 2023, interest rate of Eurobond with 10 year maturity was 9.8%. Debt of central government is around 45% of GDP while net foreign direct investment is around 1.4 % of GDP in 2022 (World Bank, 2023).

Main trading partners of Türkiye are Germany, USA, Iraq, UK, Italy, Spain, France, Russia, and China. Although Türkiye runs trade deficit for many years, its trade volume has risen significantly in last two decades. Turkish exports surpassed 250 billion USD. Foreign direct investments are mainly coming from Netherlands, USA, UK, Austria, Germany, and Azerbaijan. There are 55 banks in Türkiye while 34 of them deposit banks and remaining are development and investment banks and participation banks. Banking sector is still healthy. Liquidity ratio is enough to cover short term liabilities. Capital adequacy ratio is 19.5 % which is adequate and higher than minimum ratio 8%.

The Capital Market Law, which came into effect in 2012, sought to improve corporate accountability, protect minority shareholders, and ensure transparency in financial reporting. Capitalisation in Borsa İstanbul (BIST) has growth significantly after the CML has been enforced. Borsa İstanbul Market Capitalization 332 billion USD. 511 companies are traded in BIST. Share turnover ratio 512.6%. This shows how liquid trading platform BIST is. The proportion of foreign investors in the bond market is less than 1%, while their share in the equity market is approximately 30%. More than 1000 investment funds are traded and their total net asset is around 25 billion USD. There are 70 insurance firms. 45 of

them are non-life insurance companies while remainings are life and pension and reassurance (Türkiye Finance Office, 2023)

To summarize, Türkiye has a strategic economic location which makes possible to reach Middle East, Asia and Europe markets. Proximity to export markets is a great economic advantage of Türkiye. The economy has enough manufacturing diversification. However, dependency on import inputs and import energy is one of the main vulnerability of the Turkish economy. High inflation, increasing budget deficit and current account deficits, risk arising from low level of international reserves and private external debt, credit driven economic growth are major concerns of Turkish economy.

Part 2:15 United Arab Emirates (UAE)

Among global economies, the United Arab Emirates (UAE) is considered one of the largest with 10 million population in Middle East. High per capita income which is over 40,000 USD, low unemployment rate, low inflation and low amount of public are favourable economic indicators of UAE. Stable economic and political conditions makes UAE optimum place for portfolio investments to the stock market.

Although economic diversification efforts are ongoing in UAE, the country is strongly depending on hydrocarbon exports to the whole world. Although sustainable GDP growth is accompanied with low inflation, low public debt, positive budget and current account balance, high dependency of the government and the country on revenues collected through export of hydrocarbons, dependency on foreign labour and concentration of the national workforce outside of private sector are main drawbacks of UAE economy.

One of the main economic problems of Gulf Cooperation Council (GCC) Countries is high dependency on oil reserves and oil revenues. Most of the economic activity and industrial production are centred on oil production and oil exports. 90% of GDP was created by oil sector in 1971 in United Arab Emirates. However, this ratio decreased to 30% today. 30 of GDP is created by private sector while 70% of it is created by public sector. Although there is much space to go further for diversification of economy and increasing role of private sector, UAE have improved a lot within this respect (The Hong Kong Trade Development Council, 2023).

GDP is dominated by three sectors which are services, industry and agriculture. Share of service sector is %58.2 while share of industry sector is 40.9%. Agriculture's share is less than 1%. Major export commodities are oil based and they are mineral fuels, mineral oils, pearls stones, precious metals. Major import commodities are pearls, stones, precious metals, machinery and vehicles. Major export destinations are Taiwan, Saudi Arabia, India, Iraq and Hong Kong while major import destinations are China, India, United States, Japan, and Türkiye. As outlined in the Investment Report published by the United Nations Conference on Trade and Development (UNCTAD), United Arab Emirates making foreign direct investment which more than foreign direct investment it takes for many years (United Nations, 2021).

Banks' net foreign assets are in surplus position after 2017. Banks' capital is adequate and liquidity in the banking system is high enough. Non-performing loans (NPLs) are declining after Covid-19 pandemic. UAE adopts pegged exchange rate regime which provides stability and credibility to the domestic currency. UAE Stock market index positively decoupled from MSCI Emerging Market after the Covid-19 pandemic. Long term bond spreads declined significantly after the outbreak. Amount of NPLs is around 7% in the financial system. In short; financial conditions are well enough in United Arab Emirates (International Monetary Fund, 2023).

Part 2:16 China

China experienced economic reform process beginning from 1980s through opening up the economy. Beginning from 1978, China reached average over 9% of economic growth. China is upper middle income country today. One of the biggest advantage of China economy is low-cost of mass production, current account surplus created through massive exports. Although economic growth has slowed down in recent years, sustainable economic growth, low inflation and current account surplus continue to run (World Bank, 2023).

After sustainable long economic growth of China, GDP per capita and gross domestic savings increased significantly. High amount of international reserves collection through current account surplus, massive low cost manufacturing due to cheap labour force, national and foreign direct investments make China second largest producer and exporter of the world. However, central government's budget run deficit and public debt has increased significantly in recent years. Around 3% of budget deficit and more than 80% of public debt

occurred in last year. Since public debt is denominated in local currency, sovereign risk is limited even though. With the rise of e-commerce which is accompanied by good infrastructure, China achieved employment of its large labour force and high growth in addition to the Belt and Road Initiative (COFACE, 2023)

Chinese economy has some weaknesses. It certainly depends on import of key technology components. Political disputes, sanctions, concerns about environmental and carbon emission related issues create risk for Chinese economy. High indebtedness of private sector, housing market problems, aging population are another medium and long term obstacles for China.

China was the top merchandise exporter worldwide in 2022. China's merchandise exports increased dramatically in last 40 years. Chinese economy exported 14 billion USD worth of merchandise in 1979. This value increased 2.72 trillion USD in 2022. 14% of total world export has been made by China in 2022 (World Trade Organization, 2023). In other words, China's share in world's total export is 14%. Although China is exporting to the whole world, it has some major trading partners. European Union countries, South Korea, Japan Hong Kong, member of Association of Southeast Asian Nations (ASEAN), United States and Taiwan are major trading partners of China. Main export destinations for Chinese goods are EU countries, United States and ASEAN countries. Commodities exported by China are mostly labour intensive and low cost final products of which components of them are assembled in China. However, this situation is changing. Chinese economy is producing and exporting value-added products in many sectors in recent years (United States Congressional Research Service, 2019).

Globally, China's capital market is recognized as one of the largest. It enables allocation and management of funds for private and public companies as well as local and central government. Huge amount of foreign portfolio investments are attracted to the Chinese financial markets. Liberalization of interest rates, allowing foreign institutional investors access to domestic financial markets and financial institutions improved the capital markets a lot in China. China equities are major component of MSCI's Emerging Markets indexes. Around 40% of MSCI Emerging Market indexes are created by deployment of Chinese equities (Wang & Miao, 2022). Nevertheless, the banking sector remains the most influential component of China's financial system. The Shanghai Stock Exchange and the Shenzhen Stock Exchange are the two primary stock exchanges in China. Beginning with

2000s, number of stocks traded in those stock exchanges and capitalization of those stock exchanges increased dramatically (Hu, Jun, & Wang, 2020)

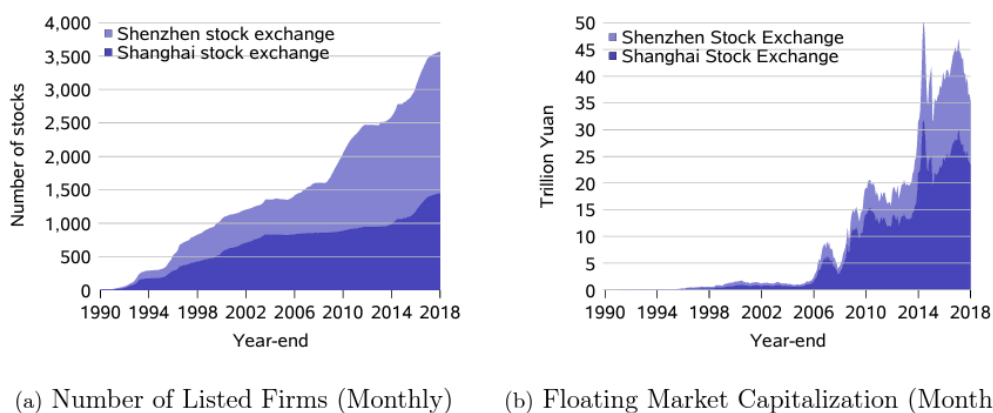


Figure 10: China Capital Markets

In addition, high volatility has been seen in Chinese stock markets in past three decades. Stock market volatility and turnover rates can be seen in the figure below. Equity markets of China show some specific features historically. The stock markets included a dual structure of floating and non-floating shares. Non-floating shares, as opposed to floating shares, were transacted at book value among government or semi-government institutions. Later on, legal reform has been made for non-floating shares and most of them have been converted to floating shares. Percentage of non-floating shares and their market capitalization declined significantly in last decades. However, there are still non-floating shares in the financial system of China (Hu, Jun, & Wang, 2020).

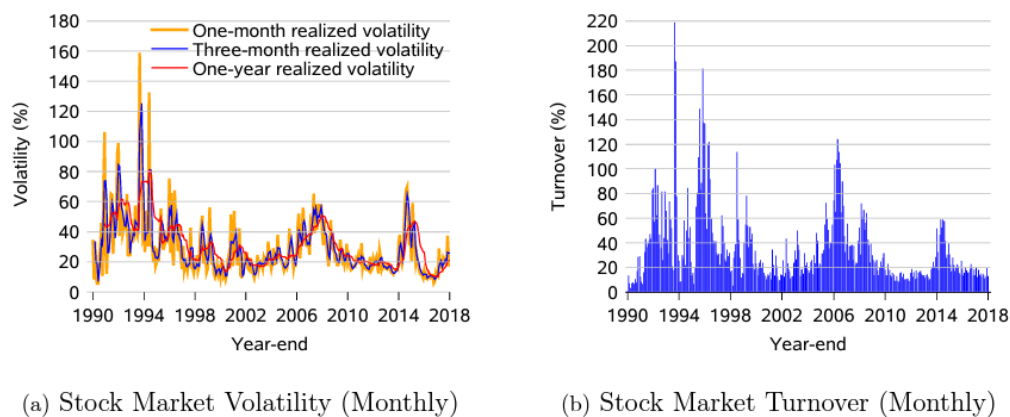


Figure 11: China Capital Markets' Volatility

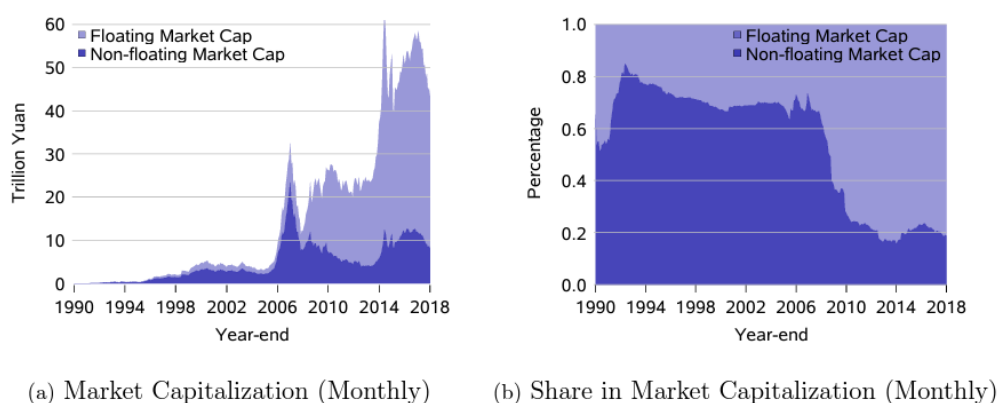


Figure 12: Floating and Non-Floating Market Shares in China's Stock Markets

Apart from two stock exchanges, China's financial system encompasses an interbank market alongside an over-the-counter market for commercial banks. In addition, many financial instruments such as treasury or corporate bonds, are traded on those markets. Every kind of investors such as medium and small size investors, security firms, fund institutions, insurance companies take place in the stock exchanges. Institutional investors, such as banks, fund management institutions, securities firms, and insurance companies, are actively involved in the interbank market. Individual investors and commercial banks make transactions in commercial bank OTC market. Yearly return of securities traded in these markets are provided in summary below (Hu, Jun, & Wang, 2020).

Table 9: Yearly Returns of Securities in China's Exchange Market

	1997-2018			2000-2018		
	Geometric Mean	Arithmetic Mean	Standard Deviation	Geometric Mean	Arithmetic Mean	Standard Deviation
Large Company						
Stocks	6.98	16.51	51.21	7.04	17.35	53.73
Small Company						
Stocks	16.21	30.52	68.69	12.49	28.39	73.56
Long-Term						
Enterprise Bonds	4.85	5.15	8.37	4.85	5.15	8.37
Long-Term						
Treasury Bonds	5.83	6.23	9.66	3.71	3.98	7.85
Medium-Term						
Treasury Bonds	5.44	5.60	5.97	4.10	4.20	4.80
Short-Term						
Treasury Bonds	3.40	3.42	1.98	2.96	2.98	1.66
Inflation	1.90	1.92	1.97	2.18	2.19	1.84

Part 2.17: India

India has shown speedy economic growth during last two decades like China. India has over 1.4 billion population which is driving force the economy. This fast and significant economic growth created middle income class in the economy, and poverty declined quite a lot. This economic growth and huge population made India an attractive place for portfolio and direct investments. Interest of many portfolio investors and multinational companies has been drawn to Indian markets. Therefore; in last decades significant amount of foreign direct investments have been made to India. Yearly foreign direct investment reached 85 billion USD which is new record for Indian economy in 2022. Foreign direct investment to manufacturing sector increased by 76% last year.

India has been affected negatively from Covid-19 pandemic like other developing countries. Economy has slowed down. However, it recovered fast after the outbreak. GDP increased significantly through expansionary monetary and fiscal policies. Inflation is around 7-8% for last years in Indian economy. Private consumption, investment and foreign direct investment have been source of fast economic growth after the outbreak. Electronic and digital sectors investment play critical role for this economic growth (SP Global, 2023).

Public debt of Indian government reached over 80% of GDP after the outbreak. Fiscal deficit is around 7-8% of GDP in last years. Currently, the current account deficit stands at about 1% of GDP, with expectations for it to rise in the future. Therefore, twin deficits are seen in Indian economy with a bit high of public debt. Main import goods of India are energy products such as coal and oil while main exports are manufactured products (International Monetary Fund, 2022).

Exchange rate stabilization is key for emerging economies. Although Indian Rupee has depreciated in last year, performance of it slightly better than other developing economies' currencies. Despite a recent decline in foreign portfolio investments linked to the Covid-19 pandemic, a recovery trend emerged in late 2022. Stock market indices has not performed well but its performance is better compared to other main emerging economies. 3 month, 1 year and 10 year government bond yields increased and got closer to each other (see Figure below).

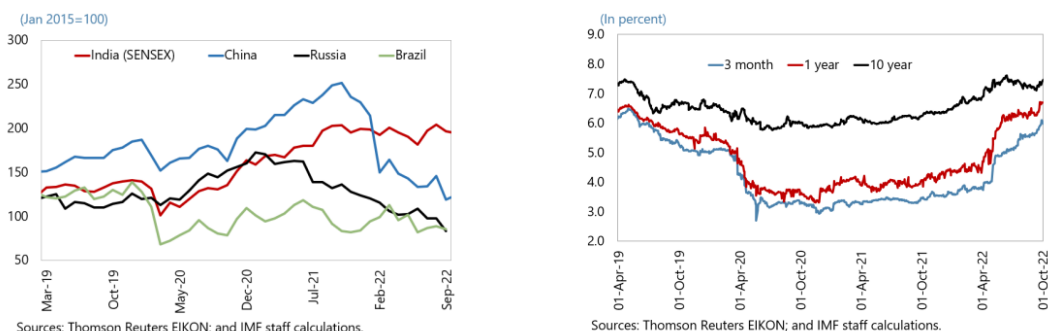


Figure 13: India Stock Market Indices and Government Bond Yields

Nonperforming assets in financial institutions remain high even though it declined recently. Nonperforming loans in public banks are higher than other financial institutions. Capital adequacy ratio improved in financial institutions (International Monetary Fund, 2022).

Although India is experiencing current account deficit, it is one of the major exporter and importer in the world. India engages primarily with Switzerland, Saudi Arabia, United Arab Emirates, China, the United States, and Hong Kong in trade. Main export products are refined petroleum, diamonds and jewellery, rice, cotton and pepper. Major import products are crude petroleum, coal, diamonds, and petroleum gas.

In short, due to its large population and substantial untapped potential, India's economy stands as one of the largest on a global scale. Nearly 7% of world output is manufactured by Indian economy. Share of service sector rose to near 50% while share of agriculture sector declined below 20% in the economy in recent years. Share of industry sector stayed steady and around 30% in last decades. One of the main source of growth is foreign direct investments and portfolio investment for Indian economy.

Part 2.18: Indonesia

Indonesia, boasting a population of 275 million, is recognized as one of the largest emerging markets in the world. It has diverse natural resources in different sectors such as agriculture, energy and mining. Contribution of tourism sector to GDP is high. Low labour cost provides competitiveness to Indonesian merchandise products. Large domestic market and investable grade given by rating agencies makes Indonesia attractive for investors

There is dominance of public companies or state-owned enterprises in Indonesian economy. This hinders potential of private sector. Compared to its counterparts in other emerging markets, Indonesia exhibits lower labour productivity (OECD, 2023). With 1.3 billion USD GDP, GDP per capita is nearly 5000 USD. Indonesia was 16th largest economy with respect to GDP in the world in 2021. Indonesia's major trading partners consist of the United States, India, China, Malaysia, Singapore, and Japan. Main export products are coal, palm oil, petroleum gas, steel and alloy. Indonesia is largest producer and exporter of palm oil, ferroalloys, stainless steel. On the other hand, major import products are electrical, electric equipment; plastic, organic chemicals, pharmaceuticals; machinery, nuclear reactors; motor vehicles and parts; mineral fuels, oils, distillation products.

Government budget is in deficit and it is around 3.4% of GDP in last years. Current account surplus is nearly 1% of GDP. Government gross debt is around 40% of GDP and the trend of decline is expected to carry on into the near future. The majority of public debt is held in the national currency. Maturity of the most of the debt instruments are long term which are more than 5 years. Headline inflation declined significantly in recent years and it is around 3% (OECD, 2022). Main contribution to GDP growth is coming from net exports and investments while private consumption is stable.

Debt securities are largely sold by foreign investors and outflow has been experienced in 2022 while equity inflows has been seen in order to offset the outflows. Foreign holdings of the government bonds decreased as well in recent years. In addition, stock prices' rise have slowed down in last year. Net international investment position in deficit although it slightly improves in recent years. Gross international reserves also declined in last year. Most of the government bonds are held by banks. Holding of Rupiah Government Bonds of nonbank financial institutions and Bank Indonesia increased significantly recently. Foreign exchange market is not deep enough. Foreign exchange market turnover in Indonesia is composed of 0.4% of total global foreign exchange market turnover (International Monetary Fund, 2023).

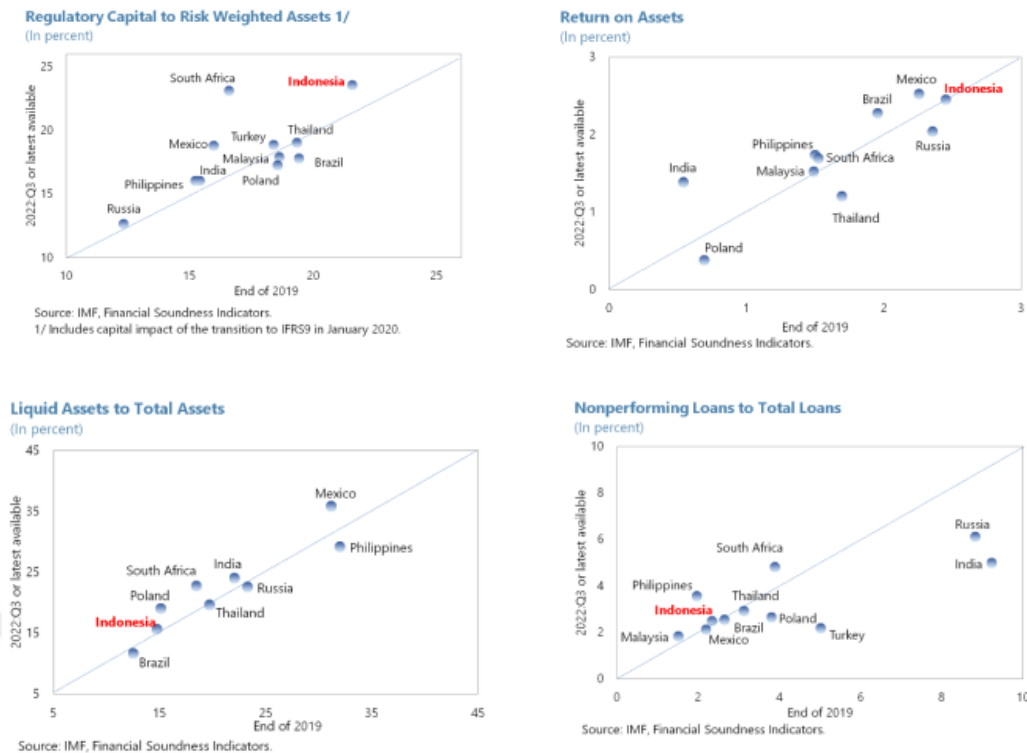


Figure 14: Indonesia Financial Indicators

Banking sector protects its strong stance. Capital adequacy is high enough especially compared to the emerging market peers. Similarly, return on assets in banking sector remain high. Liquidity is ample although amount of nonperforming loans have slightly risen (International Monetary Fund, 2023).

Part 2.19: South Korea

South Korea is one of the foremost economies globally, recognized within the emerging market segment. It has around 33,000 USD per capita GDP and this puts South Korea in high income country status. South Korea succeed to reach high level of GDP and per capita GDP vary fast within narrow span of time. South Korea is a success story in terms of sustainable real GDP growth which is around 6% in last four decades for many researchers. The country achieved this high and sustainable real growth by concentrating and depending on exports of high technology products such as electronic goods and telecommunications equipment. The country continues to make investment on consumer electronics, nuclear technology, biotechnology, internet of things, smart grid technology and

similar technological areas for protecting competitiveness and economic growth. South Korea is largest manufacturer of semiconductors in the world (The Hong Kong Trade Development Council, 2023).

South Korea is poor with respect to having fertile lands, therefore South Korea has a negligible share of agriculture in its economic composition. Share of agriculture in the Korean economy is nearly 2% while share of industry is 35.6% and service sector accounts for 62.4% of the economy. In addition, South Korea is also poor with respect to having mining and mineral resources. The country has sustainable economic growth for a long time. Inflation is moderate. Unemployment rate is around 3%. Current account creates surplus for many decades as well. Exports are nearly accounting for 40% of GDP in Korean economy. Public debt is around 55% of GDP, it is under 60% and well suited to Maastricht criteria. Budget deficit is a bit over 3% of GDP.

Main export products electrical machinery and equipment, vehicles, mechanical appliances and plastics while main import products are mineral fuels, mineral oils, electrical machinery parts. In other words, South Korea mainly exports semiconductor, chemical, car and machinery and imports intermediary goods. In terms of trade, South Korea is primarily engaged with Japan, the United States, Hong Kong, China, Vietnam, Saudi Arabia, and Australia.

South Korea has a diversified economy with being one of the largest producers of high-end electronics in the world. The country seeks to protect its competitive position by high amount of research and development spending. Foreign direct investment outflow is bigger than inflow and it is well diversified in Asia. These are strengths of Korean economy. On the other hand, fierce competition with China in many areas such as electronics, automotive and shipbuilding create risks for the economy. High level of household debt, aging population, geopolitical tensions are other risks to the economy. Although the private sector plays a crucial role, South Korea's economy is notably skewed towards large, family-run conglomerates with strong links to government institutions (COFACE, 2023).

Although financial risks increased in Korean market in recent years, systematic risks are on manageable level due to high capital buffer, tight macro prudential conditions, and quick monetary policy reactions. Financial liabilities of corporations declined, corporate debt to GDP ratios is stable and moderate. Although household debt is increasing, household debt

to GDP ratio is slightly rising. Lastly household financial liabilities to assets ratio is stable in last years.

Korean corporate bond yields declined in recent years compared to the peers while government bond yield stayed stable and in line with its peers. Stock index of the economy stayed high compared to the peers while high volatility in exchange rate compared to the peers has been observed. Liquidity coverage ratio, liquid assets to short term liabilities ratio, regulator capital to risk-weighted assets ratio are close to the average of its peers. Foreign portfolio investment is much more coming as debt form rather than equity investment. Foreign exchange reserves are high enough even though it decreased in last year (International Monetary Fund, 2023).

Part 2.20: Malaysia

Malaysia has 32.7 million population and per capita GDP of the country is around 12500 USD. Malaysia has export oriented growing strategy and openness to trade and foreign direct investments is really high. Significant amount of GDP is created through exports of goods and services and this shows how Malaysian economy is depending on exports. Economic benefits derived from the country's extensive natural resources are prominently seen in its oil and gas export activities. In addition, strategic location of Malaysia makes it attractive for foreign direct investments. Rather than natural resources, Malaysia has significant amount merchandise export. Moreover, tourism revenues, high domestic demand and being manufacturer and supplier of ICT products such as semiconductors, electronic devices drag sustainable and strong economic growth in Malaysia. Having good infrastructure for manufacturing and ICT sector, high amount of natural resources, skilled human resources, high domestic demand and strategic location of the country makes Malaysia attractive for foreign direct investments. Foreign direct investment was about 12.5 billion USD in 20221 (U.S. Department of State, 2024).

Major trading partners of Malaysia are Singapore, China, United States of America, European Countries and Japan. Trade made with Singapore and China holds nearly one-third of total trade. Agricultural products, electronic products, mining and oil and gas are main exports of the country. Country provides sustainable current account surplus for many years. Diversified exports, high domestic demand, ICT and R&D infrastructure, developing local financial market and high and sustainable foreign direct investments, exchange rate

flexibility are main strengths of Malaysian economy. Lack of national government's budget discipline, very high household debts which is around 80% of GDP as of December 2022, dependency on imported foods are weaknesses of Malaysian economy (Coface, 2024).

State-owned banks dominate banking industry in Malaysia. State-owned banks hold $\frac{3}{4}$ of total banking sector loans. Although high household indebtedness is a significant risk for the sector, capital adequacy and loss coverage ratio, liquidity rate are high enough in banking sector. This shows how Malaysia has a healthy banking sector. In addition, Islamic banking is very developed and actively used in Malaysia. Corporate bond market in Malaysia is highly large and East Asia's largest Islamic bond – Sukuk market takes Place in Malaysia. Tax incentives are provided by Malaysian government for foreign investors and companies which issue Islamic bonds and financial instruments (U.S. Department of State, 2024). Stock market volatility is high in Malaysia while exchange rate stability is nearly ensured (see Figure below). Banks credit to private sector declined while loan to household increased. In addition; short term external debt become main financial source for Malaysian banks (International Monetary Fund, 2023)

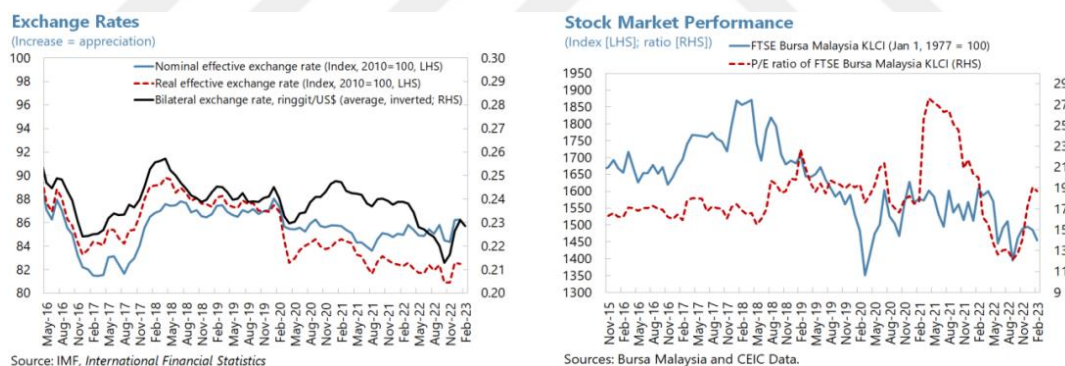


Figure 15: Malaysia Stock Market Performance and Exchange Rate Volatility

Part 2.21: Philippines

Philippines has over 115 million population and around 400 billion USD GDP. Compared to the global and regional average, GDP and per capita GDP is lower. Service sector dominates GDP and private consumption accounts for 75% of GDP. Manufacturing industry dominates exports. 80% of total exports are made up of manufacturing products. Ores & metals and food products are other industries that contribute exports. Same industries

also play vital role for imported products. Total exports are worth 79 billion USD while total imports are 137 billion USD in 2022. Therefore, current account deficit sustains for many years in the country. The primary trading counterparts include China, Singapore, the United States, Korea, Indonesia, Japan, and Hong Kong. In addition, fiscal debt is also in deficit position in last decades. Inflation and unemployment rates are stable and low while public debt remains at reasonable level which is around 60% of GDP (International Monetary Fund, 2023).

Philippine Stock Exchange is only stock market of the country. The PSE Composite Index or PSEi is an index which is composed of most liquid and actively traded 30 largest stocks which are chosen according to the liquidity, market capitalisation criteria. Corporate bond issuing nearly reached 10 billion USD in 2022 while initial public offerings were worth of 2 billion USD in the same year. Banking sector protects its stance and strong position in financial activity and the sector is healthy with respect to capital adequacy ratio, amount of non-performing loans. Capital adequacy ratio is over 8% which is well above international standards while amount of non-performing loans is around 3.6% in total loans in 2022. The country is attracting significant amount of foreign direct investment. Net FDI inflow is higher than investments outflow. FDI inflow is around 10 billion USD yearly (Coface, 2024).

In short; Philippines has significant economic and financial potential with young population. However, low level of budget disciplines, dependency on energy and capital goods causing trade deficit and high level of income inequality hinders economic potential to be realized (Hong Kong Trade Development Council , 2023)..

Part 2.22: Taiwan

Taiwan is a rich country with high amount of GDP and per capita GDP which is around 34,000 USD. Service sector dominates the economy as it is usual. GDP is around 800 billion USD. Taiwan has population around 24 million. External trade plays critical and important role for the economy. Taiwan economy's dependency on exports is significantly high. Total external trade size is higher than its GDP. Research and development activities play significant role as well in Taiwan economy. Foreign direct investment inflow creates significant amount of fund for the economy. In short; Taiwan economy is open and liberal economy with sustainable growth, stable and low level of inflation and unemployment rates (Hong Kong Trade Development Council, 2022).

As it is stated above, Taiwan has an export dependent economy and the country is creating sustainable current account surplus in last decades. Major export products of Taiwan are machinery and telecommunication equipment. Those products are also major import goods. This shows how Taiwan economy creates value added. Taiwan's key and foremost trading partners consist of Hong Kong, Singapore, China, Japan and United States. Taiwan is a major global hub for electronic goods production. ICT products especially semiconductors play vital role for export and economy. There is significant support to research and development activities dedicated to electronics through public authorities in order to incentivize production of consumer electronics. However, this concentration on technology and electronics also creates risk of less diversification in the economy. In addition, dependency on external trade makes economy vulnerable to external shocks. On the other hand, this high amount of export creates strong financial position for Taiwan. Although budget balance is slightly deficit position, level of public debt is very low which is around 25% of GDP thanks to external position and diversified FDI portfolio (Coface, 2024).

Financial sector holds it strong stance amid global problems. Banking sector has strong capital adequacy and liquidity is high. Loan growth is stable. Non-performing loan level is really low it is under 1% for a long time. Capital adequacy ratio is nearly 15% in 2022 and it is well above international standards. In addition, banks' liquidity coverage ratio is around 135% and it is above 100% which is recommended ratio by Basel III Criteria. Return on average assets (ROAA) improved after the decline due to unfavourable stock market conditions and it is around 2.5%. Leverage ratio in securities sector is close 3.6x and risk-adjusted capital ratio is nearly 14%. Foreign ownership is high in portfolio investments in Taiwan. Nearly 40% of total portfolio investment is made through foreign investors in Taiwan Stock Exchange (TWSE) and Taipei Stock Exchange. Total trading value of nearly one thousand stocks traded in Taiwan Stock Exchange reached 2 trillion USD in 2022. Turnover ratio was 110.4% in the same year (S&P Global Ratings, 2023) In short; Taiwan is an open and liberal economy with highly skilled human resource and strong economic and financial position. It is centre of attraction with respect to economic conditions.

Part 2.23: Thailand

Thailand with a 70 million population creates over 500 billion USD GDP per year. Per capita GDP is around 7300 USD. Service sector dominates economy. Industry and agriculture are following sectors in terms of size. Another important sector for Thailand is tourism. Nearly 20% of GDP is created through tourism sector. With respect to economic volume, Thailand comes in 2nd place among ASEAN countries. The country is exporting agricultural products including rice. This is significant source of international reserves. Current account balance is usually providing surplus even though it is in deficit position in last years. Major trading partners of Thailand is United States, China, Japan, Vietnam, Malaysia and Taiwan (Hong Kong Trade Development Council, 2022).

Budget disciplinary is not provided in last years, fiscal deficit widen due to increasing spending. Although public debt is at reasonable level, which is around 60%, it is sharply increasing in recent years. Due to deterioration in global supply chains, inflation increased significantly in recent years although unemployment rates continue at reasonable level. Due to fiscal and monetary expansionary policies, corporate loans and corporate debts increased substantially in recent years. However, capitalization of commercial banks in Thailand is well enough and risk weighted assets is around 15% of total capital. Liquidity assets are enough to cover short-term liabilities in banking sector. Loan to deposit ratio was around 100% and it remains high. Amount of non-performing loans in total loans remains low, which is close to 3%. Profitability and return on assets are at reasonable level in the banking sector in Thailand. Net foreign direct investment in deficit position in Thailand (International Monetary Fund, 2022).

To summarize; Thailand has strategic economic location due to proximity to Asian markets. It has abundant agricultural resources such as natural rubber, rice, sugar cane. Thailand exports are well diversified from tourism to machinery, vehicles, electronic components and agricultural commodities. Strong and healthy banking industry is another economic advantage of Thailand. However high household debts rises as a risk to Thailand financial system (Coface, 2024).

PART 3: LITERATURE ON HEDGING CAPABILITY OF CRYPTOCURRENCIES

Financial markets has grown and deepened and many different kind of financial instruments emerged in last decades. Due to economic and political crises/shocks and increasing volume and value of financial instruments, major variations and deviations in prices have been observed in those grown financial markets and financial instruments. Therefore, risk of financial instruments have risen and this created need of risk aversion for investors. In order to fulfil need of risk aversion, hedging products or safe-haven financial commodities have been recommend by financial consultants, analysts and media. One of the prominent and popular hedging or safe-haven financial instrument recommended by financial media is gold. It is argued that gold has more than 5.000 years of history; it serves as hedge at least against inflation. There is extensive research on the financial role of gold and its interconnections with other financial instruments in order to test whether gold really play the role attributed to it in finance. There are many articles on arguing whether gold is hedging asset or safe-haven. However, one popular study on hedging capability of gold in the literature stands out from others with respect to creating theoretical framework and definitions.

