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Article

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Impact of Oil Price Shocks on Crypto and Conventional Financial Assets during Financial Crises: Evidence from the Russian Financial Market

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ABSTRACT

This study offers a multidimensional solution to mitigate the risk raised due to oil price volatility for navigating investments within the Russian financial landscape. This study assesses spillover effects between crypto assets and traditional financial assets encompassing equities, bonds, precious metals, foreign currency reserves, and crude oil prices. It adopts a significant temporal perspective to assess the potential ramifications of various financial crises, including global health crises and regional conflicts, on oil prices. Utilizing a daily frequency dataset spanning from January 1, 2018, to December 30, 2023, this study investigates the contagion effects of financial crises across normal, bullish, and bearish market conditions. It introduces oil price shocks for the 1st time to effectively gauge the impact of exogenous shocks on both crypto and conventional asset classes. Additionally, the study employs Cross Quantilogram (CQ) and TVP-VAR spillover estimation techniques to examine interconnectedness among the underlined assets. Furthermore, the study utilizes the quantile wavelet coherence estimation model to unveil volatility patterns, laying the groundwork for hypotheses related to diversification, hedging, and safe-haven investment strategies among the assets. The findings underscore the effectiveness of crypto assets in diversifying risk and serving as a hedge, particularly evident during crises, leading to heightened volatility. Conversely, government-owned bonds exhibit the lowest resilience to external shocks. Moreover, the dynamic interconnectedness among assets provides guidance to investors for implementing the proposed hypotheses that underscores the importance of prudent asset allocation policies for risk management, optimizing portfolio utilization.

Keywords: Oil Price Shocks, Crypto Assets, Conventional Assets, Hedging, Diversification, Safe-haven Investment Strategies
JEL Classifications: G11, G12, G17

1. INTRODUCTION

Global economies are continuously facing a significant fluctuation in oil prices due to various factors such as supply and demand disruptions, geopolitical events, shifts in market sentiment, and economic conditions. Oil price shocks potentially effects oil-producing and consuming countries. The crisis between Russian and Ukraine (2022) has a major influence on global energy landscape. Cryptocurrencies have become a ubiquitous topic in the realms of finance and information technology, garnering daily headlines due to their widespread acceptance and trading volumes. During the heightened uncertain economic the financial market participants are searching for a solution to mitigate the risk and earn higher return on investments. This study examined the new class of investment backed by technology alongside conventional assets such as equities, bonds, precious metals,

foreign currency reserves, and crude oil prices during extreme oil price volatility.

Several crypto assets have emerged after the inception of the pioneering digital asset Bitcoin (BTC) in the financial market in 2009. The market capitalization of crypto assets in Q1 of 2024 stands at a staggering $2.61 trillion USD. However, crypto assets have been marked by notable volatility, characterized by significant price surges and corrections. Discerning investors view it as an enticing alternative investment avenue and a potent hedge against market fluctuations (Bouri et al., 2017; Sudharshan Reddy et al., 2023; Sakurai and Tetsuo Kurosaki, 2023). In contrast to traditional financial assets crypto assets have been witnessed as safe investment during financial crisis (Yousaf et al., 2023). The crypto assets have been recognized for their efficacy in circumventing sanctions in restricted markets, providing an alternative means to mitigate the impact of sanctions on fund mobility (Ullah, 2024). Similarly, (Ullah et al. 2023) explored the case of the Russian financial market and identified the potential of crypto assets for facilitating international transactions, both in terms of payments and receipts in crude oil trading.

Numerous studies have compared the performance of Bitcoin with traditional stock indices. However, delving into the dynamics of return on investment between cryptocurrencies and conventional assets, particularly within the Russian financial market, presents a compelling avenue for deeper analysis. Following the Ukraine crisis in 2022, the Russian financial landscape witnessed a series of economic and trade sanctions, suspension from the SWIFT network, and disruptions in the crude oil and gas supply chain (Yang, 2023). These crises propelled the Russian financial market into the global spotlight, attracting heightened attention from investors worldwide. Ranked as the 12th largest economy globally, Russia plays a significant role as a major exporter of energy, precious metals, and commodities, intricately intertwining it with the global economic landscape (Chowdhury et al., 2022). Consequently, major investment firms closely monitor developments in the Russian financial market. Moreover, a substantial portion of cryptocurrency mining operations is based in Russia, owing to its favorable energy cost dynamics, while cryptocurrencies themselves are traded on a global scale (Bernardelli et al., 2023). The multifaceted nature of these dynamics underscores the motivation behind conducting an extensive investigation into the dynamic interconnectedness among the aforementioned assets. This research aims to provide investors and policymakers with invaluable insights for crafting prudent investment policies and informed decision-making strategies. Given the challenges arising from the ongoing crisis, this study is conducted to offer a theoretical and empirical solution to this identified financial scientific problem, with a comprehensive level of elaboration suitable for both domestic and foreign counterparts.

This study is propelled by a conspicuous gap in scholarly inquiry, where limited attention has been directed towards exploring the hedging potential of crypto assets compared to esteemed counterparts in conventional financial assets such as equities, bonds, precious metals, and the forex market, specifically focusing on oil price volatility and exchange rates between the US dollar and the Russian ruble (RUB/USD), amidst the persistent backdrop of the peace conflict in the Russian financial market in 2022. Primarily, existing research suggests that the performance of crypto assets is contingent upon a convergence of factors, including sentiment, regulatory frameworks, and the intricate tapestry of geopolitics (Kumar, 2023). Notably, crypto assets exhibit complex relationships with traditional assets, including precious metals, stocks, bonds, and various currencies, as elucidated by Bouri et al. (2017), Delia et al. (2023), and Khalfaoui et al. (2023). Moreover, scholarly investigations have sought to determine whether crypto assets assume the role of a crisis hedge, particularly in tumultuous scenarios like peace conflict, as underscored by the seminal work of Yousaf et al. (2023). Secondly, amidst crises, crypto assets emerge as financial instruments imbued with protective attributes (Demir et al., 2018; Bouri et al., 2021; Grassi et al., 2022; Corbet et al., 2023), facilitating cross-border transactions and enabling uncensored payments within Russia's borders (Aharon et al., 2022; Alam et al., 2023; Bejaoui et al., 2023). Moreover, geopolitical fluctuations foster heightened volatility within the realm of crypto assets (Boubaker et al., 2023). Nonetheless, the present study seeks to ascertain whether crypto assets can ascend to the echelons of a safe-haven asset, a hedging mechanism, or a decentralized resource, employing Markowitz's seminal portfolio theory of 1952 as a foundation for rational investment decision-making and robust risk management practices.

