

Mapping the Crypto currency Landscape: A Conceptual Analysis of Research and Adoption

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Abstract

Crypto currencies have rapidly gained popularity and adoption over the past decade. This conceptual paper provides an extensive literature review on crypto currencies, examining their growth, risk interdependence, volatility dynamics, and impact on fiat currencies. The review synthesizes key findings on the evolution of the crypto currency landscape, the interconnectedness of major crypto currencies, their asymmetric volatility patterns across timescales, and evidence of crypto currency returns Granger causing fiat currency returns. The conceptual analysis highlights research gaps and future directions for understanding crypto currency markets, risks, and integration with the broader financial system.

Introduction

The past decade has witnessed a transformative disruption in finance and technology catalyzed by the advent of crypto currencies, notably spearheaded by Bit coin's inception in 2009. Functioning as digital payment assets, crypto currencies leverage cryptography and distributed ledger technology, such as block chain, to facilitate peer-to-peer decentralized financial transactions, eliminating the need for intermediaries. The crypto currency market, which originated with Bit coin, has expanded exponentially, boasting a staggering 6000 crypto currencies and tokens and amassing a total valuation surpassing \$3 trillion by late 2021, as indicated by CoinMarketCap data. This proliferation has not gone unnoticed, garnering substantial interest from academia, businesses, governments, and the wider public. A surge in global searches for "crypto currency" on Google Trends starting in 2016, surpassing previous peaks during price surges in 2017 and 2021, underscores the escalating prominence of these digital assets.

This heightened visibility is reflected in the substantial growth of scholarly research on crypto currencies across diverse disciplines, encompassing computer science, engineering, economics, finance, law, and management. A bibliometric analysis of Web of Science and Scopus articles reveals a significant acceleration in publications on crypto currencies post-2016, with the total number doubling from 2016-2017 and again by 2020. While initial literature predominantly concentrated on the foundational block chain technology, recent studies delve into applications in banking, financial markets, regulation, and macroeconomics. Notably, the recognition of crypto currencies' growing significance is further exemplified by the establishment of new academic journals dedicated to the subject since 2016, including Ledger, Journal of Crypto currency, and Block chain: Research and Applications. Additionally, conferences such as Consensus, CryptoFin, and IEEE Blockchain

have achieved mass scale, complemented by the inauguration of university research centres at prestigious institutions like MIT and Stanford.

Beyond the measurable outputs of research, the real-world adoption of crypto currencies has witnessed a sharp ascent among consumers, investors, corporations, and financial institutions. A study from 2017 estimated that there were 5 million identity-verified global crypto currency users, based on downloads of major wallet apps such as Block chain and Coinbase, with projections indicating this figure could reach 200 million worldwide users by 2024. The total crypto currency market capitalization has experienced remarkable growth, surging over 20 times from under \$600 billion in early 2021 to surpassing \$3 trillion in November 2021, constituting 3% of global financial assets. Surveys indicate that up to one-third of populations in developed economies are now involved in owning or trading crypto currencies. Major Wall Street banks, including Goldman Sachs, Morgan Stanley, and BNY Mellon, have ventured into the crypto currency space, providing services to clients amid increasing asset allocations. Moreover, payment firms such as Visa and PayPal facilitate crypto currency transactions on their networks as adoption continues to spread.

The swift and extensive proliferation of crypto currencies in finance and technology over the past decade represents a watershed moment for scholarship and policy across disciplines. As crypto currencies transition from a niche innovation to a mainstream asset class and payment medium, there is an urgent need to develop comprehensive cross-disciplinary knowledge regarding their risks, governance, and societal impacts. This conceptual review aims to synthesize current empirical findings and explore frontiers in crypto currency research, with the goal of informing various stakeholders, from investors to regulators to computer scientists, as the adoption of crypto currencies continues its acceleration into the 2020s.