Baur & Lucey (2010) investigates function of gold if it is a hedge or safe haven by distinguishing average and extreme shocks. In this study, Baur & Lucey (2010) defines three terms, which are “hedge”, “diversifier”, “safe haven” in terms of finance as follows. “A **hedge** is defined as an asset that is uncorrelated or negatively correlated with another asset or portfolio on average”. This definition implies that a hedge may not always effectively reduce losses during periods of market stress or financial turmoil because it could show a positive correlation. However, on average (times that there is no shock or stress in the market) it is expected hedge asset to unccorrelate or negatively correlate with other assets. “A **diversifier** is defined as an asset that is positively (but not perfectly correlated) with another asset or portfolio on average”. This means diversifier cannot prevent losses in adverse market conditions. In usual market scenarios, an asset functioning as a diversifier is prone to exhibit a positive correlation with other assets. A **safe haven** is defined as an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil. Safe haven needs negative correlation or no correlation under extreme unfavourable market scenarios while normal market conditions do not require the correlation to be inherently positive, negative, or neutral. In essence, a safe haven asset should either be

negatively correlated or have no correlation with other assets in extreme market scenarios, but it might have a positive, negative, or zero correlation in average market conditions. An asset that displays a negative correlation with other assets or portfolios during a market collapse can be regarded as a robust safe haven. On the other hand, if the asset remains uncorrelated with other assets or portfolios during such extreme conditions, it is likely to be a less effective safe haven. (Baur & McDermott, 2010). Therefore, safe haven assets protect investor for its losses in extreme market conditions.

In this study, terms “hedge”, “diversifier” and “safe haven” refers to definitions stated above. In other words, this study will stick to Baur & Lucey’s definitions in this manner. In our study, we will seek role of gold whether it is hedge or safe haven asset rather than being diversifier asset. Cryptocurrencies are decentralized, they do not have physical value and they cannot be controlled by a central authority. In addition, it can be divided infinitely; its worth is not tied to conventional assets or the operational performance of a firm or economic conditions. This makes cryptocurrencies attractive as an alternative hedging or safe haven asset in eye of investors and researchers. This study will observe whether cryptocurrencies is able to fulfil this hedging or safe haven role attributed to them by investors.

Cryptocurrencies stand out from other financial assets, offering unique opportunities for investors in risk management and portfolio analysis. Given that cryptocurrencies are not yet fully understood by market participants, it is crucial to assess their potential across various financial dimensions. To our best knowledge, the ability of cryptocurrencies to serve as hedges and safe havens for emerging stock markets has not been explored in existing literature. In this study, hedging or safe haven capabilities of cryptocurrencies against stocks in emerging stock markets will be investigated. However, there are many studies scrutinizing relationship between major cryptocurrencies with stock indices in literature. Most of researches concentrate on correlation between Bitcoin-Ethereum and some stock indices such as S&P500, MSCI World Index, and DAX30 etc. However, we could not find any single study observing hedging or safe haven role of altogether major cryptocurrencies with comprehensive, holistic and detailed approach for emerging 24 countries. The objective of this research is to examine new possibilities for diversifying portfolios and mitigating risk by incorporating cryptocurrencies. In this part of the study, all studies observing relationship and correlation between cryptocurrencies and stock markets will be provided below in details. Summary of the studies will be given in table below as well. First, studies, which

find cryptocurrencies as effective hedge, safe haven, or diversifier after analysis, will be summarized. Later on, studies, which detect cryptocurrencies ineffective as hedge, safe haven or diversifier asset, will be provided.

To begin with, Dyhrberg (2016) observes hedging capability of Bitcoin. The author scrutinizes correlation between Financial Times Stock Exchange (FTSE) Index and Bitcoin by applying asymmetric Generalized Autoregressive Conditional Heteroscedasticity (GARCH) method. The analysis covers 19th of July 2010 to 22nd of May 2015 period and daily data is used. Dyhrberg concludes that Bitcoin can behave as virtual gold. Bitcoin could play role of hedge instrument against FTSE Index (Dyhrberg, 2016).

Osman et al. (2023) concentrates on diversification benefits of crypto markets. The authors employ GARCH model and use Vine copulas for application of conditional value at risk (CVaR) optimization approach. The study covers 03 October 2017 to 25 October 2021 period. Stock indices used in the study are The Toronto Stock Exchange Composite Index (TSX), the Dow Jones Industrial Average Index (DJI), the S&P 500 Index (SPX), the Nasdaq Composite Index (IXIC), and the Financial Times Stock Exchange 100 Index (FTSE 100). Study creates two portfolios. One of them include Bitcoin while other incorporates Bitcoin and Ethereum. Authors determine that Bitcoin and Ethereum have role of hedge asset for Dow Jones while they exhibit weak hedge property for Canadian stock market, NASDAQ and S&P500. Cryptocurrencies shows weak hedge or safe haven for financial stock markets. Additionally, adding Ethereum to portfolios that already include Bitcoin does not lead to an improvement in returns (Osman, Galariotis, Guesmi, Hamdi, & Naoui, 2023).

In another study, the focus is on Bitcoin's ability to act as a hedge, safe haven, or diversifier for five countries: Japan, Venezuela, China, Estonia, and Sweden. The analysis includes the Shanghai Composite Index (SHC), OMX Tallinn Index (OMXT), Venezuela Stock Exchange General Index (IBVC), OMX Stockholm 30 Index (OMXS30) and Nikkei 225 (NKX). Stochastic Volatility Model with the Dynamic Conditional Correlation is used as an analysis method in the study. Bitcoin prices in local currencies are used in the analysis as well as US dollar price of Bitcoin. The study is made for the period 2014-2017 by employing daily price data. The authors conclude that Bitcoin is a safe haven asset for Venezuela when investment is made through local currency bolivars. Bitcoin exhibited diversifier property for China and Japan when investment is made by local currency. When investment is made by using USD, Bitcoin shows weak hedge property for all financial markets in the analysis (Kliber, Marszałek, Musiałkowska, & Świerczyńska, 2019)

Stensås et al. (2019) observes association between Bitcoin and seven developed and six developing markets by using GARCH Dynamic Conditional Correlation (DCC) model. The study cover the period 13 September 2011 to 1 January 2018. Daily data have been used in the study. S&PTSX 60, IBRX, MSCI Zimbabwe, Nikkei 225, FTSE MIB, CAC 40, MICEX 10, DAX 30, NIFTY 50, Shanghai A-Share, KOSPI, FTSE 100, S&P 500indexes have been employed as a proxy for developed and developing markets. In addition; Asia, BRIC, Pacific, MSCI World, and European Indexes have been used in the study. Merrill Lynch Commodity Index Extra (MLCX) Agriculture, Standard & Poor's Goldman Sachs (SPGS), MLCX Energy and World Commodity Index, London Metal Exchange (LME) have been used as proxies for commodities. In short; G7 developed stock markets, BRIC and South Korea and Zimbabwe stock markets have been analysed in the study. The authors investigated whether Bitcoin functions as a hedge, safe haven, or diversifier for the aforementioned countries. They concluded that Bitcoin behaves as hedge asset for emerging markets like South Korea, India, Russia and Brazil. On the other hand, it can be only diversifier for developed markets and commodities. Additionally, Bitcoin demonstrates safe haven characteristics across both emerging and developed markets (Stensås, Nygaard, Kyaw, & Treepongkaruna, 2019).

Shahzad et al. (2019) assess whether Bitcoin functions as a safe haven asset in relation to stock markets by using cross-quantilogram technique. The study covers 19 July 2010 to 22 February 2018 period. Daily data is employed in the study. MSCI World, MSCI Developed, S&P Goldman Sachs Commodity Index (S&P GSCI), MSCI Emerging Markets, MSCI US indexes and MSCI China are used as proxies in the research. The analysis focuses on Bitcoin's potential as a safe haven. This means that how Bitcoin contributes to portfolio in extreme market conditions or market crashes. The authors suggest that Bitcoin might function as a weak safe haven asset for both the global stock market index and the Chinese stock market. For developing markets, commodities, and US investors, the results of the study indicate that Bitcoin does not qualify as a safe haven asset. The study suggests that the limited correlation between Bitcoin and stock markets is a result of the disparate nature of investors in each market. Stock market investors are still hesitating to invest on Bitcoin due to different legal issues (Shahzad, Bouri, Roubaud, Kristoufek, & Lucey, 2019).

Pengfei et al. (2019) analysed cryptocurrencies with a comprehensive and dynamic approach. They analysed connection between cryptocurrencies and stock indices by employing 973 cryptocurrencies and 30 different international stock indices. The study used

cryptocurrencies, which are traded more than 10 months. Daily data have been employed in the study beginning from 28 April 2013 to ending 30 November 2018. Dynamic Conditional Correlation Generalized Autoregressive Conditional Heteroscedasticity (DCC – GARCH) model has been used in the analysis. General conclusion obtained from the study is that cryptocurrencies could be utilized as safe haven assets for stock markets. However, Bitcoin is not a hedge instrument against international stock indices. Moreover, Cryptocurrencies may function as a safe haven asset mostly for developed markets and markets with high capitalization and liquidity (Pengfei, Wei, Xiao, & Dehua, 2019).

Bouri et al. (2020) explored the safe haven attributes of stock markets, comparing them with gold and commodities by employing wavelet coherency approach. The study have used daily data starting from 20 July 2010 to 22 February 2018. MSCI stock market indices of world, developed, and emerging markets, China, and the USA have been used as proxies for stock market. The study finds that the connection between Bitcoin and stock markets is tenuous. However, Bitcoin is better diversifier for stocks than gold and commodities. In addition, Bitcoin behaves as safe haven asset for analysed stock markets. In other words, Bitcoin's safe haven property surpasses gold's safe haven role (Bouri, Shahzad, Roubaud, Kristoufek, & Lucey, 2020).

Bouri et al. (2020) questions hedge and safe haven property of cryptocurrencies for US stock markets in another study. Eight cryptocurrencies, which are namely Ether, Ripple, Monero, Bitcoin, Litecoin, Stellar, Dash, and Nem and S&P500 and its 10 equity sectors, are employed in order to analyze hedging capability of cryptocurrencies. The study employed daily data spanning from August 7, 2015, to May 4, 2018. Log returns of daily data have been used in the study. Cross-quantilogram approach have been selected to conduct the study. Authors conclude that Stellar, Bitcoin and Ripple act as safe haven asset for US stock market and equity sectors. However, Litecoin and Monero behave as safe haven asset against US stock market aggregate index. Ethereum, Dash and Nem exhibit hedging property for some equity sectors (Bouri, Shahzad, & Roubaud, 2020).

The study by Diniz-Kini et al. (2021) explored Bitcoin's safe haven potential during the COVID-19 pandemic over a short timeframe of four months. The study questioned correlation between Bitcoin and MSCI world index after the World Health Organization officially announced COVID-19 as a global pandemic. The study compared Bitcoin with gold, US dollar with respect to being safe haven asset or not. 11 March 2020 – 10 July 2020 period was analyze period. Multifractal Detrended Fluctuation Analysis (MF-DFA) has been

used price efficiency of Bitcoin while Detrended Partial Cross-Correlation Analysis (DPCCA) has been employed for correlation among time series. The authors determine that Bitcoin's effectiveness as a safe haven asset becomes evident for durations exceeding three months (Diniz-Maganini, Diniz, & Rasheed, 2021).

Będowska-Sójka & Kliber (2021) analyze safe haven property of Bitcoin, Ether and gold for different market shocks and crashes. The study uses daily returns of four stock indices namely S&P500, DAX, FTSE250, and STOXX Europe 600 Index along with Bitcoin, Ether and gold. The period of study is between August 10, 2015 and April 24, 2020. Bayesian Dynamic Conditional Correlation Multivariate Stochastic Volatility (DCC-MSV) model has been employed in the study for detecting dynamic correlations. Authors researched safe haven property of the analyzed cryptocurrencies during several extreme market conditions, which are Chinese stock market shocks 2015-2016, Brexit Referendum 2016, Sino-American trade tensions in August 2018, International Sanctions on Iran in November 2018 and Covid-19 pandemic. The study concludes that gold behaves as safe haven asset for the analyzed period except Covid-19 pandemic. However, Bitcoin and Ether acted as weak safe haven asset against analyzed stock market indices.

Mariana et al. (2021) questions safe have property of two main cryptocurrencies that Bitcoin and Ethereum during popular stock market crash Covid-19 outbreak. The analyze covers short-term period, from July 1, 2019, until April 6, 2020. GARCH Dynamic Conditional Correlation (DCC) methodology has been employed in order to detect dynamic correlation between S&P500 and cryptocurrencies. The authors asserted Bitcoin and Ethereum could behave as safe haven for the analyzed stock market at the end of the study (Mariana, Ekaputra, & Husodo, 2021).

Kliber (2022) analyzed safe haven properties of cryptocurrencies for US stock markets. The study covers March 2020–May 2022 period. DeFi and CeFi coins, which are Dai, Tether and USDC respectively, Bitcoin and Ethereum, have been used as proxies for cryptocurrencies. Proxy for US stock markets is S&P500. The study analyzed correlation between S&P500 and cryptocurrencies. The study has been conducted through quantile coherency approach. Estimation has been made for quantile coherency between the residuals from univariate GARCH models. Models include S&P500 and assumed safe haven cryptocurrencies. As a result, authors asserted that stable coins could act as safe haven asset for US stock markets.

Bouri et al. (2017) analyzed Bitcoin whether it shows hedge or safe haven property against stock indices, bonds, oil, gold and commodity index. S&P 500, FTSE 100, DAX 30, Nikkei 225 and Shanghai A-share, MSCI European, MSCI Asia Pacific, Standard & Poor's Goldman Sachs (SPGS) Commodity Index, Pimco Investment Grade Corporate Bond Index Exchange-Traded Fund have been used as proxies for variables stated above. Daily and weekly data have been employed. Bivariate DCC model has been for estimation of relationship between variables. According to the result of this study, Bitcoin can exhibit diversifier property for most of stock indices and financial assets while it behaves as safe haven asset only for Asian stock markets for a limited time horizon (Bouri, Molnár, Azzi, Roubaud, & Hagfors, 2017).

Jeribi et al. (2021) analyzed safe haven properties of five major cryptocurrencies, which namely are Bitcoin, Ethereum, Dash, Monero, and Ripple. Covid-19 pandemic process has been scrutinized. 31 January 2020 to 17 September 2020 period is investigated by authors through comparing 1 January 2016 to 30 January 2020 period. BVSP of Brazil, RTSI of Russia, BSE Sensex 30 of India, SSE of China, and JSE 40 of South Africa indices have been used as proxies for emerging markets. The study has analyzed dynamic correlation between cryptocurrencies and emerging market indices stated above through Nonlinear Autoregressive Distributed Lag (NARDL) methodology. All major five cryptocurrencies in the study is proven that they could serve as safe haven asset for Brazil, China and Russian stock markets during the pandemic (Jeribi, Jena, & Lahiani, 2021). However, in another study conducted by same main author, Jeribi, Chamsa, & Manzlı (2021) on safe haven properties of cryptocurrency for BRICS and GCC countries through OLS regression model, it is detected that major two cryptocurrencies, which are Bitcoin and Ethereum, are not suitable for being safe haven asset for Russia, Brazil, Abu-Dhabi, Bahrain, and Qatar. They can behave as diversifier or hedge asset for these countries.

Shahzad et al. (2020) studied hedging and diversifying capability of Bitcoin for developed stock markets, G7 countries. The authors compared and contrasted gold and Bitcoin whether they are safe haven, hedge or diversifier. In other words, correlation among stock market indices of G7 countries, MSCI G7 index and Bitcoin and Gold have been investigated through AGDCC-GARCH model for period of 20 July 2010 to 31 December 2018. Empirical results exhibit that is a more effective safe haven, hedge, and diversification asset than Bitcoin for developed stock markets. Bitcoin shows strong safe haven property

for only Canada stock market. For other developed countries in the analysis, Bitcoin exhibits weak safe haven or hedge properties (Shahzad, Bouri, Roubaud, & Kristoufek, 2020).

Another study compared and contrasted safe haven characteristics of gold and bitcoin during Covid-19 pandemic for six stock market indices namely DJIA, CAC40, NSE50, S&P 500, NASDAQ, and EUROSTOXX for the period of January 2015 to end of 2020. Kumar & Padakandla (2022) adopted wavelet quantile correlation approach in this study to exhibit interrelation between Bitcoin and stock markets. Authors concluded that Bitcoin can behave as safe haven asset for NASDAQ, EUROSTOXX and NSE50 stock market indices while it cannot be evaluated as safe haven for S&P500. In addition; Bitcoin can also act as diversifier for stock market indices stated above although its effectiveness and needed time period vary across different stock markets. However, Gold outperforms Bitcoin as a safe haven asset in all stock markets.

Another study in this manner has been conducted in the framework of modern portfolio analysis. Ma et al. (2020) studied on portfolio optimization through adding five major cryptocurrencies on four traditional asset portfolios. Then, return and variance of portfolios have been recalculated. The study covered period of November 2015 to November 2019 and daily data has been used. Performance of portfolios have been calculated according to three methods which are Naïve portfolio equalizing weights of assets in the basket, Markowitz Mean-Variance portfolio calculating return for per variance and Optimized Sharpe ratio. Five major cryptocurrencies which are used in this study are Bitcoin, Ethereum, Ripple, Bitcoin Cash, and Litecoin. Empirical evidence showed that portfolios containing cryptocurrencies achieve better performance than portfolios lacking them. Adding cryptocurrencies to portfolios increased return of portfolios while decreasing variance and risk of the portfolios. This results exhibit that cryptocurrencies are good diversifiers for asset portfolios (Ma, Ahmad, Liu, & Wang, 2020).

Baur et al. (2018) questions characteristics of cryptocurrencies by concentrating on Bitcoin. The authors discuss whether cryptocurrencies fulfil properties of fiat and commodity currency or not. Relationship between Bitcoin and S&P500, S&P600, Gold, Silver, Bloomberg US Corporate Bond Index, Bloomberg US Treasury Bond Index, Bloomberg USD High Yield Corporate Bond Index, Exchange Rates, Energy Prices, US Weighted Dollar Index are scrutinized. Return of Bitcoin is compared with other financial assets stated above. Daily data is used for the period of July 2010 to June 2015 in the study. Ordinary least squares method is employed in the study and covariance matrix is created.

Correlations among them are analyzed in the study. The study mainly asserts that Bitcoin has significant correlation with S&P500 and S&P600 stock indices and high-yield corporate bonds. Other remaining 13 variables employed in the study does not exhibit significant correlation with Bitcoin. Therefore, for many financial assets including currencies, Bitcoin can serve as a safe haven asset for normal and extreme conditions in financial markets. However, due to limited usage and lack of traditional properties, Bitcoin cannot be used as a medium of exchange. Bitcoin can a speculative asset in portfolios and it can be used as investment tool (Baur, Hong, & Lee).

Eisl et al. (2015) observes contribution of Bitcoin to portfolio diversification for period of July 2010 to April 2015. The authors questions whether Bitcoin makes better off an already well well-diversified portfolio or not. Conditional Value-at-Risk is preferred as an analysis methodology because Bitcoin's returns are not normally distributed. Portfolios are created through traditional financial assets in U.S financial markets. Portfolios cover different stock indices, money market and commodity market instruments, fixed income financial instruments and real estates. Sample are composed of 57 monthly data of Bitcoin. Authors conclude that Bitcoin significantly contributes to portfolios with respect to diversification and return. Sometimes, it raises variance of portfolio but it increases potential gains as well (Eisl, Gasser, & Weinmayer, 2015).

Anyfantaki et al. (2018) observed whether cryptocurrencies can provide diversification to portfolios which are created by traditional financial assets. Authors created portfolios including and not including cryptocurrencies by assigning stochastic spanning methodology. S&P 500 Total Return Index, the Barclays U.S. Aggregate Bond Index and the one-month Libor rate are used in order to represent traditional financial assets. Bitcoin, Ethereum, Ripple and Litecoin US dollar prices are representative of cryptocurrencies. Daily and weekly data are assigned in the analysis. July 2015 to December 2017 has been defined as analysis period. Empirical results exhibit that portfolios including cryptocurrencies are better diversified with respect to risk and return (Anyfantaki, Arvanitis, & Topaloglou, 2018)

Okoroafor & Leirvik (2023) observes safe haven and hedge characteristics of Bitcoin and gold in different markets where those markets operate in inefficient conditions. The study concentrates on Japan, China, US, Europe and emerging markets. The study uses daily prices of variables. Bitcoin, SPDR gold Exchange Traded fund (gld), iShares MSCI Japan (ewj), iShares China Large-Cap ETF (fxi), SPDR S&P500 (spy), Vanguard FTSE Europe (vgk) and Vanguard FTSE Emerging markets (vwo) are used as variables in the study.

Logarithmic prices of variables have been employed in the study. The study covers period of December 2007, through February 2023 except Bitcoin due to availability of data. Bitcoin price data is starting from September 2014. Pearson correlation test has been used in the analysis. Time-Varying Autoregressive model and Adjusted Market inefficiency Measure have been used in order to measure market efficiency in the study. The authors determine that Bitcoin could serve as hedge asset for inefficient markets. This means that Bitcoin could play role of hedge asset in extreme market conditions for analyzed inefficient markets or time markets operate inefficiently.

Another study observes whether Bitcoin could serve as safe haven or diversifier asset for portfolios during Covid-19 pandemic for crude oil US markets. US West Texas Intermediate (WTI) price and Brent Price has been used as proxy for US oil markets. DCC-GARCH model has been employed as analysis method. The analysis period covers December 2014 to March 2020 time span and daily data were utilized in the research. The authors find that Bitcoin fails to behave as a safe haven for oil markets while it can be evaluated as only diversifier for those markets Dutta et al. (2020).

Belhassine & Karamti (2021) examines association between Bitcoin and Chinese stock market. The authors applied bivariate DCC-GARCH model by using daily data for period 2018-2021. Empirical findings of the study has shown that Bitcoin can behave as safe haven asset for Shanghai Stock Exchange for extreme market conditions.

Brière et al. (2015) analysed diversification property of Bitcoin over July 2010-December 2013 period by employing weekly data for US stock markets and alternative investments such as hedge funds, real estate, commodities etc. Euro, Japanese Yen, Developed Stocks, Emerging Stocks, Government Bonds Development, Government Bonds Emerging, IL Bonds Worldwide, Corporate Bonds Worldwide, Gold, Oil, Real Estate, Hedge Funds are representative of US financial markets in the study. Relationship between those variables and Bitcoin has been scrutinized in the article. Correlations among them have been tested. Mean-variance spanning test has been used as analyse method. The empirical evidence asserts that Bitcoin could be used as diversifier asset in portfolios in the early stage of its life phase (Brière, Oosterlinck, & Szafarz, 2015)

Jin & Tian (2024) analysed safe-haven characteristics of Bitcoin in extreme shocks or uncertainties for US financial markets. KBW Nasdaq Bank Index, Gold, S&P 500 Financials Index, Nasdaq Composite Index, Dow Jones Industrial Average Index, S&P 500

Index, US dollar index, VIX index, U.S. Aggregate Bond Index are proxies for US financial markets. Daily data has been used and CEEMDAN-based event analysis approach have been adopted in the study. Analyse period covers period over July 2022 to June 2023. Authors conclude that Bitcoin has outperformed other traditional assets during economic uncertainties although its variance is high. Bitcoin exhibited safe-haven property during extreme conditions in the financial markets.

Kayral et al. (2022) observes hedging or safe haven effectiveness of Bitcoin over period January 2016 to January 2023 for G7 stock markets. In order to find correlation among them, the study adopted DVECH-GARCH model. Daily data was incorporated into the study. United States (S&P 500), France (CAC40), Germany (DAX40), the United Kingdom (FTSE 100), Italy (FTSE-MIB 30), Japan (Nikkei 225), and Canada (SP-TSX) have been used as proxies for stock markets in the study. According to the empirical evidence, authors concluded that Bitcoin could play role of hedge asset for stable times in financial markets. In addition, it can act as diversifier for extreme conditions in stock markets (Kayral, Jeribi, & Loukil, 2023)

Kajtazi & Moro (2019) analysed diversification property of Bitcoin across many financial markets in different countries. The authors adopted mean-CvaR methodology in order to make scenario analysis and back-test of created portfolios. Data covers period of February 2012 to February 2017 and daily data have been used in the study. Analyse has been made for United States, European Countries and China. S&P U.S. Treasury Bill Index, S&P U.S. Treasury Bond Index, Dow Jones Equal Weights U.S. Issued Corporate Bonds, S&P WCI Gold (ER), S&P 100, S&P 500, S&P 600, S&P WCI, Dow Jones U.S. Real Estate Index, Global hedge fund index, Alternative Dow Jones FXCM Dollar Index have been used as proxies for U.S. financial markets. S&P Pan-Europe Developed Sovereign Bond Index, S&P Eurozone Investment Grade Corporate Bond Index, S&P WCI Gold (ER), S&P Europe 350, S&P WCI Europe, Dow Jones Europe Select Real Estate Securities Index, Global Hedge Fund Index, S&P Euro Futures Index Spot were representatives for European financial markets. S&P China Government Bill Index, S&P China Sovereign Bond Index, S&P China Corporate Bond Index, S&P WCI Gold (ER), S&P China A 100 Index (RMB), S&P China A 200 Index (RMB), S&P China A Small cap Index (RMB), S&P WCI ASIA, Guggenheim China Real Estate ETF (TAO), Global hedge fund index, USDCNY Exchange are proxies for Chinese financial markets. BTC USD Index, BTC and BTC CNY Index are proxies for Bitcoin. In most scenario or optimal portfolios, adding to Bitcoin to the portfolios

provided diversification benefits. This study created 21 optimal portfolios. 18 of 21 total portfolios benefited from inclusion of Bitcoin to portfolios. Inclusion of Bitcoin to only 3 portfolios decreased return of the portfolios. On the other hand, inclusion of Bitcoin caused rise in risk level in most of the portfolios. Although riskiness of portfolios have gone up, risk-return ratio became better off in most scenario. This means, inclusion of Bitcoin increases return more than risk in many portfolios. In conclusion, Bitcoin is a risky asset. It increases volatility of portfolios. However, it increases return of portfolios (Kajtazi & Moro, 2019).

Guesmi et al. (2019) examined diversification role of Bitcoin over global stock and financial markets by employing multivariate GARCH methodology. MSCI Emerging Markets Index, MSCI Global Market Index, Gold, Oil, Volatility Index are variables used in the analysis. Daily data has been used and data covers period over January 2012 to January 2018. Authors conclude that Bitcoin could be assessed as diversifier and hedger asset for portfolios. Risk of portfolios decrease while return is not sacrificed by including Bitcoin to the portfolios (Guesmi, Saadi, Abid, & Ftiti, 2019).

Corbet et al. (2018) analysed diversification properties of different cryptocurrencies for U.S. stock markets. MSC GSCI Total Returns Index, the US\$ Broad Exchange Rate, the SP500 Index, COMEX closing gold price, VIX and the Markit ITTR110 index have been used as proxies. Bitcoin, Ripple and Litecoin are used as representatives for cryptocurrencies. Daily data has been used in the analysis. Analyse period covers years from 2013 to 2017. Authors applied Generalized Variance Decomposition Methodology to explore spill overs and interconnectedness among variables. They conclude that connectedness of cryptocurrencies to traditional assets such as stock market, gold is very low. Therefore, cryptocurrencies can be evaluated as diversifier and hedger for stock markets. Cryptocurrencies are isolated from traditional assets (Corbet, Meegan, Larkin, Lucey, & Yarovaya, 2018).

Chan et al. (2019) examined role of Bitcoin whether it can be included to portfolios as diversifier or hedger. Euro STOXX, Nikkei, Shanghai A-Share, S&P 500, and the TSX Index are proxies for financial markets. Correlation and connectedness among those variables and Bitcoin is investigated through Pairwise GARCH models. Authors used different data frequencies (daily, weekly, monthly) between years 2010 to 2017. Analysis made through monthly data prove that Bitcoin can act as hedge instrument for financial markets. However, this cannot be verified through analysis made by daily and weekly data.

In short, authors claim that Bitcoin could behave as strong hedge instrument for U.S. and European financial markets (Chan, Le, & Wu, 2019)

Riahi et al. (2024) examined role of cryptocurrencies for portfolios before and after Covid-19 pandemic. Bitcoin, Ethereum, Binance Coin, Tether, Cardano, XRP, USD Coin Doge coin are proxies for cryptocurrencies. Authors selected 10 countries (the United States, Turkey, Brazil, India, Mexico, the United Kingdom, Italy, France, Germany and Russia) which are mostly affected economically from the pandemic for study. Authors used main stock indexes as proxies for stock markets. S&P 500, Borsa Istanbul stock exchange [BIST] 100, Sao Paulo Stock Exchange [BVSPT], Bombay Stock Exchange Sensitive Index [BSESN], S&P/Bolsa Mexicana de Valores Indice de Precios y Cotizaciones [BMV IPC], GB 100, Italy 40, Cotation Assistée en Continu [CAC] 40, DAX, Russian Trading System Index [RTSI] are variables employed in the analysis. The daily data covers period from April 2019 to January 2021. Analysis period is divided in two sub periods. Researchers examined correlation among variables through multivariate analysis. Authors concluded that Bitcoin, Cardano, Ethereum and Binance can act as diversifier for indexes stated above according to the empirical analysis during Covid-19 pandemic. On the other hand, Tether and USD coin shows safe haven property for portfolios (Riahi, Bennajma, Jahmane, & Hammami, 2024)

Tiwari et al. (2019) analyzed hedging capability of cryptocurrencies for United States stock markets. Ripple, Dash, Stellar, Litecoin, Ethereum, and Bitcoin are cryptocurrencies in the study as representatives of all cryptocurrencies. S&P500 is proxy for United States stock markets. Analysis period covers August 2015 to June 2018. Copula-ADCC-EGARCH model is employed as analysis method. According to empirical evidences, authors conclude that cryptocurrencies can act as hedge asset for S&P500 especially during negative market shocks (Tiwari, Raheem, & Kang, 2019).

Akhtaruzzaman et al. (2020) examines diversification property of Bitcoin for industries and bonds in United States financial markets. Analysis period covers August 2011 to 30 November 2018 and daily data is used. Authors scrutinize correlation among 11 industry indexes and Bitcoin through VARMA DCC-GARCH model. Global Market, Basic Materials, Consumer Goods, Consumer Services, Diversified REITs, Health Care, Industrials, Oil and Gas, Technology, Telecom, Utilities, Financials Indexes and PIMCO Bond Indexes are proxies for the United States industries. Empirical evidence shows that Bitcoin could behave as hedge asset for United States stock markets (Akhtaruzzaman,

Sensoy, & Corbet, 2020). Because, correlation between Bitcoin and stock market indexes are low. Therefore, cryptocurrencies can be evaluated as good diversifier for portfolios.

Xu & Kinkyo (2023) analysed hedging capability of Bitcoin for Group of 7 Countries' financial markets over period of January 2017 to June 2022. Daily data has been used and Morlet wavelet has been selected as methodology of the analysis. MSCI country index returns and BTC prices are used as variables in the study. Covariance and correlation between Bitcoin and stated countries' MSCI indexes are calculated in the study. Correlation among those variables are not statistically significant in most cases except in extreme market conditions which are global pandemic and Russia-Ukraine war. During extreme market conditions, correlation between Bitcoin MSCI Country Indexes are negative. Those empirical results prove that BTC can act as hedge asset for G7 stock market portfolios (Xu & Kinkyo, 2023).

Chkili et al. (2021) analyzed hedging and safe haven characteristics of Bitcoin for Islamic stock markets. Daily data has been used. January 2010 to May 2020 is analysis period. DCC-FIGARCH model has been adopted for analysis method. Dow Jones Islamic World Index, Dow Jones Islamic USA Index, Dow Jones Islamic Europe Index, Dow Jones Islamic Asia/Pacific Index, Dow Jones Islamic GCC Index, Dow Jones Islamic Developed Index and BTC daily prices are variables whose correlation among them is observed. According to the empirical evidences, authors assert that connectedness between Bitcoin and Islamic equities is weak. Moreover, this correlation is negative under extreme market conditions. This proves how Bitcoin can behave as hedge asset for Islamic stock markets. In addition, adding Bitcoin to portfolios in Islamic stock markets provide diversification benefits (Chkili, Rejeb, & Arfaoui, 2021)

Mensi et al. (2020) examined relationship between Bitcoin and Islamic Stock markets. Daily closing prices of variables have been used in the study. Analysis period covers from July 2010 to March 2018. BTC (XBTUSD currency) and the DJ Islamic Market World Index (DJIM), US Islamic Index (IMUS), Europe Islamic Index (DJIEU), Asia-Pacific Islamic Index (DJIAP), UK Islamic Index (DJIUK), Japan Islamic Index (DJIJP), Canada Islamic Index (DJICA), DJ Islamic Market Titans 100 Index (IMXL), and DJ Sukuk Index (DJSUKUK) are variables employed in the study. Correlation between Bitcoin and those indexes have been observed by Wavelet coherence analysis method. The study concentrates on co-movement among variables in both short run and long run. According to empirical evidences, authors put forward that Bitcoin can behave as diversifier asset for short

run investment rather than long term investment. Likely, it can best act as hedge asset for short run investment rather than long term investment. This shows that time span is important for benefitting from Bitcoin in portfolios (Mensi, Rehman, & Maitra, 2020).

Huang et al. (2021) observes whether Bitcoin can behave as safe haven asset in extreme market conditions, global Covid-19 pandemic through Bayesian Panel VAR analysis method for five countries' stock markets. July 2019 to July 2020 is analysis period. Data frequency is daily. Australia, Canada, Europe, United Kingdom and United States stock markets are under investigation in this study. Specifically, S&P ASX200, S&P TSX, STOXX, FTSE100, and S&P500 are variables used as proxies for those stock markets. According to the empirical results, Bitcoin can behave as diversifier asset for all stock markets stated above and it contributes to down risk in the portfolios created through conventional assets (Huang, Duan, & Mishra, 2021).

Alana et al. (2020) analysed hedging capability of cryptocurrencies over six stock markets through univariate analysis. Fractional integration and cointegration analysis have been made in the study. May 2015 to October 2018 is analysis period and daily data has been used. 6 cryptocurrencies which have largest market capitalization have been used as proxies for cryptocurrencies. They are Bitcoin, Ethereum, Ripple, Litecoin, Stellar and Tether. S&P 500 Composite, S&P GSCI Commodity Total Return, VIX, S&P Bond Index, S&P GSCI Gold Total Return and US Nominal Dollar Broad Index are representatives of U.S. stock markets. Association between those cryptocurrencies and stock market indexes stated above is very low. In other words, connectedness and relationship among them is insignificant. Therefore, cryptocurrencies can be evaluated as diversifier or hedger for investors who carry portfolio in U.S. stock markets (Gil-Alana, Abakah, & Rojo, 2020).

Summary of literature advocating presence of hedging, diversifier and safe haven characteristics of cryptocurrencies against stock markets is provided Table below.

Table 10: Summary of Literature Review (1)

Author(s)	Variables	Time Frame	Methodology	Outcome of Research
Anne Haubo Dyhrberg (2016)	FTSE Index, Bitcoin	Daily Data, 2010 – 2015	Asymmetric GARCH	Bitcoin has hedging capability against FTSE Index
Myriam Ben Osman et al. (2023)	S&P 500, Nasdaq Composite Index, Dow Jones Industrial Average index, FTSE 100, Toronto Stock Exchange Composite Index, Bitcoin, Ethereum	Daily Data, 2017 – 2021	GARCH Model and Vine Copulas	Bitcoin and Ethereum exhibits weak hedge or safe haven property for financial markets observed
Agata Kliber et al. (2019)	Venezuela Stock Exchange General Index (IBVC), Nikkei 225 (NKX), Shanghai Composite (SHC), OMX Stockholm 30 Index (OMXS30) and OMXT all in (OMXT), Bitcoin	Daily Data, 2014– 2017	Stochastic Volatility Model with the Dynamic Conditional Correlation	Bitcoin shows weak hedge property for all financial markets in the analysis when USD trade is used.
Stensås et al. (2019)	S&P 500, FTSE 100, Nikkei 225, FTSE MIB, DAX 30, CAC 40, S&PTX 60, IBRX, MICEX 10, NIFTY 50, Shanghai A-Share, KOSPI, MSCI Zimbabwe, MSCI World, BRIC, Asia, Pacific and European Indexes, Standard & Poor's Goldman Sachs (SPGS) World Commodity Index, London Metal Exchange (LME), Merrill Lynch Commodity Index Extra (MLCX) Agriculture and MLCX Energy, Bitcoin	Daily Data 2011 - 2018	GARCH Dynamic Conditional Correlation (DCC) Model	Bitcoin behaves as hedge asset for emerging markets like South Korea, India, Russia, and Brazil. On the other hand, it can be only diversifier for developed markets and commodities. In addition; Bitcoin exhibits safe haven property for all emerging and developed markets
Shahzad et al. (2019)	S&P Goldman Sachs Commodity Index (S&P GSCI), MSCI World, MSCI Developed, MSCI Emerging Markets, MSCI China, and MSCI US Indexes, Bitcoin	Daily Data 2010 - 2018	Cross-Quantilegram Technique	The authors conclude that Bitcoin could play role of weak safe haven asset against world stock market index and China stock market. For developing markets, commodities, and US investors, Bitcoin cannot behave as safe haven asset according to consequences of the study.