Significantly, the utility of crypto assets as hedging financial instruments has witnessed considerable adoption amid the tumultuous landscape of the health crisis and the persistent peace conflict. Given the dynamic nature of crypto assets, the present study endeavors to evaluate their correlation with traditional financial assets. Specifically, this study focuses on the most traded cryptocurrencies with the highest capital size, such as Bitcoin (BTC), Ethereum (ETH), Binance Coin (BNB), and Cardano (CRD). Additionally, we incorporate key financial assets traded at the Moscow Stock Exchange (MOEX), including equity indices, government bonds with maturities of 10, 5, and 3 years, precious metals indices, the foreign currency exchange rate of RUB/USD, and crude oil prices.

Beyond the importance of selecting impactful financial assets with a significant timeline, this study introduces several novelties for the 1st time in the context of the Russian financial market. Firstly, building upon the modern portfolio theory (MPT) proposed by Harry Markowitz in 1952, this study introduces a modified version of MPT that includes the new class of crypto assets for consideration in portfolio investment. Secondly, this study offers key guidelines for portfolio-based investments by examining three hypotheses: portfolio diversification, hedging, and safe haven analysis among the aforementioned financial assets. Particularly, practical guidelines are provided for using crypto assets as diversification and hedging tools against conventional financial assets during different market horizons, such as normal, bullish, and bearish market conditions. Thirdly, apart from application of advance econometric estimations, this study provides insights to identify the most suitable financial assets that are more resilient to exogenous shocks, such as oil price shocks (OPS). Finally, practical policy implications are offered for investments in

optimizing portfolio utilization. The contribution of this study is evident in addressing all the aforementioned developed problems.

Findings of this study provides significant theocraticals and practical results to the challenges faced by the Russian financial market amidst heightened oil price shocks Ukraine started in 2022 and continue (Kayani, U.N., 2023). With application of various sophisticated econometric estimation models, this study comprehensively investigates the role of crypto assets in the Russian financial landscape. The findings disclose that crypto assets not only serve as a hedge but also establish bi-directional connectedness with MOEX equity, Russian 10-year government bonds, precious metals, and the exchange rate RUB/USD. Additionally, they act as reliable safe havens, facilitating risk diversification during the current turmoil. To estimate potential losses within the portfolio, researchers utilize the Cornish-Fisher expansion. In light of the 2022 Ukraine conflict, it is noteworthy that investments in crypto assets surged in Russia, intensifying volatility and uncertainty. Consequently, prudent asset allocation assumes paramount importance as a cornerstone of effective risk management strategies. Furthermore, this study aims to examine the impact of the current crisis on the Russian financial market based on the fundamental hypothesis that crypto assets such as Bitcoin, Ethereum, BNB, Cardano, along with conventional financial assets including equity indices, bond indices, precious metals, and foreign currency exchange, can be utilized for diversification, hedging, and safe haven purposes across different time horizons and market conditions in the Russian financial market, particularly amidst extreme oil price shocks.

The structure of this study is as follows: Section 2 delves into the historical insights of previous studies and related literature. Section 3 provides explanations of the methods, models, and materials used in this study, while Section 4 presents the theoretical and empirical estimations, along with analysis and discussions of the findings. The final section concludes the study with theoretical and practical policy implications.

2. REVIEW OF LITERATURE

2.1. Crypto Assets Portfolio Diversification

The global equity markets experienced a significant downturn in response to unprecedented financial crises such as the COVID-19 pandemic and the Ukraine conflict of 2022. During the COVID-19 outbreak, the US stock market witnessed its largest single-day drop since the 1987 crash, with all G7 indices plummeting by 40% in a single day, ultimately resulting in a 100% decrease. Emerging markets also suffered, with the NSE50 losing 30% of its value, and the S&P 500 circuit breakers being triggered 4 times during the health crisis (Kumar and Padakandla, 2022). Similar trends were observed across other equity and commodity markets, leading to heightened uncertainty. In response to the 2022 Ukraine crisis, the Moscow Stock Exchange experienced a 45% downturn, persisting for 6 months (Sohag and Ullah, 2022). Investors worldwide, particularly those in the Russian financial market, incurred significant losses and faced heightened investment risks. Ozdurak et al. (2022) employed an asymmetric VAR-GARCH model to study major crypto assets and their spillover effects on clean energy and technology indices, concluding that crypto assets can serve as a hedge against clean energy equity indices. Akbulaev et al. (2023) investigated the role of crypto asset currencies as investment and speculative trading vehicles, revealing connections between natural gas and crude oil prices and crypto asset prices.

During such crises, investors typically seek refuge in safe-haven assets to protect their investments. Asset management companies prefer to diversify risks and hedge potential losses. The primary focus of diversification strategies lies in determining whether crypto assets serve as safe haven assets, diversifiers, or hedges in comparison to conventional financial assets such as equity (Shang et al., 2022), government bonds (Corbet et al., 2018), commodities (Goodell et al., 2022), and precious metals (Klein et al., 2020). Ahmadova et al. (2024) explored the interaction between Bitcoin and Nasdaq, the U.S. Dollar Index, and commodities, discovering a positive relationship between Bitcoin and Nasdaq, as well as oil prices, while noting a negative impact of the U.S. Dollar Index on Bitcoin prices, with gold showing no significant impact on Bitcoin price fluctuations. However, existing studies fail to elucidate how crypto asset portfolios react and function in portfolio utilization during the Russia-Ukraine crisis. In times of high market uncertainty, investors tend to gravitate towards safe or low-risk assets. According to Baur and Lucey (2010), a hedge is an asset that is, on average, negatively correlated with another asset or portfolio, while a diversifier is an asset that is positively correlated with another asset or portfolio on average. Similarly, a safe haven is an asset that is uncorrelated or negatively correlated with another asset or portfolio during market stress or turmoil, compensating investors for losses as its price increases when the price of other assets or portfolios decreases. Similarly, the strategy of safe-haven investing positing can be takeover when an asset or group (or class of assets, for example in the current study the crypto-assets) that is uncorrelated or may negatively associated to other asset in such situations to reward the investors for losses as its price increases when the price of other assets or portfolios decreases.

H1: Considering crypto assets in portfolio utilization offers significant benefits in terms of portfolio diversification, hedging, and safe-haven during the financial crisis.

2.2. Exogenous Shocks

Previous research studies have examined the ability of crypto assets to use as diversification tools during the crisis of COVID-19 pandemic, in this context (Le et al., 2021) finding are meaningful in term of emphasizing market efficiency and profitability of crypto assets. Others have inspected their profitability of crypto assets and compared to global equity indices amidst various phases of the pandemic (Haffar and Le Fur, 2022), with findings indicating that crypto assets, particularly Bitcoin (BTC), act as shock transmitters in emerging markets. Examining the hedging and safe-haven property, Naeem et al. (2023) found that Bitcoin (BTC) function as shock transmitters, Corbet et al. (2018) analyzed the retention of BTC for holding of long and short-time period and found them to be shock transmitters. Ullah (2024b) noted that crypto assets are particularly responsive to information shocks in the Russian financial market. In contrast, Diniz-Maganini et al. (2021) compared BTC to precious metals and revealed that BTC

has the potential to resist the crises of COVID-19. Contrary to traditional views on gold as a safe haven, studies have found conflicting evidence regarding its effectiveness during crises (Baur and Lucey 2018; Abidi et al., 2024). Abidi et al. (2024) examined the safe-haven property of Bitcoin and precious metals during the COVID-19 pandemic and the Russian-Ukraine conflict, concluding that BTC shares similarities with gold in terms of hedging capabilities, while both BTC and gold exhibit weak safe-haven characteristics during the health crisis and stronger attributes during the war period. Kumar and Padakandla (2022) studied gold versus BTC and concluded that BTC is responsive to financial market shocks. Furthermore, Bossman and Gubareva, 2023 explored the rise and fall of crypto assets during various financial crises, highlighting their active role in transmitting shocks to other financial assets.

