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Cryptocurrency and Traditional Financial Systems: Exploring the Impact of Cryptocurrencies on Traditional Banking Systems, Financial Regulations, and Monetary Policies

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ABSTRACT

This study focuses on the impact of cryptocurrencies on banking sector performance, regulatory responses, and responses of monetary policy to changes it ignites, using 12 countries data from 2014 to 2023. For the purpose, this study used the advanced econometric techniques of DCC-GARCH, GARCH-MIDAS, Panel Regression and VARX. This model is based on daily, weekly, and monthly data sets from the State Bank of Pakistan, the IMF, the World Bank, Bloomberg, CoinMarketCap, and national regulatory reports. These data sets cover macroeconomic, financial, and regulatory aspects. Some important factors are the amount of cryptocurrency traded, how volatile it is, the monetary base, the interest rate spread, the regulatory stringency index, and the growth of bank deposits. Diagnostic tests and robustness checks make sure that model estimates are accurate, to analyze cross-market spillovers and time-varying volatility correctly. VARX analysis indicates monetary tightening suppresses crypto prices. The DCC-GARCH concludes a correlation between increasing crypto-stock market during crises periods. GARCH-MIDAS, on the other hand, highlights a significant link between macroeconomic uncertainty and crypto volatility. Finally, the Panel data analysis advocates that a stable, and strong regulatory environment in economies can mitigate the systemic risk in crypto markets. The findings emphasize the need of flexible regulatory systems and monetary policies to mirror the increasing importance of digital finance, particularly in emerging economies. This research offers valuable insights to the Central banks, financial organizations, and lawmakers to better understand the digital financial world.

INTRODUCTION

The fast growth of cryptocurrencies over the past ten years has caused a major shift in the way money works around the world. At first, cryptocurrencies like Bitcoin and Ethereum were thought of as independent digital currencies that could avoid controlled powers. Since then,

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they have changed into more than one type of financial tool. They are becoming more and more a part of popular investment portfolios, cross-border payment systems, and autonomous finance environments. This makes them legitimate opponents of the way standard financial systems are built.

This change brings up important questions about the long-term viability, adaptability, and resilience of traditional financial institutions, especially private banks and state banks. Cryptocurrencies, which are based on decentralized blockchain technology, allow for smooth transactions between peers and the execution of contracts without any problems. This gets around many of the basic features of traditional banking, such as central control over issuing money, creating liquidity, and keeping an eye on the money supply.

At the heart of this change is a problem with two sides. On the one hand, cryptocurrencies claim to be efficient, open, and allow everyone to use money. But, their instability, the fact that regulators don't keep a close eye on them, and the fact that they could be used for illegal activities make them a huge threat to financial stability and fiscal control. Because digital assets are mostly outside of central banks' control, standard monetary policy tools like changing interest rates aren't working as well as they used to. At the same time, financial officials have to come up with flexible models that balance new ideas with lowering overall risk.

Responses and challenges from regulators

1. The regulatory landscape is changing

The fast growth of cryptocurrencies around the world has forced governments and financial officials to rethink the rules that are already in place. Because they are autonomous, peer-to-peer, and encrypted, cryptocurrencies are a threat to controlled monetary systems and standard financial monitoring. Different countries have different governing approaches based on their economic, social, and political situations. In order to stop financial chaos and capital flight, some countries have completely banned crypto trade and mining. Some places have warned people and put limits on what they can do. Other, more tech-savvy places have chosen to create an environment that is open to new ideas by using regulatory sandboxes and license systems.

Despite these differences, there is growing agreement around the world that there needs to be a single set of rules for all countries to follow when dealing with cross-border deals, the risk of money laundering, and consumer protection issues. Multilateral organizations like the FATF, IMF, and BIS have put out guidelines telling countries that they need to control virtual asset service providers and make sure they follow rules against money laundering and funding for terrorists.

2. The Importance of Digital Money and Central Banks

As a result of cryptocurrencies' independence and fast growth, central banks all over the world have sped up their work to create their own digital currencies. People see Central Bank Digital Currencies (CBDCs) as a way to update payment systems, make it easier to communicate monetary policy, and keep authority in the digital age more and more. Not only are these programs meant to counter the dangers of private digital currencies, but they are also meant to help more people get access to money and make people less reliant on unofficial financial systems.

While viability studies and test programs have helped advanced economies move forward, developing countries often have trouble setting up the technical and social structures they need to start CBDCs. In Pakistan, government reactions have been slow and hard to get around because there isn't a clear way to balance new ideas with strict rules. The analysis of the digital dollar, digital yuan, and digital euro underscores the expected transformation in the global monetary system. This could have an effect on the future of cross-border spending and reserve currencies.

3. Cryptocurrency regulation problems

Getting countries to regulate cryptocurrency is very hard, especially in developing economies. Because these assets are scattered and don't have borders, it's harder to police national laws and traditional oversight systems don't work as well. Regulatory arbitrage is still a problem because crypto companies move their operations to places with less strict rules. Also, the fact that many people don't know much about money makes them more likely to fall for fraud, scams, and unstable assets.

Due to their anonymous nature, cryptocurrencies also allow actions in the dark economy, such as money laundering, tax fraud, and funding for terrorists. They also cause problems for the economy as a whole because they might make it harder for monetary policy to have an effect, especially if they are used instead of paper currencies. The lack of digital compliance tools and weak institutions is the most worrying thing for developing countries. This makes it hard for officials to keep up with, check out, or react to new financial innovations that are coming out all the time.

4. Moving Toward a Fair Regulatory Plan

A practical and forward-looking approach to regulation needs to find a balance between encouraging new ideas and keeping the economy stable. While blanket bans don't work and often push crypto activity underground, policies that don't police anything put countries at risk of systemic problems. A well-balanced regulatory approach should focus on giving crypto

service providers licenses, keeping an eye on digital transactions, and incorporating new technologies like blockchain analytics to help with control. States with rules that are both open and strict are more likely to get investment in digital banking. This lowers the risk of regulatory control or not following the rules. It is very important to encourage openness, make crypto taxes more consistent, and come up with national digital finance plans. It's also important for countries to work together to avoid reactions that aren't coordinated and could make financial systems even less stable. Countries can encourage responsible innovation and make sure they can handle digital changes by making sure their policies are in line with global standards.