Author(s)	Variables	Time Frame	Methodology	Outcome of Research
Bouri et al. (2020)	MSCI Stock Market Indices of World, Developed, and Emerging Markets, China, and the USA, Bitcoin, Gold, Commodities	Daily Data 2010 - 2018	Wavelet Coherency Approach	Bitcoin behaves as safe haven asset for analyzed stock markets.
Bouri et al. (2020)	8 cryptocurrencies which are namely Bitcoin, Ether, Ripple, Litecoin, Stellar, Dash, Nem, and Monero along with S&P500 and its 10 equity sectors	Daily Data 2015 - 2018	Cross-Quantilogram Approach	Authors conclude that Bitcoin, Ripple and Stellar act as safe haven asset for US stock market and equity sectors. However, Litecoin and Monero behave as safe haven asset against US stock market aggregate index. Ethereum, Dash and Nem exhibit hedging property for some equity sectors
Diniz-Maganini et al (2021)	Bitcoin, MSCI world Index, Gold	Daily Data 11 March 2020 – 10 July 2020	Multifractal Detrended Fluctuation Analysis (MF-DFA), Detrended Partial Cross-Correlation Analysis (DPCCA)	Authors conclude that Bitcoin can behave as safe haven asset for time scale longer than 3 months
Będowska-Sójka & Kliber (2021)	S&P500, DAX, FTSE250, and STOXX Europe 600 Index along with Bitcoin, Ether and gold.	Daily Data 2015 - 2020	Bayesian Dynamic Conditional Correlation Multivariate Stochastic Volatility (DCC-MSV)	The study concludes that gold behaves as safe haven asset for the analyzed period except Covid-19 pandemic. However, Bitcoin and Ether behaved as weak safe haven asset against analyzed stock market indices.
Mariana et al. (2021)	Bitcoin, Ethereum, S&P500	Daily Data, July 2019 to April 2020	GARCH Dynamic Conditional Correlation (DCC) Model	The authors asserted Bitcoin and Ethereum could behave as safe haven for the analyzed stock market
Kliber (2022)	DeFi and CeFi coins, which are Dai, Tether and USDC respectively and Bitcoin and Ethereum, S&P500	Daily Data 2020 - 2022	Quantile Coherency Approach	Authors asserted that stable coins could act as safe haven asset for US stock markets
Jeribi et al. (2021)	Bitcoin, Ethereum, Dash, Monero, and Ripple, BVSP of Brazil, RTSI of Russia, BSE Sensex 30 of India, SSE of China, and JSE 40 of South Africa	Daily Data 2016 - 2020	Nonlinear Autoregressive Distributed Lag (NARDL)	All major five cryptocurrencies in the study is proven that they could serve as safe haven asset for Brazil, China and Russian stock markets during the pandemic

Author(s)	Variables	Time Frame	Methodology	Outcome of Research
Shahzad et al. (2020)	Stock market indices of G7 countries, MSCI G7 index, Bitcoin and Gold	Daily Data 2010 - 2018	AGDCC-GARCH model	Empirical results exhibit that gold is better safe haven, hedge and diversifier asset than Bitcoin for developed stock markets. Bitcoin shows strong safe haven property for only Canada stock market. For other developed countries in the analysis, Bitcoin exhibits weak safe haven or hedge properties
Ma et al. (2020)	Bitcoin, Ethereum, Ripple, Bitcoin Cash, Litecoin, Asset Portfolios	Daily Data 2015-2019	Naïve portfolio, Markowitz Mean-Variance, Optimized Sharpe Ratio	Adding cryptocurrencies to portfolios increased return of portfolios while decreasing variance and risk of the portfolios. This results exhibit that cryptocurrencies are good diversifiers for asset portfolios
Baur et al. (2018)	Bitcoin and S&P500, S&P600, Gold, Silver, Bloomberg US Corporate Bond Index, Bloomberg US Treasury Bond Index, Bloomberg USD High Yield Corporate Bond Index, Exchange Rates, Energy Prices, US Weighted Dollar Index	Daily Data 2010-2015	Ordinary Least Squares Estimation and Covariance Matrix	Bitcoin can behave as safe haven for normal and extreme conditions in financial markets.
Eisl et al. (2015)	Bitcoin and Portfolios	Monthly Data 2010-2015	Conditional Value-at-Risk	Bitcoin significantly contributes to portfolios with respect to diversification and return
Anyfantaki et al. (2018)	S&P 500 Total Return Index, the Barclays U.S. Aggregate Bond Index and the One-Month Libor Rate, Bitcoin, Ethereum, Ripple and Litecoin	Daily and Weekly Data 2015-2017	Stochastic Spanning Methodology	Empirical results exhibit that portfolios including cryptocurrencies are better diversified with respect to risk and return

Author(s)	Variables	Time Frame	Methodology	Outcome of Research
Okoroafor & Leirvik (2023)	Bitcoin, SPDR Gold Exchange Traded Fund (gld), iShares MSCI Japan (ewj), iShares China Large-Cap ETF (fxi), SPDR S&P500 (spy), Vanguard FTSE Europe (vgk) and Vanguard FTSE Emerging Markets (vwo)	Daily Data December 2007-2023	Pearson Correlation Test, . Time-Varying Autoregressive Model	The authors conclude that Bitcoin can act as hedge asset when markets are inefficient.
Dutta et. all (2020)	US West Texas Intermediate (WTI) Price, Brent Price, Bitcoin, Gold	Daily Data 2016 - 2020	DCC-GARCH Model	The authors conclude that Bitcoin cannot behave as safe haven for oil markets while it can be evaluated as only diversifier for those markets
Belhassine & Karamti (2021)	Gold, Silver, Bitcoin, WTI, S&P 500, Euro STOXX 50, SSE	Daily Data 2018-2021	Bivariate DCC-GARCH Model	Empirical evidence indicates that Bitcoin can behave as safe haven asset for Shanghai Stock Exchange for extreme market conditions
Brière et. all (2015)	Euro, Japanese Yen, Developed Stocks, Emerging Stocks, Government Bonds Development, Government Bonds Emerging, IL Bonds Worldwide, Corporate Bonds Worldwide, Gold, Oil, Real Estate, Hedge Funds, Bitcoin	Weekly Data 2010 - 2013	Mean-Variance Spanning Test	The empirical evidence asserts that Bitcoin could be used as diversifier asset in portfolios in the early stage of its life phase
Jin & Tian (2024)	KBW Nasdaq Bank Index, Gold, S&P 500 Financials Index, Nasdaq Composite Index, Dow Jones Industrial Average Index, S&P 500 Index, US dollar Index, VIX Index, U.S. Aggregate Bond Index, Bitcoin	Daily Data 2022-2023	CEEMDAN-Based Event Analysis	Bitcoin exhibited safe-haven property during extreme conditions in the financial markets
Kayral et. all (2022)	United States (S&P 500), France (CAC40), Germany (DAX40), the United Kingdom (FTSE 100), Italy (FTSE-MIB 30), Japan (Nikkei 225), and Canada (SP-TSX), Bitcoin	Daily Data 2016-2023	DVECH-GARCH Model	According to the empirical evidence, authors concluded that Bitcoin can serve as hedge asset for stable times in financial markets. In addition; it can act as diversifier for extreme conditions in stock markets

Author(s)	Variables	Time Frame	Methodology	Outcome of Research
Kajtazi & Moro (2019)	U.S. European and Chinese Financial Market Indexes, Bitcoin	Daily Data 2012 - 2017	Mean-CVaR Methodology	Bitcoin is a risky asset. It increases volatility of portfolios. However, it increases return of portfolios
Guesmi et. all (2019)	MSCI Emerging Markets Index, MSCI Global Market Index, Gold, Oil, Volatility Index, Bitcoin	Daily Data 2012 - 2018	Multivariate GARCH	Risk of portfolios decrease while return is not sacrificed by including Bitcoin to the portfolios
Corbet et. all (2018)	MSC GSCI Total Returns Index, US\$ Broad Exchange Rate, SP500 Index, COMEX closing Gold Price, VIX and Markit ITTR110 Index, Bitcoin, Ripple, Litecoin	Daily Data 2013 - 2017	Generalized Variance Decomposition Methodology	They conclude that connectedness of cryptocurrencies to traditional assets such as stock market, gold is very low. Therefore; cryptocurrencies can be evaluated as diversifier and hedger for stock markets.
Chan et al. (2019)	Euro STOXX, Nikkei, Shanghai A-Share, S&P 500, and the TSX Index, Bitcoin	Daily, Weekly, Monthly Data 2013 - 2017	Pairwise GARCH Models	Authors claim that Bitcoin can act as strong hedge instrument for U.S. and European financial markets
Riahi et al. (2024)	S&P 500, BIST 100, BVSP, BSESN, BMV IPC, GB 100, Italy 40, CAC 40, RTSI, Bitcoin, Ethereum, Binance Coin, Tether, Cardano, XRP, USD Coin, Doge Coin	Daily Data 2019 - 2021	Multivariate Analysis	Authors concluded that Bitcoin, Cardano, Ethereum and Binance can act as diversifier for indexes stated above according to the empirical analysis during Covid-19 pandemic. On the other hand, Tether and USD coin shows safe haven property for portfolios
Tiwari et al. (2019)	S&P500, Ripple, Dash, Stellar, Litecoin, Ethereum, and Bitcoin	Daily Data 2015 - 2018	Copula-ADCC-EGARCH	According to empirical evidences, authors conclude that cryptocurrencies can act as hedge asset for S&P500 especially during negative market shocks
Akhtaruzzaman et al. (2020)	Global Market, Basic Materials, Consumer Goods, Consumer Services, Diversified REITs, Health Care, Industrials, Oil and Gas, Technology, Telecom, Utilities, Financials Indexes and PIMCO Bond Indexes, Bitcoin	Daily Data 2011 - 2018	VARMA DCC-GARCH Model	Empirical evidence shows that Bitcoin can act as hedge asset for United States stock markets

Author(s)	Variables	Time Frame	Methodology	Outcome of Research
Xu & Kinkyo (2023)	G7 MSCI Country Index Returns and Bitcoin	Daily Data 2017 - 2022	Morlet Wavelet Spectrum Analysis	Empirical results prove that BTC can act as hedge asset for G7 stock market portfolios
Chkili et al. (2021)	Dow Jones Islamic World Index, Dow Jones Islamic USA Index, Dow Jones Islamic Europe Index, Dow Jones Islamic Asia/Pacific Index, Dow Jones Islamic GCC Index, Dow Jones Islamic Developed Index and Bitcoin	Daily Data 2010 - 2020	DCC-FIGARCH Model	Bitcoin can act as hedge and diversifier asset for Islamic stock markets
Mensi et al. (2020)	BTC (XBTUSD Currency) and the DJ Islamic Market World Index (DJIM), US Islamic Index (IMUS), Europe Islamic Index (DJIEU), Asia-Pacific Islamic Index (DJIAP), UK Islamic Index (DJIUK), Japan Islamic Index (DJJP), Canada Islamic Index (DJICA), DJ Islamic Market Titans 100 Index (IMXL), and DJ Sukuk Index (DJSUKUK)	Daily Data 2010 - 2018	Wavelet Coherence Analysis	Bitcoin can act as hedge and diversifier asset for Islamic stock markets
Huang et al. (2021)	S&P ASX200, S&P TSX, STOXX, FTSE100, and S&P500, Bitcoin	Daily Data 2019 - 2020	Bayesian Panel VAR	Bitcoin can behave as diversifier asset for all stock markets stated above and it contributes to down risk in the portfolios created through conventional assets
Alana et al. (2020)	Bitcoin, Ethereum, Ripple, Litecoin, Stellar and Tether; S&P 500 Composite, S&P GSCI Commodity Total Return, VIX, S&P Bond Index, S&P GSCI Gold Total Return and US Nominal Dollar Broad Index	Daily Data 2015 - 2018	Univariate Analysis	Cryptocurrencies can be evaluated as diversifier or hedger for investors who carry portfolio in U.S. stock markets

Literature on advocating that cryptocurrencies cannot behave as hedge, diversifier or safe haven asset for stock markets are provided below. To begin with, Conlon et al. (2020) questioned whether Bitcoin, Ethereum and Tether could be safe haven assets in extreme market conditions especially in Covid-19 pandemic for stock markets. Proxies to stock markets are MSCI World Index, S&P 500, FTSE 100, FTSE MIB, IBEX and CSI 300 indices. Daily returns of those indices have been employed in the study for the period 11 April 2019 to 9 April 2020. Value at risk (VaR) and the related conditional value at risk (CVAR) models have been determined for econometrical analysis. Authors concluded that while Tether could be as safe haven asset since it is pegged to US dollar, Bitcoin and Ethereum do not act as safe haven asset for most of the international stock indices (Conlon, Corbet, & McGee, 2020).

Conlon & McGee (2020) analyzed safe haven property of Bitcoin during Covid-19 crash in United States financial market. The authors questioned whether Bitcoin acts as shelter for extreme conditions in US stock markets. The variables used in the study are S&P 500 and Bitcoin and daily data have been employed. Analysis covers three different periods: July 2010 - March 2020, March 2019 – March 2020 and April 2016 to Covid-19 crisis. Two-moment value at risk (VaR) method has been used for measurement of portfolio risk. The study provided empirical findings asserting that adding Bitcoin to portfolios in US stock markets does not cause to decline in risk of portfolio. Therefore, Bitcoin does not serve as shelter or safe haven for extreme market conditions in US stock markets because there is positive correlation between S&P500 and Bitcoin during market crash.

Ji et al. (2020) analyzed safe haven property of Bitcoin along with gold and some commodities such as crude oil, soybeans during Covid 19 market crashes. Analysis concentrates on United States, Europe and China stock markets. MSCI China, MSCI Europe and MSCI US indexes have been used as proxies for the stock markets stated above. Daily closing prices of indexes and prices have been used in the study. Authors preferred sequential monitoring test and cross-quantilogram approach for analysis. The study period is between August 2019 and November 2020. The authors conclude that gold is more effective than Bitcoin with respect to being safe haven asset. Bitcoin can only serves as weak shelter or safe haven asset for US, China and Europe stock markets (Ji, Zhang, & Zhao, 2020)

Corbet et al. (2020) concentrates on Chinese stock markets and analyses whether Bitcoin and Gold could serve as safe haven assets for the stock markets during global pandemic, Covid 19. The authors employed Dynamic Conditional Correlation with dummy

variables method during the period December 2019 and March 2020 by scrutinizing contagion effects of Covid 19 on Chinese stock markets. Price volatility in Shanghai and Shenzhen Stock Exchanges have been used as centre in contagion effect investigation. The authors cast doubt on usage of Bitcoin as safe haven asset. Empirical findings assert that Bitcoin could not behave as shelter in market shocks in Chinese stock markets (Corbet, Larkin, & Lucey, 2020).

Thampanya et al. (2020) investigated association between Bitcoin and Thai stock markets from 2013 to 2019. Daily data of Thai stock market index and Bitcoin prices have been used for the analysis. Autoregressive distributed lag (ARDL) models (linear and non-linear) has been adopted in the study and long run cointegration between variables have been researched. Authors conclude that Bitcoin has limited influence on Thai stock market and putting Bitcoin in stock basket (portfolio) does not cause a significant rise in return while holding risk constant (Thampanya, Nasir, & Huynh, 2020).

Chemka et al. (2021) explored connection between Bitcoin and S&P500, EUROSTOXX50, NIKKEI225, FTSE100 indices with Asymmetric Dynamic Conditional Correlation adding dummy variables during Covid 19 outbreak. The study covers period of April 2013 to January 2021 and daily data have been used in the analysis. Empirical findings of the study assert that Bitcoin cannot be evaluated as safe haven asset for extreme market conditions. However, gold can be accepted as a weak safe haven asset for stock markets (Chemkha, BenSaïda, Ghorbel, & Tayachi, 2021).

Goodell & Goutte (2021) investigated whether cryptocurrencies could be a diversifier or not for stock markets during the pandemic, Covid 19. The study analyzed relationship between price volatility in stock markets and price movements in cryptocurrencies. The study concentrates on co-movement between stock prices or indices and cryptocurrencies' prices. Wavelet coherence, and neural network analyses have been selected as econometric methodology. Two periods are investigation for the period of February 2019 – February 2021. Before and after Covid-19 have been investigated and compared in the study. SWISS Index, IBEX 35 Spain, DAX, CAC 40 French, FTSE 100 UK, EUROSTOXX and S&P 500 were used as proxies for stock markets. Bitcoin, Litecoin, Ethereum and Tether have been used as representative of cryptocurrencies. Empirical results of the study suggested that cryptocurrencies cannot be evaluated as safe haven assets for stock markets except Tether.

Similar to other studies, Wen et al. (2022) investigated safe haven characteristics of gold and Bitcoin during the global outbreak. Time-Varying Parameter VAR Model has been employed and daily data for the period January 2019 to June 2021 have been used. COMEX gold futures price (COMEX), the WTI oil price (WTI), and the S&P 500 index (SPX) have been used as proxies for gold and oil price and stock market respectively. Authors conclude that gold can behave as safe haven asset for U.S. stock market while Bitcoin cannot behave as safe haven asset for the stock market (Wen, Tong, & Ren, 2022).

Maitra et al. (2022) analyze hedging property and effectiveness of cryptocurrencies for stock markets in extreme market conditions. Ethereum and Bitcoin are used as proxies for cryptocurrencies. S&P500, FTSE100, CAC40, DAX30, FTSE MIB, IBEX35, NIKKEI225 and SSE have been used as proxies for major stock markets. Five minutes interval data pre and post Covid 19 period have been employed in the analysis. August 1, 2019, to May 29, 2020 is adopted as analysis period. Before December 2019 period is accepted as pre Covid-19 period. After December 2019 period is assumed post Covid 19 period. Conditional Value-at-Risk and Copula were methods of econometrics applied in this study. Empirical findings of the study suggest that cryptocurrencies are not suitable tools for hedging for major stock markets (Maitra, Rehman, Dash, & Kang, 2022)

Baur et al. (2022) investigates hedge property of Bitcoin for U.S. stock markets. They claim that looking only correlation between cryptocurrencies and stock markets could be misleading due higher price volatility in cryptocurrencies. They assert that higher volatile assets are bad choice as hedging or diversifier instrument in financial markets. Bitcoin and S&P500 are used as proxies in econometric analysis. Daily and monthly return data are used for period January 2011 to May 2021. Optimal hedge ratio analysis has been made. Authors conclude that Bitcoin cannot behave as safe haven asset for U.S. stock market or developed markets due high volatility of the cryptocurrency (Baur, Hoang, & Hossain, 2022).

Jiang et al. (2021) analyzed hedging capability of cryptocurrencies for stock markets. MSCI World, MSCI Developed, MSCI Emerging, S&P 500, Shanghai Composite and Nikkei 225 indices have been used as proxies for stock markets while Bitcoin, Ethereum, Ripple, Litecoin, Monero and Stellar are cryptocurrencies employed in the study. Analysis period is March 2015 to August 2020 and daily data have been used. Quantile cross-spectral (coherency) approach has been used and hedging effectiveness is measured in the study. Authors questioned whether cryptocurrencies could be hedge, safe have or diversifier assets for highly capitalized stock markets. Empirical results of the study suggested that

cryptocurrencies do not have hedge or safe haven capability but they can behave as diversifier. Especially ethereum can act as strong diversifier asset for short time against stock market indices (Jiang, Lie, Wang, & Mu, 2021)

Choi & Shin (2022) scrutinize whether Bitcoin could serve as hedge or safe-haven asset during extreme market conditions for US stock markets. The weekly data has been employed for period July 2010 and December 2020 in the study. Vector Autoregression (VAR) model has been used for analysis. Bitcoin Prices, Gold Prices and S&P500 Index are variables in the study. This study expanded analysis framework and authors observed relationship among gold, Bitcoin and S&P500 by taking inflation and uncertainty into consideration. Empirical results showed that Bitcoin cannot behave as safe haven in financial shocks.

Klein et al. (2018) analysed correlation between Bitcoin and financial markets and they examined hedging property of cryptocurrencies by using Bitcoin as proxy. Variables used in the study are Bitcoin, Gold, Silver, West Texas Intermediate (WTI), the S&P 500 index, MSCI World and the MSCI Emerging Markets 50 index. The daily data covers the period from July 2011 to end of 2017. BEKK-GARCH model has been employed in order to find correlation among variables. The authors find that Bitcoin is significantly positively correlated with falling financial markets and it does not have any hedging capability for financial markets (Klein, Thu, & Walther, 2018).

Summary of literature advocating that cryptocurrencies do not have characteristics of hedging, diversifier or safe haven for stock markets is provided in Table below.

Table 11: Summary of Literature Review (2)

Author(s)	Variables	Time Frame	Methodology	Outcome of Research
Conlon et al. (2020)	MSCI World Index, S&P 500, FTSE 100, FTSE MIB, IBEX and CSI 300 Indexes, Bitcoin, Ethereum	Daily Data 2019-2020	Value at risk (VaR)	Bitcoin and Ethereum are not considered safe haven assets for most of the international stock indices
Conlon & McGee (2020)	S&P500, Bitcoin	Daily Data, July 2010 - March 2020, March 2019 – March 2020 and April 2016 to Covid-19 crisis.	Two-moment value at risk (VaR)	Bitcoin does not behave as shelter or safe have for extreme market conditions in US stock markets
Ji et al. (2020)	MSCI China, MSCI Europe and MSCI US Indexes, Bitcoin, Ethereum	Daily Data August 2019 and November 2020	Preferred Sequential Monitoring Test and Cross-Quantilegram Approach	Bitcoin and Ethereum do not act as safe haven asset for US, China and Europe stock markets
Corbet et al. (2020)	Shanghai and Shenzhen Stock Exchanges, Bitcoin, Gold	Daily Data December 2019 and March 2020	DCC with Dummy Variables	Empirical findings assert that Bitcoin could not behave as shelter in market shocks in Chinese stock markets
Chemka et al. (2021)	S&P500, EUROSTOXX50, NIKKEI225, FTSE100, Bitcoin, Gold	Daily Data 2013-2021	Asymmetric Dynamic Conditional Correlation with Dummy Variables	Empirical findings of the study assert that Bitcoin cannot be evaluated as safe haven asset for extreme market conditions
Goodell & Goutte (2021)	SWISS Index, IBEX 35 Spain, DAX, CAC 40 French, FTSE 100 UK, EUROSTOXX and S&P 500, Bitcoin, Litecoin, Ethereum and Tether	Daily Data 2019-2021	Wavelet Coherence, and Neural Network Analyses	Empirical results of the study suggested that cryptocurrencies cannot be regarded as safe haven assets for stock markets except Tether
Wen et al. (2022)	COMEX gold futures price (COMEX), WTI oil price (WTI), the S&P 500 Index (SPX), Gold, Bitcoin	Daily Data 2019-2021	Time-Varying Parameter VAR Model	Gold is concluded to be a safe haven asset for the U.S. stock market, whereas Bitcoin is found ineffective as a safe haven asset for stock markets
Maitra et al. (2022)	S&P500, FTSE100, CAC40, DAX30, FTSE MIB, IBEX35, NIKKEI225, SSE, Ethereum and Bitcoin	Five minute interval data, 2019-2020	Conditional Value-at-Risk and Copula	Empirical findings of the study suggest that cryptocurrencies are not suitable tools for hedging for major stock markets
Baur et al. (2022)	S&P 500, Bitcoin	Daily and Monthly Data, 2011–2021	Optimal hedge ratio	Authors conclude that Bitcoin cannot behave as safe haven asset for U.S. stock market or developed markets due high volatility of the cryptocurrency
Jiang et al. (2021)	MSCI World, MSCI Developed, MSCI Emerging, S&P 500,	Daily Data, 2015–2020	Quantile cross-spectral (coherency) approach	Empirical results of the study suggested that cryptocurrencies

Author(s)	Variables	Time Frame	Methodology	Outcome of Research
	Shanghai Composite and Nikkei 225 indices, Bitcoin, Ethereum, Ripple, Litecoin, Monero and Stellar			do not have hedge or safe haven capability but they can behave as diversifier.
Choi & Shin (2022)	Bitcoin Prices, Gold Prices and S&P500 Index	Weekly Data, 2010–2020	Vector Autoregression (VAR)	Empirical results showed that Bitcoin cannot act as safe haven in financial shocks
Klein et al. (2018)	Bitcoin, Gold, Silver, West Texas Intermediate (WTI), S&P 500 Index, MSCI World, MSCI Emerging Markets 50 Index	Daily Data, 2011–2017	BEKK-GARCH	The authors find that Bitcoin is significantly positively correlated with declining financial markets and lacks any hedging capability for financial markets

PART 4 DATA, METHODOLOGY AND EMPIRICAL ANALYSIS

Part 4.1 Data

Volatility in emerging markets with respect to financial assets is higher than developed markets. This creates tremendous risk for investors who invest on emerging markets. Similarly, cryptocurrencies are also highly volatile. This directs us on thinking to create portfolio by combining traditional stock market instruments with cryptocurrencies in order to minimize risk of portfolio. The likelihood of a volatile asset being used as a hedge is greater in emerging markets relative to developed markets. During extreme stock market crashes or shocks, cryptocurrencies can arise as potential hedging or safe haven asset candidates for emerging markets (Baur, Hoang, & Hossain, 2022). The exploration of cryptocurrencies as potential safe haven or hedging instruments for emerging markets drives the focus of our study. Therefore, we concentrate on emerging markets in this study.

In the literature, there are many definitions and classifications for emerging markets. Morgan Stanley Capital International (MSCI) classifies markets in three groups which are namely, developed markets, emerging markets and frontier markets. In literature, MSCI indexes and this country classification are highly used and referred. MSCI market classification is accepted reliable in the literature. Many studies are conducted through employing MSCI indices. To illustrate; Shahzad et al. (2019), Bouri et al. (2020), Diniz-Maganini et al (2021), Shahzad et al. (2020), Guesmi et. all (2019), Corbet et. all (2018), Conlon et al. (2020), Ji et al. (2020), Jiang et al. (2021), Klein et all. (2018) and many other studies have adopted MSCI indexes in their analysis. Therefore, MSCI country classification will be adopted in this study.

MSCI classifies countries as developed markets, emerging markets and frontier markets. There are five main criteria for this classification: Openness to foreign ownership, ease of capital inflows / outflows, efficiency of the operational framework, availability of investment instruments, stability of the institutional framework. There are sub criteria under those main criteria. Openness to foreign ownership is determined through grading countries with respect to investor qualification requirement, foreign ownership limit, foreign room level and equal rights to foreign investors. Ease of capital inflows / outflows is determined by rating countries with respect to capital flow restriction level, foreign exchange market liberalization level. Efficiency of the operational framework is determined by grading

markets with respect to market entry (investor registration & account set up), market organization (market regulations, information flow), and market infrastructure (clearing & settlement, custody, registry & depository, trading, transferability, stock lending, short selling). There are no sub criteria for availability of investment instruments and stability of institutional framework. Grading is made by giving minus (-), plus (+) or two plus (++). If a country has no issue with respect to that criteria, then the country gets (++). If a market faces no major issues with respect to that criteria, it gets (+). If improvements needed for that criteria, then the country gets (-) from that criteria (MSCI, 2024). In addition to criteria stated above, economic development and size and liquidity are also influential on when deciding classifications.

According to MSCI country classification, there are 24 emerging markets: Brazil, Chile, Colombia, Mexico, Peru, Czech Republic, Egypt, Greece, Hungary, Kuwait, Poland, Qatar, Saudi Arabia, South Africa, Turkey, UAE, China, India, Indonesia, Korea, Malaysia, Philippines, Taiwan, Thailand. There are 24 MSCI country indices as well. Saudi Arabia will be excluded from the study due to unavailability of data. In addition to this, MSCI Emerging Market Index will take place in this study. There will 24 emerging market indices in the study overall. Cryptocurrencies observed in this study will be Bitcoin, Ethereum and Binance Coin (BNB), Cardano (ADA) and Ripple (XRP). These five cryptocurrencies will represent cryptocurrency market since they create %79.4 of total market cap in cryptocurrencies (Statista, 2024). In addition to market cap, they are highly traded in the market and their daily trade volume is high enough and this creates liquidity for those cryptocurrencies. Moreover, high market cap and high trade volume makes price manipulation very difficult on those cryptocurrencies. This situation creates base for solid empirical analysis. In addition, 85% of trading volume in last four years has been created by four major cryptocurrencies which are Bitcoin, Ethereum, Binance Coin and Ripple Huang L. (2024). In the literature, Bitcoin and/or Ethereum are mostly selected as proxies for cryptocurrency market. However, to choose only stable coins as proxies for cryptocurrencies will not represent cryptocurrency market and its volatility well because cryptocurrency market is highly volatile. In addition, low volatility reduces hedging capability of cryptocurrencies for emerging stock markets as literature suggested (Conlon et al.(2020), Kliber (2022)). Therefore, we do not only add stable coins but also we included volatile and mostly traded cryptocurrencies which are Binance Coin (BNB), Cardano (ADA) and Ripple (XRP) to study. Moreover, although there are more than 10.000 cryptocurrencies worldwide,

these cryptocurrencies (Bitcoin, Ethereum, BNB, ADA and XRP) hold their leading position in terms of market capitalization (Statista, 2024). Bitcoin is mostly used representative of cryptocurrencies in literature to scrutinize correlation between traditional assets/markets and cryptocurrencies (Charfeddine, Benlagha, & Maouchi, 2020). However, Ethereum, BNB, ADA and XRP attracted significant interest from investors and portfolio managers due to decentralized system, enormous flexibility and market capitalization growth. Therefore, we include them to our analysis in addition to Bitcoin. These five coins dominate cryptocurrency market in terms of market capitalization and trade volume. To summarize; variables in this study will be 23 different MSCI Country Indexes, MSCI Emerging Market Index, Bitcoin Price, Ethereum Price, BNB Price, Cardano Price and Ripple Price. 29 different variables will take place in the study.

Sample period start from October 01, 2017 -due to availability of price data of cryptocurrencies- and ends at June 30, 2024. We expanded analysis period as possible as much in order to obtain reliable and robust empirical evidence and inference. The proxies for stock market in Brazil, Chile, Colombia, Mexico, Peru, Czech Republic, Egypt, Greece, Hungary, Kuwait, Poland, Qatar, South Africa, Türkiye, UAE, China, India, Indonesia, Korea, Malaysia, Philippines, Taiwan, Thailand are respectively MSCI Brazil Index, MSCI Chile Index, MSCI Colombia Index, MSCI Mexico Index, MSCI Peru Index, MSCI Czech Republic Index, MSCI Egypt Index, MSCI Greece Index, MSCI Hungary Index, MSCI Kuwait Index, MSCI Poland Index, MSCI Qatar Index, MSCI South Africa Index, MSCI Türkiye Index, MSCI UAE Index, MSCI China Index, MSCI India Index, MSCI Indonesia Index, MSCI Korea Index, MSCI Malaysia Index, MSCI Philippines Index, MSCI Taiwan Index, MSCI Thailand Index. They are all denominated in USD. USD price of Bitcoin, Ethereum, BNB, ADA and XRP will also be used in the analysis. MSCI Index data has been retrieved from MSCI own database (MSCI, 2024). Price data of cryptocurrencies has been obtained from <https://coinmarketcap.com>. Daily closing price data for MSCI indexes and cryptocurrencies will be used in econometric analysis.

MSCI Price Index methodology will be provided briefly. Price performance of a group of securities is measured through price indexes. MSCI Country Indexes are created to evaluate performance a group of large and mid-cap stocks. Stocks which are included in these indexes comprises 85% of total stocks in that country with respect to market capitalization. Daily prices of securities are used in calculation. Each security in the group takes place according to its market capitalization. Each index encompasses the market

capitalization-weighted returns of all its included constituents (MSCI, 2024). MSCI equity indexes' calculation is conducted through Laspeyres' concept of a weighted arithmetic average together with the concept of chain-linking. Formulation and example of calculation are given below:

$$PriceIndexLevelUSD_t = PriceIndexLevelUSD_{t-1} * \frac{IndexAdjustedMarketCapUSD_t}{IndexInitialMarketCapUSD_t}$$

Where

- $PriceIndexLevelUSD_{t-1}$ is the Price Index level in USD at time t-1.
- $IndexAdjustedMarketCapUSD_t$ is the Adjusted Market Capitalization of the index in USD at time t.
- $IndexInitialMarketCapUSD_t$ is the Initial Market Capitalization of the index in USD at time t.

$$IndexAdjustedMarketCapUSD_t =$$

$$\frac{\sum_{s \in I, t} (EndOfDayNumberOfShares_{t-1} * PricePerShare_t * InclusionFactor_t * PAF_t)}{FXrate_t}$$

$$IndexInitialMarketCapUSD_t =$$

$$\frac{\sum_{s \in I, t} (EndOfDayNumberOfShares_{t-1} * PricePerShare_{t-1} * InclusionFactor_t)}{FXrate_{t-1}}$$

Where

- $EndOfDayNumberOfShare_{t-1}$ is the number of shares of security s at the end of day t-1.
- $PricePerShare_t$ is the price per share of the security s at time t.
- $PricePerShare_{t-1}$ is the price per share of security s at time t-1.
- $InclusionFactor_t$ is the inclusion factor of the security s at time t. The inclusion factor can be one or the combination of the following factors: Foreign Inclusion Factor, Domestic Inclusion Factor, Growth Inclusion Factor, Value Inclusion Factor, and Index Inclusion Factor (*).
- PAF_t is the Price Adjustment Factor of the security s at time t.

- $FXrate_t$ is the FX rate of the price currency of security s vs USD at time t . It is the value of 1 USD in foreign currency
- $FXrate_{t-1}$ is the FX rate of the price currency of security s vs USD at time $t-1$. It is the value of 1 USD in foreign currency.

Table 12: MSCI Index Calculation

Example of index calculation.										
Day 1										
	NumberOf Shares $t-1$	PricePer Share t	PricePer Share $t-1$	Inclusion Factor t	PAF t	FXrate t	FXrate $t-1$	IndexAdjusted MarketCapUSD t (see 1.1.1)	IndexInitialMar ketCapUSD t (see 1.1.1)	IndexAdjusted MarketCapFor Local t (see 1.1.1)
Security A	150000	152.60	154.00	0.75	1	1.50	1.49	11,445,000	11,627,517	11,521,812
Security B	26000	98.40	105.00	1.00	1	1.15	1.14	2,224,696	2,394,737	2,244,211
Security C	290000	1592.60	1603.50	0.60	1	125.00	125.50	2,216,899	2,223,179	2,208,067
Security D	360000	268.00	265.30	0.85	1	1.50	1.50	54,672,000	54,121,200	54,672,000
Total Index								70,558,595	70,366,633	70,646,090
		t	$t-1$	daily perf						
PriceIndexLevelUSD (see 1.1)		100.273	100.000	0.27%						
PriceIndexLevelLocal (see 1.1)		100.397	100.000	0.40%						
Day 2										
Security C is ex Right issue 1 : 1 @ 1300										
	NumberOf Shares $t-1$	PricePer Share t	PricePer Share $t-1$	Inclusion Factor t	PAF t	FXrate t	FXrate $t-1$	IndexAdjusted MarketCapUSD t (see 1.1.1)	IndexInitialMar ketCapUSD t (see 1.1.1)	IndexAdjusted MarketCapFor Local t (see 1.1.1)
Security A	150000	160.00	152.60	0.75	1	1.51	1.50	11,920,530	11,445,000	12,000,000
Security B	26000	95.00	98.40	1.00	1	1.16	1.15	2,129,310	2,224,696	2,147,826
Security C	290000	1450.00	1592.60	0.60	1.1034	124.50	125.00	2,236,145	2,216,899	2,227,200
Security D	360000	265.00	268.00	0.85	1	1.51	1.50	53,701,987	54,672,000	54,060,000
Total Index								69,987,971	70,558,595	70,435,026
		t	$t-1$	daily perf						
PriceIndexLevelUSD (see 1.1)		99.462	100.273	-0.81%						
PriceIndexLevelLocal (see 1.1)		100.221	100.397	-0.18%						

Asset prices are not usually used directly as raw data in empirical analysis in finance literature. Time series are usually converted to returns and then employed in econometric analysis. To use returns instead of prices provide significant benefits. Stationarity property is matched or fulfilled better in returns than prices. To normalize returns is easier than normalizing prices. Volatility which is important for this study are usually more related with returns than prices. As it has been usually used in finance literature, natural logarithmic returns will be adopted in this study (Kothari & Zimmerman, 1995).