During the Russian-Ukraine crisis, precious metals faced challenges as traditional safe havens due to Russia's significant holdings, causing a meltdown in their ability to serve as such (Islam et al., 2024). However, silver and other precious metals experienced positive rallies in prices later in 2023. Yousaf et al. (2022) compared crypto assets to precious metals during the 2022 Russian-Ukraine crisis and found that crypto assets are more volatile. Shahzad et al. (2019a) and Akhtaruzzaman et al. (2021) studied the resilience of crypto assets to economic policy uncertainty and banking crises, respectively, while Beckmann et al. (2015) examined their response to extreme oil price volatility during the COVID-19 pandemic. Similarly, Baur and Glover (2016) investigated their reaction to economic policy uncertainty during the Middle East crisis in 2017. Klein (2017) assessed BTC to study the potential of resilient transnational financial crises. Bouri et al., (2017b) and Shahzad et al., (2019) recognizes Bitcoin as potential hedge and safe-haven instruments against the traditional financial assets. In this current study we assumed that the Russian financial market may react similar as other developing economies we hypothesized that exogenous shocks such as oil price shocks (OPS) significantly impact investment portfolio utilization in the Russian financial market.

H2: Oil price shocks (OPS) significantly impact portfolio utilization in the Russian financial market.

2.3. Resilience of Crypto Assets to Financial Crisis

Sohag et al. (2024) suggested that Ethereum could be viewed as a safe haven rather than Bitcoin. Conversely, (Trollman et al., 2022) investigated the safe haven property of Tether, Ethereum, and Bitcoin against international equity indices and concluded that crypto assets cannot be considered safe havens during COVID-19. Urquhart, (2022) suggested that crypto assets have the potential to act as excellent diversifiers for stocks, bonds, commodities, and specific currencies. Studies examining the COVID-19 period yielded mixed findings. Similarly, studies by Corbet et al. (2020) reached similar conclusions, refuting the notion of crypto assets as safe havens during the pandemic. Another line of research examined the efficiency and multifractality of crypto assets to explore diversification possibilities. Bondarev et al. (2020) studied the energy consumption of Bitcoin during its mining process and identified potential limitations due to the magnitude of energy consumption, which could restrict Bitcoin mining usage. Similarly, studies by Naeem et al. (2023) highlighted different levels of time-varying multifractality and efficiency of crypto assets during the pandemic. Karim et al., 2023 applied MF-DFA to assess major crypto assets' multifractality and market efficiency during COVID-19, revealing varying levels of time-varying multifractality. Overall, these studies underscore the varied levels of crypto assets' market efficiency and safe haven properties. The construction of crypto assets portfolios and diversification strategies under government interventions during COVID-19 remain relatively unexplored.

Bitcoin has been identified as a portfolio diversifier (Dyhrberg, 2016; Denisova et al., 2019) and a short-term hedge (Bouri et al., 2017a; Bouri et al., 2017b). Schinckus et al. (2020) investigated crypto assets trading's impact on energy consumption and climate change, revealing a significant positive influence on energy consumption in the short and long run, with a negative impact on the environment. During January-March 2020, Bitcoin prices experienced significant fluctuations, dropping from a 5-month high to a low of $4106 in a single day before recovering to $20,000 by mid-December 2020, suggesting its potential as a safe-haven asset. Dzyuba et al. (2023) examined pricing mechanisms in mining data centers, highlighting the potential for reducing electricity prices through energy cost management. Recent studies have suggested that Bitcoin is at most a weak safe-haven, especially during turbulent times like the Covid-19 crisis. Conlon and McGeee (2020), Ivanchenkova et al., 2023), and other researchers have echoed similar conclusions. Figure 1 provide a comprehensive graphical representation of the theoretical framework of the study.

H3: Crypto assets in portfolio utilization exhibit significant resilience to counter the impact of financial crises in the Russian financial market.

3. METHODOLOGY

This study delves into the dynamic interconnections between oil price fluctuations and their impact on crypto assets, as well as key financial assets such as equity, precious metals, bonds, and foreign exchange rate volatility, amidst a series of crises including the Health Crisis of 2020 and the Peace Conflict of 2022. To comprehensively investigate the real-time nexus among these factors shaping global economic conditions, advanced econometric estimations were employed. The study encompasses various types of variables, including crypto assets, conventional assets, and exogenous shock parameters. Table 1 presents comprehensive descriptions of these variables and parameters, along with their respective data sources.

3.1. Materials Description and Sources

The materials utilized in this study include historical data on oil prices, crypto assets (such as Bitcoin, Ethereum, etc.), equity indices, precious metal prices, bond indices, and foreign exchange rate data. These data sets span the periods affected by the Health Crisis of 2020 and the Peace Conflict of 2022, providing a comprehensive view of the financial landscape during these crises.