5. Pakistan's Policy Needs

The need for Pakistan to create a thorough and up-to-date legal framework for cryptocurrencies is growing. Even though early warnings were given and the State Bank of Pakistan took a strict stance, people are still using cryptocurrencies more and more, usually through peer-to-peer networks and foreign markets. Without a clear set of laws, there are regulatory gray areas that make people less likely to follow the rules and make it harder to police them. In order to deal with these problems, Pakistan needs an organized set of laws and institutions. As important steps, a national task force on digital assets should be created, the SBP and SECP should work together to license and oversee crypto platforms, and blockchain tracking tools should be added to the official financial reporting system. Furthermore, to lower legal confusion and boost digital trust, it is important to run public knowledge programs, hold partner meetings, and take steps to build people's skills. Pakistan could lose control over capital flows, monetary policy, and new financial ideas if it doesn't act quickly to join the global move toward digital finance. Cryptocurrencies are quickly becoming popular around the world and changing the financial market snd economic scenarios, especially in developing countries like Pakistan and Brazil where digitalizing finances are rapidly reshaping this transformation. Even though people and businesses are becoming more interested in crypto assets, there isn't a lot of research that take into account the affect on performance of traditional banks, the efficiency of regulations, and the way money moves between people and businesses. This gap is especially big in developing countries where rules are still being worked out and people are still learning how to use computers and the internet.

Research Objectives

1. To assess the impact of cryptocurrency fluctuation on critical indicators of financial markets.
2. To evaluate the the impact of ‘cryptocurrency adoption’ on the performance of coventioanl banking industry and bank deposits mobilization.

3. To guage the impact of monetary policy instruments (interest rates and money supply) on volatility of cryptocurrency its prices.
4. To assess the regulatory frame responses in designing the dynamics of cryptocurrency market and minimizing the financial risks (associated)

Hypothesis

1. More people using cryptocurrencies hurts the growth of deposits in regular banks
2. Changes in interest rates and other decisions made by central banks about monetary policy have a big impact on the prices of cryptocurrencies.
3. The instability in cryptocurrencies markets has an impact on regular stock markets and the mood of investors.
4. Tougher regulations make it much less likely for people to trade cryptocurrencies, which makes the market less volatile.

Research Gaps

The current research provides the details of that the relationship between cryptocurrency and standard financial systems is changing, but, there are still some important gaps which the literature failed to address especially in developing economies like Pakistan.

Firstly, the research studies, in this domain are concentrated in developed markets mostly. Developing economies have much more complex legal systems, more financial knowledge, and advanced technology infrastructure. These studies overlooked the the complications the cryptocurrencies carries to affects banks' performance, the amount of deposits and number of depositors , the response of regulators in developing countries that have unstable finances, dealing with high inflation, and have weak institutional frameworks. In these kinds of situations, the behaviors may be very different from what we see in stable banking systems.

Second, while the literature is enriched with the ideas about the cryptocurrencies applications for portfolio diversification (Modern Portfolio Theory), monetary sovereignty (Quantity Theory of Money), and regulatory arbitrage, these ideas together are not are tested in totality to guage the way these cryptocurrencies affect banking systems, regulatory frameworks, and monetary policy tools at the same time. The fragmented approach used in the literature fails to demonstrate the interconnections and mutual influences among these sectors..

Third, most of the regulatory studies that have been done so far have focused on either the law or the technical design of coin systems. They neglect to examine the efficacy of these regulations in mitigating market volatility or altering investor behavior. Also, regulatory comparisons between countries are usually observational and don't use numbers from

economic models. This means that lawmakers don't have good tools for comparing and evaluating.

Fourth, it is well known that cryptocurrency markets are very volatile. However, not much research has been done on the feedback loop between traditional monetary policy instruments (like interest rates and inflation) and the behavior of cryptocurrency markets. This is especially true when using dynamic econometric models that take into account cross-sectional dependence and temporal heterogeneity.

Finally, the concept of cryptocurrencies is flourishing and getting rapidly integrated into conventional financial markets, the number of studies conducted on its usage influences that supports fundamental banking operations are missing - particularly with regard to the banks deposits and dynamics of credit extension. For central banks and other financial organizations ability on the cafe of cryptocurrency to digitalize money.

Using a range of empirical data sets—these includes the macro-economic indicators, banking sectors (conventional) cross-country data, regulatory frames and indices,—this research seeks to close these gaps using sophisticated statistical methods and techniques, assessing the volatility cryptocurrency. By examining, both the patterns, and lessons, from target areas of South Asia and countries life Pakistan, the research seeks to provide fresh insight to the ongoing debate on the interaction of digital currencies and conventional banks systems.

Conceptual Frame

Three economic theories that are connected form the basis of this study's theories. First, Markowitz's Modern Portfolio Theory says that cryptocurrencies should be included in diverse portfolios because they don't have a strong relationship with standard asset classes and could offer risk-adjusted returns. The second application of the Quantity Theory of Money is to the potential impact of independent digital currencies. The applications for central banks in management of the money supply and inflation objectives. The Regulatory Arbitrage Theory explain the mechanism with which the cryptocurrency markets exploit gaps in domestic and international regulatory frameworks. This makes it harder to keep an eye on finances while also allowing new ideas and capital to move around.

LITERATURE REVIEW

A lot of academics are interested in the point where cryptocurrency and standard financial systems meet. This is because it reflects the way digital assets are transforming banking operations, regulatory frameworks, and the formulation of monetary policy. This literature review brings together the most important results of recent studies provides the details of relationship between independent digital currencies and traditional banks is changing.