$R_t = \ln (p_t / p_{t-1}) * 100$ formula will be used to calculate return of the series in the study. P_t and P_{t-1} represent MSCI closing index value at time t and $t-1$ respectively.

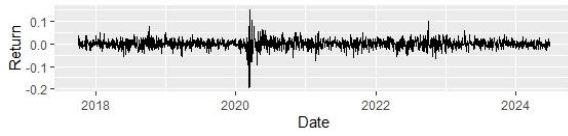
There are 1760 observations for each variable in the study. Summary descriptive statistics of data is provided below. R package programme which has 4.4.1 version and R Studio are used in this study to conduct empirical analysis (The R Project, 2024).

Table 13: Summary Statistics of Daily Returns

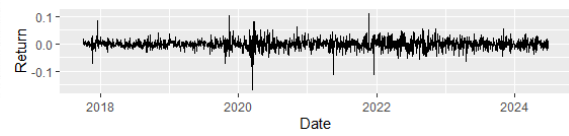
	Minimum	Maximum	Mean	Median	Std. Dev.	Skewness	Kurtosis
Brazil	-0.194332	0.151581	-0.000223	0.000000	0.020813	-0.987353	12.990559
Chile	-0.167361	0.111804	-0.000354	-0.000184	0.018549	-0.686630	9.435272
China	-0.085344	0.135763	-0.000206	-0.000202	0.015475	0.323760	5.337314
Colombia	-0.218999	0.159411	-0.000229	0.000000	0.020599	-1.317058	20.422783
Czech	-0.131052	0.074329	0.000144	0.000269	0.014352	-1.294607	12.078587
Egypt	-0.468556	0.127451	-0.000273	0.000000	0.020224	-7.525871	169.745623
Greece	-0.143226	0.085469	0.000045	0.000650	0.017864	-0.726774	7.892545
Hungary	-0.179796	0.108178	0.000066	0.000276	0.019178	-1.375974	15.053876
India	-0.156226	0.091706	0.000383	0.000634	0.012341	-1.696297	21.948955
Indonesia	-0.115149	0.156326	-0.000106	0.000000	0.014516	-0.131229	15.414166
Korea	-0.109966	0.101407	0.000008	0.000000	0.015373	0.058002	4.933210
Kuwait	-0.226120	0.045007	0.000212	0.000068	0.010472	-6.532534	131.965053
Malaysia	-0.060023	0.072029	-0.000177	0.000000	0.008387	-0.089443	8.749501
Mexico	-0.111832	0.063828	0.000004	0.000268	0.015179	-0.820279	5.892722
Peru	-0.135610	0.101776	0.000086	0.000000	0.017744	-0.647662	7.360031
Philippines	-0.145108	0.079864	-0.000205	0.000000	0.013787	-1.073850	11.854512
Poland	-0.176497	0.111512	-0.000084	0.000000	0.018026	-0.783255	11.083411
Qatar	-0.138918	0.059800	0.000025	0.000000	0.010872	-1.175222	18.640150
South Africa	-0.123459	0.083486	-0.000085	0.000000	0.018709	-0.439172	3.734665
Taiwan	-0.072278	0.074452	0.000459	0.000000	0.012625	-0.177904	3.774273
Thailand	-0.118816	0.082628	-0.000222	0.000000	0.012027	-1.150678	17.711884
Türkiye	-0.191440	0.259425	-0.000069	-0.000111	0.023177	-0.074287	15.322731
UAE	-0.153985	0.085962	-0.000046	0.000000	0.011609	-1.699685	30.821229
Emerging Markets (Overall)	-0.069433	0.055818	0.000002	0.000464	0.010339	-0.487419	5.206457
Bitcoin	-0.464730	0.225119	0.001487	0.001084	0.043888	-0.776244	10.488053
Ethereum	-0.550732	0.353652	0.001381	0.000344	0.055679	-0.669482	9.395960
BNB	-0.543084	0.529218	0.003220	0.001692	0.062257	0.280173	13.368378
Cardano	-0.503652	0.886875	0.001534	-0.000737	0.075324	2.303425	26.257117
XRP	-0.550504	0.626740	0.000479	-0.000809	0.068290	1.220748	18.019450

To begin with, return of time series have been calculated through taking first difference of the natural logarithm of the closing prices. Mean and median values of all series in the study is close to zero. However, standard deviation of series are significantly higher compared to mean values of the series. This result coincides with random walk feature of time series in general (Ding & Vo, 2012). Higher standard deviation than mean value is sign of high volatility as well. In addition, the difference between minimum and maximum value of these time series are large enough. To illustrate, cryptocurrencies have minimum values around 50%. This means those coins have experienced 50% loss in a single day. Bitcoin, Ethereum, BNB, ADA, XRP gained in value 22%, 35%, 53%, 88%, 62% respectively. MSCI country indexes are less volatile compared to cryptocurrencies except Egypt and Kuwait. Minimum value of return of MSCI Egypt index is around 42% while this index appreciated around 12% in a single day. MSCI Kuwait index appreciated around 45% in single day while it depreciated around 22% in one day. Although MSCI country indexes are less volatile compared to cryptocurrencies, variability in those indexes are large as it is common in emerging markets. MSCI Kuwait, MSCI Colombia, MSCI Brazil, MSCI Türkiye has minimum value around -0.20. This means that those indexes have lost value around 20% in one day. On the other hand, they have maximum value around 0.20. Those indexes gained value around 20% in one day. MSCI Hungary, MSCI Poland, MSCI Chile, MSCI India, MSCI UAE, MSCI Philippines, MSCI Greece, MSCI Qatar, MSCI Peru and MSCI Czech have minimum index value around -0.15. This illustrates that those indexes have lost value around 15% in single day. Their value also increased around 10% in one day according to maximum value of those series. MSCI Thailand, MSCI Indonesia, MSCI Mexico, MSCI Korea, MSCI China, MSCI Taiwan and MSCI Malaysia indexes appreciate and depreciate around 7% to 10% in single day according to their maximum and minimum values. MSCI Emerging Market Index (overall index) depreciated around 7% and appreciated nearly 5.5% in one day according to minimum and maximum value obtained in the analysis. Those statistics prove volatility of cryptocurrencies and emerging stock markets. This outcome corroborates the results reported in the literature. It is asserted that emerging markets are more volatile compared to developed markets (Muguto & Muzindutsi, 2022). In addition, result of descriptive statistics support claim that cryptocurrencies can arise as potential hedging or safe haven asset candidates for emerging markets since both of them indicate high volatility (Baur, Hoang, & Hossain, 2022). This can also be viewed in graph of return series in Figure below.

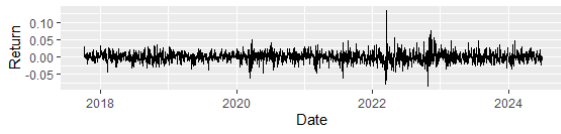
RBrazil



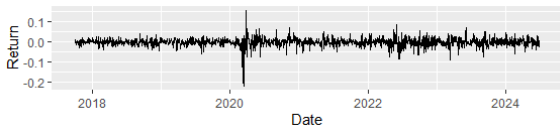
RChile



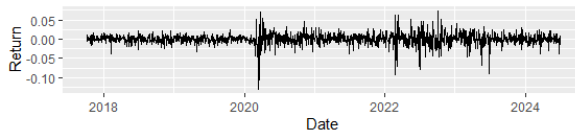
RChina



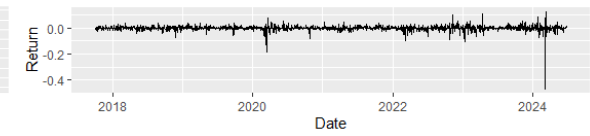
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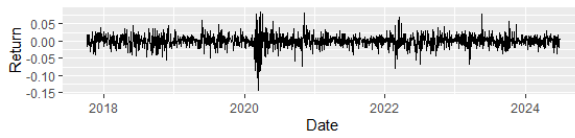
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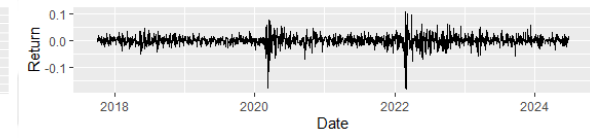
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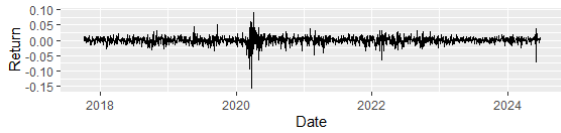
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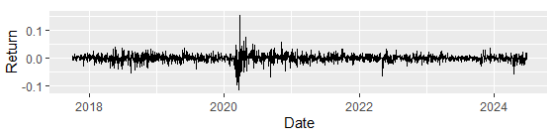
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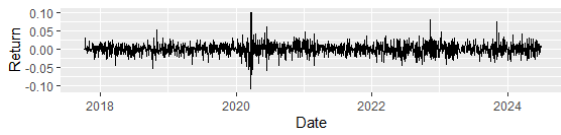
RIndia



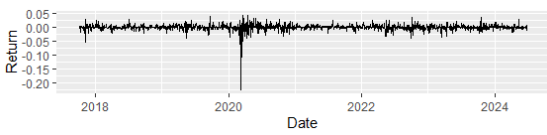
RIndonesia



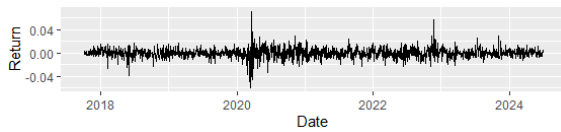
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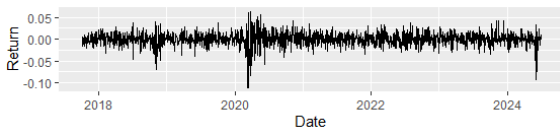
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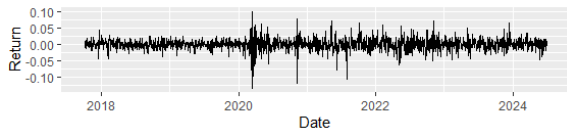
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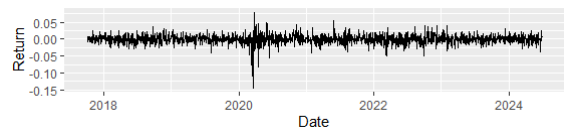
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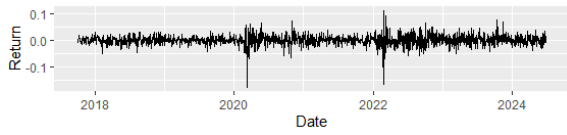
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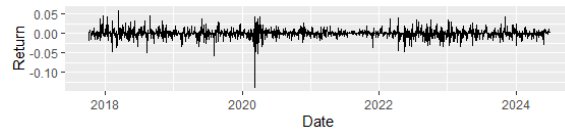
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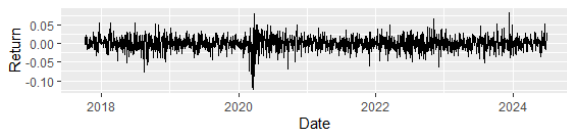
RPoland



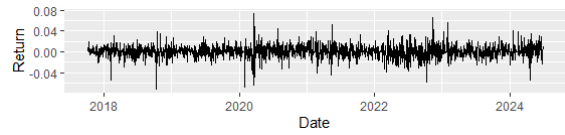
RQatar



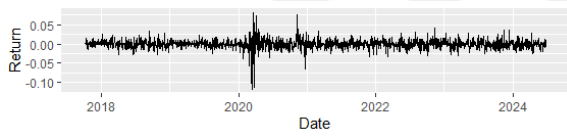
RSouth Africa



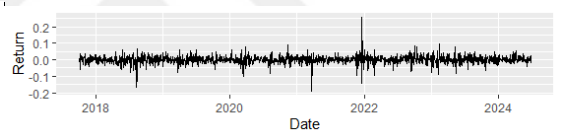
RTaiwan



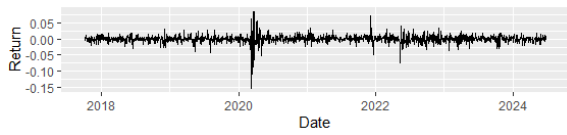
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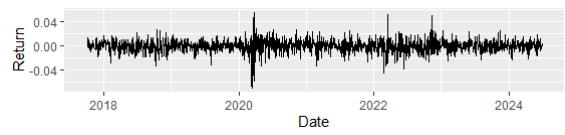
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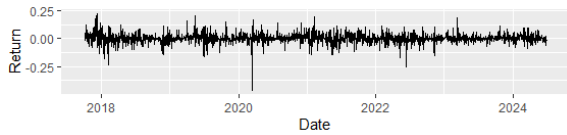
RUAE



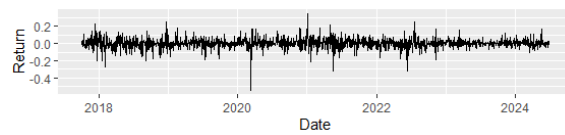
REmerging Markets



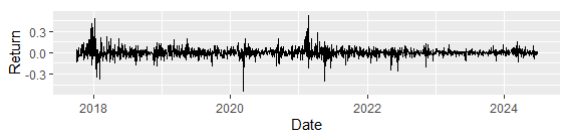
RBTC



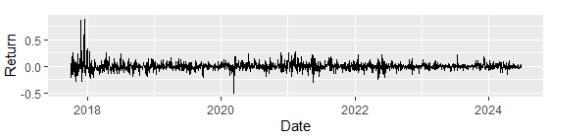
RETH



RBNB



RADA



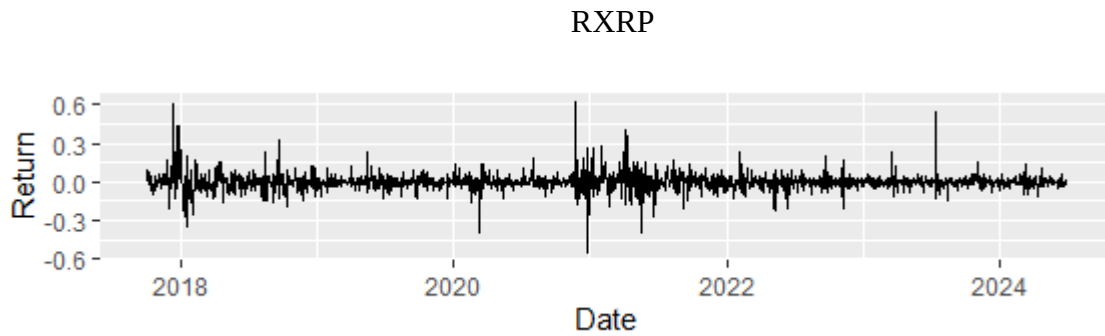


Figure 16: Dynamics of Daily Return Indices for Whole Period

MSCI Brazil, MSCI Chile, MSCI Colombia, MSCI Czech, MSCI Egypt, MSCI Greece, MSCI Hungary, MSCI India, MSCI Indonesia, MSCI Kuwait, MSCI Malaysia, MSCI Mexico, MSCI Peru, MSCI Philippines, MSCI Poland, MSCI Qatar, MSCI South Africa, MSCI Taiwan, MSCI Thailand, MSCI Türkiye, MSCI UAE, MSCI EM, Bitcoin and Ethereum are negatively skewed and they are left-tailed. MSCI China, MSCI Korea, BNB, Cardano and Ripple are positively skewed and they are right-tailed. All variables' kurtosis statistic are greater than 3. This indicate that series are steeper than normally distributed series. Those skewness and kurtosis statistics put forward that all series are not normally distributed. They all have leptokurtic distribution. To check this result, Jarque Bera Normality Test will be applied to all return series. Results can be seen in Table below. P-values of Jarque Bera statistics are almost zero. Null hypothesis which state that series has normal distribution is rejected. In other words; return series are not normally distributed as Jarque Bera Normality Test indicated (Jarque & Bera, 1987).

Variables do not have any trend and they look stationary from the graph of daily return index dynamics below. To test stationarity of return series; Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979), Phillips-Perron (PP) (Perron, 1988) have been applied to return series. In addition, KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test have been applied to return series in order to check presence of trend and stationarity (Asteriou & Hall, 2011). According to ADF, PP and KPSS tests, all series are stationary and there is no trend in the series. Because ADF and PP Tests' Null Hypothesis assert that series are nonstationary. Null hypothesis is rejected for all return series in ADF and PP tests. Series are stationary for all significance level according to ADF and PP tests. KPSS Test Null Hypothesis claim that series are stationary. We do not reject null hypothesis for KPSS test.

Series are stationary for all significance level except Türkiye. Türkiye is stationary for %5, %1 significance level.

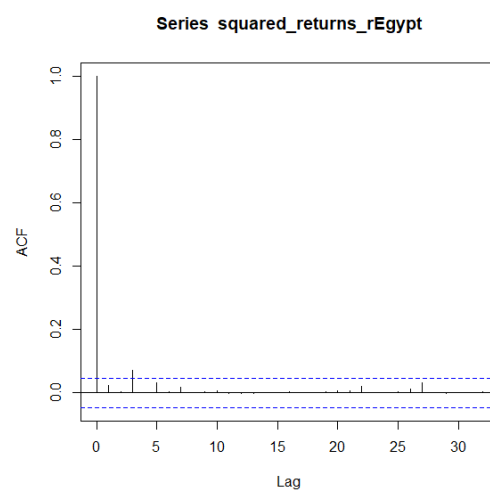
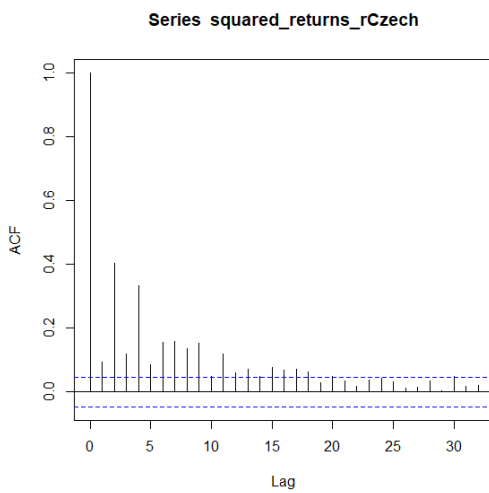
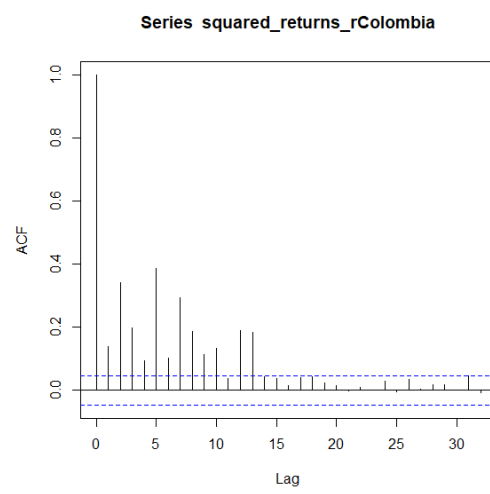
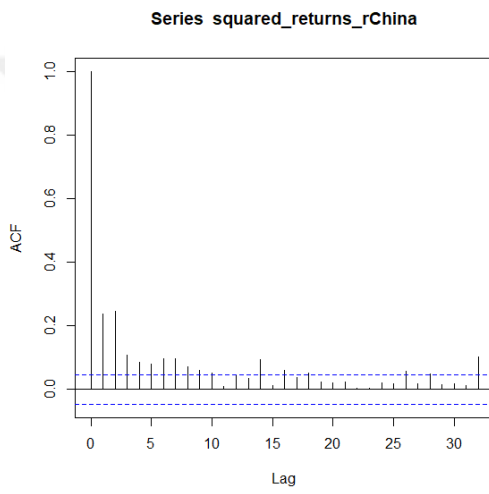
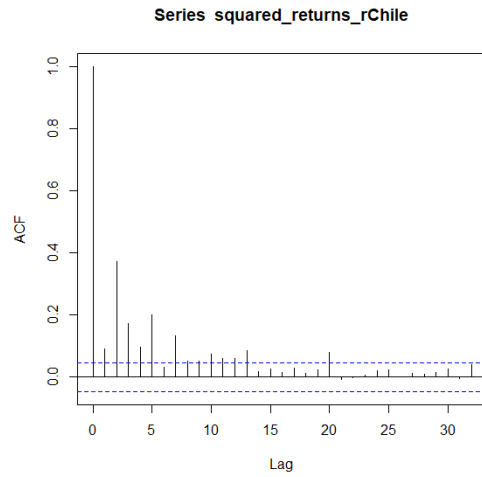
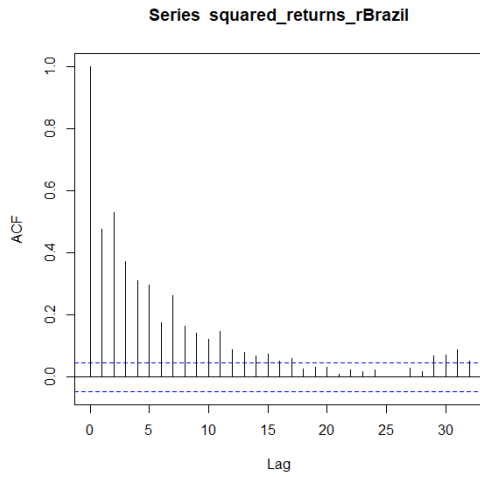
It is indicated in the Figure that mean of return series stay constant for observed period although returns are highly volatile. High variability is followed by high variability in the return series. Low volatility is followed by low volatility in the return series. This is called volatility clustering. Therefore, volatility clustering is observed in variables as it can be seen in dynamic graph of the return series above. For better indication of volatility clustering, Autocorrelation Function (ACF) and Box Pierce tests on squared returns have been applied to the return series (Box, Jenkins, Reinsel, & Ljung, 2015). Results are provided in Figure and Table below. According to ACF tests, statistical results are higher/lower than upper/lower limits except Egypt and Kuwait. Return of Egypt index shows only small autocorrelation between 0-5 lags. Kuwait index shows only small autocorrelation for 5 lag. We suspect lack of volatility clustering for Egypt and Kuwait index returns. This indicates strong dependence of squared returns and it can be clearly said that volatility clustering is present in the series except Egypt and Kuwait. In other words; ACF tests have shown that there is high autocorrelation in squared returns except return of Egypt and Kuwait. The return series except Egypt and Kuwait are suitable for modelling autoregressive models. Box Pierce test have been applied to the squared return series in order to detect variance clustering. Results can be seen Table below. Box Pierce test has null hypothesis stating that series have no autocorrelation. If we reject null hypothesis, we easily infer that series have autocorrelation. Box Pierce test statistics below indicate that all return series except Egypt and Kuwait return series have autocorrelation since p-value is smaller than 0.05. We reject null hypothesis for all return series except Egypt and Kuwait series. Therefore, presence of volatility clustering in the all return series except Egypt and Kuwait can be easily deduced from empirical results. However, we cannot reject null hypothesis for Egypt and Kuwait return index. This means that squared return series of Egypt and Kuwait do not have autocorrelation. We may infer that return series of Egypt and Kuwait do not have volatility clustering. Presence of volatility clustering enables to apply multivariate GARCH analysis to our return series. Therefore, according to AFC and Box-Pierce tests, multivariate GARCH analysis can be applied to all series in this study except Egypt and Kuwait index (He, Li, & Wang, 2016)

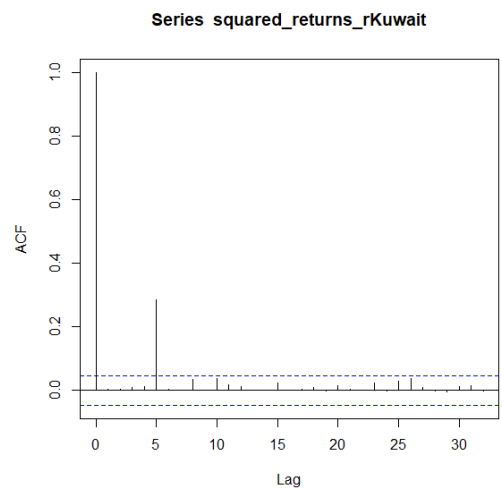
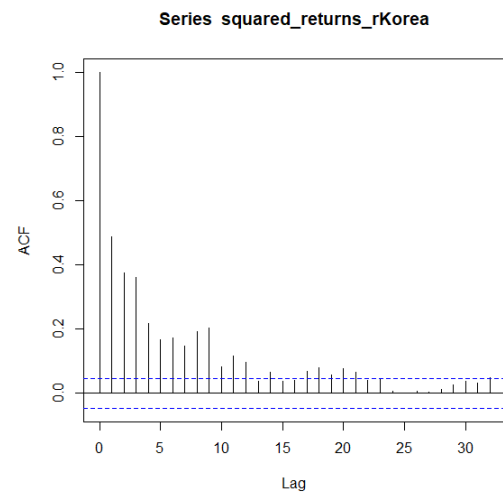
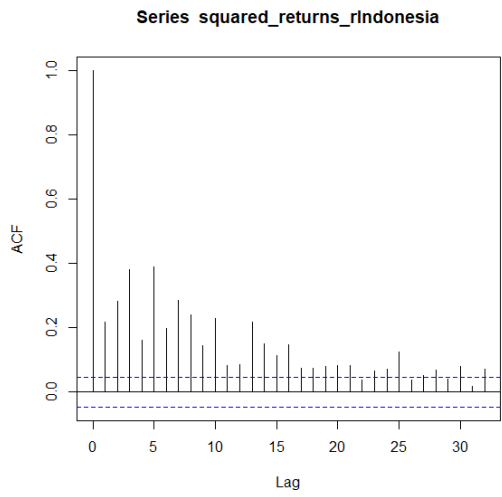
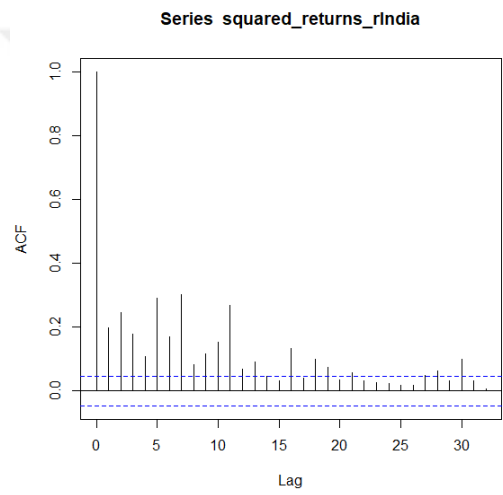
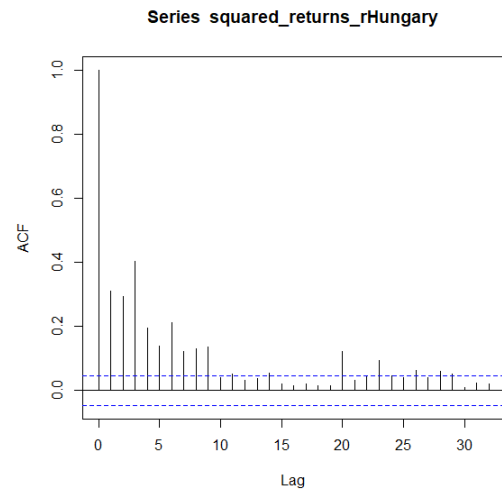
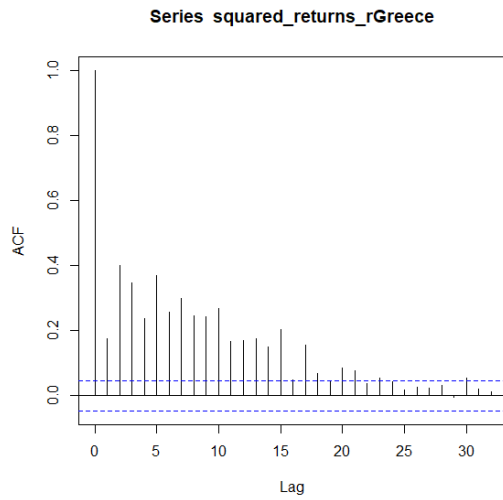
Table 14: Test Statistics for Stationarity, Normality and Volatility Clustering

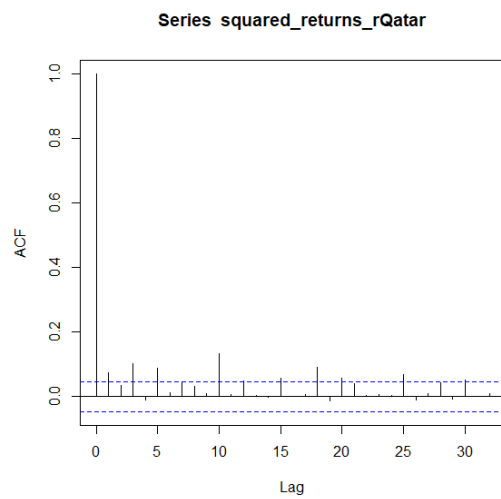
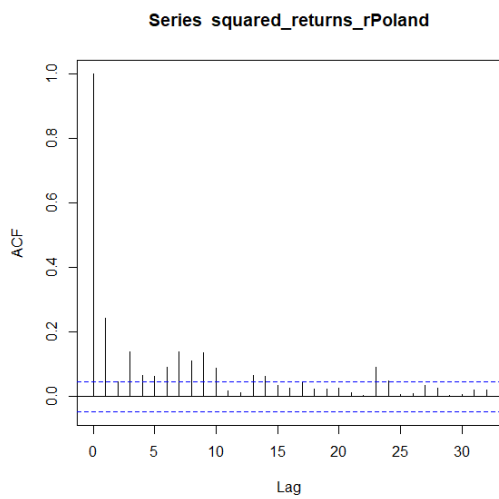
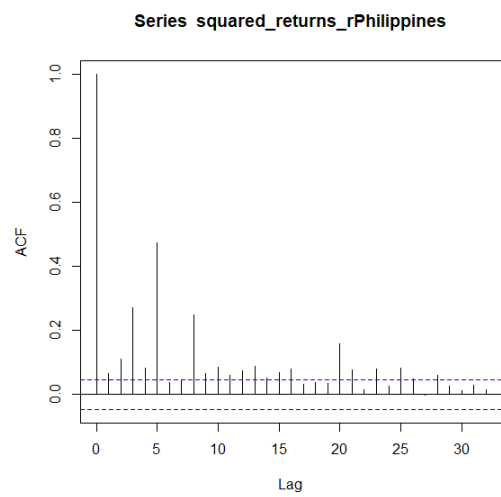
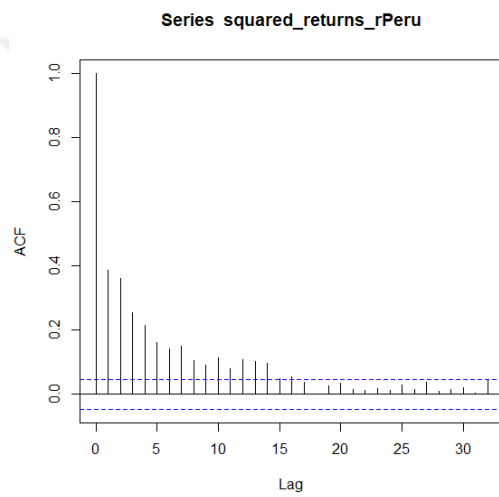
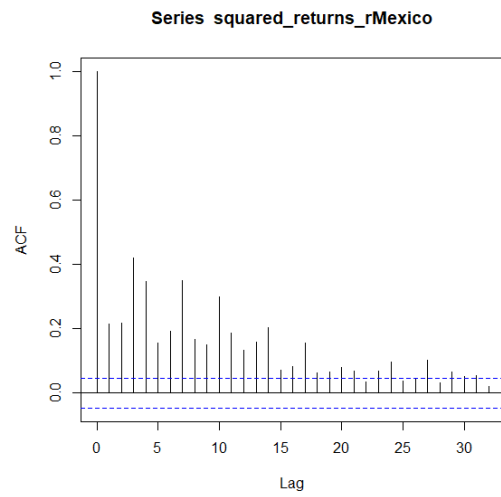
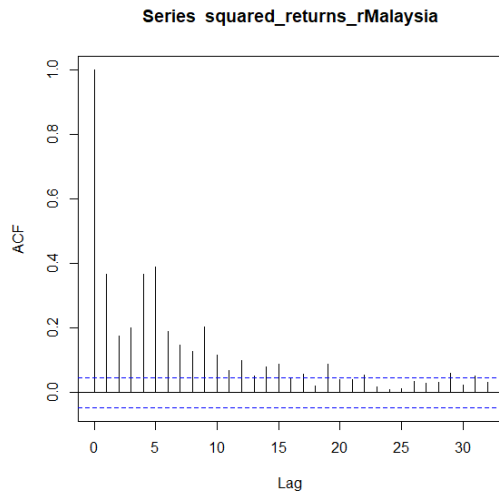
	ADF (Lag=12)	PP (Lag=8)	KPSS (Lag=8)	Jarque-Bera Statistics	Box-Pierce Statistics
RBrazil	-10.512 *** (p≤0.01)	-2006.6*** (p≤0.01)	0.023629 (p≥0.1)	12689*** (p≤2.2e-16)	397.95*** (p≤2.2e-16)
RChile	-11.447*** (p≤0.01)	-1650.3*** (p≤0.01)	0.046965 (p≥0.1)	6682.8*** (p≤2.2e-16)	14.254*** (p=0.0001597)
RChina	-11.766*** (p≤0.01)	-1514.9*** (p≤0.01)	0.10294 (p≥0.1)	2126.1*** (p≤2.2e-16)	98.739*** (p≤2.2e-16)
RColombia	-12.117*** (p≤0.01)	-1755.3*** (p≤0.01)	0.029892 (p≥0.1)	31158*** (p≤2.2e-16)	34.11*** (p=5.208e-09)
RCzech	-10.823*** (p≤0.01)	-1800.2*** (p≤0.01)	0.06558 (p≥0.1)	11215*** (p≤2.2e-16)	15.543*** (p=8.064e-05)
REgypt	-11.078*** (p≤0.01)	-1779.6*** (p≤0.01)	0.041049 (p≥0.1)	2133322*** (p≤2.2e-16)	0.99659 (p=0.3181)
RGreece	-10.926*** (p≤0.01)	-1775*** (p≤0.01)	0.13783 (p≥0.1)	4735*** (p≤2.2e-16)	54.571*** (p=1.5e-13)
RHungary	-11.572*** (p≤0.01)	-1707.4*** (p≤0.01)	0.067211 (p≥0.1)	17211*** (p≤2.2e-16)	168.38*** (p≤2.2e-16)
RIndia	-10.45*** (p≤0.01)	-1988.1*** (p≤0.01)	0.11252 (p≥0.1)	36245*** (p≤2.2e-16)	68.983*** (p≤2.2e-16)
RIndonesia	-11.373*** (p≤0.01)	-1762*** (p≤0.01)	0.030735 (p≥0.1)	17466*** (p≤2.2e-16)	83.116*** (p≤2.2e-16)
RKorea	-12.053*** (p≤0.01)	-1937.8*** (p≤0.01)	0.064618 (p≥0.1)	1791.2*** (p≤2.2e-16)	418.91*** (p≤2.2e-16)
RKuwait	-11.083*** (p≤0.01)	-1714*** (p≤0.01)	0.064953 (p≥0.1)	1291863*** (p≤2.2e-16)	0.0056822 (p=0.9399)
RMalaysia	-11.181*** (p≤0.01)	-1877.6*** (p≤0.01)	0.040513 (p≥0.1)	5630.3*** (p≤2.2e-16)	235.74*** (p≤2.2e-16)
RMexico	-10.954*** (p≤0.01)	-1605.2*** (p≤0.01)	0.11316 (p≥0.1)	2751.3*** (p≤2.2e-16)	80.849*** (p≤2.2e-16)
RPeru	-11.422*** (p≤0.01)	-2008.3*** (p≤0.01)	0.11793 (p≥0.1)	4106.1*** (p≤2.2e-16)	262.53*** (p≤2.2e-16)
RPhilippines	-12.067*** (p≤0.01)	-1892.7*** (p≤0.01)	0.022924 (p≥0.1)	10668*** (p≤2.2e-16)	7.5095*** (p=0.006137)