Figure 1: Conceptual framework of the study

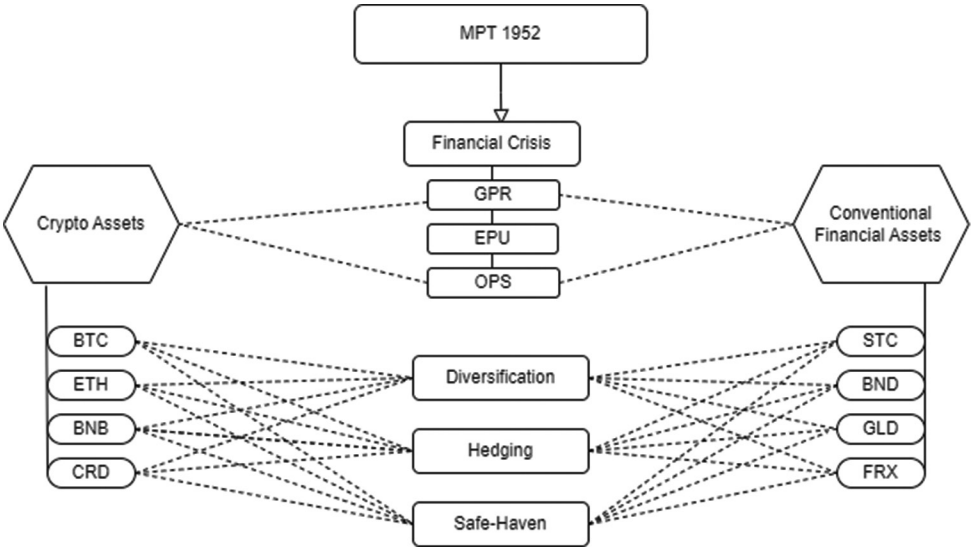


Table 1: Data description

Variables	Measure of variables	Source
Crypto Index (CRPT)	Top trading Crypto Currencies with respect to market capital size (price in US dollars)	www.coinmarket.com
Equity Index (EQT)	Top trading Equity Assets (Index) with respect to market cap. Listed at Moscow Stock Exchange Russian MOEX Index	Moscow Stock Exchange Russian MOEX Index https://www.moex.com/en
Bonds Index (BND)	10-, 5- and 3-Years Russian State bonds (Index) Trading at Moscow Stock Exchange Russian MOEX Index	Moscow Stock Exchange Russian MOEX Index https://www.moex.com/en
Exchange Rate (XRT)	Exchange rate of Russian ruble (RUB) into USD measured as RUB/USD (Sum of RUB per 1-US Dollar)	Central Bank of Russia https://www.cbr.ru
Precious metals (PMT)	Top trading precious metals (Index) with respect to market cap. Listed at Moscow Stock Exchange Russian MOEX Index	Moscow Stock Exchange Russian MOEX Index https://www.moex.com/en
Oil Price Shocks (OPS)	Ural Crude Oil Index spot (price in US dollars per million Btu)	Energy Information Administration https://www.eia.gov

The table presents comprehensive descriptions of these variables and parameters, along with their respective data sources

This study uses daily frequency data spanning from January 1, 2018, to December 30, 2023, focusing on crisis of COVID-19 and Russian-Ukraine conflict (2022). The selection of this data timeline is driven by the recognition that the dynamics of financial markets underwent significant changes of the crisis this timeframe allows for an empirical assessment of the potential ramifications of significant financial crises.

3.2. Oil Price Shocks

Oil price shocks (OPS) refer to significant fluctuations in the price of crude oil due to various factors such as geopolitical events, changes in supply and demand dynamics, production disruptions, shifts in market sentiment, and economic conditions. OPS affects both oil-producing and consuming economies where declines in oil prices leads to reduce the revenues and call a deficit with economic downturns. Similarly, the price upward spikes result in windfall profits for exporters. OPS impact almost every sub-sector of the economy which creates uncertainty in financial market and impact the commodity prices, exchange rates, and interest rates. The OPS significant drivers of economic activity play a crucial role in re-shaping the global energy landscape. Examining the causes and effects is essential for financial market participants investors and fund managers to mitigate the risk profile and navigate the complexities of the oil market.

The oil price shocks in the context of exogenous shocks for the financial markets where the landscape of digital assets which has been rapidly evolving, with crypto assets dominating the headlines of both IT and financial news due to their remarkable fluctuations. While numerous studies have explored the influence of factors like Twitter sentiments on Bitcoin prices (Ullah, 2022), and the impact of crises such as COVID-19 and geopolitical conflicts on crypto asset volatility (Ullah, 2024), the effect of crude oil price shocks on the prices of digital assets remains relatively unexplored. This study's novelty lies in its utilization of the Crude Oil Urals Europe CFR Spot (URL-E) as a primary metric. This choice ensures the reliability and significance of the commodity, particularly considering the high levels of uncertainty surrounding it and its profound impact on the Russian economy. Moreover, Urals oil serves as a benchmark for price determination and comparison with other crude oils in Russian oil exports. Geographically, URL-E represents a blend of sour and heavy oil from the Urals region, transported to Europe via the Baku-Druzhba pipeline and the Novorossiysk pipeline for further distribution to markets such as India and China. The St. Petersburg International Mercantile Exchange (SPIMEX) facilitates trading with future contracts of 1000 Barrels of Brent crude oil, utilizing contract for difference (CFD) financial instruments and over the counter (OTC) transactions.

Following the crisis with Ukraine, the price of Urals oil experienced a significant decline, plummeting by 10% due to export-related issues. Given the Russian economy's heavy reliance on energy revenue, particularly from natural gas and crude oil exports, such price fluctuations have profound implications for its economic stability and growth trajectory. Therefore, this study has opted to investigate the impact of oil price shocks on both crypto and conventional financial assets empirically. By doing so, it aims to shed light on the intricate dynamics between oil prices and asset prices, providing valuable insights for investors and policymakers alike.

3.3. Models

The study utilizes advanced econometric estimation models to assess quantile connectedness among the underlined assets classes. The study used Cross-Quantilogram (CQ) estimation for quantil connectedness analysis, along with application of Time-Varying Parameter Vector Autoregressive (TVP-VAR) estimation models for spillover estimation. These models allow for the examination of interconnectedness, spillover effects, and volatility dynamics among the assets. To cross examination and robustness of the models this study uses a newly developed estimation model of Quantile Wavelet Coherence (QWC). Thes study applied several pre-estimation examinations such as consistency and reliability check, and relationships and dynamics among the data for further statistical techniques to measure the effectiveness of various assets as hedging instruments, diversifiers, and safe havens during times of crisis. To manage differences in price levels, logarithmic returns are utilized as a standard measure in the analysis.

$$Rt = ln(Pt / Pt - 1) \times 100 \quad (1)$$

3.4. Cross-Quantilogram Approach

The Cross-Quantilogram (CQ) stands out as a unique estimation method employed in this study to scrutinize the multilayered dynamic relationships among crypto and conventional financial assets amidst various exogenous shocks. Proposed by Han et al. (2016), the application of this estimation method in our study is motivated by several compelling reasons. Where the CQ estimation method does not rely solely on any parametric assumptions, making it particularly suitable for analyzing data distributed with nonstandard frequency. This method has the potential to simultaneously forecast both the size and duration of the impact of regressors on regressed variables. For instance, in our study, the CQ approach discerns the effect of crypto assets on all other conventional financial assets, providing clear insights into the magnitude and duration of these effects across different time horizons. Moreover, the CQ estimation technique is adept at assessing multilevel segments of the sample distribution, including normal central portions, as well as extreme lower and higher observations. Its ability to handle fat-tailed distributed data is particularly noteworthy, owing to its application of the quantile matching property, which does not necessitate moment conditions among the data of the underlying assets.

Furthermore, the CQ estimation method facilitates the forecasting of multiple time horizons, enabling the assessment of connectedness among underlying variables over both short and long periods. By considering multiple lags, the CQ approach evaluates the transmission of volatility spillovers within multi-level memory, encompassing daily, weekly, monthly, and semiannual timeframes, while also specifying the extent and direction (sign) of the coefficients.