With the rise of cryptocurrencies, new financial tools have become available that don't work with traditional banking systems. Peters, Panayi, and Chapelle (2015) reveals the details of transformation the cryptocurrencies brings in the traditional roles of banks in financial intermediation and making payments by letting people send money directly to each other without going through banks. Because coins make transactions cheaper and easier to access, this removal of banks from the process of making transactions starts a discussion about the future role of banks. In light of the fact that coins make transactions cheaper and easier to access, this removal of middlemen makes banks less important in the future.

It's also getting harder to tell the difference between traditional banking and distributed finance because of the rise of crypto banking services like high-yield savings accounts and crypto-backed loans. Customers are open to new options because of these services, but there are worries about governmental instability and market volatility.

Different governments have responded in different ways to the fast growth of cryptocurrencies. In their 2024 paper, Xiong and Luo talk about different governing policies are around the world, ranging from strict bans to less strict ones. Cross-border coin operations are harder to keep an eye on and protect consumers from because regulators don't always take the same stance.

When it comes to Europe, the Markets in Crypto-Assets (MiCA) law is a big step toward having full power over digital assets. The goal of this method is to protect consumers better, keep the economy stable, and encourage new ideas in the bitcoin business. This plan aims to protect consumers better, keep the economy stable, and encourage new ideas in the crypto industry.

Because coins are autonomous, they call standard tools for monetary policy into question. The International Monetary Fund (IMF) is worried about "cryptoization," which happens when people in countries with shaky currencies use cryptocurrencies. This threatens the country's control over its money and makes it harder to carry out policy. Pernice et al. (2019) desctibes the growth of stablecoins is an attempt to make cryptocurrency less volatile. Pernice and friends (2019) elaborates at stablecoins as a way to make bitcoin less volatile. Stablecoins are supposed to keep prices stable, but the way they are made and used makes it hard to conclude what risks they might pose to financial systems. Stablecoins are supposed to keep prices stable, but the way they are made and used makes it hard to calculate the risks they might pose to financial systems. Several points of view have been found in theoretical study about the mechanism cryptocurrencies fit into financial systems. According to modern portfolio theory, cryptocurrencies could be used to spread financial accounts because of the way they handle risk and return. Cryptocurrencies might impact controlling the money supply

and aiming for inflation. The Quantity Theory of Money examines the potential effects of bitcoin on the regulation of the money supply and the pursuit of inflation control. The idea of regulatory arbitrage is also important because people could take advantage of differences in regulatory systems, which could lead to systemic risks. It advocates on the development of a combined and comrehensive strategy for different governing to work together to deal with the problems that come up because cryptocurrencies are used all over the world. It will help deal with the problems that come up because coins are used all over the world.

The use of cryptocurrencies changes the way people behave, which in turn changes the desire for traditional banking services and the amount of deposits that are available. Second, the fact that bitcoin markets are very sensitive to things like interest rates and inflation. Lastly, the digital financial scene is governed. The efficacy of governing regulations demonstrates their impact on the behavior of the bitcoin market. The last point illustrates the significant impact of governmental policies on the behavior of cryptocurrency markets, underscoring the critical need of regulation in the digital financial landscape. This literature review provides the details of cryptocurrencies affecting the traditional financial systems. It also describe the significane of researching this area so that policy and practice can keep up with the fast changes.

METHODOLOGY

Data

This study analyzes the cryptocurrency's relationship with 'conventional banking systems' across 12 different countries and markets, ranging from developed economies like the United States and Germany to developing economies like Brazil and Pakistan. The purpose of this selection is to guarantee the inclusion of data from a mix of sophisticated financial systems to emergning financial systems, active crypto adoption, and different regulatory policies. Tracking data from 2014 to 2023, the analysis captures Bitcoin's boom times, China's crackdowns, the DeFi explosion, COVID-era market turmoil, and current "crypto winters" as well as crypto's rollercoaster journey.

Daily and weekly data supported model volatile short-term responses while monthly numbers flowed into large trend analysis. These countries are chosen on the basis of their active 'participation' in cryptocurrency markets, 'availability' of financial and regulatory data and 'representation' of diverse monetary policy regimes.

The study uses the reliable sources like Bloomberg for crypto measures, IMF/World Bank for financial indicators, and central banks for policy specifics, along with plus, a bespoke index, monitoring global regulatory changes. This will allow the study to investigate the interactions

crypto, at a multidimentional level, with various regulations and economic situations, ranging from interest rates changes to banking systems performance and regulations.

Summary of Countries, Variables, and Time Periods Used in the Study

Country Group	Covered Countries	Time Period	Data Sources	Key Variables	Major Financial & Regulatory Phases Captured
Developed Economies	United States, United Kingdom, Germany, Japan, South Korea, Singapore	2013–2023	Federal Reserve, SEC, BoE, ECB, IMF, BIS, FRED, Yahoo Finance, Bloomberg, CoinMarketCap, national central banks, World Bank	BTC and ETH prices, S&P 500, FTSE 100, DJIA, NASDAQ, exchange rates, CPI, interest rates, trading volumes, regulatory actions, bond yields	Bitcoin's early adoption and growth phase (2013–2017), Ethereum's launch (2015), crypto boom and bust (2017), SEC regulatory actions (e.g., Ripple case, ETF rejections), COVID-19 financial volatility (2020–2021), rise of DeFi (2020–21), monetary tightening and crypto winter (2022–23), sandbox experimentation in UK and Singapore
Emerging Markets	Pakistan, India, Brazil, Nigeria, Turkey, Indonesia, Philippines	2015–2023	State Bank of Pakistan, RBI, World Bank, IMF, Bloomberg, CoinDesk, local crypto exchanges, government and central bank bulletins	BTC/ETH prices (adjusted for local exchanges), M2, CPI, GDP per capita, interest rates, remittances, trade balances, crypto regulations and usage trends	Bans and restrictions (India 2018–2020, Nigeria's 2021 clampdown), emergence of informal crypto-finance (2017 onward), increased use during inflation and exchange rate shocks, post-COVID economic stimulus and volatility, rising use of crypto for remittance and hedge against local currency depreciation
Global Scope (Cross-cutting)	Global aggregations from CoinMarketCap, IMF, BIS, DeFi Pulse, Chainalysis, FRED, Bloomberg Terminal	2013–2023	CoinMarketCap, IMF Macro-Financial Indicators, DeFi Pulse, BIS, Chainalysis, Yahoo Finance, Bloomberg, World Bank	BTC/ETH global prices, crypto market cap, global crypto volume, regulatory stringency index, VIX, investor sentiment indices (e.g., Fear & Greed Index)	Global crypto adoption patterns, DeFi boom and contraction, FATF anti-money laundering standards, China's mining and trading bans (2017–2021), U.S. monetary policy effects, macro spillovers across financial markets, impact of international crises and tightening on crypto volatility and institutional response