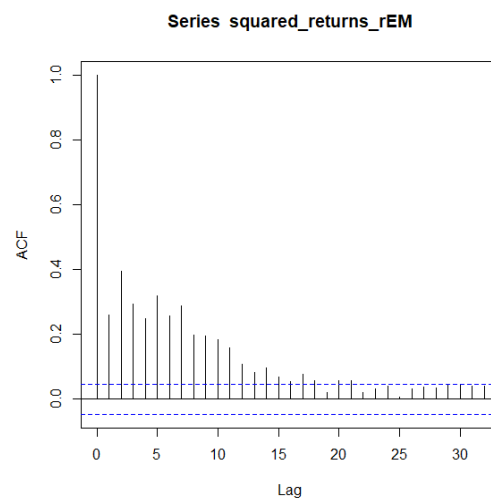
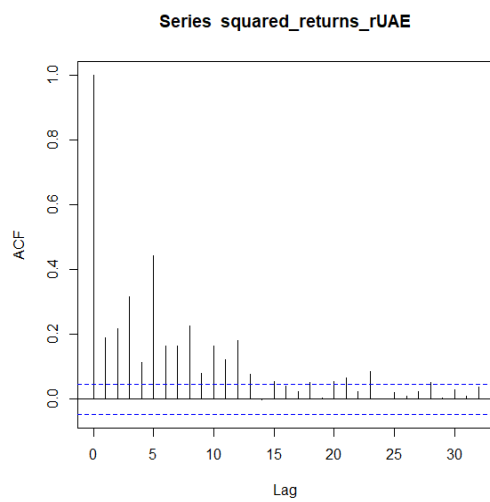
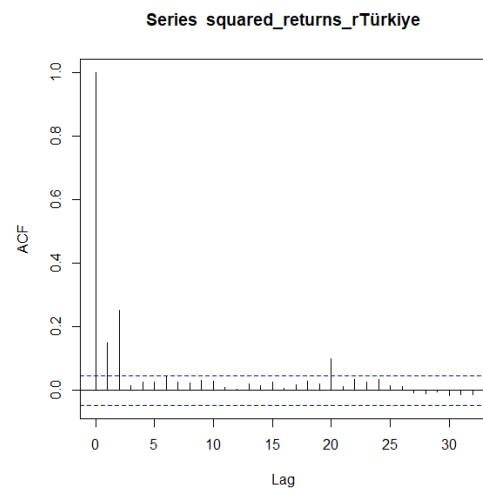
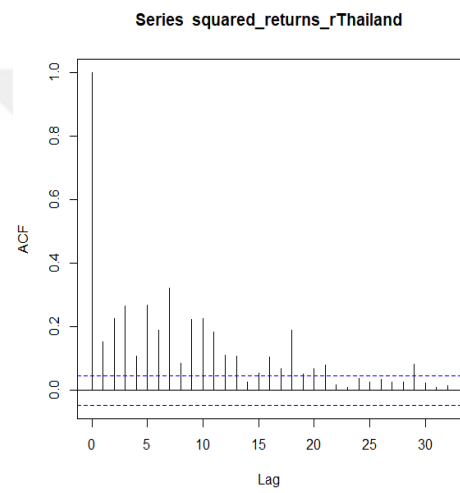
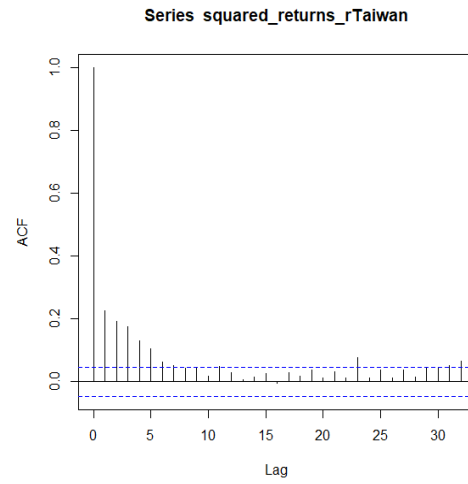
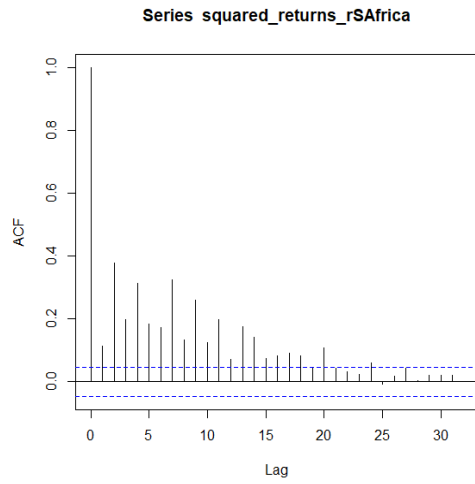
	ADF (Lag=12)	PP (Lag=8)	KPSS (Lag=8)	Jarque-Bera Statistics	Box-Pierce Statistics
RPoland	-11.041*** (p≤0.01)	-1818.3*** (p≤0.01)	0.13533 (p≥0.1)	9209.5*** (p≤2.2e-16)	102.46*** (p≤2.2e-16)
RQatar	-12.575*** (p≤0.01)	-1733.4*** (p≤0.01)	0.13183 (p≥0.1)	25938*** (p≤2.2e-16)	9.2674*** (p=0.002333)
RSouth Africa	-12.135*** (p≤0.01)	-1640.3*** (p≤0.01)	0.030419 (p≥0.1)	1083.1*** (p≤2.2e-16)	22.584*** (p=2.011e-06)
RTaiwan	-11.16*** (p≤0.01)	-1794.3*** (p≤0.01)	0.11391 (p≥0.1)	1057.6*** (p≤2.2e-16)	88.544*** (p≤2.2e-16)
RThailand	-10.642*** (p≤0.01)	-2057.5*** (p≤0.01)	0.057419 (p≥0.1)	23442*** (p≤2.2e-16)	41.149*** (p=1.411e-10)
RTürkiye	-11.873*** (p≤0.01)	-1719.7*** (p≤0.01)	0.34829* (p=0.09945)	17256*** (p≤2.2e-16)	38.808*** (p=4.676e-10)
RUAE	-10.763*** (p≤0.01)	-1763.1*** (p≤0.01)	0.10876 (p≥0.1)	70646*** (p≤2.2e-16)	62.163*** (p=3.109e-15)
REmerging Markets	-11.375*** (p≤0.01)	-1648.4*** (p≤0.01)	0.055821 (p≥0.1)	2063.6*** (p≤2.2e-16)	117.41*** (p≤2.2e-16)
RBTC	-10.399*** (p≤0.01)	-1895.4*** (p≤0.01)	0.072663 (p≥0.1)	8262.6*** (p≤2.2e-16)	7.073*** (p=0.007826)
RETH	-10.427*** (p≤0.01)	-1931.3*** (p≤0.01)	0.11207 (p≥0.1)	6621.6*** (p≤2.2e-16)	10.991*** (p0.0009155)
RBNB	-9.6593*** (p≤0.01)	-1780.2*** (p≤0.01)	0.14847 (p≥0.1)	13158*** (p≤2.2e-16)	67.324*** (p=2.22e-16)
RADA	-8.8278*** (p≤0.01)	-1931.6*** (p≤0.01)	0.14995 (p≥0.1)	52216*** (p≤2.2e-16)	80.183*** (p≤2.2e-16)
RXRP	-10.532*** (p≤0.01)	-1883.2*** (p≤0.01)	0.041332 (p≥0.1)	24299*** (p≤2.2e-16)	27.344*** (p=1.703e-07)

Note: ADF and PP Tests' Null Hypothesis: Series are nonstationary. Null hypothesis is rejected for all return series in ADF and PP tests. Series are stationary for all significance level. KPSS Test Null Hypothesis: Series are stationary. Do not reject null hypothesis. Series are stationary for all significance level except Turkey. RTürkiye is stationary for %5, %1 significance level. Box-Pierce Tests' Null Hypothesis: Series have no autocorrelation. P value is smaller than 0.05 for all series except return Egypt and return Kuwait. Squared return of series have autocorrelation except return Egypt and return Kuwait. Jarque Bera tests' null hypothesis states that series have normal distribution. Since p-values are smaller than 0.05, null hypothesis is rejected. Series are not normally distributed. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.









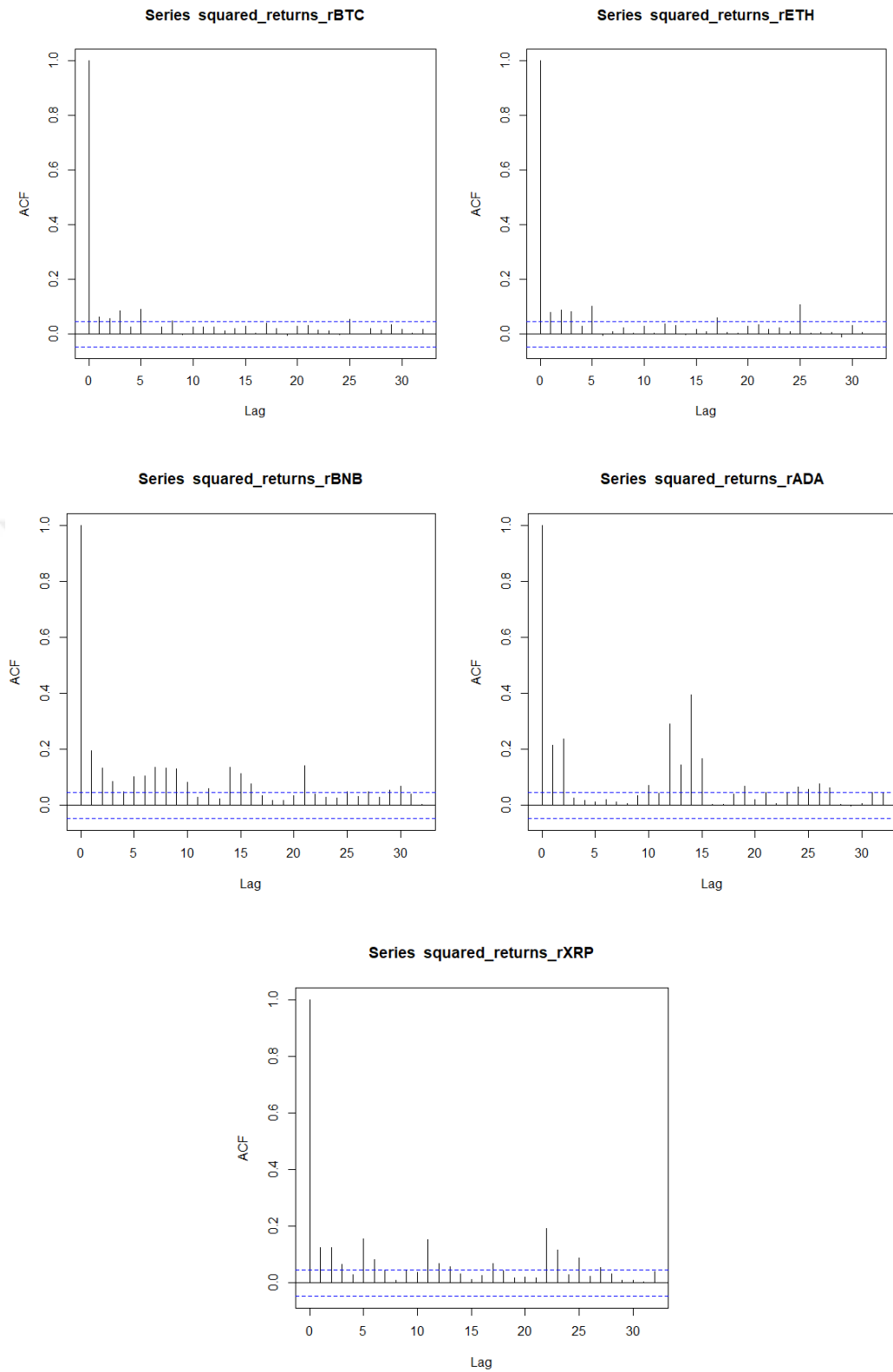


Figure 17: ACF Statistics for Squared Returns

In order to run multivariate GARCH analysis, presence of ARCH effect is compulsory for all series. ARCH effect is actually conditional heteroscedasticity. The variance of the current period is modelled as a function of past squared returns (Engle R. F., 1982). GARCH model is generalized version of ARCH model. Therefore, GARCH model is derivative of Autoregressive Conditional Heteroscedasticity model. Therefore, to run any type of GARCH model, conditional heteroscedasticity (ARCH effect) has to be present in time series (Tsay, 2010). There are two types of tests to detect whether there is ARCH effect or not. One of them is McLeod and Li test (Ljung-Box Q-statistics) (McLeod & Li, 1983). Another one is ARCH Lagrange Multiplier (LM) test which is developed by Engle (1982). ARCH LM test is mostly used test for detecting ARCH effect in the literature (Charfeddine, Benlagha, & Maouchi, 2020). Thus, ARCH LM test will be applied for determining presence of ARCH effect in this study parallel to the literature. ARCH LM tests' null hypothesis states that there is no ARCH effect. If null hypothesis is rejected then presence of ARCH effect is proven. ARCH LM test results are provided in Table below. P values for all return series are smaller than 0.05 except return Egypt. We reject null hypothesis stating that there is no ARCH effect for all return series except return Egypt. This result indicates that all return series except return Egypt have ARCH effect. Therefore, multivariate GARCH analysis can be applied to all series except return Egypt.

Table 15: ARCH LM Test Statistics

	Chi-Squared	P-Value		Chi-Squared	P-Value
RBrazil	660.48***	(p<2.2e-16)	RPhilippines	531.34***	(p<2.2e-16)
RChile	302.11***	(p<2.2e-16)	RPoland	180.46***	(p<2.2e-16)
RChina	180.14***	(p<2.2e-16)	RQatar	72.054***	(p=1.32e-10)
RColombia	446.5***	(p<2.2e-16)	RSouth Africa	428.08***	(p<2.2e-16)
RCzech	385.19***	(p<2.2e-16)	RTaiwan	154.37***	(p<2.2e-16)
REgypt	12.326	(p=0.4198)	RThailand	419.19***	(p<2.2e-16)
RGreece	499.01***	(p<2.2e-16)	RTürkiye	144.7***	(p<2.2e-16)
RHungary	409.13***	(p<2.2e-16)	RUAE	480.47***	(p<2.2e-16)
RIndia	433.18***	(p<2.2e-16)	REmerging Markets	426.56***	(p<2.2e-16)
RIndonesia	491.56***	(p<2.2e-16)	RBTC	39.327***	(p=9.295e-05)
RKorea	542.46***	(p<2.2e-16)	RETH	48.092***	(p=3.013e-06)
RKuwait	147.12***	(p<2.2e-16)	RBNB	139.04***	(p<2.2e-16)
RMalaysia	473.79***	(p<2.2e-16)	RADA	289.62***	(p<2.2e-16)
RMexico	493.62***	(p<2.2e-16)	RXRP	121.07***	(p<2.2e-16)
RPeru	373.51***	(p<2.2e-16)			

Note: ARCH LM tests' null hypothesis: There is no ARCH effect. Since p value is smaller than 5%, null hypothesis is rejected for all return series except Egypt. Degrees of freedom is 12 for all return series. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

To summarize; return series in the study exhibit classical properties of times series. It is proven with skewness-kurtosis statistics and Jarque-Bera tests that return series are not normally distributed. Return series data exhibit high volatility. ACF and Box-Pierce tests put forward that return series have volatility clustering. ADF, PP and KPSS tests clearly exhibited that return series are stationary. ARCH LM tests have proven presence of ARCH effect in the series. Returns of Egypt and Kuwait indexes do not meet volatility clustering condition of multivariate GARCH. Return of Egypt index does not provide presence of ARCH effect condition which is compulsory for multivariate GARCH analysis. Therefore; we cannot apply DCC GARCH method to Egypt and Kuwait indexes. Egypt and Kuwait indexes will not be analysed after this stage of the study. DCC GARCH analysis will be applied to remaining 27 variables in the study.

Part 4.2 Methodology and Empirical Analysis

Correlation and volatility are two main concerns in financial management when creating portfolios. In order to put hedging or diversifier assets into portfolio, financial managers or investors should have data and information on correlation among assets. Therefore, correlation information is needed for allocation of assets and hedging purposes. In addition, data and information on volatility which refers to variance (standard deviation) in finance is necessary for creating modern portfolio today.

Volatility or variability is measured by variance or standard deviation (Markowitz, Portfolio Selection, 1952). Mandelbrot (1963) asserts that small variations are followed by small changes while major variations are followed by major changes. This phenomena is called volatility clustering and it implies that volatility is time varying. On the other hand, linear regression models assume that error terms have constant variance. Therefore, linear regression models are ineffective when making estimation. In other words, variance of error term changes through observations with explanatory variables and this creates heteroscedasticity problem in estimation. It is put forward that changing variance (non-constant variance of error term) problem is observed in time series data in finance (Engle R. F., 1982). Variance of series changes. Assumption of constant variance in series does not hold. Therefore, it is necessary to identify and eliminate varying variance to do effective and robust estimation. The problem of varying variance develops autoregressively in financial time series. This varying variance is modelled and included in univariate and multivariate autoregressive models. The problem of varying variance autoregressively has been put forward and modelled by Engle (1982). Engle has proven that error terms vary small and large amounts in inflation models. Many models have been developed to solve this problem in estimations.

As stated above, financial time series usually does not satisfy constant variance condition and heteroscedasticity problem arises. Ordinary Least Square (OLS) method assumes that expected value of the variance of all error terms are same and constant for each value of the variable. This is called homoscedasticity in OLS and estimation is made on homoscedasticity assumption. However, significant increase and decrease are observed in financial time series and error terms are affected from those variations. Therefore, error terms do not have constant variance. The fact that the variance varies for each value of the variable is called "heteroscedasticity". In addition, volatility is auto correlated. It means that volatility

is influenced by past volatility. Therefore; varying volatility should be estimated and included to model in order to get robust and good fitting model.

Engle (1982) developed Autoregressive Conditional Heteroscedasticity (ARCH) method to model series which have heteroscedasticity problem because OLS method cannot estimate effectively and robustly in case of non-constant variance. ARCH model does not lean on constant variance assumption. ARCH method adds variance of error terms as a function of past variance of error terms to model. In other words; variance of error terms are modelled through a function instead of being taken as constant in ARCH model. However, ARCH model is subjected to criticisms. It is criticised that ARCH model's reaction to shock is slow so it overestimates volatility. In addition; negative and positive shocks are equally treated in ARCH model but in real life positive and negative shocks have asymmetric influence. ARCH model only concentrates on behaviour of variance of error term but it does not provide explanations for shocks in financial returns. Lastly, coefficients in ARCH model have strict restrictions

Another model that accounts for volatility clustering is Generalized Autoregressive Conditional Heteroscedasticity (GARCH) (Bollerslev, Generalized autoregressive conditional heteroskedasticity, 1986). ARCH model have some restrictions such as using fixed lag structure and relatively long lags. In addition, there is possibility to reaching negative variance in ARCH models. Due to this disadvantages of ARCH model, the model has been expanded as GARCH. GARCH model provides flexibility with respect to lags. GARCH model puts forward a simple function for time-varying volatility. ARCH model captures volatility clustering with large number of lags. This causes increase in number of parameters to be estimated in ARCH model. On the other hand, GARCH model can capture volatility clustering even a single lag. Therefore GARCH model is preferred to ARCH model. GARCH model is obtained through adding lags of conditional variance to ARCH model (Bollerslev, 1987).

Forecast of covariance matrix is needed in addition to correlation among financial variables in risk management. Dependency among returns of assets should be estimated. To illustrate, covariance of assets in the portfolio is necessary for valuation of assets. Co-movements among assets in the portfolio should be taken into consideration. Univariate ARCH and GARCH models do not satisfy these conditions. Therefore; multivariate GARCH models have been developed. Multivariate GARCH models makes easier to analyse conditional variance and conditional correlation by taking more than one variable into

consideration. Multivariate GARCH models enable to study volatility dependency or relationship between volatilities across markets or assets. In other words, those models try to answer whether volatility is contagious or not across markets-assets. Multivariate GARCH models try to answer whether a shock which creates volatility transmit this volatility on another asset through conditional variance/covariance or not. Similarly, time-varying correlations among assets is another issue dealt by multivariate GARCH models. Those kind of studies have been made by adopting multivariate GARCH models with the help of specification of dynamic correlation/covariance (Bauwens, Laurent, & Rombout, 2006).

In short, multivariate GARCH models are based on modelling conditional variances/correlations rather than simply creating conditional covariance matrix. The first multivariate GARCH model is VEC-GARCH model. This VEC-GARCH model is developed through applying Vec parametrization solution technique to univariate ARCH/GARCH model. This is suitable for analysing risk structure of single asset or market (Bollerslev, Engle, & Wooldridge, 1988). However, VEC-GARCH model is difficult to apply since it has large number of parameters. To illustrate, bivariate VEC-GARCH model include 21 parameters. This makes model forecast difficult. In order improve VEC-GARCH model, Diagonal VEC GARCH model has been developed (Bollerslev, Engle, & Wooldridge, 1988). In many models, variance, covariance and correlation matrix are required to be positive. Diagonal VEC GARCH model cannot guarantee this condition for all circumstances. Therefore, Diagonal VEC GARCH model cannot be applied under all scenarios. Engle & Kroner (1995) has developed BEKK GARCH model to satisfy condition of positive conditional variance matrix. BEKK GARCH model has also large number of parameters. This creates difficulty when using the model and making estimations with the model. To overcome problem of large number of parameters, Constant Conditional Correlation (CCC) GARCH model has been developed (Bollerslev, 1990). CCC GARCH Model has been developed and used to decrease large number of parameters in multivariate GARCH models and to make estimation easier. In this model, conditional correlation is constant while conditional covariance is varying. CCC GARCH model assumes that conditional correlations are not time-varying and they are assumed constant. However, this assumption is not realistic because conditional correlations could be time-varying. To overcome problem of constant conditional correlations, Dynamic Conditional Correlation GARCH model has been developed by Engle (2002) and (Tse & Tsui, 2002).

To summarize, univariate ARCH/GARCH models try to model volatility for single variable or asset. ARCH/GARCH which is used for modelling volatility of a single asset remains inadequate for modelling volatility of more than one asset. However, today co-movements or dependencies are experienced across several financial markets and assets. In other words, relationships and interactions are observed among financial assets today. Therefore, multivariate models are needed to analyse correlation and volatility across financial markets and assets. Main difference between univariate ARCH/GARCH models and multivariate ARCH/GARCH models arise calculation of conditional variance and conditional covariance. Univariate ARCH/GARCH model only calculate and obtain conditional variance while multivariate ARCH/GARCH model calculate and obtain both conditional variance and conditional covariance. Those models are VEC GARCH and BEKK GARCH. In addition to conditional variance, CCC GARCH model took conditional correlation into consideration when modelling. However, constant conditional correlation assumption does not fit to reality in empirical studies. To overcome this problem, DCC GARCH model has been developed and conditional correlation has been adopted as time-varying in the model. DCC GARCH model has been forecasted through Maximum Likelihood methodology.

In this study, we scrutinize hedging capabilities of cryptocurrencies for emerging markets. To make this study, we need to clarify what we means by phrase “hedging”. In literature, nearly all of the studies adopt definition of Baur & Lucey (2010). To illustrate, Bouri et al. (2017), Mariana et al (2021), Dutta et al. (2020), Baur et al. (2022), Brière et al. (2015), Będowska-Sójka & Kliber (2021), Chan et al. (2019), Chemkha et al. (2021), Corbet et al. (2020), Dyhrberg (2016), Goodell & Goutte (2021), Guesmi et al. (2019), Huang et al. (2021), Jeribi et al. (2021), Ji et al. (2020), Jiang et al. (2021), Kajtazi & Moro (2019), Klein et al. (2018), Kliber (2022), Maitra et al. (2022), Mensi et al. (2020), Okoroafor & Leirvik (2023), (Pengfei et al. (2019), Riahi et al. (2024), Shahzad et al. (2019), Stensås et al. (2019), Thampanya et al. (2020), Tiwari et al. (2019), Xu & Kinkyo (2023) many other studies adopted definitions of Baur & Lucey (2010). Baur & Lucey (2010) provided definitions for phrases which are diversifier, hedge and safe haven for the first time in the literature. In addition, these authors determined testable criteria for those definitions. By applying testable criteria to assets, it becomes possible to determine characteristics of an asset whether it is diversifier, hedge or safe haven with respect to another asset. The definitions are given below:

“A **diversifier** is defined as an asset that is positively (but not perfectly) correlated with another asset or portfolio on average.

A **hedge** is an asset that is uncorrelated or negatively correlated with another asset or portfolio on average. A strict hedge is (strictly) negatively correlated with another asset or a portfolio on average.

A **safe haven** is defined as an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil.”

Baur & McDermott (2010) improved those definitions by making a certain distinction between strong and weak form of hedge as followed:

“A **strong (weak) hedge** is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio on average.

A **strong (weak) safe haven** is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio in certain periods only, e.g. in times of falling stock markets.”

As it can be understood easily definitions from above, there is similarity between phrases hedge and safe haven because both definitions ask non-correlation or negative correlation among assets under investigation. However, to call an asset as hedge asset, it has to be negatively correlated (uncorrelated) with another asset or portfolio on average rather than specific period of time such as extreme shocks. Therefore, an asset could be named as safe haven asset if it is negatively correlated or uncorrelated with another asset under extreme market conditions such as Covid-19 period. However, correlation among assets could be positive or negative on average in stable market conditions. Therefore, safe haven property of an asset could be examined for specific period of time. We will stick to definitions of “hedge”, “diversifier” and “safe haven” in the literature in this study.

As it is explained above, in order to determine hedging capabilities of cryptocurrencies with respect to emerging markets, correlation among those markets and cryptocurrencies must be examined. Therefore, correlations among many variables which have heteroscedasticity problem should be scrutinized. There are multivariate GARCH methods examining variability such as VEC-GARCH and BEKK GARCH, CCC GARCH. First of all, number of parameters to be estimated is large for models stated above. This makes optimization difficult. However, Dynamic Conditional Correlation (DCC) GARCH

does not have complexity of other multivariate GARCH models. DCC GARCH has flexibility of univariate GARCH and it is easy to apply. DCC GARCH is mainly estimated through two steps. In the first step, univariate GARCH is estimated. In the second step, DCC GARCH is estimated by employing inputs of first step. Number of parameters to be estimated for correlation do not have link with number of series to be correlated in DCC GARCH model. DCC GARCH makes very large correlation matrix to be estimated possible. This creates computational advantage for DCC GARCH method over other multivariate GARCH models (Engle R. , 2002). In addition, VEC-GARCH, BEKK GARCH, CCC GARCH model can cause convergence problems and unreasonable parameter estimates (Bouri, Jalkh, Molnár, & Roubaud, 2017). Lastly, CCC GARCH model has constant conditional correlation limitation although DCC GARCH obtains conditional correlation as time-varying. It is proven that CCC-GARCH is not capable of determining co-movements and interdependency across several assets and markets (Hafner & Reznikova, 2012). Moreover, conditional correlation between cryptocurrencies and stock markets is not constant, it is dynamic (Klein, Thu, & Walther, 2018).

In addition, univariate GARCH models are inadequate for estimating correlation and covariance matrix which is necessary to estimate due to interdependency among assets or markets. In order to create an optimal portfolio with many restrictions, estimation of covariance matrix of all assets is needed. Similarly, to find standard deviation or variance of portfolio, covariance matrix of assets is required. This causes large number of correlations to be calculated.

To summarize, as noted earlier, the DCC GARCH model provides numerous benefits over both univariate and multivariate GARCH models. DCC GARCH makes possible to determine conditional time-varying correlation across several assets and markets. It retains the versatility of univariate GARCH models and lacks the intricate complexity of multivariate GARCH models. It has clear computational advantages. It makes possible to capture correlation between cryptocurrencies and other assets. Correlation coefficients of standardized residuals are estimated through application of DCC GARCH model and heteroscedasticity is taken into consideration directly in this way (Chiang, Jeon, & Li, 2007). The DCC GARCH model is less prone to convergence problems and unrealistic parameter estimates compared to other multivariate GARCH models such as BEKK GARCH and VEC GARCH. For all reasons stated above, we selected DCC GARCH model as method of this study. For the purpose of this study, it is the most convenient model as method. This method

is vastly used by many authors in the literature in order to observe correlation between cryptocurrencies and assets/markets. To illustrate; Agata Kliber et al. (2019), Stensås et al. (2019), Będowska-Sójka & Kliber (2021), Mariana et al. (2021), Dutta et. all (2020), Belhassine & Karamti (2021), Guesmi et. all (2019), Akhtaruzzaman et al. (2020), Chkili et al. (2021), Corbet et al. (2020) and Chemka et al. (2021) are some studies adopt DCC GARCH method in the analysis.

DCC-GARCH model will be applied in two stages in this study. In the first step, univariate GARCH (p, q) model will be estimated. In the second step, time-varying conditional correlations will be estimated by employing standardized residuals produced from first step.

Mean equation of the DCC model is provided below:

$$r_t = \mu_t + \omega \cdot r_{t-1} + \epsilon_t \quad (1)$$

Where

r_t : Vector of the price return of cryptocurrencies and stock indices. (Return is calculated by taking first difference of the logarithm of closing prices)

μ_t : Conditional mean vector of returns,

ϵ_t : Vector of the standardized residuals

Then variance equation becomes as:

$$h_t = c + \alpha \epsilon_{t-1}^2 + b h_{t-1} \quad (2)$$

Where

h_t : Conditional variance

c : Constant

α : Parameter capturing the short-run persistence or the ARCH effect

b : Long-run persistence of volatility or the GARCH effect

DCC equation which is square positive-definite matrix is estimated by equation below:

$$Q_t = (1-\alpha-\beta) \bar{Q} + \alpha \epsilon_{t-1} \epsilon'_{t-1} + \beta Q_{t-1} \quad (3)$$

Where

Q_t : Time-varying unconditional correlation matrix of ϵ_t

ϵ_t : Vector of standardized residuals generated through the first-step estimation of the GARCH process

α and β : Parameters that represent, respectively the effects of previous shocks and previous DCCs on the current DCC

α and β should be greater than zero ($\alpha > 0$ and $\beta > 0$)

$\alpha + \beta < 1$ condition should be satisfied. It implies that DCC estimation is stationary.

DCC between assets i and j is computed as followed in equation 4:

$$\rho_{ij, t} = \frac{q_{ij, t}}{\left(\sqrt{q_{ii, t}} \sqrt{q_{jj, t}} \right)}$$

After DCC has been computed using equations and formulas above, we will obtain pairwise dynamic conditional correlations from DCC model as separate time series. Later on, those time series will be regressed on dummy (D) variables. Dummy variables represent shocks or extreme volatilities in the lower 10th, 5th or 1st percentile of the return distribution as followed.

$$DCC_t = m_0 + m_1 D(r_{\text{other asset}} q_1) + m_2 D(r_{\text{other asset}} q_5) + m_3 D(r_{\text{other asset}} q_{10}) + v_t \quad (5)$$

Where

DCC_t : Pairwise conditional correlation between cryptocurrencies and stock indices

$r_{\text{other asset}}$: Return of other assets

v_t : Error term

Results will be interpreted as follows:

- If m_0 is significantly positive, then the cryptocurrency is a good diversifier against other asset (stock indices)
- If m_0 is zero, then the cryptocurrency is a weak hedge against other asset (stock indices)
- If m_0 is significantly negative, then the cryptocurrency is a strong hedge against other asset (stock indices)
- If parameters m_1 , m_2 and m_3 are insignificantly different from zero, then cryptocurrency is a weak safe haven against other asset (stock indices)
- If parameters m_1 , m_2 and m_3 are significantly negative, then cryptocurrency is a strong safe haven against other asset (stock indices)

To begin with, univariate GARCH (p , q) model will be estimated. p and q in the parenthesis mean number of lags for conditional variance and squared residuals respectively. GARCH (1, 1) model is mostly used in the literature since it carries certain properties of volatility clustering and it is easy and efficient to compute. It provides balance between being effective and being practice. It makes estimation quiet easy and it holds most of the necessary properties of volatility clustering which is common in financial time series. To illustrate, Stensås et al. (2019), Bouri et al. (2017), Baur & McDermott (2010), Mariana et al. (2021), Dutta et al. (2020), Charfeddine et al. (2020), Karanasos et al. (2018), Yousaf et al. (2024), Sha & Song (2021), Bampinas & Panagiotidis (2024), (Dyhrberg, 2016), Akin et al. (2023), Wang et al. (2024), Salem et al. (2024), Wang et al. (2020), Just & Echaust (2024) and many other studies adopted GARCH (1,1) due to its computational advantage and fitness to DCC GARCH analysis for financial time series. To further verification of GARCH (1,1) usage, different GARCH (p , q) models have been regressed where $p = 1,2,3$; $q = 1,2,3,4,5$. Then, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values of those models have been computed and compared. Lower AIC and BIC values exhibit better model (Cavanaugh & Neath, 2018). Different GARCH (p , q) has been selected as best fitting model according to the lower AIC and BIC values for return series. We applied Standard-GARCH, EGARCH, GJR-GARCH, TGARCH, APARCH (Asymmetric Power ARCH) to return series for estimation of univariate GARCH. The applications of those GARCH model

to return series were for testing. In other words; Standard-GARCH, EGARCH, GJR-GARCH, TGARCH, APARCH (Asymmetric Power ARCH) (p, q) models where $p = 1, 2, 3$; $q = 1, 2, 3, 4, 5$ have been tested and their AIC and BIC values have been calculated. In estimation of those models above, Student-t distribution (Std), Generalised Error Distribution (Ged), Skewed Normal Distribution (SNorm), Skewed Student-t Distribution (SStd), Skewed Generalised Error Distribution (SGed), Normal Inverse Gaussian Distribution (Nig) and Generalised Hyperbolic distribution (ghyp) have been used for distribution of residuals for each model separately. Then, best fitting model have been decided for each series according to AIC, BIC information criteria and Log-Likelihood value. Determined models for return series are provided in Table below. The results of the models that are only set up for testing will not be provided here as they are not directly relevant to the study.

As stated above, DCC GARCH analysis is mainly composed of two stages. First stage is to estimate univariate GARCH for all return series. In this way, conditional volatility/variance is estimated. Univariate GARCH estimation for return series are given in Table below.