In Equation (2), the CQ is derived between the employed vectors of specific assets, denoted as Y and Z, subject to conditions such as $Yt \leq q^1 t(\tau)$, similarly $Zt-k \leq q^2 t\text{-}k(\tau 2)$, where Y and Z represent regressors and regressed variables, respectively, and K denotes the length of the lag for the pair τ^1,and τ^2:

$$\rho\tau\ (k) = \frac{As[\psi\tau^1\left\{Y^{1t} \leq q^{1t}\left(\tau^1\right)\tau^1\right\}Y^{1t} \leq q^{1t}\ \psi\tau^2\ \{Y^{2t} - k \leq q^{1t} - k\left(\tau^2\right)\}]}{\sqrt{As\left[\psi\tau^1\left\{Y^{1t} \leq q^{1t}\left(\tau^1\right)\tau^1\right\}\right]}\sqrt{As\left[\psi\tau^2\ \{Y^{2t} - k \leq q^{1t} - k\left(\tau^2\right)\}\right]}} \quad (2)$$

In Equation (2), where Y^{1t} and Y^{2t} represent the stationary time series observations, "*i*" denotes the periods such as 1, 2, 3, or 4, and "*t*" represents the time (t=1,2,…, distributed with the density function for the relevant quantile function pair τ^1, and τ^2 both belonging to $\in(0,1)\in(0,1)$. The quantile hit for τ^1,and τ^2, denoted as ψ, is represented with similar econometric notations.

3.5. Time-Varying Parameter (TVP) Vector Autoregression (VAR)

This study employs the dynamic time-varying parameter (TVP) vector autoregression (VAR) technique proposed by Antonakakis et al. (2020). TVP-VAR estimation has potential to forecasting the magnitude and volatility of the underlying assets where this approach has advantageous due to its ability to utilize a Kalman filter to adjust variance for estimating stochastic volatility and forgetting factors (Gainetdinova et al., 2024). TVP-VAR selects random parameter sizes for the rolling window, enabling the use of data with short intervals and lower frequency, as in our case of daily data spanning 6 years of crisis periods.

$$\rho\tau\ (\mathrm{k}) = \sum_{i=1}^{p} X_{it} W_{t-i} + \varepsilon_t = \sum_{i=0}^{\infty} a_{jt} + \varepsilon_{t-j} \quad (3)$$

In Equation (3), where *XitXit* and *Wt-iWt-i* represent the magnitude of the pair of assets with respect to time-varying parameters *ii*, and the specified periods as mentioned above.

3.6. Application of Hedging, Diversification, and Safe Haven Investment Strategies

This research delineates an empirical methodology aimed at identifying the most resilient assets amidst exogenous shocks such as fluctuations in crude oil prices. Following the estimation framework utilizing the cross-quantilogram (CQ) technique (as described above), insights are gleaned into the dynamic behavior of assets across various quantiles, capturing daily, weekly, monthly, and quarterly fluctuations. Here, this study proposes an estimation model that extends the analysis to explore investment

strategic properties, enabling investors, whether individual or corporate, to position themselves as diversification, hedging, and safe-haven instruments in response to changing market dynamics. For instance, whether the market trend is bullish, bearish, or normal, the findings of this study aid investors in making informed decisions regarding the buying, selling, or holding of their financial assets. To this end, the study employs the modern estimation methodology of wavelet-based quantile correlation (WQC) estimation.

3.7. Robustness of the Model

In addition to the robust existing estimation model of the cross-quantilogram (CQ) technique, this study performs a dual estimation of the results to confirm the findings with another robust estimation model, namely the wavelet-based quantile correlation (WQC) estimation model. This study investigates the hedging, diversification, and safe haven investment strategies of all the underlying assets, such as crypto assets and conventional financial assets, amidst heightened crude oil price volatility in the Russian market. WQC estimation offers several distinct potential advantages by providing a clear directional correlation between the returns of two underlying assets in bullish, bearish, and normal market conditions.

3.8. Wavelet Quantile Correlation (WQC)

This study employs a novel methodology of WQC proposed by Kumar and Padakandla (2022) to assess the diversification, hedging, and safe-haven properties of digital assets and conventional financial assets. To examine the dynamic interconnectedness between the underlying pairs of assets Li et al. (2021) defines Quantile Correlation (QC) as the correlation between two different sets of variables at different quantiles where (i) represents the indicator function. For $0 < \tau < 1$, the quantile covariance is defined as:

$$\mathrm{WQC}(d_j(\mathrm{Y}),\ d_j(\mathrm{X})) = \frac{q(\mathrm{cov})\tau\{d_j(\mathrm{Y}),\ d_j(\mathrm{X})\}}{\sqrt{VAR\ (\phi_\tau)\{d_j(\mathrm{Y}) - \mathrm{Q}d_j(\mathrm{XY})\ \mathrm{VAR}\{d_j(\mathrm{x})\}}} \quad (4)$$

In Eq—(4) the digital assets denoted by X and Y as in where the $Q\tau,X$ be the τth quantile of X and $Q\tau,\ Y(X)$ be the τth quantile of Y conditional upon X. $Q\tau,Y(X)$ is independent of X if and only if the random variables $I(Y–Q\tau,Y) > 0$ and X is independent.

4. THEORETICAL EMPIRICAL RESULTS AND DISCUSSION

4.1. Theoretical Contribution

Integrating digital assets alongside conventional ones across diverse market conditions with the principle of Markowitz's portfolio theory including exogenous shocks like crude oil price fluctuations. This study incorporates asset management via diversification, hedging, and safe-haven hypotheses for understanding investor responses bullish, bearish, or normal market scenarios. Emphasizing portfolio-based investment study advocates optimal allocation of crypto and conventional financial assets based on individual risk profiles. We formulate investment strategic analysis rooted in the causal relationships among the underlined assets including assessment of resilience to external shocks of oil price fluctuations. This research study offers practical policy implications for investment to mitigate risks and enhance returns in the Russian financial realm. These insights significantly contribute to a holistic theoretical framework encompassing diverse aspects of investment across different asset classes during oil price volatilities, fostering a broader understanding of portfolio-based investments.

4.2. Empirical Results

4.2.1. Summary statistics

Table 2 presents descriptive statistics of the variables. The findings indicate that Crypto assets exhibit the highest average return and notable risk, evident from their substantial standard deviation, consistent with previous research. Moreover, the analysis reveals that Crypto assets, alongside the MOEX Russia stock index and MOEX 10-year bond index, demonstrate left-skewed returns, while MOEX precious metals and USD/RUB exchange rates display right-skewed returns. Furthermore, Crypto assets stand out with the highest kurtosis value, suggesting a distribution deviating from the norm, and also showcase quantile disparities among the various assets under scrutiny.