Review of Literature

Growth of Crypto currency Research and Adoption

The landscape of crypto currency research and adoption has experienced an exponential surge in the past decade, marked by the inception of Bit coin in 2009. Bibliometric analyses illuminating publishing trends underscore a notable expansion in interdisciplinary scholarship, with fields such as computer science, economics, finance, and law recognizing the profound significance of crypto currencies. A comprehensive study examining 771 articles from Web of Science and 648 from Scopus on crypto currencies identified a substantial increase in publications, particularly from 2017 onward. The early literature predominantly focused on the foundational block chain technology, while by 2019, crypto currency research had diversified, delving into applications spanning finance, regulation, monetary policy, technology, and macroeconomics. This evolution is evident in the proliferation of academic journals, conferences, and dedicated research centers specifically focusing on crypto currencies and block chain, signaling a growing acknowledgment of their legitimacy within academic spheres.

The momentum observed in academia mirrors the rapid real-world adoption of crypto currencies. Industry analyses meticulously track the ascent in active crypto currency wallets, transaction volumes, and the user base of wallet applications. In 2017, approximately 5 million identity-verified crypto currency users were estimated globally, a number projected to surge to 200 million by 2024 based on major wallet app downloads. The total market value of crypto currencies experienced a remarkable surge, escalating from nearly \$600 billion in early 2021 to surpassing \$3 trillion by late 2021, capturing widespread attention in both media and investment circles. A significant manifestation of this trend is reflected in the participation of American adults, with approximately 16% reported to have personally invested in crypto currencies. Surveys further indicate that up to a third of populations in developed economies engaged in crypto currency ownership or trading in 2021, underscoring the widespread embrace of these digital assets.

The enthusiasm surrounding crypto currencies has extended to central banks, prompting initiatives in research and pilot programs exploring potential digital currency projects. This strategic response is aimed at keeping pace with the evolving landscape of crypto currency technology. The confluence of burgeoning academic research and the burgeoning adoption of crypto currencies in real-world scenarios illustrates a transformative journey, evolving from an obscure novelty to a prominent player in mainstream finance. The multifaceted growth in both scholarly exploration and practical application underscores the dynamic and increasingly pervasive role that crypto currencies play in shaping the contours of the global financial landscape.

Risk Interdependence of Major Crypto currencies

As crypto currencies gain wider acceptance, it becomes crucial to understand the transmission of risk and interconnectedness among the myriad crypto-assets. Researchers have applied econometric and network modeling to gauge interdependence, revealing a more significant degree of connectivity within the realm of crypto currencies compared to traditional markets. GARCH-based tail risk models have exposed volatility clustering and contagion risks among 12 major crypto currencies, surpassing long-run averages, with the onset of the COVID-19 pandemic further magnifying these intricate interlinkages. Granger causality tests consistently pinpoint Bit coin as the most influential crypto currency, exerting a unidirectional influence on the volatility of alternative "altcoins," particularly during periods of market stress. However, it is crucial to acknowledge the persistence of idiosyncratic risks, with crypto-assets demonstrating lower joint tail probabilities in conjunction with bonds and stocks.

An exploration into the levels of co-movement and risk spillovers unveils distinctions among various crypto currency subgroups. Platform tokens, exemplified by Ethereum, closely mirror Bit coin prices due to their interconnected block chains. On the other hand, emerging sectors like decentralized finance and non-fungible tokens carve out distinct risk profiles within the

crypto currency ecosystem. Notably, volatility connectedness appears most pronounced among proof-of-work mineable crypto currencies and assets characterized by larger liquidity and valuations. This intricate differentiation underscores the multifaceted nature of risk dynamics within the crypto currency space, necessitating regulators to grapple with the intricate task of monitoring both overarching interconnections and the evolving relationships within specific sectors as the market undergoes fragmentation.

Crucially, evidence suggests that tail dependencies among crypto currencies strengthen in the aftermath of adverse shocks, delineating key channels for the amplification of volatility during crypto currency selloffs. This observation aligns with established principles in traditional finance, emphasizing the importance of mapping the topological structure of risk interactions and vulnerabilities within the crypto currency ecosystem. Such insights are instrumental in aiding market participants and regulatory bodies in effectively managing exposures to mitigate potential systemic risks.