Table 16: Best Fitting Models and Optimal Parameters

Return Index	Model and Distribution	ω	α_1	α_2	β_1	β_2
Brazil	sGARCH(1,1) Normal	0.000010*** (p=0.00)	0.069355*** (p=0.00)		0.901842*** (p=0.00)	
Chile	sGARCH(1,1) Skewed Normal	0.000010*** (p=0.00)	0.12571*** (p=0.00)		0.851383 *** (p=0.00)	
China	sGARCH(1,1) Student's t-distribution	0.000008*** (p=0.00)	0.075143*** (p=0.00)		0.888737*** (p=0.00)	
Colombia	sGARCH(1,1) Skewed Normal	0.000021*** (p= 0.00)	0.162819*** (p=0.00)		0.788909*** (p=0.00)	
Czech	eGARCH(1,1) Skewed Student's t-distribution	-0.15228*** (p=0.00056)	-0.029121** (p=0.04432)		0.982707*** (p=0.00)	
Greece	sGARCH(1,1) Skewed Student's t-distribution	0.00001*** (p=0.00)	0.08313*** (p=0.00)		0.882331*** (p=0.00)	
Hungary	gjrGARCH(1,1) Skewed Student's t-distribution	0.000009*** (p= 0.00)	0.035706*** (p=0.00)		0.877795 *** (p=0.00)	
India	sGARCH(1,2) Skewed Normal	0.000006*** (p= 0.00)	0.144124*** (p= 0.00)		0.366852*** (p=0.004452)	0.442528*** (p=0.000307)

Return Index	Model and Distribution	ω	α_1	α_2	β_1	β_2
Indonesia	eGARCH (1,2) Skewed Normal	-0.13563*** (p= 0.00)	-0.11087*** (p= 0.00)		0.236127*** (p= 0.00)	0.746940*** (p= 0.00)
Korea	eGARCH(1,1) Skewed Normal	-0.41322*** (p= 0.00)	-0.06044*** (p= 0.00)		0.950522*** (p= 0.00)	
Malaysia	eGARCH(1,1) Skewed Normal	-0.19413*** (p= 0.00)	-0.03411*** (p= 0.0033)		0.979157*** (p= 0.00)	
RMexico	sGARCH(1,1) Skewed Student's t- distribution	0.000014*** (p= 0.00)	0.090483*** (p= 0.00)		0.840745*** (p= 0.00)	
Peru	sGARCH(1,1) Normal	0.000021*** (p= 0.00)	0.140625*** (p= 0.00)		0.792303*** (p= 0.00)	
Philippines	gjrGARCH(1,2) Skewed Normal	0.000016*** (p= 0.00)	0.054982*** (p=0.00)		0.247759*** (p=0.004682)	0.544711*** (p= 0.00)
Poland	eGARCH(1,1) Skewed Normal	-0.12808*** (p= 0.00)	-0.08643*** (p=0.00)		0.983801*** (p=0.00)	
Qatar	sGARCH(1,1) Student's t- distribution	0.000007*** (p=0.00)	0.097254*** (p=0.00)		0.901746*** (p=0.00)	
South Africa	sGARCH(1,1) Normal	0.000015*** (p=0.00)	0.060200*** (p=0.00)		0.894119*** (p=0.00)	
Taiwan	sGARCH(1,1) Normal	0.000009*** (p=0.00)	0.063532*** (p=0.00)		0.878725*** (p=0.00)	
Thailand	fGARCH(1,1)- TGARCH Student's t- distribution	0.000606*** (p= 0.0021)	0.044796*** (p=0.00)		0.916885*** (p=0.00)	
Türkiye	sGARCH(1,1) Normal	0.000024*** (p=0.00)	0.097973*** (p=0.00)		0.860212*** (p=0.00)	
UAE	gjrGARCH(1,1) Skewed Normal	0.000008*** (p=0.00)	0.061645*** (p=0.00)		0.812428*** (p=0.00)	
EM	eGARCH(1,1) Student's t-distribution	-0.4736*** (p=0.00)	-0.1018*** (p=0.00)		0.949333*** (p=0.00)	
BTC	sGARCH(1,2) Skewed Normal	0.000153*** (p=0.00)	0.125255*** (p=0.00)		0.245900*** (p=0.015684)	0.554235*** (p=0.00)
ETH	sGARCH(1,2) Skewed Normal	0.000115*** (p=0.0018)	0.130409*** (p=0.00)		0.150569*** (p=0.0144)	0.691027*** (p=0.00)
BNB	sGARCH(2,1) Normal	0.000081*** (p=0.0001)	0.117813*** (p=0.00)		0.030128 (p=0.400830)	0.843465*** (p=0.00)
ADA	sGARCH(1,2) Skewed Normal	0.000144*** (p=0.00)	0.149789*** (p=0.00)		0.312595*** (p=0.003675)	0.514457*** (p=0.00)
XRP	sGARCH(1,2) Skewed Normal	0.000571*** (p=0.00)	0.303010*** (p=0.00)		0.352417*** (p=0.001743)	0.267650*** (p=0.012140)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

To begin with, null hypothesis for optimal parameters states that parameter is insignificant. If this null hypothesis is rejected (when $p\text{-value} < 0.05$), then it can be inferred that parameter is statistically significant. If optimal parameters ($\omega, \alpha_1, \beta_1$) are significant then it can be easily inferred that GARCH model is appropriately estimated (Gujarati & Porter, 2006). As it can be seen in Table above, all parameters are statistically significant and univariate GARCH models are appropriately estimated. In order to check validity, robustness and reliability of univariate GARCH estimation, further tests have been applied to series. First of all, Akaike (AIC), Bayes (BIC), Shibata and Hannan - Quinn information criteria have been computed. Lowers value of information criteria shows goodness of model fit. If differences among information criteria values is small then it can be concluded that model selection criteria is relatively consistent (Gujarati & Porter, 2006). Since difference among information criteria is very small, it can be clearly told that model selection is relatively consistent. Then, Log-Likelihood value has been computed to indicate how models fit. Higher Log-Likelihood values exhibit how well the models are estimated. Weighted Ljung-Box Test on Standardized Squared Residuals has been applied. Weighted Ljung-Box Test on Standardized Residuals have null hypothesis stating that there is no serial correlation in the standardized residuals. If null hypothesis cannot be rejected then it can be inferred that there is no serial correlation among residuals. Weighted Ljung-Box Test on Standardized Squared Residuals have null hypothesis stating that there is no serial correlation in the squared standardized residuals. If null hypothesis cannot be rejected then it means that GARCH model captures the volatility clustering (Hsu, Cheng, & Yang, 2024). As it can be seen in Table below, null hypothesis stating that there is no serial correlation in the standardized residuals cannot be rejected for all series. Therefore, GARCH models capture volatility clustering.

Table 17: Robustness and Validity Tests for GARCH Models

	Log-Likelihood	Information Criteria				Weighted Ljung-Box Test on Standardized Squared Residuals		
Return Index	Log-Likelihood	Akaike (AIC)	Bayes (BIC)	Shibata	Hannan-Quinn	Lag(x)	Lag(y)	Lag(z)
Brazil	4562.029	-5.1825	-5.1701	-5.1825	-5.1779	[1] 0.3093 (p= 0.57813)	[5] 4.4953 (p= 0.198)	[9] 8.9752 (p= 0.082)
Chile	4694.167	-5.3316	-5.3161	-5.3316	-5.3259	[1] 0.001926 (p= 0.9650)	[5] 0.218194 (p= 0.9912)	[9] 1.513243 (p= 0.9545)
China	4983.944	-5.6611	-5.6456	-5.6611	-5.6554	[1] 0.2604 (p= 0.6098)	[5] 4.6405 (p= 0.1843)	[9] 6.0111 (p= 0.2969)
Colombia	4643.067	-5.2735	-5.2580	-5.2735	-5.2678	[1] 0.4806 (p= 0.4882)	[5] 1.2949 (p= 0.7901)	[9] 2.1044 (p= 0.8922)
Czech	5385.603	-6.1155	-6.0937	-6.1156	-6.1075	[1] 0.02256 (p= 0.8806)	[5] 2.85514 (p= 0.4341)	[9] 4.86450 (p= 0.4496)
Greece	4860.434	-5.5195	-5.5009	-5.5262	-5.5126	[1] 2.23e-05 (p= 0.9962)	[5] 0.4678 (p= 0.9625)	[9] 1.924 (p= 0.9138)
Hungary	4867.291	-5.5262	-5.5044	-5.5165	-5.5181	[1] 0.1813 (p= 0.6702)	[5] 2.9764 (p= 0.4114)	[9] 4.9604 (p= 0.4353)
India	5591.649	-6.3509	-6.3323	-6.3510	-6.3440	[1] 1.404 (p= 0.2361)	[8] 2.880 (p= 0.7075)	[14] 5.702 (p= 0.6787)
Indonesia	5275.442	-5.9903	-5.9685	-5.9903	-5.9822	[1] 0.08659 (p= 0.7686)	[8] 3.90368 (p= 0.5228)	[14] 5.44055 (p= 0.7133)
Korea	4992.078	-5.6692	-5.6506	-5.6692	-5.6623	[1] 0.05843 (p= 0.8090)	[5] 0.60539 (p= 0.9403)	[9] 4.72640 (p= 0.4707)
Malaysia	6097.437	-6.9260	-6.9074	-6.9260	-6.9191	[1] 0.7644 (p= 0.3820)	[5] 3.2634 (p= 0.3610)	[9] 6.8884 (p= 0.2087)
Mexico	5074.544	-5.7630	-5.7443	-5.7630	-5.7561	[1] 0.8753 (p= 0.3495)	[5] 3.7761 (p= 0.2834)	[9] 6.1928 (p= 0.2766)
Peru	4793.314	-5.4455	-5.4331	-5.4455	-5.4409	[1] 1.27 (p= 0.2598)	[5] 1.86 (p= 0.6518)	[9] 2.90 (p= 0.7753)
Philippines	5214.217	-5.9207	-5.8989	-5.9207	-5.9126	[1] 0.1413 (p= 0.70695)	[8] 8.8425 (p= 0.0626)	[14] 16.5341 (p=0.01211)
Poland	4797.089	-5.4475	-5.4288	-5.4475	-5.4406	[1] 0.004456 (p= 0.9468)	[5] 0.807676 (p= 0.9014)	[9] 1.988496 (p= 0.9064)
Qatar	5892.671	-6.6943	-6.6788	-6.6944	-6.6886	[1] 0.1047 (p= 0.7463)	[5] 2.4901 (p= 0.5080)	[9] 6.4178 (p= 0.2530)
South Africa	4606.429	-5.2330	-5.2206	-5.2330	-5.2284	[1] 0.4817 (p= 0.4877)	[5] 1.8131 (p= 0.6632)	[9] 3.8121 (p= 0.6208)
Taiwan	5273.287	-5.9912	-5.9788	-5.9912	-5.9866	[1] 0.0819 (p= 0.7747)	[5] 0.8656 (p= 0.8893)	[9] 1.7196 (p= 0.9357)
Thailand	5287.288	-6.0049	-5.9862	-6.0049	-5.9980	[1] 0.1874 (p= 0.6651)	[5] 2.7317 (p= 0.4582)	[9] 4.2624 (p= 0.5450)
Türkiye	4263.174	-4.8427	-4.8303	-4.8427	-4.8381	[1] 0.0103 (p=0.9192)	[5] 4.5498 (p= 0.1930)	[9] 6.0910 (p= 0.2879)
UAE	5697.693	-6.4715	-6.4528	-6.4715	-6.4646	[1] 0.2558 (p=0.6131)	[5] 2.2949 (p= 0.5506)	[9] 6.0545 (p= 0.2920)

	Log-Likelihood	Information Criteria				Weighted Ljung-Box Test on Standardized Squared Residuals		
Return Index	Log-Likelihood	Akaike (AIC)	Bayes (BIC)	Shibata	Hannan-Quinn	Lag(x)	Lag(y)	Lag(z)
EM	5757.477	-6.5383	-6.5166	-6.5384	-6.5303	[1] 1.145 (p=0.2847)	[5] 3.279 (p=0.3585)	[9] 5.186 (p= 0.4025)
BTC	3097.927	-3.5156	-3.4969	-3.5156	-3.5087	[1] 1.041 (p=0.30769)	[8] 8.148 (p=0.088)	[14] 10.349 (p= 0.175)
ETH	2697.829	-3.0606	-3.0420	-3.0607	-3.0537	[1] 0.6039 (p=0.4371)	[8] 4.6996 (p= 0.3953)	[14] 8.0216 (p= 0.3816)
BNB	2711.002	-3.0768	-3.0612	-3.0768	-3.0710	[1] 0.02349 (p=0.87820)	[8] 8.35072 (p= 0.079)	[14] 11.221 (p= 0.126)
ADA	2387.288	-2.7075	-2.6889	-2.7076	-2.7006	[1] 2.449 (p=0.11757)	[8] 8.320 (p=0.081)	[14] 12.426 (p= 0.077)
XRP	2480.091	-2.8131	-2.7944	-2.8131	-2.8062	[1] 0.1134 (p=0.7363)	[8] 0.5418 (p= 0.9953)	[14] 0.9024 (p= 0.9998)

[] represents length of lag. Values in () represent p-values.

The Weighted ARCH LM Test is conducted to detect the presence of ARCH effects. Weighted ARCH LM Tests have null hypothesis stating that there is no ARCH effect. If null hypothesis cannot be rejected, then it can be clearly inferred that there is no remaining ARCH effect. This means that GARCH model appropriately captures the volatility and conditional heteroscedasticity (Feng, Yuan, & Jiang, 2024). According to results in Table below, null hypothesis in Weighted ARCH LM test cannot be rejected for all series. Therefore, it can be deduced that there is no remaining ARCH effect in return series.

Sign Bias test is applied to detect asymmetry in the volatility of financial time series. Sign Bias Test's null hypothesis is stating that there is no sign bias. If null hypothesis cannot be rejected then it means that model does not indicate any significant biases in capturing volatility signs (Engle & Victor, 1993). Null hypothesis in Sign Bias test cannot be rejected for all series. Then it can be concluded that there is no significant sign biases when capturing volatility signs for all return series. Results are indicated Table below.

Table 18: Weighted ARCH LM and Sign Bias Tests Statistics

	Weighted ARCH LM Tests			
Return Index	Lag(x)	Lag(y)	Lag(z)	Sign Bias Test
Brazil	[3] 2.468 (p= 0.1162)	[5] 2.876 (p= 0.3082)	[7] 2. 3.208 (p= 0.4752)	0.4648 (p= 0.6421)
Chile	[3] 0.2472 (p= 0.6191)	[5] 0.4224 (p= 0.9063)	[7] 1.3504 (p= 0.8508)	0.09129 (p= 0.9273)
China	[3] 0.1857 (p=0.6666)	[5] 0.6073 (p= 0.8516)	[7] 1.4319 (p= 0.8349)	1.751 (p= 0.0800587)
Colombia	[3] 0.1747 (p= 0.6759)	[5] 1.4543 (p= 0.6044)	[7] 1.8674 (p= 0.7454)	0.6991 (p= 0.4846)
Czech	[3] 0.3099 (p=0.5778)	[5] 4.0653 (p= 0.1681)	[7] 4.6463 (p= 0.2628)	0.08771 (p=0.9301)
Greece	[3] 0.1045 (p= 0.7465)	[5] 0.2149 (p= 0.9619)	[7] 1.7760 (p= 0.7646)	0.4504 (p= 0.6525)
Hungary	[3] 3.896 (p= 0.0484)	[5] 4.839 (p= 0.1120)	[7] 5.379 (p= 0.1889)	0.070194 (p= 0.9440)
India	[4] 1.987 (p=0.1586)	[6] 2.170 (p= 0.4545)	[8] 2.317 (p= 0.6774)	1.2135 (p=0.225091)
Indonesia	[4] 0.01266 (p=0.9104)	[6] 0.42316 (p= 0.9132)	[8] 0.71992 (p= 0.9608)	0.2022 (p=0.8398)
Korea	[3] 0.8805 (p= 0.3481)	[5] 0.8935 (p= 0.7648)	[7] 4.8492 (p= 0.2402)	1.4388 (p= 0.15038)
Malaysia	[3] 0.001972 (p=0.96458)	[5] 5.206422 (p= 0.09205)	[7] 6.215554 (p= 0.12739)	1.092 (p=0.274979)
Mexico	[3] 1.446 (p=0.2292)	[5] 4.962 (p= 0.1049)	[7] 6.287 (p= 0.1231)	1.5920 (p=0.1116)
Peru	[3] 0.03589 (p=0.8497)	[5] 1.36875 (p= 0.6275)	[7] 1.67322 (p= 0.7860)	1.6064 (p=0.10838)
Philippines	[4] 0.8726 (p=0.35023)	[6] 3.8629 (p= 0.20163)	[8] 11.0322 (p= 0.01329)	0.6789 (p=0.4973)
Poland	[3] 0.1310 (p=0.7174)	[5] 0.9322 (p= 0.7532)	[7] 1.3784 (p= 0.8454)	0.7181 (p=0.47278)
Qatar	[3] 0.1454 (p=0.70300)	[5] 6.2412 (p= 0.05270)	[7] 7.8802 (p=0.05578)	0.7679 (p=0.4427)
South Africa	[3] 0.5642 (p=0.4526)	[5] 2.1513 (p= 0.4387)	[7] 3.0725 (p=0.5000)	0.4784 (p=0.6324)
Taiwan	[3] 0.8714 (p=0.3506)	[5] 1.4555 (p= 0.6041)	[7] 1.8971 (p=0.7391)	1.2425 (p=0.21422)
Thailand	[3] 2.256 (p=0.1331)	[5] 3.689 (p= 0.2043)	[7] 4.120 (p=0.3296)	1.4884 (p=0.1368)
Türkiye	[3] 0.2116 (p=0.6456)	[5] 1.5525 (p= 0.5786)	[7] 2.2485 (p=0.6648)	0.02658 (p=0.97879)
UAE	[3] 0.01787 (p=0.89367)	[5] 5.54424 (p= 0.07681)	[7] 7.12646 (p=0.08156)	0.06211 (p=0.95049)
EM	[3] 3.325 (p=0.06825)	[5] 3.484 (p= 0.22686)	[7] 5.037 (p=0.22081)	0.5721 (p=0.5673)

	Weighted ARCH LM Tests			
Return Index	Lag(x)	Lag(y)	Lag(z)	Sign Bias Test
rBTC	[4] 0.2977 (p=0.5854)	[6] 1.1351 (p= 0.7093)	[8] 1.5529 (p= 0.8297)	0.8994 (p=0.3685)
rETH	[4] 0.04581 (p=0.8305)	[6] 1.28107 (p= 0.6688)	[8] 3.12058 (p= 0.5211)	0.6595 (p=0.5096)
rBNB	[4] 1.403 (p=0.2362)	[6] 2.564 (p= 0.3787)	[8] 2.988 (p= 0.5458)	0.6221 (p=0.5339)
rADA	[4] 0.5951 (p=0.4404)	[6] 1.3723 (p= 0.6442)	[8] 4.0908 (p= 0.3622)	0.01735 (p=0.9862)
rXRP	[4] 0.3385 (p=0.5607)	[6] 0.4935 (p= 0.8938)	[8] 0.6652 (p= 0.9668)	0.7437 (p=0.4572)

[] represents length of lag. (p=.....) represents p-values

The models specified are provided in Table 16 above. The mean model is ARFIMA (0, 0, 0) for all series. Different models have been estimated for each series according to AIC, BIC Log-Likelihood value. Those models have been tested for volatility clustering, ARCH effect, sign bias through Weighted Ljung-Box Test on Squared Standardized Residuals, Weighted ARCH LM Tests, and Sign Bias Test. The best fitting model have been chosen for each series with holistic evaluation.

According to univariate GARCH results, all optimal parameters (ω , α_1 , β_1) are statistically significant. Then it can be easily inferred that GARCH model is appropriately estimated for all return indexes. Lowers value of information criteria shows goodness of model fit. Differences among information criteria are small then it can be concluded that model selection criteria is relatively consistent for variables. Weighted Ljung-Box Test on Standardized Squared Residuals states that there is no serial correlation in the squared standardized residuals. This means that GARCH models capture the volatility clustering for all series. Weighted ARCH LM Test states that there is no remaining ARCH effect. This means that GARCH model appropriately captures the volatility and heteroscedasticity for all return indexes. Sign Bias Test puts forward that there is no sign bias in the series. To summarize, best fitting model for each series have been estimated through univariate GARCH with detailed approach and holistic evaluation.

It is asserted that estimation of DCC with all return series simultaneously may provide biased estimation of parameters for higher dimension time series. DCC model estimation for pairs of returns will hinder biased estimation of parameters (Bouri, Molnár, Azzi, Roubaud, & Hagfors, 2017). To our best knowledge, almost all studies in the literature

apply DCC estimation with pairs of return series rather than estimating all return series simultaneously with DCC. To illustrate, Stensås et al. (2019), Mariana et al. (2021), Shahzad et al. (2020), Dutta et. all (2020), Belhassine & Karamti (2021), Chan et all. (2019), Chkili et al. (2021), Corbet et al. (2020), Chemka et al. (2021), Ben-Ahmed et al. (2023), Yousaf & Ali (2020), Naysary & Shrestha (2024), Hsu et al. (2024), Yousaf et al. (2022), BenOsman et al. (2024), Salem et al. (2024), Guesmi et al. (2019) and many other studies analysed dynamic conditional correlation with pair of return series. In this study, we will both estimate pairs of returns separately, and all returns together at the same time. Then results will be compared and contrasted. We have 27 different time series and each have 1759 observations. DCC model estimation will be made for pairs of return series separately due to possibility of biased estimates of parameters resulting from higher dimensions. In addition, DCC model estimation will be made for all series simultaneously. Empirical results of two method will be compared and contrasted.

After 27 different univariate GARCH model has been run, standardized residuals have been obtained from those univariate GARCH models since time-varying conditional correlations with DCC GARCH will be estimated by employing standardized residuals generated from first step (univariate GARCH estimation). DCC GARCH models have been estimated. DCC order (p,q) and distribution have been selected after trial tests have been made with different combinations of dcc order and distribution. The model which have lowest AIC and BIC has been selected as best fitting model. The model having lowest information criteria is **DCC (1, 1) multivariate t-distribution** model.

Time-varying conditional correlations has been estimated by employing standardized residuals which is produced from first step, estimation of univariate GARCHs. After DCC has been computed, we have obtained pairwise dynamic conditional correlations from DCC model as separate time series. Later on, those time series have been regressed on dummy (D) variables. Dummy variables represent shocks or extreme volatilities in the lower 10th, 5th or 1st percentile of the return distribution.

Before move on, we will indicate DCC GARCH estimations below. DCC GARCH results will not be discussed here since they are not in the scope of this study. Aim of this study is to obtain dynamic conditional correlations for regressing on dummy variables. However, in order to exhibit validity and robustness of DCC GARCH estimations, DCC GARCH estimations will be provided. In other words, DCC GARCH estimation results are given in order to show that conditions of DCC GARCH estimation have been satisfied. DCC

GARCH estimation results for pairs of return series separately are provided in Tables below. To remind, proper estimation of DCC GARCH requires conditions stated below to be satisfied for this formula:

$$Q_t = (1 - \alpha - \beta) \Sigma Q + \alpha \epsilon_{t-1} \epsilon'_{t-1} + \beta Q_{t-1}$$

- α and β should be greater than zero ($\alpha > 0$ and $\beta > 0$)
- $\alpha + \beta < 1$ condition should be satisfied.

α represents short term persistency in dynamic conditional correlation while β represents long term persistency in dynamic conditional correlation. dcca1 in the Tables represents short run dynamic conditional correlation between series while dccb1 in the Tables represents long run persistency between series. dcca1 matches with “ α ” in the formula and dccb1 matches with “ β ” in the formula above. As it can be clearly seen in the Tables below, all dcca1 (α) and dccb1 (β) values are greater than zero. In addition, sum of dcca1 (α) and dccb1 (β) values are smaller than one. Therefore, both DCC GARCH estimation conditions have been satisfied in this analysis. This result has been validated by DCC GARCH estimation for pairs. DCC GARCH estimation for all series has been made simultaneously. dcca1 and dccb1 values have been calculated. dcca1 equals to 0.007203 where p-value is 0.00. dccb1 equals to 0.948039 where p-value is 0.00. Empirical result indicates that both short term and long term dynamic conditional correlations are positive and significant. Sum of dcca1 and dccb1 equals to 0.955242 which is smaller than one. Therefore both conditions of DCC GARCH estimation are satisfied as well when DCC GARCH estimation has been made for all series simultaneously. DCC GARCH estimation results for pairs of series can be seen in Tables below.

Table 19: DCC GARCH Estimation Results for Pairs

Pairs	Variables	dcca1>0	dccb1>0	dcca1 + dccb1 < 1
BTC -Brazil	BTC	0.004458*	0.994362***	0.99882
	Brazil	(p=0.053295)	(p=0.00)	
BTC - Chile	BTC	0.005108*	0.989935***	0.995043
	Chile	(p= 0.061507)	(p=0.00)	
BTC - China	BTC	0.017105**	0.943830***	0.960935
	China	(p=0.019166)	(p=0.00)	
BTC - Colombia	BTC	0.006051**	0.990169***	0.99622
	Colombia	(p=0.016508)	(p=0.00)	
BTC - Czech	BTC	0.002815	0.992641***	0.995456
	Czech	(p=0.229160)	(p=0.00)	
BTC - Greece	BTC	0.002929	0.995243***	0.998172
	Greece	(p=0.327704)	(p=0.00)	
BTC - Hungary	BTC	0.006854*	0.985503***	0.992357
	Hungary	(p=0.078624)	(p=0.00)	
BTC - India	BTC	0.007698	0.883194**	0.890892
	India	(p=0.585548)	(p=0.048478)	
BTC - Indonesia	BTC	0.000000	0.910383***	0.910383
	Indonesia	(p= 0.999729)	(p=0.00)	
BTC - Korea	BTC	0.014767	0.701942	0.716709
	Korea	(p=0.419761)	(p=0.116090)	
BTC - Malaysia	BTC	0.000000	0.917801	0.917801
	Malaysia	(p=0.999988)	(p=0.134167)	
BTC - Mexico	BTC	0.009746***	0.986322***	0.996068
	Mexico	(p=0.003881)	(p=0.00)	
BTC - Peru	BTC	0.010784***	0.985504***	0.996288
	Peru	(p=0.000628)	(p=0.00)	
BTC - Philippines	BTC	0.005546	0.909799***	0.915345
	Philippines	(p=0.542455)	(p=0.00)	

Note: Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 20: DCC GARCH Estimation Results for Pairs (continue)

Pairs	Variables	dcca1>0	dccb1>0	dcca1 + dccb1 < 1
BTC - Poland	BTC	0.007990	0.976620***	0.98461
	Poland	(p=0.346747)	(p=0.00)	
BTC - Qatar	BTC	0.001965	0.986439***	0.988404
	Qatar	(p=0.690176)	(p=0.00)	
BTC – South Africa	BTC	0.005683**	0.989572***	0.995255
	South Africa	(p=0.048012)	(p=0.00)	
BTC - Taiwan	BTC	0.007944	0.967632***	0.975576
	Taiwan	(p=0.200013)	(p=0.00)	
BTC - Thailand	BTC	0.006648	0.690534***	0.697182
	Thailand	(p=0.472721)	(p=0.00)	
BTC – Türkiye	BTC	0.045443	0.655462*	0.700905
	Türkiye	(p=0.215367)	(p=0.075699)	
BTC - UAE	BTC	0.001716	0.987263***	0.988979
	UAE	(p=0.308294)	(p=0.00)	
BTC – EM	BTC	0.010723	0.971876***	0.982599
	EM	(p=0.410636)	(p=0.00)	
ETH -Brazil	ETH	0.006719	0.991437***	0.998156
	Brazil	(p=0.145150)	(p=0.00)	
ETH - Chile	ETH	0.005245	0.992773***	0.998018
	Chile	(p=0.353844)	(p=0.00)	
ETH - China	ETH	0.010429	0.967989***	0.978418
	China	(p=0.111156)	(p=0.00)	
ETH - Colombia	ETH	0.003647**	0.996349***	0.999996
	Colombia	(p=0.035659)	(p=0.00)	
ETH - Czech	ETH	0.002299	0.996569***	0.998868
	Czech	(p=0.159987)	(p=0.00)	
ETH - Greece	ETH	0.003390**	0.987310***	0.990700
	Greece	(p=0.041012)	(p=0.00)	

Note: Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 21: DCC GARCH Estimation Results for Pairs (continue)

Pairs	Variables	dcca1>0	dccb1>0	dcca1 + dccb1 < 1
ETH - Hungary	ETH	0.002647	0.985353***	0.987911
	Hungary	(p=0.220844)	(p=0.00)	
ETH - India	ETH	0.004430*	0.993409***	0.997839
	India	(p=0.080985)	(p=0.00)	
ETH - Indonesia	ETH	0.002560***	0.976230***	0.97879
	Indonesia	(p=0.00)	(p=0.00)	
ETH - Korea	ETH	0.009487	0.941239***	0.950726
	Korea	(p=0.253945)	(p=0.00)	
ETH - Malaysia	ETH	0.000000	0.931559***	0.931559
	Malaysia	(p=0.999997)	(p=0.00)	
ETH - Mexico	ETH	0.008313*	0.990414***	0.998727
	Mexico	(p=0.090857)	(p=0.00)	
ETH - Peru	ETH	0.009778***	0.986175***	0.995953
	Peru	(p=0.003328)	(p=0.00)	
ETH - Philippines	ETH	0.009199	0.948199***	0.957398
	Philippines	(p=0.221869)	(p=0.00)	
ETH - Poland	ETH	0.003514	0.995738***	0.999252
	Poland	(p=0.243574)	(p=0.00)	
ETH - Qatar	ETH	0.000816	0.990321***	0.991137
	Qatar	(p=0.791425)	(p=0.00)	
ETH – South Africa	ETH	0.005236**	0.993542***	0.998778
	South Africa	(p=0.029563)	(p=0.00)	
ETH - Taiwan	ETH	0.006312	0.945958***	0.95227
	Taiwan	(p=0.410626)	(p=0.00)	
ETH - Thailand	ETH	0.020066	0.679657***	0.699723
	Thailand	(p=0.130353)	(p=0.000078)	
ETH – Türkiye	ETH	0.020866	0.904755***	0.925621
	Türkiye	(p=0.245678)	(p=0.00)	

Note: Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 22: DCC GARCH Estimation Results for Pairs (continue)

Pairs	Variables	dcca1>0	dccb1>0	dcca1 + dccb1 < 1
ETH - UAE	ETH	0.002733	0.993933***	0.996666
	UAE	(p=0.204234)	(p=0.00)	
ETH – EM	ETH	0.010334*	0.980905***	0.991239
	EM	(p=0.055181)	(p=0.00)	
BNB -Brazil	BNB	0.003302*	0.996693***	0.999995
	Brazil	(p=0.080328)	(p=0.00)	
BNB - Chile	BNB	0.012231*	0.964200***	0.976431
	Chile	(p=0.050120)	(p=0.00)	
BNB - China	BNB	0.007289	0.956195***	0.963484
	China	(p=0.242087)	(p=0.00)	
BNB - Colombia	BNB	0.002276	0.9956345***	0.9979105
	Colombia	(p=0.153885)	(p=0.00)	
BNB - Czech	BNB	0.001181	0.998570***	0.999751
	Czech	(p=0.339644)	(p=0.00)	
BNB - Greece	BNB	0.004858	0.942068***	0.946926
	Greece	(p=0.442410)	(p=0.00)	
BNB - Hungary	BNB	0.007606*	0.974732***	0.982338
	Hungary	(p=0.095201)	(p=0.00)	
BNB - India	BNB	0.004098	0.645151**	0.649249
	India	(p=0.751394)	(p=0.011973)	
BNB - Indonesia	BNB	0.000000	0.912831***	0.912831
	Indonesia	(p=0.998754)	(p=0.00)	
BNB - Korea	BNB	0.000000	0.926932***	0.926932
	Korea	(p=0.999967)	(p=0.00)	
BNB - Malaysia	BNB	0.000000	0.920233***	0.920233
	Malaysia	(p=0.999967)	(p=0.00)	
BNB - Mexico	BNB	0.006366*	0.992590***	0.998956
	Mexico	(p=0.067052)	(p=0.00)	

Note: Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 23: DCC GARCH Estimation Results for Pairs (continue)

Pairs	Variables	dcca1>0	dccb1>0	dcca1 + dccb1 < 1
BNB – South Africa	BNB	0.005087	0.985222***	0.990309
	South Africa	(p=0.570256)	(p=0.00)	
BNB - Taiwan	BNB	0.002050	0.962782***	0.964832
	Taiwan	(p=0.659761)	(p=0.00)	
BNB - Thailand	BNB	0.009140	0.743258***	0.752398
	Thailand	(p=0.434589)	(p=0.008687)	
BNB – Türkiye	BNB	0.005452	0.981595***	0.987047
	Türkiye	(p=0.308422)	(p=0.00)	
BNB - UAE	BNB	0.003614	0.652348***	0.655962
	UAE	(p=0.646475)	(p=0.000926)	
BNB – EM	BNB	0.004502	0.964903***	0.969405
	EM	(p=0.375598)	(p=0.00)	
ADA -Brazil	ADA	0.009085*	0.976685***	0.98577
	Brazil	(p=0.058166)	(p=0.00)	
ADA - Chile	ADA	0.019656**	0.951798***	0.971454
	Chile	(p=0.040250)	(p=0.00)	
ADA - China	ADA	0.013098	0.932553***	0.945651
	China	(p=0.191628)	(p=0.00)	
ADA - Colombia	ADA	0.003057	0.994601***	0.997658
	Colombia	(p=0.519888)	(p=0.00)	
ADA - Czech	ADA	0.004974	0.973646***	0.97862
	Czech	(p=0.459777)	(p=0.00)	
ADA - Greece	ADA	0.006011	0.974456***	0.980467
	Greece	(p=0.378202)	(p=0.00)	
ADA - Hungary	ADA	0.041532**	0.285665	0.327197
	Hungary	(p=0.195748)	(p=0.378602)	
ADA - India	ADA	0.002405	0.986382***	0.988787
	India	(p=0.144159)	(p=0.00)	

Note: Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 24: DCC GARCH Estimation Results for Pairs (continue)

Pairs	Variables	dcca1>0	dccb1>0	dcca1 + dccb1 < 1
ADA - Indonesia	ADA	0.000000	0.937638***	0.937638
	Indonesia	(p=0.999966)	(p=0.00)	
ADA - Korea	ADA	0.009088	0.923001***	0.932089
	Korea	(p=0.347000)	(p=0.00)	
ADA - Malaysia	ADA	0.000000	0.919756**	0.919756
	Malaysia	(p=0.999940)	(p=0.046558)	
ADA - Mexico	ADA	0.004418	0.994486***	0.998904
	Mexico	(p=0.198260)	(p=0.00)	
ADA - Peru	ADA	0.005662	0.989237***	0.994899
	Peru	(p=0.238446)	(p=0.00)	
ADA - Philippines	ADA	0.008052	0.880234***	0.888286
	Philippines	(p=0.426153)	(p=0.00)	
ADA - Poland	ADA	0.009068	0.940934***	0.950002
	Poland	(p=0.257972)	(p=0.00)	
ADA - Qatar	ADA	0.000000	0.913274	0.913274
	Qatar	(p=0.999999)	(p=0.267467)	
ADA – South Africa	ADA	0.007012	0.973762***	0.980774
	South Africa	(p=0.120071)	(p=0.00)	
ADA - Taiwan	ADA	0.029185	0.624481*	0.653666
	Taiwan	(p=0.147213)	(p=0.055877)	
ADA - Thailand	ADA	0.014308	0.732102***	0.74641
	Thailand	(p=0.391603)	(p=0.007512)	
ADA – Türkiye	ADA	0.023509**	0.897301***	0.92081
	Türkiye	(p=0.013962)	(p=0.00)	
ADA - UAE	ADA	0.006972	0.975159***	0.982131
	UAE	(p=0.103742)	(p=0.00)	
ADA – EM	ADA	0.010993	0.958515***	0.969508
	EM	(p=0.126081)	(p=0.00)	

Note: Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level

Table 25: DCC GARCH Estimation Results for Pairs (continue)

Pairs	Variables	dcca1>0	dccb1>0	dcca1 + dccb1 < 1
XRP -Brazil	XRP	0.003019	0.985481***	0.9885
	Brazil	(p=0.18081)	(p=0.00)	
XRP - Chile	XRP	0.017761**	0.950737***	0.968498
	Chile	(p=0.011738)	(p=0.00)	
XRP - China	XRP	0.007826	0.951480***	0.959306
	China	(p=0.26945)	(p=0.00)	
XRP - Colombia	XRP	0.006530*	0.982207***	0.988737
	Colombia	(p=0.057529)	(p=0.00)	
XRP - Czech	XRP	0.000880	0.988576***	0.989456
	Czech	(p=0.757677)	(p=0.00)	
XRP - Greece	XRP	0.005074	0.976229***	0.981303
	Greece	(p=0.30186)	(p=0.00)	
XRP - Hungary	XRP	0.013637	0.923365***	0.937002
	Hungary	(p=0.253170)	(p=0.00)	
XRP - India	XRP	0.006027	0.968752***	0.974779
	India	(p=0.349785)	(p=0.00)	
XRP - Indonesia	XRP	0.000000	0.917804	0.917804
	Indonesia	(p=0.999974)	(p=0.376419)	
XRP - Korea	XRP	0.018366	0.060740	0.079106
	Korea	(p=0.727351)	(p=0.997369)	
XRP - Malaysia	XRP	0.000000	0.919762*	0.919762
	Malaysia	(p=0.999945)	(p=0.059138)	
XRP - Mexico	XRP	0.003780**	0.995933***	0.999713
	Mexico	(p=0.022079)	(p=0.00)	
XRP - Peru	XRP	0.011116***	0.983245***	0.994361
	Peru	(p=0.003871)	(p=0.00)	
XRP - Philippines	XRP	0.000000	0.984158***	0.984158
	Philippines	(p=0.994962)	(p=0.00)	

Note: Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level

Table 26: DCC GARCH Estimation Results for Pairs

Pairs	Variables	dcca1>0	dccb1>0	dcca1 + dccb1 < 1
XRP - Poland	XRP	0.011800	0.947103***	0.958903
	Poland	(p=0.27902)	(p=0.00)	
XRP - Qatar	XRP	0.000943	0.969336***	0.970279
	Qatar	(p=0.884603)	(p=0.00)	
XRP – South Africa	XRP	0.004788	0.981592***	0.98638
	South Africa	(p=0.23594)	(p=0.00)	
XRP - Taiwan	XRP	0.000000	0.922973	0.922973
	Taiwan	(p=0.999980)	(p=0.601759)	
XRP - Thailand	XRP	0.009039	0.918313***	0.927352
	Thailand	(p=0.291312)	(p=0.00)	
XRP – Türkiye	XRP	0.018564**	0.877955***	0.896519
	Türkiye	(p=0.031670)	(p=0.00)	
XRP - UAE	XRP	0.007165	0.964603***	0.971768
	UAE	(p=0.163808)	(p=0.00)	
XRP – EM	XRP	0.009385	0.976523***	0.985908
	EM	(p=0.102690)	(p=0.00)	

Note: Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level

To summarize what has been done until now, 27 different univariate GARCH models have been selected and estimated, standardized residuals have been obtained from those univariate GARCH models. DCC GARCH models have been estimated by employing those standardized residuals with DCC (1, 1) multivariate t-distribution model. DCC GARCH estimation have been made for pairs of series and all series together. DCC GARCH estimation results have been provided in order to indicate robustness and validity of DCC GARCH estimations. DCC GARCH estimation results will not be explained and discussed in details since remaining empirical results of DCC GARCH rather than time-varying conditional correlations are not directly related with this study.