4.2.2. Cross-quantilogram approach

This study presents an empirical model to systematically compare crypto assets with conventional counterparts, highlighting portfolio diversification, hedging, and safe-haven hypotheses across bullish, bearish, and normal market scenarios in line with MPT (1952). The experimental model identifies an optimal asset pairing characterized by higher returns and lower risk within the Russian financial landscape. Figure 2 illustrates the transmission of spillover effects from crypto assets to Russia's equity assets. Notably, with a short-term 1-day lag order, we observe a significant negative response of equity to crypto assets. However, the spillover from crypto equity assets diminishes during weekly, monthly, and quarterly periods. Intriguingly, a direct negative response of equity to crypto assets is evident across different quintiles, indicating a weakening quantile dependence between crypto and equity assets over time. Moreover, the negative response at short-term memory lengths (daily memory) loses significance in the long term (monthly and quarterly memory). Lastly, leveraging cross-quantile spillover estimation, crypto assets such as Bitcoin, Ethereum, Binance Coin, and Cardano emerge as viable hedging instruments for equity in the Russian financial market. The results are aligned with the findings of (Anna et al., 2024 and Ullah et al., 2024). Similarly, this study explores the dynamic interconnectedness between crypto assets and the Russian government bond, precious metals, and foreign currency exchange markets.

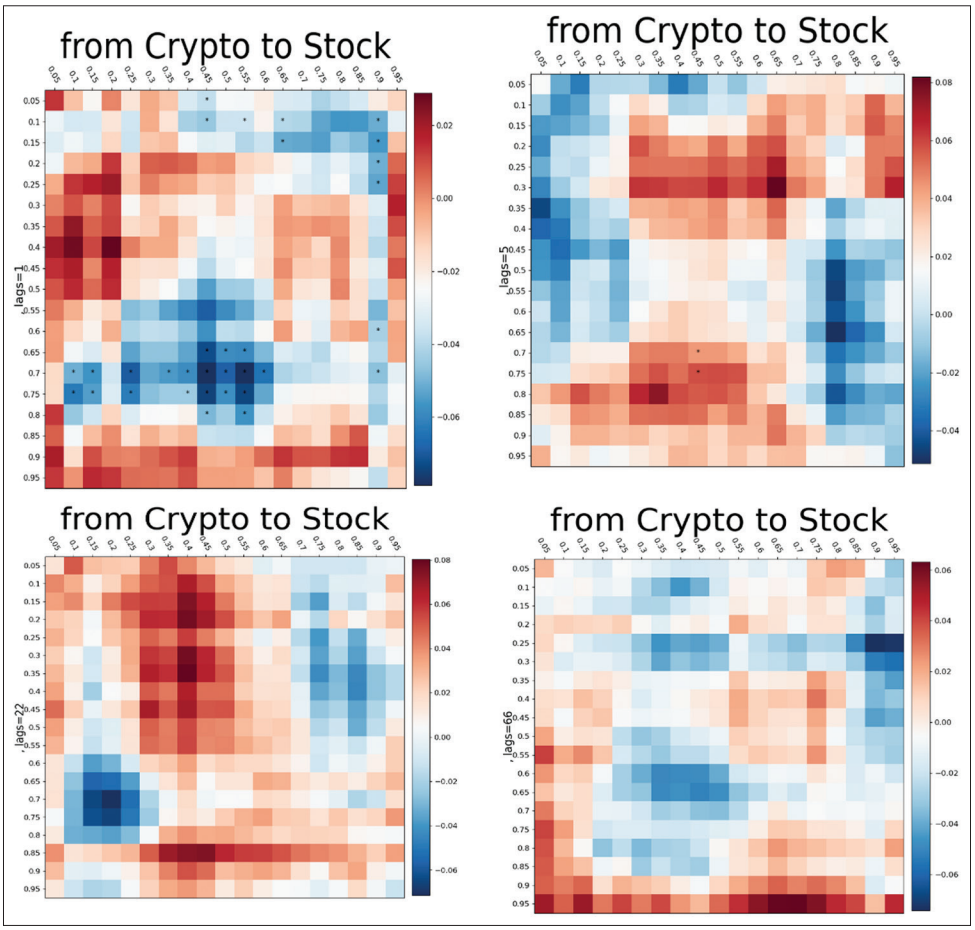
4.2.3. Assessment of resilience to oil price shocks

The assessment of exogenous shocks on crypto and conventional financial assets examined in Figure 3. The heat-map matrix in daily memory indicates the absence of a daily response from crypto assets to the oil price shocks due to the lack of significant cells. However, cross-quantile dependence reveals a negative effect transmitted from the OPS to the crypto assets at different quantiles in quarterly

Table 2: Summary statistics

	CRPT	EQT	BND	XRT	PMTL	OPS	EUI
Mean	−9.483	−0.252	−0.003	−0.017	−0.488	0	18.198
Variance	1456291.993	2318.188	0.064	1.674	228.067	0	53.776
Skewness	−0.725***	7.264***	−0.835***	−5.213***	0.061	−2.011***	1.125***
Ex-Kurtosis	23.857***	155.776***	428.930***	119.957***	6.058***	46.822***	0.787***
JB	33038.828***	1415589.747***	10640386.526***	838487.189***	2123.569***	127725.229***	328.520***
ERS	−13.437***	−14.611***	−18.624***	−8.276***	−17.969***	−15.392***	−2.044**
Q (10)	11.710**	21.433***	134.327***	147.491***	12.115**	35.563***	6144.689***
Q2 (10)	43.791***	58.953***	371.806***	494.918***	125.548***	338.089***	5992.976***