In conclusion, the evolving nature of crypto currencies demands a thorough understanding of the intricate web of risk transmission and interconnectedness that characterizes this growing market. Researchers leveraging sophisticated modeling techniques have shed light on the heightened connectivity within crypto currencies, accentuated during periods of market stress. The differentiation in risk profiles among crypto currency subgroups further complicates the regulatory landscape, requiring a nuanced approach to monitoring both overarching interconnections and sector-specific dynamics. As the crypto currency market continues to evolve, an astute comprehension of risk interactions is indispensable for navigating the complexities and ensuring the resilience of the broader financial ecosystem.

Asymmetric Volatility Dynamics of Crypto currencies

As crypto currencies continue to be marked by their high speculation, researchers are delving into their unique volatility dynamics, aiming to compare them with conventional assets. Employing advanced econometric analyses, scholars have uncovered a heightened level of time series complexity characterizing the volatility of major crypto currencies across various time scales—from daily to intraday. In a departure from stocks and traditional currencies, crypto currencies display volatility asymmetry, often referred to as "gain/loss asymmetry." This entails a scenario where the response to negative shocks results in larger and more persistent volatility compared to positive price movements. Quantitatively, the volatility of crypto currencies exhibits long memory and fractal persistence properties, a departure from the assumptions underpinning standard financial models. Structural break tests have further identified regime changes in the volatility processes of crypto currencies, coinciding with significant events such as exchange hacks, regulatory restrictions, and technological upgrades.

These empirical techniques shed light on the fact that the volatility patterns of crypto currencies violate typical stylized facts and Efficient Market Hypotheses, challenging established norms in financial modeling. For instance, the application of generalized autoregressive score (GAS) models has revealed long volatility tail dependencies for leading crypto currencies like Bit coin and Ethereum, exceeding 20 days—distinctly different from the less than 5-day persistence observed in stocks. Multifractal analysis has additionally suggested that crypto currencies exhibit "rougher" volatility on smaller time scales, featuring fat tails that common models like GARCH and FIGARCH fail to capture adequately. In a broader context, copula simulations have unveiled time-varying volatility co-movements between crypto currencies and stocks, dependent on different market phases.

Collectively, these findings underscore the importance of adopting more sophisticated volatility models, such as regime-switching copulas, fractal processes, and memory-accounting algorithms. Such models prove crucial for characterizing crypto currencies based on their microstructure and behavioral drivers, as they deviate substantially from traditional asset classes. As researchers expand their analyses to encompass newer crypto currencies and higher-frequency data, the development of an accurate volatility typology for these assets across various time horizons becomes paramount. This evolving understanding of crypto currency volatility not only challenges established financial theories but also emphasizes the necessity of adapting modeling approaches to capture the intricate dynamics of this emerging asset class.

Impact of Crypto currencies on Fiat Currencies

As crypto currencies gain increasing financial relevance, a pivotal area of research explores their potential impact on mainstream monetary systems. Theoretical models posit that widespread adoption of crypto currencies could pose challenges to central banks, currency stability, and traditional financial intermediation. However, empirical analyses examining actual spill over effects onto fiat currencies and monetary policies are relatively scarce to date. Initial research employs time series estimation to evaluate predictive relationships between crypto currency and national currency markets.

Granger causality studies, conducted on daily data, reveal significant one-way influence, indicating that Bit coin returns can predict movements in the Israeli Shekel, but not the other way around. Cross-country panel models also demonstrate that increases in aggregated crypto currency trading volumes tend to precede declines in fiat currency values. Notably, these dependencies are observed primarily in crypto currencies with sufficient liquidity and value, such as Bit coin. Crypto-assets with thinner trading volumes may not exert material influence on currency and money markets at present. Major central banks, including the Federal Reserve and the Bank of England, report limited observable impacts of crypto currencies on inflation and employment thus far.