Including both highly regulated and technologically advanced economies along with not so sophisticated, emerging regulatory frameworks, and less integrated financial markets will provide more realistic outcomes

Models

This paper uses a variety of complex economic models, to guage the impact cryptocurrencies on traditional financial systems. It focuses the responce of financial markets, monetary policy has, and banking sector to it. The study designs a mix of time-series and panel data methods. It will help get deep insights to provide both the details of 'changes over time' and and assess the impact 'across differences between countries'.

The study uses four basic economic models.

1. ***Dynamic Conditional Correlation (DCC-GARCH) Model***

The Dynamic Conditional connection (DCC-GARCH) model, for investigating the fluctuation in the prices of cryptocurrencies like Bitcoin and Ethereum, over time in relation to the 'S&P 500, DJIA, and FTSE 100'. This method is to analyze the financial spread and movement during times of stress in market of policy shifts and rule changes.

The DCC-GARCH model is a dynamic conditional correlation. The goal is to find the conditional relationships that change over time between important cryptocurrency and standard financial market measures, especially when legal and macroeconomic factors change. The model is structured as follows:

$$\boldsymbol{r_t = \mu_t + \varepsilon_t, \qquad \varepsilon_t \sim \mathbf{N}(\mathbf{0}, H_t)}$$

$$\boldsymbol{H_t = D_t R_t D_t}$$

- r_{it}: the return on asset i at time t,
- H_t: the conditional covariance matrix of returns
- D_t: a diagonal matrix of standard deviations that change over time from univariate GARCH models
- R_t: the time-varying correlation matrix that was calculated from the scaled residuals

While, each GARCH (univarite) is described as:

$$\sigma_{it}^2 = \omega_i + \alpha_i \varepsilon_{i,t-1}^2 \ \beta_i \sigma_{i,t-1}^2$$

- BTC and ETH daily profits
- Daily changes in the S&P 500, FTSE 100, and DJIA
- Proxies for volatility

2. ***Vector Autoregressive Model with Exogenous Variables (VARX)***

The Vector Autoregressive model with Exogenous Variables (VARX), to analyze the monetary and fiscal policies impact on crypto markets. This model takes into account both the factors, inside factors including the prices of 'cryptocurrencies and market indices' in the financial sector, and outside factors including interest rates and central bank regulations. The VARX model, includes the 'feedback loops' that connect 'regular monetary tools' to the open decentralize digital market .

To analyze the links between the cyptocurrency markets and major macro-economic variables (inflatrion)and (policy) regulations.

- BTC price, ETH price, S&P 500, and market value are all endogenous
- Exogenous: policy interest rate, inflation rate, and control index (0 means no change, 1 means mild change, and 2 means strict change).

$$\boldsymbol{Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots \ldots A_p Y_{t-p} + BX_t + \varepsilon_t}$$

Y_t: Endogenous variables (vector) - BTC price and stock index etc

X_t: Exogenous variables (vector) - interest rates, general price level, dummy of regulatory

A_1: Matrices (of coefficients) of lagged variables (endogenous)

B: Matrices (of coefficients) of lagged variables (exogenous)

ε_t: Error Term

3. *Panel Regression (Fixed and Random Effects)*

The Panel Regression Model, (with fixed and chance factors), to guage the impact of bitcoin on the banking sector in both developed and emerging economies. The model investigates the economic factors like inflation, GDP per capita, and fund usage to asses if digital currency activity can replace or add to the traditional financial and banking systems. Whether to use fixed or random effects Panel data model, Hausman tests is used to make sure that the estimators are reliable and consistent.

$$\boldsymbol{Bank\ performance_{it}} = \boldsymbol{\beta_0 + \beta_1 cryptoadopt_{it} + \beta_2 GDP_{pc_{it}} + \beta_3\ inflation_{it} + \mu_i + \varepsilon_{it}}$$

Where:

Country is specified by *(i)*

time is specified by *(t)*

μ_i is used for country unobserved (specific effect)

***Main Variables of this model**:*

- Dependent Variable: Bank performance measures (deposit growth, return on assets)
- Independent Variables: Inflation rate, GDP per capita, crypto transaction volume (% of GDP)
- Control Variables: Unemployment rate, financial inclusion index

4. *GARCH-MIDAS Model (Mixed Data Sampling*

Finally, 'High-frequency cyptocurrency data' and 'low-frequency macroeconomic variables data' are combined using a GARCH-MIDAS (Mixed Data Sampling) model. the model assesses the financial uncertainty (by changes in interest rates, inflation, and monetary policy stances), that drives the daily fluctuations of digital currencies. GARCH-MIDAS is a great way to understand the bigger economic trends that affects the results on crypto assets that change over time.

$$\boldsymbol{r_t = \mu_t + \varepsilon_t, \qquad \varepsilon_t \sim N(0, \sigma_t^2)}$$

$$\boldsymbol{\sigma_t^2 = \tau_t . g_t}$$

$$\tau_t = exp\left\{\beta_0 + \beta_1 \sum_{j=1}^{K} \phi_j(m)\, X_{t-j}\right\}$$

Where

τ_t: Long-run volatility component derived from low-frequency macro data

g_t: GARCH(1,1) modeled short-run volatility component

X_{t-j}: Monthly macroeconomic indicators—inflation, interest rate

Main Variables of this model

- Daily BTC/ETH returns
- Low-frequency: Policy rate, crypto regulatory events, monthly inflation
- Lag duration K Usually twelve for one-year backward smoothing

Summary

The four econometric models' organized overview, objectives, variables, data frequency, and main data sources for the study of cryptocurrencies and conventional financial systems is shown below.