Figure 2: The Cross-Quantilogram from crypto assets to Russian equity assets



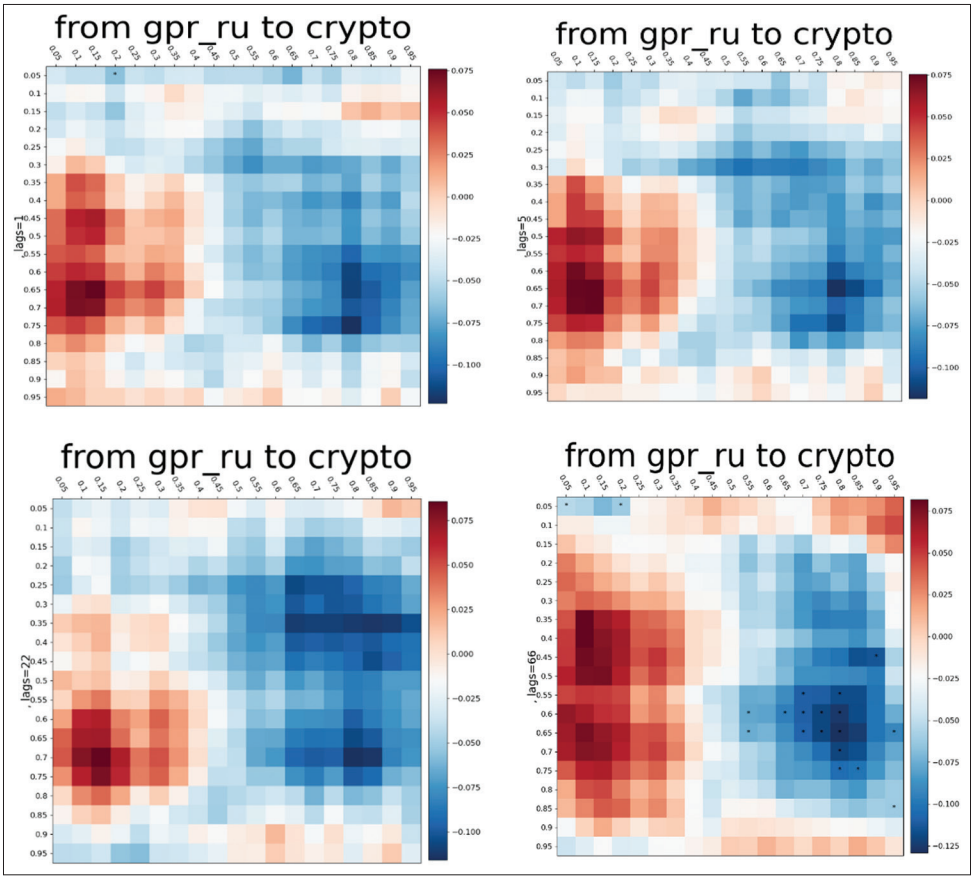
The horizontal axis represents the quantile distribution of the Russian Equity Assets, and the vertical axis corresponds to Crypto Assets. The color scale from blue to red indicates the direction of the reaction from a negative to a positive side effect.

memory. Interestingly, the negative spillovers persist in the lower right part of the heatmap matrix when we consider the number of lags equal to 66. These findings suggest that the increasing level of OPS has an impact on Russian financial market investors, prompting them to shift investments to a more stable market.

4.2.4. Wavelet quantile correlation

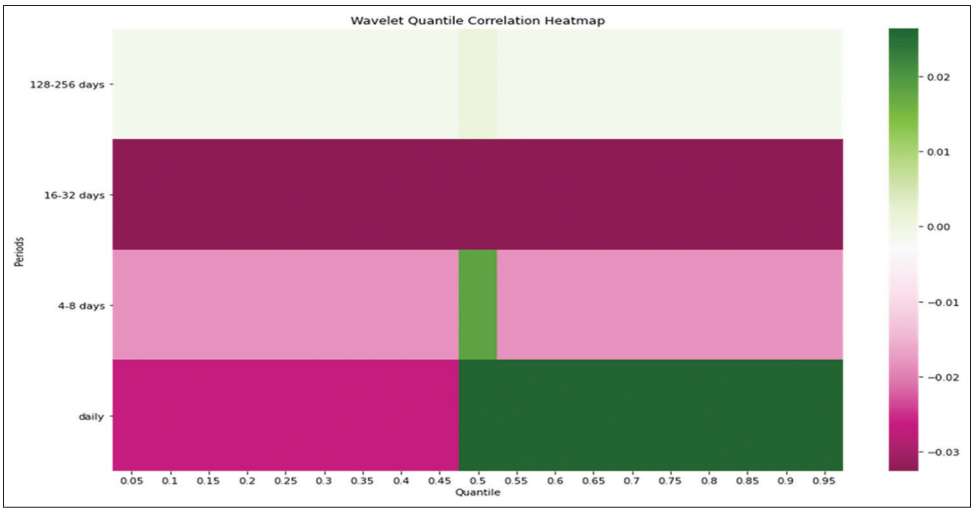
To assess the oil price shocks using wavelet transformation the Figure 4 visually represents the wavelet-based quantile correlation (WQC) between crypto assets and conventional financial assets. In daily trading memory the WQC shows a negative trend at lower to middle quantiles which suggests an investment position of hedging and safe-haven of crypto assets, while the assessment of diversification the WQC indicates potential positive nexus at the middle quantile. For crypto assets the QC is positive in the monthly trading cycle from the lower to middle quantiles indicating of ability of diversification of crypto assets during extreme OPS situation. WQC drifts close to zero across all quantiles in short-term (4–8 days weekly) and long term (128–256 days yearly) trading periods. As definition should ideally have a negative or no correlation with other assets during periods of market volatility at lower quantiles in the case of this study. Crypto assets have a negative association with EPU-Ru at daily intervals, suggesting safe-haven and hedging behavior in holding cryptocurrency. In weekly to monthly intervals, crypto assets and economic policy uncertainty in Russia exhibit a strong negative correlation, indicating the best hedging ability characteristics of crypto assets in the Russian financial market.

Figure 3: The Cross-quantilogram from OPS to crypto assets



The horizontal axis represents the quantile distribution of the OPS, and the vertical axis corresponds to Crypto Assets. The color scale from blue to red indicates the direction of the reaction from a negative to a positive side effect.

Figure 4: Wavelet-quantile correlation between crypto assets and oil price shocks of Russia



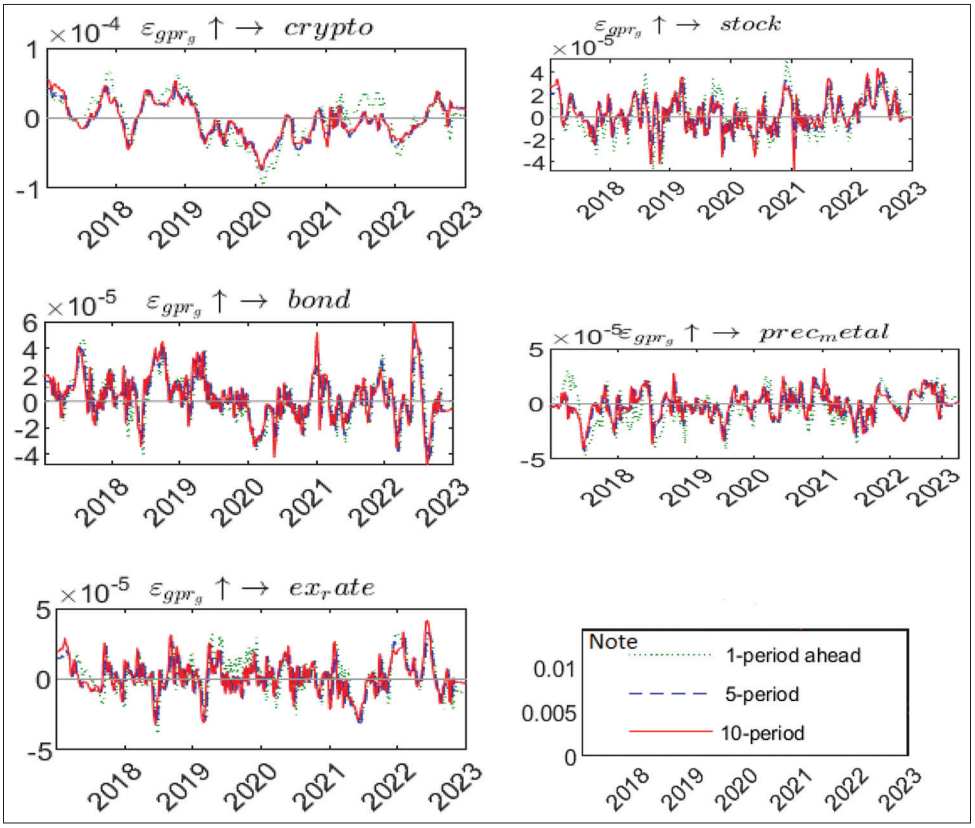
4.2.5. Time-varying parameter-vector autoregression (TVP-VAR)