As crypto currencies increasingly encroach into the realms of banking and payments, there is a growing need to monitor potential repercussions for monetary policy. Advanced econometric frameworks, such as time-varying parameter VARs, non-linear DSGE models incorporating crypto-assets, and machine learning for high-dimensional policy analysis, can provide deeper insights into the effects of crypto currency adoption. Coupled with surveys assessing the potential substitution of crypto currencies for fiat currencies, these empirical assessments can identify transmission channels and tipping points for policy priorities. Furthermore, evaluating cross-border effects and currency competition arising from major central bank digital currency projects merits careful consideration. While the macro-financial impact of crypto currencies remains limited at present, the development of forward-looking analytical tools and indicators is vital for policymakers to navigate potential future challenges and opportunities in the evolving landscape of digital assets.

Research Limitations and Future Directions

The evolving literature on crypto currencies has yielded valuable insights, yet it grapples with limitations in data, models, and policy integration, necessitating further advancement. Predominantly, existing studies concentrate on major crypto currencies, often neglecting the dynamics across the broader crypto-asset universe. While research has primarily focused on price spillovers, it has overlooked the exploration of arbitrage mechanisms that facilitate interdependence within the crypto ecosystem. Moreover, volatility analyses have predominantly utilized daily or lower frequency data, a potential limitation given the ultrafast nature of crypto currencies. Existing models frequently assume normality, efficiency, and static correlations, aspects that conflict with the empirically demonstrated complexity of crypto currencies. Lastly, integration with monetary policy and microfinance relies on reduced-form models that may not capture the intricate institutional realities at play.

To advance crypto currency research and bridge these gaps, there is a need for methodological innovation and a broader consideration of real-world linkages. Access to detailed data from decentralized exchanges at tick resolution becomes imperative to capture inherent volatility and arbitrage behaviours often missed in daily aggregates. Causal models, such as VAR-GARCH networks, are better suited to uncover the structural dependencies that drive spillovers in the crypto currency market. Multiscale volatility modelling, incorporating fractals and heterogeneous auto regression, becomes essential to understand the time-varying dynamics inherent in crypto currencies. The inclusion of agent-based simulations and stress testing, coupled with behavioural modelling, can shed light on the influence of investor coordination and market dynamics. Collaboration with computer science experts to explore security risks and engagement with central banks on policy scenarios will further enhance the practical relevance of crypto currency research.

As crypto currencies continue to assume a greater role in both finance and technology, pursuing these research frontiers becomes crucial. The complexities and nuances within the crypto-asset universe demand sophisticated methodologies and a holistic understanding that

transcends the limitations seen in current literature. By addressing these challenges head-on, researchers can provide essential knowledge that contributes to a more comprehensive comprehension of crypto currencies' impact on financial systems, paving the way for informed policy decisions and a deeper understanding of the evolving landscape.

Conclusion

This comprehensive review synthesizes the current state of interdisciplinary crypto currency research, providing invaluable baseline insights while identifying areas that require further exploration as adoption continues to progress. The findings across various studies indicate a notable surge in both scholarly contributions and crypto currency usage, underscoring the increasing significance of this digital asset class. Moreover, the research reveals a level of interconnectivity among crypto currencies that surpasses linkages observed with traditional assets. Notably, analyses spotlight distinct characteristics of crypto currency volatility, including asymmetry, long memory, and structural changes, challenging the applicability of standard financial models in this evolving landscape. While some prominent currencies like Bit coin exhibit directional influence on specific fiat exchange rates, the macro-financial effects of crypto currencies remain relatively limited as of now.

As the field of crypto currency research advances, there is a growing recognition of the need for innovative approaches and methodologies to gain a more comprehensive and practically relevant understanding of these digital assets at the frontier of finance and technology. Innovations in high-resolution data analytics offer the potential to uncover intricate patterns and behaviours within the crypto currency ecosystem, providing researchers with a more nuanced view of market dynamics. Causal modelling and fractal analysis are emerging as crucial tools to explore the complex relationships and structural dependencies inherent in crypto currency markets, offering a more accurate representation than traditional financial models. Furthermore, the inclusion of behavioural simulations allows researchers to delve into the psychological aspects influencing market participants, shedding light on the dynamics of investor behaviour and decision-making processes.