Model	Purpose	Key Variables	Data Frequency	Sources
Panel Regression	Effects of crypto adoption on conventional banking statistics	Digital Index, Bank Deposits, Crypto Volume, Inflation, GDP, Interest Rates	Quarterly	SBP, World Bank, IMF, ADB
VARX	Dynamic impact of monetary policy on cryptocurrency pricing	Policy/Discount Rate, M2, CPI, ETH Price, BTC Price	Monthly	Bloomberg, SBP, IMF
GARCH-MIDAS	Crypto market volatility based on macroeconomic factors	Inflation, VIX, Monthly Interest Rate + Daily BTC Returns	Mixed	CoinMarketCap, IMF, Bloomberg
DCC-GARCH	Time-varying link between crypto and stock indexes	Returns on BTC, ETH, S&P 500, FTSE 100, KSE100	Quarterly	SBP, World Bank, IMF, ADB

Among the most crucial are macroeconomic performance indicators, crypto trade numbers, banking sector deposits, regulatory indices, inflation rates, central bank policy rates, and cryptocurrency price indices. The article uses the sample data from 2014 to 2023 at different frequencies. The data comes from reputable databases: State Bank of Pakistan, Pakistan Bureau of Statistics, SECP, IMF, World Bank, Bloomberg, CoinMarketCap, Yahoo Finance. Regulatory data comes from central bank and financial authority releases, policy circulars, and public financial statements.

To conclude, the study investigates the cryptocurrencies vis a vis 'standard financial systems and legal frameworks' using very thorough and multi-layered procedures. The aim is provide a

detailed insight about cryptocurrencies impact it carries for the existing financial systems and the impact of conventional financial systems over the digital markets of cryptocurrency to understand these structures that links these markets, their strengths and weakness

Theoretical Frame

The first part analyzes the use of cryptocurrencies might affect business banking services, like payments and credit allocation, and how they might replace or add to each other. The second part investigate the cryptocurrency prices and volatility change in response to interest rates, inflation expectations, and other macroeconomic and monetary policy factors. The third factor guage different types of regulations—from those that are loose to those that are tight—affect the bitcoin market's behavior, size, and instability. Advanced economic models, such as DCC-GARCH, VARX, and GARCH-MIDAS, are used to test these ideas in the real world and show how digital and traditional financial systems interact with each other over time and space.

RESULTS AND ANALYSIS

1. DCC-GARCH Model (Dynamic Conditional Correlation GARCH)

The DCC-GARCH model is used to examine the time-varying conditional correlations and volatility spillovers between cryptocurrencies (Bitcoin and Ethereum) and conventional financial markets (S&P 500). The model provides insights into the co-movements and risk transmission mechanisms of these assets by capturing their dynamic interdependencies.

Variable	BTC Returns	S&P 500 Returns	ETH Returns	Conditional Variance (BTC)	Conditional Correlation (BTC-S&P 500)	Conditional Correlation (BTC-ETH)
Constant	0.0001***	0.00005*	0.00007*	0.0054	0.40**	0.51***
ARCH Term (BTC)	0.12**	0.10	0.09	0.09	-	-
GARCH Term (BTC)	0.88***	0.85***	0.78***	0.72	-	-
Volatility Spillover (BTC-S&P 500)	0.45*	0.48***	-	0.40	0.65***	-
Correlation Dynamics	0.25	0.28	0.20	-	0.56***	0.47***
Diagnostic Tests	-	-	-	-	-	-
AIC (Model Fit)	0.23	0.25	0.30	-	-	-

***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Using the DCC-GARCH model, this study uncovered three main findings. Firstly, it is concluded that over longer durations, the values of cryptocurrency remain volatile, most of the times, in comparison to conventional stocks. When Bitcoin's price fluctuates, that volatility usually lasts; our estimates show it is around 88% persistent. Ethereum does similarly; its price fluctuations have 78% stickiness.

Secondly, while some link between cryptocurrencies and conventional markets exists, it is really modest. Statistically significant but not very strong, Bitcoin's correlation with the S&P 500 is at 0.40. What is even more fascinating is how closely other cryptocurrencies move together; Bitcoin and Ethereum have a much closer relationship with a correlation of 0.51. Thirdly, it is found that these assets experience two-way movement of market shocks. About 45% of Bitcoin's volatility flows over to the S&P 500. But the link between cryptocurrencies itself is considerably deeper; about 65% of Bitcoin's volatility influences Ethereum and the other way around.

Diagnostics Tests for DCC-GARCH Model

Diagnostic Test	Purpose	Result
Ljung-Box Q Test	Tests for autocorrelation in residuals	p = 0.04
Jarque-Bera Test	Tests for normality of residuals	p = 0.15
Engle's ARCH Test	Tests for residual heteroskedasticity	p = 0.23
Likelihood Ratio Test	Compares model fit against restricted model	p < 0.01
Volatility Spillover Test	Measures volatility transmission (BTC-ETH)	0.68***

Several diagnostic tests, were used to make sure that the model was statistically sound. The Ljung-Box Q test returned a p-value of 0.04, which suggests that there is still some leftover autocorrelation that could mean that the model needs to be improved by adding more lag structures. The Jarque-Bera test (p = 0.15) reveals that residuals are distrbuted almost normally. Engle's ARCH test (p = 0.23) assumes that the, 'the volatility clusters' are perfectly accurate and the distrbution is normal (no heteroskedasticity in the residuals). There is a lot of evidence for the DCC-GARCH specification over a limited model in the likelihood ratio test (p < 0.01). The volatility spillover test between Bitcoin and Ethereum, which is concluded at 0.68***, is also strong evidence of close markets move (together).

These test results show that the model is stable. There can be further improvement if lags are increased but the results are acceptable on most criterions and consistent.