After this stage, pairwise dynamic conditional correlations from DCC GARCH models have been obtained as separate time series. Later on, those time series have been regressed on dummy (D) variables. Dummy variables represent shocks or extreme volatilities in the lower 10th, 5th or 1st percentile of the return distribution. Aim of this study is to obtain dynamic conditional correlations for regressing on dummy variables as parallel to formula below:

$$DCC_t = m_0 + m_1 D(r_{\text{other asset}} q_1) + m_2 D(r_{\text{other asset}} q_5) + m_3 D(r_{\text{other asset}} q_{10}) + v_t$$

Where

DCC_t : Pairwise conditional correlation between cryptocurrencies and stock indices

$r_{\text{other asset}}$: Return of other assets

v_t : Error term

Following Baur and McDermott (2010) and Baur and Lucey (2010), it is possible to define an asset as diversifier, hedge or safe haven against another asset or market by making regression analysis of dynamic conditional correlation on dummy variables. Dummy variables represent extreme downturn in the market in the negative 10%, 5%, and 1% quantiles of the return distribution. Dummy variables take value equals to 1 when return of country stock index is smaller than quantile value. Otherwise dummy variables take zero. For example, return of the country stock index is smaller than %1 quantile value of that

index, then dummy variable becomes equal to 1. If country stock index is greater than %1 quantile value of that index, then dummy variable becomes equal to zero. All dummy variables are calculated as explained above. Later on, coefficients of dummy variables and constants are analysed in the study. When all dummy variables are equal to zero, then dynamic conditional correlation becomes equal to constant, m_0 . Then significance of constant and sign of constant matter. Baur and McDermott (2010) and Baur and Lucey (2010) determine an asset as diversifier against another asset when constant m_0 is positive and significant. If constant m_0 is insignificantly different from zero then it can be expressed that asset is weak hedge against other asset. When constant m_0 is negative and significant then it can be concluded that asset is strong hedge against another asset. Therefore, analysis of constant term is important when deciding whether an asset is diversifier or hedge. However, to determine safe-haven characteristics of an asset, coefficients of dummy variables (m_1 , m_2 and m_3) should be taken into consideration. If m_1 , m_2 or m_3 are consistently negative and significant, then it can be deduced that asset behaves as strong safe haven for another asset. If m_1 , m_2 or m_3 are insignificantly different from zero, then it can be concluded that asset is weak safe haven for another asset. When m_1 , m_2 or m_3 are positive and significant, then asset cannot be safe haven for another asset. Regression analysis results will be evaluated as stated above.

DCC model estimation has been made for pairs of return series separately due to possibility of biased estimates of parameters resulting from higher dimensions. Then, DCC model estimation has been made for all series simultaneously. Later on, those time series have been regressed on dummy (D) variables for both cases. We provide both results to compare and contrast. Results of dummy regressions which is made through employing dynamic conditional correlations (DCCs) derived from DCC model estimation made for pairs of return series separately are exhibited in Table 27 below. Results of dummy regressions which is made through employing dynamic conditional correlations (DCCs) derived from DCC model estimation made for all series simultaneously are exhibited in Table 28 below.

Table 27: Regression Results (DCCs calculated as pairs of return series separately)

Country Indexes	Bitcoin (BTC)			
	Hedge(m ₀)	1% quantile(m ₁)	5% quantile(m ₂)	10% quantile(m ₃)
Brazil	0.143478*** (p< 2e-16)	-0.012169 (p= 0.49341)	-0.001122 (p= 0.91704)	0.022538 (p= 0.00224)
Chile	0.121375*** (p< 2e-16)	-0.029323 (p=0.1198)	0.022058* (p=0.0535)	0.009493 (p=0.2243)
China	0.087022*** (p< 2e-16)	0.050869*** (p=0.00245)	-0.013250 (p=0.19241)	0.020694*** (0.00294)
Colombia	0.109740*** (p< 2e-16)	0.045505** (p=0.0195)	0.004793 (p=0.6846)	0.017973** (p=0.0260)
Czech	0.1277564*** (p< 2e-16)	-0.0055273 (p=0.59701)	0.0075885 (p=0.23108)	0.0128449*** (p=0.00307)
Greece	0.121321*** (p< 2e-16)	-0.019930 (p=0.167)	-0.007334 (p=0.401)	-0.001786 (p=0.765)
Hungary	0.085987*** (p< 2e-16)	0.002697 (p=0.867)	0.015792 (p=0.106)	0.004525 (p=0.499)
India	0.0610172*** (p< 2e-16)	0.0503428*** (p< 2e-16)	0.0065126 (p=0.0623)	-0.0002232 (p=0.9255)
Indonesia	8.589e-02*** (p< 2e-16)	4.210e-08*** (p=2.1e-13)	4.844e-09 (p=0.16)	-2.771e-09 (p=0.24)
Korea	0.0320123*** (p< 2e-16)	0.0175556*** (p=0.00352)	0.0057117 (p=0.11682)	-0.0015944 (p=0.52196)
Malaysia	6.180e-02*** (p< 2e-16)	3.812e-07*** (p< 2e-16)	5.442e-08** (p=0.031)	9.928e-09 (p=0.565)
Mexico	0.151337*** (p< 2e-16)	0.001874 (p=0.953)	0.005462 (p=0.778)	0.013819 (p=0.296)
Peru	0.177331*** (p< 2e-16)	0.030736 (p=0.275)	0.008853 (p=0.604)	0.013701 (p=0.240)
Philippines	0.0461241*** (p< 2e-16)	0.0242521*** (p=5.27e-07)	0.0043708 (p=0.134)	-0.0003331 (p=0.867)
Poland	0.165075*** (p< 2e-16)	-0.012432 (p=0.37993)	0.005750 (p=0.50278)	0.018117*** (p=0.00205)
Qatar	0.0190651*** (p< 2e-16)	0.0119158** (p=0.039)	-0.0005092 (p=0.884)	-0.0012758 (p=0.594)
South Africa	0.152653*** (p< 2e-16)	0.009852 (p=0.583)	-0.006357 (p=0.559)	0.008032 (p=0.280)
Taiwan	0.031280*** (p< 2e-16)	0.036276*** (p=0.0027)	0.007950 (p=0.2775)	0.005113 (p=0.3071)
Thailand	0.0780206*** (p< 2e-16)	0.0179504*** (p=1.33e-07)	-0.0041902** (p=0.0415)	0.0030053** (p=0.0325)
Türkiye	0.069920*** (p< 2e-16)	0.057999*** (p=0.00012)	-0.008511 (p=0.35066)	0.008801 (p=0.15820)
UAE	0.0289472*** (p< 2e-16)	-0.0064773 (p=0.430)	-0.0019617 (p=0.694)	0.0039347 (p=0.248)
EM	0.111583*** (p< 2e-16)	0.039849** (p=0.0237)	0.020360* (p=0.0564)	0.003481 (p=0.6332)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 27: Regression Results (DCCs calculated as pairs of return series separately) cont.

	Ethereum (ETH)			
Country Indexes	Hedge(m ₀)	1% quantile(m ₁)	5% quantile(m ₂)	10% quantile(m ₃)
Brazil	0.139316*** (p< 2e-16)	-0.006560 (p=0.736876)	-0.002597 (p=0.826244)	0.030031*** (p=0.000212)
Chile	0.146540*** (p< 2e-16)	-0.039863** (0.0425)	0.014573 (p=0.2209)	0.010411 (p=0.2010)
China	0.126168*** (p< 2e-16)	0.028506 (p=0.02988)	-0.009002 (p=0.25752)	0.016814*** (p=0.00201)
Colombia	0.128510*** (p< 2e-16)	0.009029 (p=0.5490)	0.002980 (p=0.7441)	0.012180 (p=0.0512)
Czech	0.1542876*** (p< 2e-16)	-0.0038804 (p=0.70986)	0.0094929 (p=0.13325)	0.0127671*** (p=0.00318)
Greece	0.1458993*** (p< 2e-16)	-0.0288454 (p=0.0048)***	-0.0060140 (p=0.3315)	0.0024657 (p=0.5604)
Hungary	0.129981*** (p< 2e-16)	-0.020673* (p=0.0591)	0.008062 (p=0.2244)	0.004505 (p=0.3208)
India	0.092838*** (p< 2e-16)	-0.010052 (p=0.507)	0.001240 (p=0.893)	0.005546 (p=0.377)
Indonesia	0.084423*** (p< 2e-16)	-0.019597 (p=0.1100)	-0.002352 (p=0.7515)	-0.008845* (p=0.0818)
Korea	0.0789155*** (p< 2e-16)	0.0232920*** (p=0.00927)	0.0101027 (p=0.06243)*	-0.0026868 (p=0.46852)
Malaysia	6.590e-02*** (p< 2e-16)	1.589e-07*** (p=4.72e-13)	2.459e-08* (p=0.0629)	3.381e-09 (p=0.7083)
Mexico	0.182719*** (p< 2e-16)	-0.035056 (p=0.235)	-0.009428 (p=0.598)	0.015015 (p=0.220)
Peru	0.196231*** (p< 2e-16)	0.013448 (p=0.550)	0.005839 (p=0.668)	0.009665 (p=0.299)
Philippines	0.0428374*** (p< 2e-16)	0.0324852*** (p=0.00146)	0.0116251* (p=0.05994)	0.0015532 (p=0.71309)
Poland	0.191967*** (p< 2e-16)	-0.030882** (p=0.03382)	0.003987 (p=0.65099)	0.019267*** (p=0.00141)
Qatar	0.0595622*** (p< 2e-16)	0.0050520** (p=0.0379)	-0.0013911 (p=0.3453)	-0.0006159 (p=0.5411)
South Africa	0.176550*** (p< 2e-16)	-0.032213* (p=0.0986)	-0.004328 (p=0.7142)	0.007671 (p=0.3425)
Taiwan	0.0592204*** (p< 2e-16)	0.0103271 (p=0.1285)	0.0073750* (p=0.0733)	0.0006993 (p=0.8038)
Thailand	0.1099545*** (p< 2e-16)	0.0316585*** (p=0.00011)	-0.0053194 (p=0.28270)	0.0046457 (p=0.17013)
Türkiye	0.082048*** (p< 2e-16)	0.032609** (p=0.0233)	-0.019637** (p=0.0242)	0.009783 (p=0.1004)
UAE	0.0904905*** (p< 2e-16)	0.0010720 (p=0.904)	-0.0016439 (p=0.760)	0.0024280 (p=0.509)
EM	0.153066*** (p< 2e-16)	0.015883 (p=0.436)	0.013887 (p=0.261)	0.009918 (p=0.240)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 27: Regression Results (DCCs calculated as pairs of return series separately) cont.

	BNB			
Country Indexes	Hedge(m ₀)	1% quantile(m ₁)	5% quantile(m ₂)	10% quantile(m ₃)
Brazil	0.138617*** (p< 2e-16)	-0.024072* (p=0.0998)	-0.003712 (p=0.6752)	0.012198** (p=0.0442)
Chile	0.140420*** (p< 2e-16)	0.003686 (p=0.8260)	0.020327** (p=0.0456)	0.006694 (p=0.3356)
China	0.1309877 (p< 2e-16)	0.0252191 (p=0.000323)	-0.0034151 (p=0.420857)	0.0048102* (p=0.097445)
Colombia	0.1230067*** (p< 2e-16)	0.0082627 (p=0.4297)	0.0020231 (p=0.7497)	0.0079114* (p=0.0682)
Czech	0.1146914*** (p< 2e-16)	-0.0014832 (p=0.81272)	0.0054351 (p=0.15210)	0.0068974*** (p=0.00791)
Greece	0.1111289*** (p< 2e-16)	0.0049289 (p=0.211)	-0.0003193 (p=0.894)	0.0011753 (p=0.472)
Hungary	0.083495*** (p< 2e-16)	0.021081* (p=0.0606)	0.014322** (p=0.0354)	0.004163 (p=0.3710)
India	0.0664454*** (p< 2e-16)	0.0091900*** (p=8.11e-07)	0.0018606* (p=0.0983)	-0.0001707 (p=0.8244)
Indonesia	1.073e-01*** (p< 2e-16)	4.773e-08*** (p=1.6e-10)	3.349e-09 (p=0.456)	1.624e-09 (p=0.597)
Korea	5.824e-02*** (p< 2e-16)	1.385e-06*** (p=4.27e-07)	3.575e-07* (p=0.0308)	-1.490e-07 (p=0.1880)
Malaysia	7.736e-02*** (p< 2e-16)	5.521e-07*** (p< 2e-16)	6.166e-08 (p=0.114)	-3.797e-10 (p=0.989)
Mexico	0.142194*** (p< 2e-16)	-0.036290 (p=0.165)	-0.009835 (p=0.535)	0.013241 (p=0.222)
Peru	0.174449*** (p< 2e-16)	0.035194** (p=0.0305)	0.000246 (p=0.9801)	0.015338** (p=0.0229)
Philippines	0.0443660*** (p< 2e-16)	0.0076560*** (p=1.51e-06)	0.0016636* (p=0.0837)	0.0001817 (p=0.7823)
Poland	0.1578421*** (p< 2e-16)	-0.0050952 (p=0.4904)	0.0054678 (p=0.2221)	0.0062565** (p=0.0411)
Qatar	6.661e-02*** (p< 2e-16)	2.171e-07*** (p=5.92e-05)	1.699e-08 (p=0.603)	-2.039e-08 (p=0.362)
South Africa	0.1534764*** (p< 2e-16)	0.0008038 (p=0.934)	-0.0015889 (p=0.786)	0.0025063 (p=0.531)
Taiwan	0.0506310*** (p< 2e-16)	0.0057637** (p=0.0229)	0.0036560** (p=0.0173)	-0.0004890 (p=0.6411)
Thailand	0.0893576*** (p< 2e-16)	0.0257425*** (p=2.25e-08)	-0.0054751** (p=0.0488)	0.0025130 (p=0.1860)
Türkiye	0.0619888*** (p< 2e-16)	0.0107618 (p=0.248)	-0.0061832 (p=0.273)	0.0057631 (p=0.135)
UAE	0.0667631*** (p< 2e-16)	0.0080749*** (p=1.63e-05)	0.0015006 (p=0.185)	-0.0004049 (p=0.601)
EM	0.1394185*** (p< 2e-16)	0.0210566*** (p=0.000109)	0.0080800** (p=0.014127)	-0.0028860 (p=0.199659)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 27: Regression Results (DCCs calculated as pairs of return series separately) cont.

Country Indexes	ADA			
	Hedge(m ₀)	1% quantile(m ₁)	5% quantile(m ₂)	10% quantile(m ₃)
Brazil	0.1290847*** (p< 2e-16)	0.0522053*** (p=0.000399)	-0.0007642 (p=0.931713)	0.0189971*** (p=0.001868)
Chile	0.147112*** (p< 2e-16)	0.008003 (p=0.7146)	0.022462* (p=0.0905)	0.012618 (p=0.1643)
China	0.1207143*** (p< 2e-16)	0.0312168*** (p=0.00301)	-0.0045729 (p=0.47272)	0.0092302** (p=0.03416)
Colombia	0.132976*** (p< 2e-16)	0.025388** (p=0.0268)	0.004560 (p=0.5115)	0.009920** (p=0.0368)
Czech	0.1376741*** (p< 2e-16)	0.0125676* (p=0.090530)	0.0023026 (p=0.608712)	0.0111920*** (p=0.000281)
Greece	0.1523401*** (p< 2e-16)	-0.0064350 (p=0.314)	0.0060541 (p=0.118)	-0.0016643 (p=0.530)
Hungary	0.115741*** (p< 2e-16)	0.022209** (p=0.0385)	0.001796 (p=0.7824)	0.002997 (p=0.5002)
India	0.0896692*** (p< 2e-16)	-0.0139640 (p=0.143)	-0.0009351 (p=0.871)	0.0006147 (p=0.876)
Indonesia	1.112e-01*** (p< 2e-16)	2.126e-06*** (p=9.89e-13)	2.738e-07 (p=0.127)	-8.040e-08 (p=0.512)
Korea	0.0747997*** (p< 2e-16)	0.0286042*** (p=0.000235)	0.0082553* (p=0.079409)	-0.0049911 (p=0.120915)
Malaysia	8.061e-02*** (p< 2e-16)	1.497e-07*** (p=1.34e-14)	2.035e-08* (p=2.035e-08)	-5.062e-09 (p=0.5262)
Mexico	0.169157*** (p< 2e-16)	-0.029968 (p= 0.163)	-0.008371 (p= 0.520)	0.011303 (p= 0.204)
Peru	1.925e-01*** (p< 2e-16)	1.022e-02 (p=0.4790)	-3.263e-05 (p=0.9970)	1.172e-02* (p=0.0502)
Philippines	0.0626939*** (p< 2e-16)	0.0269429*** (p=4.17e-07)	0.0010917 (p=0.734)	0.0017726 (p=0.420)
Poland	0.177283*** (p< 2e-16)	0.002908 (p=0.7060)	0.007352 (p=0.1157)	0.005753* (p=0.0719)
Qatar	7.357e-02*** (p< 2e-16)	3.743e-09*** (p=2.93e-05)	-7.693e-11 (p=0.887)	-3.094e-10 (p=0.404)
South Africa	0.1732394*** (p< 2e-16)	0.0142064 (p=0.161)	-0.0013219 (p=0.830)	0.0031244 (p=0.457)
Taiwan	0.064885*** (p< 2e-16)	0.015658 (p= 0.144)	0.006861 (p= 0.291)	0.001437 (p= 0.746)
Thailand	0.1099418*** (p< 2e-16)	0.0281888*** (p=2.09e-05)	-0.0040594 (p=0.311)	0.0043933 (p=0.109)
Türkiye	0.065492*** (p< 2e-16)	0.025645 (p=0.102)	-0.010173 (p=0.284)	0.002980 (p=0.646)
UAE	0.0723070*** (p< 2e-16)	0.0339759*** (p=0.00372)	0.0007532 (p=0.91538)	0.0062201 (p=0.19956)
EM	0.151568*** (p< 2e-16)	0.048397 (p=0.000195)	0.011437 (p=0.145603)	-0.003072 (p=0.567480)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 27: Regression Results (DCCs calculated as pairs of return series separately) cont.

Country Indexes	XRP			
	Hedge(m ₀)	1% quantile(m ₁)	5% quantile(m ₂)	10% quantile(m ₃)
Brazil	0.1459444*** (p< 2e-16)	-0.0160586 (p=0.11063)	-0.0020553 (p=0.73608)	0.0117369** (p=0.00493)
Chile	0.130744*** (p< 2e-16)	0.033578* (p=0.0664)	0.013489 (p=0.2236)	0.005320 (p=0.4827)
China	0.1373536*** (p< 2e-16)	0.0121487* (p=0.0761)	-0.0035678 (p=0.3899)	0.0063668** (p=0.0249)
Colombia	0.143078*** (p< 2e-16)	0.046538*** (p=1.93e-05)	0.001230 (p=0.85174)	0.012841*** (p=0.00438)
Czech	0.1360192*** (p< 2e-16)	0.0007335 (p=0.710882)	0.0017914 (p=0.135357)	0.0030255*** (p=0.000231)
Greece	0.1171128*** (p< 2e-16)	-0.0015748 (p=0.801)	0.0044768 (p=0.237)	0.0024702 (p=0.340)
Hungary	0.1119803*** (p< 2e-16)	0.0236543** (p=0.0212)	0.0107341* (p=0.0844)	0.0061262 (p=0.1497)
India	7.001e-02*** (p< 2e-16)	3.798e-02*** (p=1.39e-06)	6.133e-03 (p=0.197)	4.835e-05 (p=0.988)
Indonesia	9.416e-02*** (p< 2e-16)	3.778e-07*** (p=2.38e-10)	6.690e-08* (p=0.0627)	-2.718e-08 (p=0.2688)
Korea	0.0825132*** (p< 2e-16)	-0.0086596* (p=0.0581)	0.0065595** (p=0.0179)	-0.0020813 (p=0.2715)
Malaysia	9.397e-02*** (p< 2e-16)	4.818e-07*** (p=8.81e-10)	4.598e-08 (p=0.332)	-2.334e-08 (p=0.471)
Mexico	0.156617*** (p< 2e-16)	-0.030538* (p=0.0906)	-0.005004 (p=0.6472)	0.008116 (p=0.2777)
Peru	0.178863*** (p< 2e-16)	0.022335 (p=0.2865)	0.006805 (p=0.5920)	0.016112* (p=0.0636)
Philippines	6.253e-02*** (p< 2e-16)	1.230e-06* (p=0.0886)	1.025e-06** (p=0.0193)	-1.900e-07 (p=0.5257)
Poland	0.1729666*** (p< 2e-16)	0.0071153 (p=0.488)	0.0084407 (p=0.175)	0.0065251 (p=0.125)
Qatar	0.0756101*** (p< 2e-16)	0.0034465** (p=0.0152)	-0.0001704 (p=0.8429)	-0.0001170 (p=0.8423)
South Africa	0.1606029*** (p< 2e-16)	0.0089520 (p=0.244)	0.0002684 (p=0.954)	0.0038632 (p=0.225)
Taiwan	7.224e-02*** (p< 2e-16)	1.839e-07*** (p=0.0036)	9.225e-08 (p=0.0159)	-2.006e-08 (p=0.4431)
Thailand	0.1090140*** (p< 2e-16)	0.0310023*** (p=0.000113)	-0.0058131 (p=0.231326i9)	0.0070407** (p=0.034092)
Türkiye	0.030224*** (p< 2e-16)	0.023014** (p=0.044965)	-0.010241 (p=0.140858)	0.016242*** (p=0.000648)
UAE	0.0437336*** (p< 2e-16)	0.0315476** (p=0.00103)	0.0009338 (p=0.87240)	0.0070483* (p=0.07642)
EM	0.162019*** (p< 2e-16)	0.013627 (p=0.319)	0.012291 (p=0.138)	-0.001380 (p=0.808)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 28: Regression Results (DCCs calculated for all series simultaneously)

	Bitcoin (BTC)			
Country Indexes	Hedge(m ₀)	1% quantile(m ₁)	5% quantile(m ₂)	10% quantile(m ₃)
Brazil	0.1416310*** (p< 2e-16)	0.0420223*** (p=1.85e-07)	0.0007570 (p=0.876362)	0.0109963*** (p=0.000967)
Chile	0.1252738*** (p< 2e-16)	0.0309194*** (p=0.00352)	0.0038928 (p=0.51764)	0.0072433* (p=0.07146)
China	0.0892212*** (p< 2e-16)	-0.0003252 (p=0.98028)	0.0178423*** (p=0.00565)	0.0016783 (p=0.65283)
Colombia	0.1153198*** (p< 2e-16)	0.0284245*** (p=0.000114)	0.0001428 (p=0.980494)	0.0091433** (p=0.030213)
Czech	0.1273683*** (p< 2e-16)	0.0303471*** (p=0.00483)	-0.0015217 (p=0.84689)	0.0143444*** (p=0.00890)
Greece	0.1232551*** (p< 2e-16)	0.0080551 (p=0.2435)	-0.0001564 (p=0.9735)	0.0060367 (p=0.0605)
Hungary	0.0865833*** (p< 2e-16)	0.0108776 (p=0.1812)	0.0077822 (p=0.2055)	0.0090482** (p=0.0374)
India	0.0606032*** (p< 2e-16)	0.0276457** (p=0.0472)	0.0398826*** (p=3.83e-05)	0.0107563* (p=0.0878)
Indonesia	0.0847847*** (p< 2e-16)	0.0442079*** (p=6.62e-05)	0.0118619 (p=0.126)	0.0048264 (p=0.329)
Korea	0.0317184*** (p< 2e-16)	0.0308210** (p=0.0102)	0.0129859** (p=0.0195)	0.0025919 (p=0.4646)
Malaysia	0.0610565*** (p< 2e-16)	0.1059280*** (p=1.45e-07)	-0.0305335** (p=0.0226)	0.0583932*** (p=4.78e-13)
Mexico	0.1525855*** (p< 2e-16)	0.0474831*** (p=4.58e-05)	0.0032157 (p=0.6816)	0.0093206** (p=0.0347)
Peru	0.1814264*** (p< 2e-16)	0.0286923*** (p=0.00183)	0.0012251 (p=0.82490)	0.0104992*** (p=0.00468)
Philippines	0.0455114*** (p< 2e-16)	0.1121520*** (p=1.1e-13)	-0.0020098 (p=0.8306)	0.0093291** (p=0.0277)
Poland	0.1664065*** (p< 2e-16)	0.0131669 (p=0.2003)	0.0052735 (p=0.3569)	0.0105292*** (p=0.0105292)
Qatar	0.0178308*** (p< 2e-16)	-0.0509328* (p=0.06203)	0.0343478*** (p=0.00469)	0.0039376 (p=0.66054)
South Africa	0.1524402*** (p< 2e-16)	0.0534194*** (p=4.05e-09)	-0.0028036 (p=0.590)	0.0015692 (p=0.653)
Taiwan	0.0321894*** (p< 2e-16)	-0.0069020 (p=0.66503)	0.0250208** (p=0.01330)	0.0149911*** (p=0.00154)
Thailand	0.0771532*** (p< 2e-16)	0.0824473*** (p=1.25e-06)	0.0021376 (p=0.868)	0.0065957 (p=0.317)
Türkiye	0.0711522*** (p< 2e-16)	0.0098706 (p=0.111)	-0.0005307 (p=0.912)	0.0027517 (p=0.399)
UAE	0.0334324*** (p< 2e-16)	0.1144349*** (p=1.39e-12)	-0.0013811 (p=0.9058)	0.0176246*** (p=0.0094)
EM	0.1140564*** (p< 2e-16)	0.0646913*** (p= 0.000923)	0.0098107 (p= 0.442115)	0.0199106*** (p= 0.001046)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 29: Regression Results (DCCs calculated for all series simultaneously) cont.

	Ethereum (ETH)			
Country Indexes	Hedge(m ₀)	1% quantile(m ₁)	5% quantile(m ₂)	10% quantile(m ₃)
Brazil	0.1413446*** (p< 2e-16)	0.0372967*** (p=9.52e-07)	0.0023261 (p=0.61277)	0.0086353*** (p=0.00606)
Chile	0.1527556*** (p< 2e-16)	0.0270045*** (p=0.00776)	0.0001912 (p=0.97352)	0.0066766* (p=0.08266)
China	0.1279442*** (p< 2e-16)	0.0086950 (p=0.4603)	0.0105422* (p=0.0675)	0.0029044 (p=0.3844)
Colombia	0.1354336*** (p< 2e-16)	0.0220066*** (p=0.00121)	-0.0040918 (p=0.44809)	0.0109814*** (p=0.00485)
Czech	0.152484*** (p< 2e-16)	0.038033*** (p=6.91e-05)	-0.005606 (p=0.42242)	0.014098*** (p=0.00374)
Greece	0.1495837*** (p< 2e-16)	0.0003825 (p=0.955)	-0.0020332 (p=0.656)	0.0042616 (p=0.172)
Hungary	0.130322*** (p< 2e-16)	0.010349 (p=0.14594)	0.002994 (p=0.57761)	0.011269*** (p=0.00307)
India	0.0923163*** (p< 2e-16)	0.0084456 (p=0.53354)	0.0351960*** (p=0.00019)	0.0080860 (p=0.18758)
Indonesia	0.0871200*** (p< 2e-16)	0.0215364* (p=0.0558)	0.0194030** (p=0.0139)	0.0024099 (p=0.6323)
Korea	0.079043*** (p< 2e-16)	0.021315* (p=0.0795)	0.007262 (p=0.1971)	0.003033 (p=0.3984)
Malaysia	0.0653592*** (p< 2e-16)	0.0832474*** (p=1.36e-05)	-0.0255124** (p=-0.0255124)	0.0460685*** (p=1.83e-09)
Mexico	0.1836965*** (p< 2e-16)	0.0390966*** (p=7.92e-05)	0.0017887 (p=0.788)	0.0054139 (p=0.149)
Peru	0.1994165*** (p< 2e-16)	0.0199687** (p=0.0152)	0.0037592 (p=0.4477)	0.0079220** (p=0.0079220)
Philippines	0.0434917*** (p< 2e-16)	0.0973435*** (p=1.08e-10)	-0.0025040 (p=0.7899)	0.0089051** (p=0.0357)
Poland	0.1954192*** (p< 2e-16)	0.0140757 (p=0.11692)	0.0037980 (p=0.44725)	0.0086993*** (p=0.00437)
Qatar	0.0583971*** (p< 2e-16)	-0.0469019** (p=0.047686)	0.0381241*** (p=0.000302)	-0.0078553 (p=0.312718)
South Africa	0.1754770*** (p< 2e-16)	0.0406201*** (p=3.42e-07)	-0.0022186 (p=0.627)	0.0001605 (p=0.958)
Taiwan	0.0591358*** (p< 2e-16)	0.0128906 (p=0.37912)	0.0033599 (p=0.71743)	0.0122320*** (p=0.00493)
Thailand	0.1100391*** (p< 2e-16)	0.0685638*** (p=2.21e-05)	-0.0035056 (p=0.775)	0.0093570 (p=0.135)
Türkiye	0.0828629*** (p< 2e-16)	0.0037230 (p=0.528)	-0.0047199 (p=0.300)	0.0027195 (p=0.382)
UAE	0.0891968*** (p< 2e-16)	0.0940734*** (p=4.23e-10)	-0.0067929 (p=0.533)	0.0159194** (p=0.012)
EM	0.1563051*** (p< 2e-16)	0.0308882* (p=0.084070)	0.0094417 (p=0.419727)	0.0185389*** (p=0.000872)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 30: Regression Results (DCCs calculated for all series simultaneously) cont.

Country Indexes	BNB			
	Hedge(m_0)	1% quantile(m_1)	5% quantile(m_2)	10% quantile(m_3)
Brazil	0.1373249*** ($p < 2e-16$)	0.0368125*** ($p = 4.22e-07$)	0.0025584 ($p = 0.5604$)	0.0062911** ($p = 0.0364$)
Chile	0.143090*** ($p < 2e-16$)	0.027366*** ($p = 0.00366$)	0.002247 ($p = 0.67429$)	0.006523* ($p = 0.06773$)
China	0.1312888*** ($p < 2e-16$)	0.0107583 ($p = 0.31688$)	0.0163392*** ($p = 0.00192$)	-0.0008799 ($p = 0.77275$)
Colombia	0.1271594*** ($p < 2e-16$)	0.0312153*** ($p = 1.1e-05$)	-0.0011007 ($p = 0.8448$)	0.0080502** ($p = 0.0475$)
Czech	0.1181946*** ($p < 2e-16$)	0.0392732*** ($p = 1.78e-05$)	-0.0040941 ($p = 0.54053$)	0.0136620*** ($p = 0.00334$)
Greece	0.1110643*** ($p < 2e-16$)	0.0088671 ($p = 0.180$)	0.0028625 ($p = 0.525$)	-0.0010324 ($p = 0.737$)
Hungary	0.0840435*** ($p < 2e-16$)	0.0210310*** ($p = 0.00383$)	0.0025266 ($p = 0.64526$)	0.0111385*** ($p = 0.00414$)
India	0.0656008*** ($p < 2e-16$)	0.0253594** ($p = 0.0373$)	0.0349070*** ($p = 3.72e-05$)	0.0086915 ($p = 0.1144$)
Indonesia	0.106018*** ($p < 2e-16$)	0.033690*** ($p = 0.00249$)	0.015881** ($p = 0.04155$)	0.004834 ($p = 0.33156$)
Korea	0.0576912*** ($p < 2e-16$)	0.0282640** ($p = 0.0111$)	0.0110837** ($p = 0.0316$)	0.0011621 ($p = 0.7237$)
Malaysia	0.0765038*** ($p < 2e-16$)	0.1177699*** ($p = 3.68e-09$)	-0.0371819*** ($p = 0.00505$)	0.0558621*** ($p = 2.75e-12$)
Mexico	0.1365604*** ($p < 2e-16$)	0.0471344*** ($p = 6.62e-06$)	0.0017075 ($p = 0.8083$)	0.0075015* ($p = 0.0583$)
Peru	0.175448*** ($p < 2e-16$)	0.028896*** ($p = 0.000638$)	-0.001467 ($p = 0.773098$)	0.011603*** ($p = 0.000674$)
Philippines	0.0434889*** ($p < 2e-16$)	0.1091754 ($p = 9.19e-16$)	0.0006469 ($p = 0.939$)	0.0062307 ($p = 0.102$)
Poland	0.157648*** ($p < 2e-16$)	0.022117** ($p = 0.0114$)	0.003120 ($p = 0.5212$)	0.006739** ($p = 0.0233$)
Qatar	0.0650607*** ($p < 2e-16$)	-0.0565633** ($p = 0.03582$)	0.0394126*** ($p = 0.00102$)	-0.0004672 ($p = 0.95790$)
South Africa	1.534e-01*** ($p < 2e-16$)	4.053e-02*** ($p = 1.01e-07$)	-3.568e-03 ($p = 0.413$)	3.179e-05 ($p = 0.991$)
Taiwan	0.0499973*** ($p < 2e-16$)	-0.0034755 ($p = 0.79845$)	0.0160741* ($p = 0.06242$)	0.0107417*** ($p = 0.00785$)
Thailand	0.0887100*** ($p < 2e-16$)	0.0821000*** ($p = 7.93e-07$)	0.0051398 ($p = 0.683$)	0.0001271 ($p = 0.984$)
Türkiye	0.0618867*** ($p < 2e-16$)	0.0038648 ($p = 0.483$)	-0.0049100 ($p = 0.248$)	0.0035353 ($p = 0.223$)
UAE	0.0654160*** ($p < 2e-16$)	0.1192122*** ($p = 1.55e-15$)	0.0034570 ($p = 0.748475$)	0.0216676*** ($p = 0.000554$)
EM	0.1390337*** ($p < 2e-16$)	0.0584528*** ($p = 0.000325$)	0.0110011 ($p = 0.300639$)	0.0158821*** ($p = 0.001687$)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 31: Regression Results (DCCs calculated for all series simultaneously) cont.