Figure 5 demonstrates the time-varying impulse response functions that allow us to assess the response of underlying assets to OPS. For instance, we observe a strictly positive impulse response of crypto assets to OPS. In contrast, the response becomes negative over time, possibly indicating the onset of economic crises such as COVID-19 in the year 2020 and the ongoing conflict between Russia and Ukraine from the year 2023.

5. DISCUSSION ON THE RESULTS

Our full sample analysis confirms that crude oil price shocks (OPS) have a mixed effect on crypto assets such as Bitcoin, Ethereum, BNB, Cardano, along with conventional financial assets including equity index, bond index, precious metals, and foreign currency exchange during different time horizons. At the lowest quantile level of OPS, the Russian conventional financial assets, particularly the exchange rate RUB/USD, appreciated from

Figure 5: Impulse response functions of OPS on all other investable assets



The x-axis represents the time span from Jan 2018 to Dec 2023, where each year on the axis corresponds to the value of the indicator in March of the respective year. The dotted white line represents the daily impulse responses, the dashed blue line refers to weekly responses, and solid red line refers to 2-weeks responses.

extreme depreciation, whereas the crypto assets such as Bitcoin, Ethereum, BNB, Cardano, fell when the OPS reached a peak. Our findings are partly in line with Salisu et al. (2022), who find that when the market is bullish, OPS transmits positive spillover to volatility in the Russian exchange rate under a different exchange rate regime. At the bullish states of OPS, our finding corresponds to that of Wang et al. (2019), who find that the imposition of sanctions leads the country to extreme depreciation in the value of the currency (in the case of Russia, where 16000 sanctions were imposed) of sanctioned countries. In comparison, crypto assets such as Bitcoin, Ethereum, BNB, Cardano are not impacted by both the crises of COVID-19 and the Russian-Ukraine conflict. Findings of this study suggest that oil price shocks cause the return of conventional financial assets to fall to its lowest point after one day of the Russian-Ukraine conflict, while crypto assets such as Bitcoin, Ethereum, BNB, Cardano are least affected. However, the detrimental impact of OPS is offset after a quarter in both classes of assets.

We also find that, in general, the value of crypto assets and RUB against the US dollar rose because of Russian domestic economic policy, which includes bans on investment in crypto assets such as Bitcoin, Ethereum, BNB, Cardano, and the removal of Rub from crypto assets online trading platforms. This reflects anecdotal evidence of the results of the Russian government's implementation of macroeconomic policy to stabilize the exchange rate and control the overall price level of trading indexes. For example, an abrupt increase in interest rates by the RCB from 9% to 20% helped solve the liquidity problem which was potentially forecasted to increase demand for the RUB. Additionally, the RCB imposed restrictions on operations using foreign currency, particularly the trading of US dollars, imposed trade restrictions, and accepted only RUB in payment for purchases of energy and commodity products, which constitute a significant share of Russian exports. More importantly, the Russian government required converting a massive share of its revenue from commodity and oil sales into Russian local currency.

The findings from the time-frequency analysis of crypto assets such as Bitcoin, Ethereum, BNB, Cardano, along with conventional financial assets including equity index, bond index, precious metals, and foreign currency exchange during different time horizons and exogenous shocks show that OPS tends to be a net contributor to Russian financial market volatility, along with some effects from COVID-19. This finding is partly in line with that of Baumeister and Kilian and Zhou (2022) and Hamilton (2013), who find that substantial fluctuations in oil prices are driven by geopolitical events and the risk of natural disasters.

Our analysis of the cross-quantile results for crypto assets such as Bitcoin, Ethereum, BNB, Cardano, along with conventional financial assets including equity index, bond index, precious metals, and foreign currency exchange during different time horizons reveals that oil prices had a smaller impact on the exchange

rate. In particular, the increase in oil prices led to depreciation in the exchange rate RUB/USD under daily and weekly memory. However, we found a mixed effect in monthly memory, resulting in depreciation at lower quantiles and appreciation at higher quantiles. The findings from TVP-VAR estimation indicate that crypto assets along with conventional assets has connection different time horizons and spillover to equity and exchange rate due to the volatility transmitted by oil prices (OPS). Our analysis suggests that OPS and crypto assets play pivotal roles in portfolio management. By analyzing the Russia-Ukraine conflict, we discover that an increase in investment in crypto assets in the short run while in the long run, the impact on conventional financial assets including equity index, bond index, precious metals, and foreign currency exchange becomes negative and tends to increase over time. Investors and policymakers must adjust their positions for investment strategies based on the findings.

6. CONCLUSION

This research study presents a comprehensive theoretical and empirical framework for portfolio-based investment in the Russian financial market, considering regulatory and global risk factors arising from oil price fluctuations. For empirical validation this study employs several sophisticated econometric estimation methods to assess a range of assets including crypto such as Bitcoin, Ethereum, Binance Coin, and Cardano, alongside conventional financial assets such as equities, bonds, precious metals, and foreign currencies. The primary objective is to furnish guidelines for informed investment decisions in the Russian financial market, integrating both crypto and traditional assets into portfolio management strategies. Through an exhaustive literature review, this study establishes a robust theoretical foundation, emphasizing the pivotal role of crypto assets in portfolio optimization in the context of Russian financial landscape. The study empirically assesses the key assumptions of diversification, hedging, and safe-haven properties across various asset classes with particularly identification of optimal investment options that facilitate risk diversification, considering the interconnectedness between different assets to manage risk effectively in the Russian market. The study highlights the adverse effects of exogenous shocks of oil price volatility on crypto asset investment and stock trading. The study emphasizes the resilience of assets in the face of these challenges, underscoring the need for adaptive investment strategies.

The findings offer significant policy implications for managing investment risks and returns amidst uncertainty of oil price volatility. These insights can inform decision-making processes for investors, fund managers and policymakers, ensuring optimal risk-return profiles for portfolio-based investments under varying market conditions. Future research directions include expanding the geographical scope, examining technology-specific impacts, and addressing environmental and social considerations associated with crypto assets. This study contributes valuable insights into portfolio management strategies in the Russian financial market, offering a comprehensive framework for integrating crypto and traditional assets while navigating complex regulatory and geopolitical landscapes.

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