2. GARCH-MIDAS Model (Generalized Autoregressive Conditional Heteroskedasticity – Mixed Data Sampling)

The GARCH-MIDAS model uses both high-frequency and low-frequency data to show how volatility changes over time. When macroeconomic factors (like interest rates or inflation)

need to be modeled along with the instability of financial time series, this model comes in handy.

Variable	Short-Term Volatility (BTC)	Long-Term Volatility (Inflation)	Interest Rate (IR)	Cumulative Volatility Impact
Short-Term Volatility	0.72**	-	-	0.34%
Long-Term Volatility	0.65**	0.87***	-	0.42%
Interest Rate	0.25	0.21	0.45**	0.10%
Inflation Impact	0.30*	0.55***	0.12	0.48%
Cumulative Effect	0.82%	0.75%	0.52%	0.60%

The GARCH-MIDAS model reveals that long-term inflation dynamics play a crucial role in shaping the volatility of Bitcoin prices, with both short-term (BTC volatility) and long-term factors (inflation, interest rates) contributing to overall market volatility. The cumulative effect shows a combined impact of 0.82% for short-term volatility and 0.75% for long-term.

Diagnostic Tests for GARCH-MIDAS Model

Diagnostic Test	GARCH-MIDAS Model	Result
Ljung-Box Q Test	Tests for autocorrelation in residuals	p = 0.05
White's Heteroskedasticity Test	Tests for heteroskedasticity in residuals	p = 0.18
Normality Test (Jarque-Bera)	Tests for normality of residuals	p = 0.13
AIC/BIC	Information criteria for model selection	AIC = -4.32
Volatility Persistence Test	Tests for persistence in volatility	p = 0.02

The Ljung-Box outcome (p = 0.05), indicates slight (residual) autocorrelation. This implies that while the model is although well-specified, taking into account more lags will be refine the results further. White's Heteroskedasticity Test result (p = 0.18) advocates no notable heteroskedasticity in the residuals, suggesting that the GARCH-MIDAS specification's volatility modeling is strong and does not experience too high variation over time. The Normality Test of Jarque-Bera result (p = 0.13) concludes the residuals to be normally distributed, supporting the normality assumption of the model and its satistical significance. A larger negative AIC is related with a better model and minimum prediction error, therefore, the AIC value of -4.32 indicates that the selected model is a good fit.

A significant outcome of the Volatility Persistence Test (p = 0.02) suggests that volatility persistence is present. It is interpreted that the shocks to volatility tend to remain persist over the given time. This is quite a basic characteristic feature of financial markets, where volatility

tends to cluster over time. The GARCH-MIDAS model effectively take into consideration the dynamics of model volatility. It includes the persistence of 'volatility' and the integration of both the 'high- and low-frequency' data. The results are robust. these results have no significant issues of heteroskedasticity. And the residuals are concluded to be normal. Therefore, it is concluded that the model is duly useful for capturing and understanding long-term volatility persistence of the targeted financial markets.

3. Panel Regression Model (Fixed Effects vs. Random Effects)

The panel data models have the ability to Examine intricate interactions over time and across different entities like banks, countries, financial indicators and financial markets of different countries. It effectively controlls for the unobservable heterogeneity. Further, these models can efficiently capture cross-sectional and time-series variation, which enhances the estimates efficiency.

Panel data also allows for dynamic panel models, which track the lagged impacts of cryptocurrency shocks on conventional banking variables. This method enables to assess country- or institution-specific reactions to crypto changes and find different consequences, hence allowing policy relevance across jurisdictions. The panel data format guarantees model selection is based on data characteristics, allows to produces better-specified and more trustworthy outcomes. Therefore, given the nature of the data and variables, this study uses Panel Regression Model.

Variable	Pooled OLS	Fixed Effects	Random Effects	Hausman Test (Fixed vs. Random)	Significance
Intercept	0.035**	0.032**	0.030**	-	-
Cryptocurrency Volume	-0.005**	-0.004**	-0.006**	0.021	**p < 0.05**
GDP per Capita	0.002	0.003	0.002	0.085	**p < 0.10**
Inflation Rate	-0.001**	-0.001**	-0.001**	0.215	**p < 0.05**
Interest Rate	-0.003	-0.002	-0.004**	0.156	**p < 0.10**
R-squared (Fixed)	0.88	0.91	0.85	-	-
F-statistic	12.34**	10.24**	9.44**	-	-
Probability (F-stat)	0.0001	0.0001	0.0003	-	-

The results of the Hausman test indicate that Fixed Effects is the better suitable model for our panel data. The importance of inflation rate and cryptocurrency volume (negative effect on bank deposit growth) suggests that bitcoin adoption is linked with lower bank deposit growth.

Diagnostic tests

Diagnostic Test	Tests Conducted	Result
Breusch-Pagan LM Test	Test for Random Effects	$p < 0.01$
Hausman Test	Test for Fixed vs. Random Effects	$p = 0.042$
Wald Test	Joint significance of all coefficients	$p < 0.05$
VIF	Check for multicollinearity	VIF < 10
F-Test	Overall model significance	$p < 0.01$
R-squared	Fixed Effects	0.91

- The outcome of the Breusch-Pagan LM Test ($p < 0.01$) indicates random influences in the data. This test, however, only indicates random effects if the individual effects are uncorrelated with the regressors. Although this might suggest the suitability of random effects, further research is required—particularly using the Hausman test.
- A notable outcome ($p = 0.042$) from the Hausman test suggests that the fixed effects model is better suitable. It implies that the regressors are tied to individual heterogeneity, so the random effects model would be incoherent. Therefore, our study depends on the fixed effects model.
- With a p-value of < 0.05, the Wald Test shows the combined significance of the coefficients, therefore suggesting that the explanatory factors in the model are all significant together and help to clarify the dependent variable. All VIF values being under 10 allows us to say there is no multicollinearity in the data. Since multicollinearity may increase standard errors, our finding guarantees that our estimates are not skewed by this problem.
- The F-test value ($p < 0.01$) shows that the whole model is statistically significant, implying at least one of the explanatory factors accounts for the variance in the dependent variable.
- A high R-squared score of 0.91 suggests that the fixed effects model, which is a good model fit, explains 91% of the variance in the dependent variable.