Country Indexes	ADA			
	Hedge(m_0)	1% quantile(m_1)	5% quantile(m_2)	10% quantile(m_3)
Brazil	0.131201*** ($p < 2e-16$)	0.046971*** ($p = 7.2e-10$)	-0.001033 ($p = 0.8221$)	0.007283** ($p = 0.0206$)
Chile	0.1499918*** ($p < 2e-16$)	0.0223680** ($p = 0.0156$)	0.0049152 ($p = 0.3495$)	0.0062992* ($p = 0.0726$)
China	0.1213410*** ($p < 2e-16$)	0.0167235 ($p = 0.146$)	0.0083116 ($p = 0.140$)	0.0030852 ($p = 0.344$)
Colombia	0.1351312*** ($p < 2e-16$)	0.0276046*** ($p = 1.42e-05$)	-0.0026762 ($p = 0.5952$)	0.0094546*** ($p = 0.0094$)
Czech	0.1381389*** ($p < 2e-16$)	0.0415286*** ($p = 2.89e-05$)	-0.0010512 ($p = 0.8848$)	0.0105231** ($p = 0.0371$)
Greece	1.528e-01*** ($p < 2e-16$)	2.748e-03 ($p = 0.658$)	5.590e-03 ($p = 0.187$)	9.927e-05 ($p = 0.973$)
Hungary	0.1153722*** ($p < 2e-16$)	0.0180847*** ($p = 0.00859$)	0.0020520 ($p = 0.69285$)	0.0101666 ($p = 0.00569$)
India	0.0920507*** ($p < 2e-16$)	0.0232209* ($p = 0.0572$)	0.0353379*** ($p = 3.16e-05$)	0.0035977 ($p = 0.5146$)
Indonesia	0.1102986*** ($p < 2e-16$)	0.0283678*** ($p = 0.00378$)	0.0211918*** ($p = 0.00201$)	0.0003835 ($p = 0.93021$)
Korea	0.0745885*** ($p < 2e-16$)	0.0271679** ($p = 0.0325$)	0.0095640 ($p = 0.1041$)	0.0011579 ($p = 0.7576$)
Malaysia	0.0800940*** ($p < 2e-16$)	0.0894634 ($p = 1.74e-06$)	-0.0269944** ($p = 0.03$)	0.0466885 ($p = 4.57e-10$)
Mexico	0.1680407*** ($p < 2e-16$)	0.0474539*** ($p = 4.84e-06$)	0.0037782 ($p = 0.588$)	0.0055278 ($p = 0.160$)
Peru	0.1944572*** ($p < 2e-16$)	0.0264627*** ($p = 0.00073$)	0.0006118 ($p = 0.89665$)	0.0087938*** ($p = 0.00535$)
Philippines	0.0622216*** ($p < 2e-16$)	0.1031402*** ($p = 8.82e-15$)	-0.0036705 ($p = 0.6571$)	0.0075549** ($p = 0.0428$)
Poland	0.177514*** ($p < 2e-16$)	0.015450* ($p = 0.0659$)	0.006758 ($p = 0.1484$)	0.006626** ($p = 0.0203$)
Qatar	0.0726001*** ($p < 2e-16$)	-0.0284721 ($p = 0.17301$)	0.0288194*** ($p = 0.00195$)	-0.0036415 ($p = 0.59584$)
South Africa	0.1732302*** ($p < 2e-16$)	0.0341026*** ($p = 1.37e-05$)	-0.0037821 ($p = 0.401$)	0.0016463 ($p = 0.585$)
Taiwan	0.065264*** ($p < 2e-16$)	-0.004835 ($p = 0.7405$)	0.017543* ($p = 0.0580$)	0.009205 ($p = 0.0336$)
Thailand	0.1096329*** ($p < 2e-16$)	0.0711919*** ($p = 8.96e-06$)	-0.0015900 ($p = 0.896$)	0.0100126 ($p = 0.107$)
Türkiye	0.0656984*** ($p < 2e-16$)	0.0063665 ($p = 0.282$)	-0.0041818 ($p = 0.360$)	0.0009599 ($p = 0.758$)
UAE	0.0730297*** ($p < 2e-16$)	0.1041002*** ($p = 2.22e-11$)	-0.0078883 ($p = 0.483$)	0.0168511*** ($p = 0.010$)
EM	0.1520093*** ($p < 2e-16$)	0.0490944*** ($p = 0.00543$)	0.0123086 ($p = 0.28651$)	0.0141750*** ($p = 0.00986$)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

Table 32: Regression Results (DCCs calculated for all series simultaneously) cont.

Country Indexes	XRP			
	Hedge(m ₀)	1% quantile(m ₁)	5% quantile(m ₂)	10% quantile(m ₃)
Brazil	0.1444849*** (p< 2e-16)	0.0347904*** (p=1.59e-08)	0.0020688 (p=0.57751)	0.0073761 (p=0.00372)
Chile	0.1315579*** (p< 2e-16)	0.0283322*** (p=0.000929)	0.0037566 (p=0.439267)	0.0037630 (p=0.245890)
China	0.1376678*** (p< 2e-16)	0.0029486 (p=0.775)	0.0059877 (p=0.235)	0.0022981 (p=0.432)
Colombia	0.1446370*** (p< 2e-16)	0.0209120*** (p=0.000255)	0.0013378 (p=0.767857)	0.0062479* (p=0.056360)
Czech	0.1354377*** (p< 2e-16)	0.0381702*** (p=1.02e-05)	-0.0033955 (p=0.5910)	0.0102874** (p=0.0193)
Greece	0.1172548*** (p< 2e-16)	0.0053593 (p=0.411)	0.0063547 (p=0.152)	0.0017229 (p=0.570)
Hungary	0.1124895*** (p< 2e-16)	0.0104412 (p=0.1258)	0.0066338 (p=0.1980)	0.0092296** (p=0.0114)
India	0.0701082*** (p< 2e-16)	0.0168113 (p=0.171723)	0.0303718*** (p=0.000382)	0.0033723 (p=0.544317)
Indonesia	0.0930034*** (p< 2e-16)	0.0169322* (p=0.08300)	0.0186530*** (p=0.00641)	0.0036081 (p=0.40894)
Korea	0.0821954*** (p< 2e-16)	0.0226152** (p=0.0413)	0.0068371 (p=0.1829)	0.0015649 (p=0.6326)
Malaysia	0.093351*** (p< 2e-16)	0.086501*** (p=8.96e-06)	-0.029638** (p=0.0222)	0.040617*** (p=1.84e-07)
Mexico	0.1549779*** (p< 2e-16)	0.0427982*** (p=4.19e-06)	-0.0010795 (p=0.8630)	0.0090034** (p=0.0106)
Peru	0.1801977*** (p< 2e-16)	0.0246854*** (p=0.0019)	-0.0013330 (p=0.7804)	0.0104635*** (p=0.0104635)
Philippines	0.061528*** (p< 2e-16)	0.087130*** (p=2.18e-11)	-0.005098 (p=0.5297)	0.006735* (p=0.0656)
Poland	0.173134*** (p< 2e-16)	0.016479** (p=0.0465)	0.005672 (p=0.2184)	0.005183 (p=0.0653)
Qatar	0.0749463*** (p< 2e-16)	-0.0334733 (p=0.11881)	0.0292195*** (p=0.00223)	-0.0061280 (p=0.38481)
South Africa	0.1604507*** (p< 2e-16)	0.0359425*** (p=3.19e-07)	-0.0004624 (p=0.909)	0.0015045 (p=0.578)
Taiwan	0.0715467*** (p< 2e-16)	0.0034003 (p=0.7890)	0.0116550 (p=0.1477)	0.0083760** (p=0.0263)
Thailand	0.1093291*** (p< 2e-16)	0.0754797*** (p=7.24e-06)	-0.0062945 (p=0.622)	0.0106871 (p=0.101)
Türkiye	0.0303241*** (p< 2e-16)	0.0067061 (p=0.25525)	-0.0036648 (p=0.42093)	0.0085660*** (p=0.00589)
UAE	0.0441918*** (p< 2e-16)	0.0913150*** (p= 1.57e-09)	-0.0083196 (p= 0.44733)	0.0168975*** (p= 0.00796)
EM	0.1623628*** (p< 2e-16)	0.0429773*** (p=0.00537)	0.0101458 (p=0.31500)	0.0091357* (p=0.05702)

Values in () represent p-values. *** corresponds to significance at the 1% level, ** corresponds to significance at the 5% level, and * corresponds to significance at the 10% level.

PART 5: CONCLUSION AND DISCUSSION

Empirical results will be evaluated, compared and contrasted in this section of the study. Diversifier, hedge and safe haven characteristics of per cryptocurrency against stock market returns will be evaluated within light of empirical evidence.

To begin with, constant m_0 is positive and significant for Bitcoin against stock market indexes without exception. This result is proven and validated by both regression results where DCCs have been calculated for pair of series separately and all series simultaneously. In this manner, DCC calculation methodology does not create any significant difference. Since m_0 is positive and significant for Bitcoin against emerging stock market returns, Bitcoin is good diversifier for those markets. In other words, positive and significant relationship has been detected between Bitcoin and emerging stock markets. Bitcoin may function as a diversification tool for emerging markets. In addition, Time-varying association between Bitcoin and the MSCI Emerging Market Index (overall index) is also positive and significant. This outcome is in agreement with the result detected for each emerging stock market. However, Bitcoin cannot act as hedge asset since connection between Bitcoin and emerging stock market index is not negative and significant. Coefficient of dummy variables, m_1 , m_2 and m_3 for dynamic correlation between Bitcoin and Brazil, Greece, Hungary, Mexico, Peru, South Africa and United Arab Emirates (UAE) are statistically insignificant and they are different from zero. This makes Bitcoin weak safe haven asset for Brazilian, Greece, Hungary, Mexico, Peru, South Africa and United Arab Emirates (UAE) stock markets. For Chile, m_1 and m_3 are insignificant while m_2 is significant and positive. Therefore, Bitcoin cannot be accepted as safe haven asset for Chile stock market. For China and Colombia, m_1 and m_3 are significant and positive while m_2 is insignificant. This result proves that Bitcoin cannot act as safe haven asset for Chinese and Colombian stock markets. For Czech, Poland m_3 is significant and positive while other dummy coefficients are insignificant. Thus, Bitcoin cannot behave as safe haven asset for Czech and Poland stock market. For India, Indonesia, Korea, Philippines, Qatar, Taiwan and Türkiye m_1 is significant and positive while other dummy coefficients are insignificant. Therefore; Bitcoin cannot be accepted as safe haven asset for India, Indonesia, Korea, Philippines, Qatar, Taiwan and Türkiye stock markets. Coefficient of dummy variables for Malaysia are significant and positive expect m_3 . This proves that Bitcoin is not safe haven asset for Malaysia stock market. While m_1 and m_3 are positive and significant, m_2 is negative and significant for Thailand. This results ae

inconsistent. Therefore, Bitcoin cannot be accepted as safe haven asset for Thailand stock market. Lastly, $m1$ and $m2$ coefficients are positive and significant for dynamic conditional correlation between Bitcoin and MSCI Emerging Market (Overall) index. This result puts forward that Bitcoin is not suitable to be safe haven asset for emerging stock markets in general. In short, Bitcoin is good diversifier for all emerging stock markets without exception. In addition, Bitcoin could serve as weak safe haven asset for Brazil, Greece, Hungary, Mexico, Peru, South Africa and UAE stock markets. However, Bitcoin is not hedge asset alternative for emerging stock market as it has been clearly indicated by empirical evidence. Regression results where DCCs are calculated for pairs of series separately and for all series simultaneously almost match and coincide. As stated above, both regression results indicate that Bitcoin is diversifier for all emerging stock markets without exception. In addition, both regression results put forward that Bitcoin cannot behave as hedge asset for all emerging stock markets. Small differences are observed when evaluating safe haven property of Bitcoin against some country indexes. To illustrate, Bitcoin cannot be weak safe haven asset for Brazil, Hungary, Mexico, Peru, South Africa and UAE stock markets according to regression results where DCCs are calculated for all series simultaneously while Bitcoin can act as weak safe haven for those stock markets according to regression results where DCCs are calculated for pairs of series separately. In addition, Bitcoin could be weak safe haven asset for Türkiye according to regression results where DCCs are calculated for all series simultaneously. Therefore, there is not much difference between results of two DCC GARCH estimation methods. To summarize, Bitcoin is good diversifier for all emerging stock markets while it cannot act as hedge asset for emerging stock markets without exception. Lastly, Bitcoin can behave as weak safe haven asset for some emerging stock markets. Bitcoin cannot be accepted as strong safe haven asset for emerging stock markets.

Result detected for Bitcoin is consistent with findings of previous studies indicating that Bitcoin can act as diversifier rather than safe haven or hedge asset for emerging markets (Brière et al., 2015; Shahzad et al., 2019; Guesmi et al., 2019; Bouri et al., 2017; Conlon et al., 2020; Pengfei et al., 2019; Riahi et al., 2024; Jiang et al. 2021; Klein et al., 2018). Feng et al. (2024) analyzes role of Bitcoin for Türkiye, Brazil, Mexico, China, Korea and Malaysia stock markets. Authors conclude that Bitcoin could only be a diversifier for those markets except Korean stock market. They assert that Bitcoin can act as strong safe haven for Korean stock market. Our empirical findings are not coinciding with this results completely.

Empirical results found in this study puts forward that Bitcoin cannot be a strong safe haven for any of those emerging stock markets. In addition, Bitcoin could only be weak safe haven for Brazil, Mexico. Although, both studies agreed on diversifier role of Bitcoin for emerging markets, small discrepancies have been detected when determining safe haven role of Bitcoin. Bejaoui et al. (2023) concentrates on dependency between Bitcoin and BRICS (Brazil, Russia, India, China, South Africa) and Gulf countries (Bahrain, Kuwait, Saudi Arabia, Jordan, Qatar, United Arab Emirates). They support only diversification role of Bitcoin for BRICS and Gulf countries. Kliber et al. (2019), Kajtazi & Moro (2019), Maghyereh & Abdoh (2020), Ji et al. (2020) and Corbet et al. (2020) analyzed characteristics of Bitcoin and/or Ethereum for stock markets. They concluded that Bitcoin and/or Ethereum can only be diversifier for Chinese stock market. Jeribi & Ghorbel (2021) determined diversifier role of Bitcoin for BRICS countries. These results mirror our empirical findings.

According to Jeribi et al. (2021), Bitcoin and Ethereum possess safe haven properties for Brazil and China. Ripple acts as safe haven for BRICS countries. Authors attribute safe haven role to cryptocurrencies for BRICS countries. Wang et al. (2019), attributes hedge and safe haven role for Bitcoin for Chinese stock markets. Garcia-Jorcano & Benito (2020) asserted that Bitcoin act as hedge asset for Chinese stock markets. Chan et al. (2019) has studied role of Bitcoin for Chinese stock markets. They attributed strong hedge role to Bitcoin for Chinese stock markets. Stensås et al. (2019) asserted that Bitcoin could be hedge asset for some developing countries named Brazil, India and Korea. Bouri et al. (2020) implies that Bitcoin could be safe haven asset for emerging markets in general. These implications and results are contradictory to our empirical findings.

As it can be seen above, most of the studies in the literature on this subject clearly state that Bitcoin could be a diversifier rather than safe haven or hedge for emerging stock markets. Few studies in the literature attribute hedge or safe haven role to Bitcoin for emerging stock markets. Empirical findings in this study support the first and dominant view on this subject. Econometric analysis in this study clearly puts forward that Bitcoin could be diversifier for most of the emerging stock markets with few exceptions.

Secondly, constant m_0 is positive and significant for Ethereum against stock market indexes without exception. This result is proven and validated by both method of DCC GARCH estimations. Thus, DCC calculation methodology does not create any significant difference. Since m_0 is not negative, it can be clearly expressed that Ethereum does not have hedge property for emerging stock markets. However, Ethereum has more safe haven feature

compared to Bitcoin for the stock markets under investigation. To indicate, Chile, Greece, Hungary, Indonesia, South Africa have negative m_1 , m_2 or m_3 values. This results prove that Ethereum is strong safe haven asset for those countries. In addition, Colombia, India, Mexico, Peru and UAE have insignificant m_1 , m_2 or m_3 values and they are different from zero. This result exhibits that Ethereum behaves as weak safe haven for those stock markets. Ethereum indicates safe haven property for half of emerging stock markets. Bitcoin's safe haven feature is limited compared to Ethereum. Ethereum is only diversifier for remaining half of emerging stock markets. Results related to safe haven property of Ethereum has been retrieved from regression results where DCCs have been calculated for pair of series separately. Regression results leaning on DCCs which are calculated through employing all series simultaneously provides different results only for safe haven feature of Ethereum. In other words; both methods of DCC application clearly state that Ethereum is good diversifier for emerging stock markets. However, there are some discrepancies on whether Ethereum is safe haven or not against stock markets. The second method where DCCs calculated through employing all series simultaneously asserts that Ethereum's safe haven capacity for emerging stock markets is limited. To indicate, Ethereum behave as weak/strong safe haven for Chile, Colombia, Hungary, India, Indonesia, Mexico, Peru, South Africa and UAE stock markets according to the first method where DCCs calculated for pairs of series separately. On the other hand, Ethereum is not effective as a safe haven for those stock markets according to second method where DCCs calculated through employing all series simultaneously. The first method provides contradictor results on safe haven feature of Ethereum for Poland and Türkiye. m_1 is negative and significant while m_3 is positive and significant for Poland. Therefore, safe haven property of Ethereum for Poland stock market cannot be acceptable. m_1 is positive and significant while m_2 is negative and significant for Türkiye. This contradictory results prevents Ethereum to be safe haven for Türkiye. Thus, Ethereum could be only diversifier for Poland and Türkiye. This result does not coincide with result found by second method where DCCs calculated through employing all series simultaneously. The second method findings put forward that Ethereum could be weak safe haven asset for Türkiye. If we observe relationship between Ethereum and MSCI Overall Emerging Market Index, difference on results with respect to being safe haven or not could be seen easily. According to the first method where DCCs calculated for pairs of series separately, Ethereum can act as weak safe haven for all emerging stock markets since m_1 , m_2 and m_3 are insignificantly different from zero. On the contrary, m_1 and m_3 are positive and significant for MSCI Emerging Market index so Ethereum cannot behave as safe haven

asset for emerging stock markets according to the second method where DCCs calculated through employing all series simultaneously. In short; Ethereum is certainly a good diversifier for emerging stock markets. Moreover, it is safe haven asset for some developing countries.

Jeribi et al. (2021) assert that Ethereum could serve as safe haven asset for Brazil and Chinese stock markets during the Covid-19 pandemic. Empirical results found in this study supports that Ethereum could be safe haven asset for Brazil but not for China. Therefore, we partially agree with claims of Jeribi et al. (2021). Ma et al. (2020) claims that adding Ethereum to portfolios increased return of portfolios while decreasing variance and risk of the portfolios. This indicates that cryptocurrencies are good diversifiers for asset portfolios in emerging markets. Riahi et al. (2024) claimed that Ethereum could be diversifier but it does not serve as safe haven for emerging stock markets. These findings corroborate the empirical results observed in this study. Ethereum could be good diversifier for emerging stock markets as stated above. Ji et al. (2020) and Corbet et al. (2020) put forward that Ethereum could not be safe haven asset for Chinese stock markets. Likewise, Jiang et al. (2021) claimed that Ethereum could not be safe haven or hedge asset for developing stock markets. It can only be a diversifier for emerging stock markets. As it is stated at the beginning of this study, there are few studies concentrating on dependency between Ethereum and developing stock markets. Most of the studies in the literature investigate relationship between Bitcoin and developed stock markets. To illustrate, Myriam Ben Osman et al. (2023), Bouri et al. (2020), Będowska-Sójka & Kliber (2021), Mariana et al. (2021), Kliber (2022), Tiwari et al. (2019), Alana et al. (2020) and Corbet et al. (2020) research dependency between Ethereum and developed stock markets. They assert that Ethereum is utilized as a hedge and safe haven asset in developed stock markets, including those in the U.S. and Europe. However, empirical evidence in this study has proven that Ethereum could not be hedge asset for developing stock markets. Ethereum could be weak/strong safe haven for some emerging stock markets. Moreover, Ethereum is certainly a good diversifier for emerging stock markets rather than being a hedge asset. Therefore, role of Ethereum differs for emerging stock market according to empirical evidence provided in this study. Lastly, there are few studies concentrating on relationship between Ethereum and some developing stock markets. Those studies claim that Ethereum is mostly a diversifier for emerging stock markets. Our empirical results support this claim.

Thirdly, constant m_0 is positive and significant for Binance Coin, BNB against stock market indexes except China. m_0 is insignificantly different from zero for Chinese stock market. This indicates that BNB can act as weak hedge for Chinese stock market. However, BNB could only be diversifier for other stock markets rather than Chinese stock market. This result is provided by the first method of DCC GARCH where DCCs are calculated for pairs of series separately. On the other hand, according to the second method of DCC GARCH where DCCs are estimated through employing all series simultaneously, hedge coefficient m_0 is positive and significant without any exception. This result put forward that BNB could be diversifier rather than being hedge asset for all emerging stock markets without any exception. Almost all results of both DCC GARCH estimation methods are matched and coincided except China. The findings of the first method of DCC GARCH estimation assert that BNB could be a weak hedge asset for Chinese stock market. On the other hand, the findings of the second method of DCC GARCH estimation claim that BNB is only diversifier for all emerging stock markets including Chinese stock market. Therefore, a very small discrepancy has been detected whether BNB is diversifier or hedge asset for emerging stock markets according to comparison of results of both DCC GARCH estimation methods.

The regression results of first method where DCCs are calculated for pairs of series separately will be evaluated for BNB with respect to being safe haven or not. Brazil has negative and significant m_1 (1% quantile) while m_3 (10% quantile) for Brazil is positive and significant. m_2 for Brazil is insignificantly different from zero. Results are contradictory to each other for Brazil with respect to being safe haven or not. Therefore, BNB could not be accepted as safe haven for Brazil stock market. To assess safe haven feature of BNB for emerging stock markets; m_1 , m_2 or m_3 are positive and significant for Chile, Colombia, Czech, Hungary, India, Indonesia, Korea, Malaysia, Peru, Philippines, Poland, Qatar, Taiwan, Thailand and UAE according to the regression results of first method. These results indicate that BNB cannot act as safe haven asset for those countries' stock markets. m_1 , m_2 and m_3 are insignificantly different from zero for Greece, Peru, South Africa and Türkiye. Therefore, BNB can behave as weak safe haven for Greece, Peru, South Africa and Türkiye stock markets. To summarize, regression results of first method where DCCs are calculated for pairs of series separately assert that BNB is a good diversifier for emerging stock market except China and it is weak safe haven for some developing stock markets. According to regression results of second method where DCCs are calculated for all series simultaneously, m_1 and m_3 are positive and significant while m_2 is negative and significant for Malaysia.

This results are contradictory thus BNB cannot be accepted as safe haven asset for Malaysia. Likewise, m_1 is negative and significant while m_2 is significantly positive for Qatar. Contradictory results prove that BNB could not be a safe haven asset for Qatar. The first method of regression results also support the view that BNB is not safe haven for Malaysia and Qatar. Regression results of second method put forward that BNB cannot be safe haven asset for Mexico as opposed to regression results of first method since m_1 and m_3 are significantly positive. m_1 , m_2 and m_3 are insignificantly different from zero for Philippines according to the regression results of second method. Therefore, BNB is weak safe haven for Philippines stock markets. The regression results of first method claim that BNB could be weak safe haven for South Africa since all coefficients of dummy variables are insignificant and they are different from zero. On the contrary, regression results of second method assert that BNB cannot be safe haven since coefficients of dummy variables are positive and significant. Rather than differences stated above, both methods of DCC GARCH estimation consent that BNB is a good diversifier for all emerging stock markets except China. In addition, BNB could act as weak safe haven for some developing markets such as Türkiye and Greece. Both estimation results approve that BNB could be diversifier and weak safe haven for Türkiye and Greece. Similarly, both method of estimation results prove and coincide that BNB is diversifier for Brazil, Chile, Colombia, Czech, Hungary, India, Indonesia, Korea, Malaysia, Peru, Poland, Qatar, Taiwan, Thailand and UAE. Lastly, estimation results of both methods state that BNB is diversifier for MSCI Emerging Market Index in overall. In short, it can be clearly inferred from the empirical evidences in this study that BNB is good diversifier for emerging stock markets and it could act as weak safe haven for some developing markets.

As stated in the beginning of this study, there are few studies investigating capabilities of cryptocurrencies for emerging stock markets. Most of the studies in the literature concentrate on connectedness between Bitcoin and developed markets. Therefore, there are few studies scrutinizing relationship between BNB and stock markets. Our study will fill this gap in the literature. Riahi et al. (2024) investigated role of BNB for S&P 500 (United States), BIST 100 (Türkiye), BVSP (Brazil), BSESN (India), BMV IPC (Mexico), GB 100 (United Kingdom), Italy 40 and CAC 40 (France). Authors conclude that BNB could be diversifier rather than safe haven during Covid-19 process in the world. This result is consistent with empirical findings of the study. Ali et al. (2024) puts forward that BNB could be weak safe haven for developed US and European stock markets. Just & Echaust (2024)

asserted that BNB could not be safe haven or hedge asset for G7 and BRICS countries. Pengfei et al. (2019) indicated with empirical evidences that BNB could not be hedge asset for most of the international indices. Huang L. (2024) indicated that BNB could provide diversification benefits for U.S. stock markets. To summarize, studies related with dependency between BNB and developed stock markets in the literature attribute diversifier role for BNB for developed markets. Those studies could not approve safe haven or hedge role of BNB for developed markets. We have found similar result for developing stock markets in this study. Binance Coin could be diversifier rather than hedge for emerging stock markets and it can act as weak safe haven for some developing stock markets. This result has been further proven with m_1 , m_2 or m_3 value of MSCI Emerging Market Index. BNB is good diversifier for emerging stock markets in overall according to the statistics of MSCI Emerging Market index which is provided by both methods.

Fourthly, constant m_0 is positive and significant for Cardano (ADA), against all stock market indexes. This result indicates that ADA could be good diversifier for all emerging stock markets without exception. This result is provided by the regression results of the first method where DCCs are estimated for pairs of series separately. Regression results of the second method where DCCs are estimated through employing all series simultaneously support findings of the first method. In other words; both method of estimation prove that ADA is good diversifier for emerging stock markets without any exception. They do not attribute hedge role for ADA. In this manner, regression results of both methods match and coincide. Dummy coefficients m_1 , m_2 and m_3 are insignificantly different from zero for Greece, India, Mexico, South Africa, Taiwan and Türkiye. These results are obtained from regression results of first method. These results indicate that ADA can be weak safe haven for those countries. Regression results of second method where DCCs are estimated for all series simultaneously put forward that ADA could be only weak safe haven for China, Greece and Türkiye. In addition; ADA is strong safe haven for Malaysia as well. Regression results of the first method put forward that ADA could be diversifier and weak safe haven for emerging stock markets in general. This result has been obtained through observing dependency between ADA and MSCI Emerging Market Index in overall. However, regression results of second method does not approve this result. The second method puts forward that ADA could only be diversifier for emerging stock markets in general since m_1 , m_2 or m_3 are significantly positive for MSCI Emerging Market Index. Apart from these discrepancies, both methods prove that ADA is good diversifier for emerging stock markets

and it is weak safe haven for some developing stock markets. Implication of empirical results for role of ADA is very similar to other cryptocurrencies in this study. Riahi et al. (2024) investigated role of ADA for S&P 500 (United States), BIST 100 (Türkiye), BVSPT (Brazil), BSESN (India), BMV IPC (Mexico), GB 100 (United Kingdom), Italy 40 and CAC 40 (France). Authors conclude that ADA could be diversifier rather than safe haven during Covid-19 process in the world. This result is consistent with empirical findings of the study about Cardano.

Lastly, role of Ripple (XRP) has been researched in this study. According to the empirical results, XRP is diversifier for emerging stock markets like other cryptocurrencies in the study. This result has been proven by both methods of DCC GARCH estimation. According to the regression results of first method where DCCs are calculated for pairs of series separately, XRP could fulfill roles of diversifier and weak safe haven for Greece, Mexico, Poland and South Africa since m_1 , m_2 and m_3 for those countries are insignificantly different from zero. Moreover, m_1 , m_2 and m_3 are statistically insignificant for MSCI Emerging Market Index. This exhibits that XRP is diversifier and weak safe haven for emerging stock markets in general. The regression results of first method provide contradictory results for Korea. m_1 is significant and negative while m_2 is significantly positive. Therefore, XRP could not be accepted as strong safe haven as sign of m_1 suggested. Regression results of second method where DCCs are calculated for all series simultaneously support that XRP is weak safe haven for Greece. However it does not approve that XRP could be weak safe haven for Mexico, Poland and South Africa stock markets. Last discrepancy is about MSCI Emerging Market Index. While first method suggests that XRP could be weak safe haven for emerging stock markets in overall, the second method puts forward that XRP could not be weak safe haven for overall MSCI Emerging Market Index. Apart from these differences, both methods consent and prove that XRP is good diversifier for emerging stock markets. In addition, XRP could serve as weak safe haven asset for some developing stock markets such as Greece and China. Lastly, regression results of second method related with Malaysia are contradictory with respect to safe haven role of XRP. While m_1 and m_3 are significantly positive for Malaysia, m_2 is significantly negative. This result indicates that we cannot accept XRP as safe haven asset due to opposed empirical results.

Bouri et al. (2020) claim that Ripple acts as safe haven asset for US stock market and equity sectors. Empirical results found in this study does not role of strong safe haven for

most of emerging stock markets on the contrary to claims of Bouri et al. (2020). Ripple could be safe haven for U.S. stock markets but we cannot firmly validate same result for emerging stock markets. Jeribi et al. (2021) assert that Ripple could serve as safe haven asset for Brazil, China and Russian stock markets during the pandemic. Our empirical findings in this study does not support view that Ripple could be safe haven asset for Brazil stock market. However, empirical evidence in this study indicates that Ripple could be safe haven asset for Chinese stock markets. Therefore, we can partially agree on empirical findings of Jeribi et al. (2021). Ma et al. (2020) and Anyfantaki et al. (2018) claim that Ripple could be a good diversifier for portfolios. This result is consistent with empirical findings of our study. Corbet et. all (2018), Alana et al. (2020) and Tiwari et al. (2019) attribute role of diversifier and hedge for XRP against U.S. stock markets. Although diversifier role of XRP is also valid for developing stock markets, it can be clearly said that Ripple could not be a hedge asset for emerging stock markets according to empirical evidences in the study. Jiang et al. (2021) assert that Ripple cannot serves as hedge or safe haven but it can behave as diversifier against MSCI World, MSCI Developed, MSCI Emerging, S&P 500, Shanghai Composite and Nikkei 225 indices. Empirical findings of this study coincide with this result with respect to MSCI Emerging Market Index. To summarize, role of XRP as diversifier and weak safe haven against emerging stock markets is empirically indicated in this study. In the literature, Hedge or strong safe haven role has been attributed to Ripple for some developed and developing countries. However, hedge or strong safe haven role of XRP against developing stock markets could not be proven as opposed studies in the literature. We accept empirical findings of the studies in the literature which claim that Ripple could only be diversifier or weak safe haven for emerging stock markets.

Table 33: Summary of Regression Results (DCCs as pairs, separate)

Country Indexes	Bitcoin	Ethereum	BNB	ADA	XRP
Brazil	Diversifier Weak Safe Haven	Diversifier	Diversifier	Diversifier	Diversifier
Chile	Diversifier	Diversifier Strong Safe Haven	Diversifier	Diversifier	Diversifier
China	Diversifier	Diversifier	Weak Hedge	Diversifier	Diversifier
Colombia	Diversifier	Diversifier Weak Safe Haven	Diversifier	Diversifier	Diversifier
Czech	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Greece	Diversifier Weak Safe Haven	Diversifier Strong Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven
Hungary	Diversifier Weak Safe Haven	Diversifier Strong Safe Haven	Diversifier	Diversifier	Diversifier
India	Diversifier	Diversifier Weak Safe Haven	Diversifier	Diversifier Weak Safe Haven	Diversifier
Indonesia	Diversifier	Diversifier Strong Safe Haven	Diversifier	Diversifier	Diversifier
Korea	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Malaysia	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Mexico	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier Strong Safe Haven
Peru	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier	Diversifier	Diversifier
Philippines	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Poland	Diversifier	Diversifier contradict	Diversifier	Diversifier	Diversifier Weak Safe Haven
Qatar	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
South Africa	Diversifier Weak Safe Haven	Diversifier Strong Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven
Taiwan	Diversifier	Diversifier	Diversifier	Diversifier Weak Safe Haven	Diversifier
Thailand	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Türkiye	Diversifier	Diversifier contradict	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier
UAE	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier	Diversifier	Diversifier
EM	Diversifier	Diversifier Weak Safe Haven	Diversifier	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven

Table 34: Summary of Regression Results (DCCs all series, simultaneous)

Country Indexes	Bitcoin	Ethereum	BNB	ADA	XRP
Brazil	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Chile	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
China	Diversifier	Diversifier	Diversifier	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven
Colombia	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Czech	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Greece	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven
Hungary	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
India	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Indonesia	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Korea	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Malaysia	Diversifier	Diversifier	Diversifier	Diversifier Strong Safe Haven	Diversifier
Mexico	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Peru	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Philippines	Diversifier	Diversifier	Diversifier Weak Safe Haven	Diversifier	Diversifier
Poland	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Qatar	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
South Africa	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Taiwan	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Thailand	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
Türkiye	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier Weak Safe Haven	Diversifier
UAE	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier
EM	Diversifier	Diversifier	Diversifier	Diversifier	Diversifier

To summarize, this study aims to find role of cryptocurrencies for developing stock markets. We have concluded that cryptocurrencies are good diversifiers for emerging stock markets in general. This result has been put forward by empirical evidences. Empirical evidences has been produced by two different DCC GARCH estimation methods. Regression results of both methods can be seen in Table 33-34 above as summary. Anne Haubo Dyhrberg (2016), Myriam Ben Osman et al. (2023), Agata Kliber et al. (2019), Shahzad et al. (2020), Okoroafor & Leirvik (2023), Kayral et. all (2022), Corbet et. all (2018), Chan et all. (2019), Tiwari et al. (2019), Akhtaruzzaman et al. (2020), Xu & Kinkyo (2023), Alana et al. (2020) asserted that cryptocurrencies can behave as hedge asset for developed stock markets. However, we cannot validate same result for developing stock

markets. In other words; our study provided exact evidences that cryptocurrencies cannot act as hedge asset for emerging stock markets. Bouri et al. (2020a), Bouri et al. (2020b), Diniz-Maganini et al (2021), Będowska-Sójka & Kliber (2021), Mariana et al. (2021), Kliber (2022), Baur et al. (2018) and Jin & Tian (2024) asserted that cryptocurrencies could act as safe haven asset for developed markets while Conlon et al. (2020), Conlon & McGee (2020), Ji et al. (2020), Chemka et al. (2021), Goodell & Goutte (2021), Wen et al. (2022), Baur et al. (2022) and Choi & Shin (2022) claimed that cryptocurrencies cannot behave as safe haven asset for developed stock markets. Empirical results detected in this study indicate similar mixed conclusion for safe haven role of cryptocurrencies against developing stock markets. Empirical results of this study exhibit that cryptocurrencies could only be weak safe haven for some developing stock markets. Empirical results of this study do not suggest that cryptocurrencies could be strong safe haven for emerging stock markets. Moreover, even weak safe haven role cannot be attributed to cryptocurrencies against most of the developing countries according to this study. Empirical evidences of the study strongly proves that cryptocurrencies can behave as weak safe haven for Greece, Mexico and South Africa stock markets. Cryptocurrencies could only be diversifier for remaining developing stock markets.

To sum up, we have aimed to determine hedging capability and role of cryptocurrencies for emerging stock markets with empirical analysis. Two different DCC GARCH estimation methods have been applied. Regression results of these two DCC GARCH estimation have been compared and contrasted within themselves and with the literature. It is clearly and empirically indicated that cryptocurrencies cannot act as hedge asset. Cryptocurrencies could be weak safe haven asset for some developing markets. Cryptocurrencies is good diversifier for emerging stock markets. There are important results and implications for investors, portfolio managers and academia in this study.

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