Collaboration across disciplines and with practitioners in the field is becoming increasingly vital. By bringing together insights from computer science, economics, finance, and other relevant fields, researchers can develop a more holistic understanding of the multifaceted nature of crypto currencies. The evolving landscape of crypto currency adoption necessitates a forward-looking approach, and researchers are poised to leverage these interdisciplinary collaborations to tackle emerging challenges and opportunities.

The ongoing advancements in crypto currency research not only contribute to academic knowledge but also have practical implications for policymakers, market participants, and technology developers. The synthesis of insights from diverse studies forms the foundation for a more informed and nuanced perspective on the role of crypto currencies in the broader financial ecosystem. As the adoption of crypto currencies continues to evolve, researchers

stand at the forefront, equipped with the tools and methodologies to navigate the complexities of this dynamic and transformative landscape.

References

Baur, D.G., Hong, K., Lee, A.D. (2018). Bitcoin: Medium of exchange or speculative assets? *Journal of International Financial Markets, Institutions and Money*, 54, 177-189.

Bouri, E., Gupta, R., Tiwari, A.K., Roubaud, D. (2017). Does Bitcoin hedge global uncertainty? Evidence from wavelet-based quantile-in-quantile regressions. *Finance Research Letters*, 23, 87-95.

Caporale, G. M., Gil-Alana, L., & Plastun, A. (2021). Persistence in the cryptocurrency market. *Research in International Business and Finance*, 56, 101312.

Chuen, D. L. K., Guo, L., & Wang, Y. (2017). Cryptocurrency: A new investment opportunity? In *Handbook of Blockchain, Digital Finance, and Inclusion* (Vol. 2, pp. 145-165). Academic Press.

CoinMarketCap (2021). Today's Cryptocurrency Prices by Market Cap. <https://coinmarketcap.com/>

Corbet, S., Lucey, B., & Yarovaya, L. (2019). Datestamping the Bitcoin and Ethereum bubbles. *Finance Research Letters*, 26, 81-88.

Demir, E., Gozgor, G., Lau, C. K., & Vigne, S. A. (2018). Does economic policy uncertainty predict the Bitcoin returns? An empirical investigation. *Finance Research Letters*, 26, 145-149.

Dyhrberg, A.H. (2016). Bitcoin, gold and the dollar – A GARCH volatility analysis. *Finance Research Letters*, 16, 85-92.

Fry, J., Cheah, E.T. (2016). Negative bubbles and shocks in cryptocurrency markets. *International Review of Financial Analysis*, 47, 343-352.

García-Corral, F. J., Cordero-García, J. A., de Pablo-Valenciano, J., & Uribe-Toril, J. (2021). A bibliometric review of crypto currencies: How have they grown?. *Financial Innovation*, 8(1), 1-28.

Gkillas, K., Longin, F. (2018). An application of extreme value theory to crypto currencies. *Economics Letters*, 164, 38-41.

Jiang, Y., Nie, H., Ruan, W. (2018). Time-varying long-term memory in Bitcoin market liquidity. *Finance Research Letters*, 26, 280-284.

Kristoufek, L. (2015). What are the main drivers of the Bitcoin price? Evidence from wavelet coherence analysis. *PLoS ONE*, 10(4), e0123923.

Kumar, M., & Arora, R. (2021). Time varying extreme dependency between cryptocurrency and stock markets: A copula-GARCH-EVT approach. *Physica A: Statistical Mechanics and its Applications*, 565, 125592.

Lee, J.C., Hsiao, Y.C., Yang, S.Y. (2021). The nexus between cryptocurrency and stock market — New evidence from quantile causality-in-variance tests. *Economic Modelling*, 98, 66-78.

Phillip, A., Chan, J.S.K., Peiris, S. (2018). A new look at Crypto currencies. *Economics Letters*, 163, 6-9.

Stosic, D., Stosic, D., Ludermir, T., Stosic, T., & Stosic, T. (2018). Collective behavior of cryptocurrency price changes. *Physica A: Statistical Mechanics and its Applications*, 507, 499-509.

Urquhart, A. (2016). The inefficiency of Bitcoin. *Economics Letters*, 148, 80-82.