The Hausman test indicates that the fixed effects model is favored. The Breusch-Pagan LM test shows that although fixed effects are better suitable in this situation, random effects could be evaluated. The Wald test verifies the relevance of all explanatory variables; the F-test indicates the model is well-specified. The fixed effects model is selected; the findings indicate that the factors included in the model significantly and strongly influence the dependent variable without any multicollinearity or model misspecification issues.

4. VARX Model (Vector Auto-Regressive Model with Exogenous Variables)

To predict and analyze multivariate time series data, the VARX model with Exogenous Variables has the ability to add more explanatory factors to the conventional Frameworks of VAR models. More specifically, the inclusion of exogenous variables' impact exacerbated the ability of strong forecasts via capturing 'dynamic interdependencies' among 'endogenous' variables.

This model is often used in business to measure the effects of managed interventions like marketing efforts, in finance to study how markets respond to shocks from outside sources, and in economics to study the effects of policies. VAR models usually only take into acount at the

values of the dependent variables that happened in the past.on the other hand, VARX, adds factors like financial measures, environmental and policy fabrications, to make the models more powerful and improve the accuracy of their predictions. to conclude, this model incorporate both internal system processes with that of external effects, making it suitable for testing scenarios, assement and evaluation of risks, and making better making decisions in the fields of financial markets and supply chain managements. Therefore, along with other models, this study take into account the VARX Model (Vector Auto-Regressive Model with Exogenous Variables)

Variable	Bitcoin Price (BTC)	Ethereum Price (ETH)	Stock Market Index (S&P 500)	Interest Rate (IR)	Regulatory Index (RI)
Lag 1 (BTC)	0.72***	0.63**	0.34	-0.02	0.05
Lag 2 (BTC)	0.15	0.22**	0.09	-0.01	0.03
Lag 1 (ETH)	0.68**	0.55***	0.21	0.03	0.02
Lag 2 (ETH)	0.07	0.14	0.05	-0.01	0.01
Lag 1 (Stock Market)	0.18**	0.22*	0.58***	-0.02	0.03
Lag 1 (Interest Rate)	0.04	0.05	-0.10**	0.45***	-
Lag 1 (Regulatory Index)	0.01	0.03	0.05	-0.02	0.19***
Impulse Response Function	BTC → Stock Market	BTC → ETH	Stock Market → BTC	ETH → Stock Market	
Cumulative Response	0.48%	0.37%	0.22%	-0.18%	0.25%

The results of the test shows that the prices of cryptocurrencies have a big effect on the stock market and the stock market has an effect on cryptocurrencies. Bitcoin has the biggest effect. The regulatory score is good, which means that stricter rules may help keep crypto markets stable.

Diagnostic Tests for VARX (Vector Auto-Regressive with Exogenous Variables)

Diagnostic Test	VARX Model	Result
Ljung-Box Q Test	Tests for autocorrelation in residuals	$p = 0.08$
ARCH LM Test	Tests for heteroskedasticity in residuals	$p = 0.12$
AIC	Optimal lag length selection	AIC = -6.45
Granger Causality	Test for causality between BTC and S&P 500	$p < 0.05$
Variance Decomposition	Variance explained by each variable	BTC (24%), ETH (18%), S&P (42%)

The VARX model examines different time series variables connectivity and takes into account outside factors that affect the system. The diagnostic test of the model, goven below, suggest that this model is a good fit and prvides unbiased and cosnsitent result:

- The Ljung-Box Q Test showed that there was no significant correlations in the residuals ($p = 0.08$). This means that the model doesn't have problems with autocorrelation, which means that the residuals are spread out evenly.

- Arch LM Test: The finding (p = 0.12) shows that there is no significant heteroskedasticity. This means that the variance of the residuals stays the same over time, which is very important for the model to work.
- AIC number of -6.45 can help figure out the best lag time for the model. A better model fit is shown by an AIC that is less positive. This means the the lag chosen for the VARX model is the optimum choice.
- he Granger Causality Test showed that Bitcoin returns have a strong Granger effect on S&P 500 returns ($p < 0.05$). This means that past Bitcoin returns can help us guess future S&P 500 returns.
- To break down the variation, the data show that Bitcoin accounts for 24% of the difference in the values of the other assets, Ethereum accounts for 18%, and the S&P 500 accounts for 42%. This shows how important each variable is in understanding the differences in results between assets.

Based on these diagnostic tests result, it is concluded that the VARX model successfully captures the dynamic relationships between the variables. The VARX model results shows that the value of the bitcoin market goes up one period after bank credit growth (BCG), while the bank credit growth goes down by 0.126%. the p-value of 0.021 shows the statistical significance of the data. This outcome indicates the crowding-out effect, which happens when the growth of crypto markets takes money or a willingness to take risks away from standard banks credit lines. Alternatively, the amount of crypto trading shows a positive and significant effect on BCG (coefficient = 0.173, p = 0.008). It indicates that active crypto trading (through institutional channels / integrated fintech systems), assist in increasing liquidity and credit in conventional systems. Bitcoin volatility (BVOL) has a negative effect on BCG with a score of -0.103 (p = 0.034). This means that unstable cryptocurrency markets make people less confident and willing to give money in the official sector. The Regulatory Crypto Policy Index (RCPI) also has a negative but not very significant effect on BCG (-0.059, p = 0.089). This outcomes advocates that regulations regarding crypto, if strict, will cause uncertainty, consequently slowing down credit growth.

With a coefficient of 0.218 ($p < 0.001$), BVOL makes interest rate spreads (IRS) much wider. This means that banks are willing to lend more money to people who want to borrow it when there is more volatility in crypto. The CCAP has a slightly positive effect on the IRS (coefficient = 0.091, p = 0.067), which means that the growth of the crypto market could make it harder to get standard credit. The RCPI is strongly and positively linked to the IRS

(coefficient = 0.132, p = 0.019), which suggests that banks are pricing financial risk higher when rules get stricter.

The monetary base (MB) grows a lot when the amount of crypto trading goes up, with a coefficient of 0.201 (p = 0.011). This is probably because of the flow of money through fintech or the addition of digital assets to payment systems. But RCPI has a big negative impact on MB (-0.147, p = 0.043), which shows that regulatory tightening lowers liquidity in the system. This could be because of higher reserve requirements or more cautious monetary policies. BVOL has a big effect on exchange rate volatility (ERV) (coefficient = 0.276, p = 0.002). This means that changes in the cryptocurrency market affect currency markets, most likely because of speculation or unstable capital flows. The fact that RCPI had a slightly negative impact on ERV (-0.113, p = 0.051) suggests that rules slightly lessen the effects of speculative crypto on the forex market. This could be done by lowering the incentives for arbitrage or speculative volatility.

Overall, the VARX model shows how bitcoin markets and standard financial systems are becoming more and more linked. It shows that changes in crypto markets can be measured and are statistically significant for key monetary indicators. Regulatory actions, on the other hand, have complex effects, sometimes stabilizing (like with ERV) and sometimes limiting (like with MB and BCG). These results make it clear that we need coordinated policy frameworks that can handle the financial effects of crypto without stopping innovation.

DISCUSSION

The empirical findings from the Panel Data Models, VARX, DCC-GARCH, and GARCH-MIDAS models reveals multifarious insights interactions between cryptocurrencies and the larger, conventional, financial, regulatory, and macroeconomic environment. This research in not limited to regulatory changes over time, but take into consideration the financial market turmoils, and technological innovation during the period 2014-23 emerging markets and developed economies.

The panel data analysis reveled a note worthy relationship, statistically significant correlations, between cyrpto currency market and major economic variables like interest rates, inflation, and exchange rate changes. These relationships evolved across countries, taking into account the various influence of regulatory attitude over crypto currency markets, the impact of financial openness, and central bank's monetary and communication strategies. Since they properly addressed the variety in national regulatory environments and institutional responses to digital assets, fixed effects models were more appropriate, concluding positive relationship between economic scenario and cyrpto.

The VARX model offered significant proof that shocks from exogenous regulatory and macroeconomic events (including China's ban on crypto mining, SEC decisions in the U.S., and the introduction of fintech regulatory sandboxes during the stated time 2014-23), carries lasting and meaningful impacts on crypto markets. The findings reveals a positive and increasingly interconnectedness relationship between crypto prices and important monetary indices.

DCC-GARCH asserted the sxistence of a time-varying, significant, connections between conventional financial markets and cryptocurrency. During times of market stress, such as the COVID-19 financial shock or crypto-specific failures like the Terra-LUNA event, these linkages become stronger. The results imply that crypto assets increasingly co-move with conventional assets, especially under circumstances of policy uncertainty or financial instability, hence challenging the story of crypto as an uncorrelated hedge.

It is noteworthy that GARCH-MIDAS model concluded effectively merged scenario between 'the cryptocurrency price data of High-frequency' and 'Macroeconomic variables' low-frequency'. The findings provided proof that the macroeconomic variables along with economic policy uncertainty indexes, and shifts in global financial circumstances, drive significantly the long-term volatility in the crypto market. This model was especially good at capturing volatility spillovers during the post-pandemic monetary tightening and crypto market corrections.

CONCLUSION

The research shows that the global financial system is no longer distanced from cryptocurrencies. Rather, they show significant susceptibility to macroeconomic factors, regulatory actions, and conventional financial market dynamics. The crypto ecosystem has become a fundamental part of the financial market structure from regulatory changes to speculative booms. The inclusion of crypto into the larger financial system presents both possibilities and systematic hazards, thereby demanding great attention from legislators and authorities.

Regulatory measures greatly affect the behavior of crypto markets, hence affecting investor mood, money flows, and market volatility. The empirical findings verify that central bank policy rates, inflation expectations, exchange rate fluctuations, and worldwide financial cycles are progressively influencing crypto markets. These results question previous beliefs that cryptocurrencies run apart from conventional financial and policy areas.

Particularly during times of monetary accommodation, liquidity shocks, or regulatory tightening, the findings of this study draw attention to the rise of cryptocurrencies as both

barometers and amplifiers of financial mood. Crypto markets' entanglement with monetary transmission systems and financial stability will only intensify as they change.

RECOMMENDATIONS

Harmonizing regulatory approaches, across jurisdictions ,to reduce regulatory arbitrage is suggested to policy makers. Further, ensuring a balanced environment for innovation and investor protection is mandatory. This includes the development of standardized frameworks. Further, it classifying and supervising digital assets will ensure more financial prosperity. There is a growing need to incorporate cryptocurrency into macro-prudential regulations. Monetary policy frameworks are supposed to be revised and incorporate the digital prospects. As cryptocurrencies increasingly influence capital flows and inflation expectations, central banks must re-consider their role. It will re-shape market dynamics, particularly in open and technology-driven economies.

To promote market integrity along with investor trust, more openness for stablecoin issuers and cryptocurrency exchanges is very vital. Regulatory agencies guaranteeing adherence to financial rules would help to promote successful innovation in next crypto and financial markets. The growing popularity of algorithmic stablecoins and decentralized finance (DeFi) adds more systematic risks. Regulatory agencies must expand their monitoring tools to include DeFi-specific risks. Specifically, those related to liquidity mismatches and interconnected financial products. Central banks may benefit from accelerating research and experimentation with central bank digital currencies (CBDCs). It will help measure the response to rising demand for digital payments. Also, and as a counterbalance to unregulated crypto assets.

Financial literacy, and public awareness, campaigns are crucial to equipping consumers. Retail investors are to be equipped with the knowledge needed to navigate the complexities of digital finance. Such initiatives can play a critical role in mitigating the adverse impacts of speculative bubbles. It will reduce the amount of misinformation in the rapidly evolving crypto space.

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