Gaidar Institute for Economic Policy

Kirill Dm. Shilov

CRYPTOCURRENCIES AS FINANCIAL ASSETS: FUNCTIONS, MARKET STRUCTURE AND RETURN FACTORS

Specialty 5.2.4. «Finance»

Abstract of the Dissertation

for the degree of

Candidate of Economic Sciences

Scientific Supervisor:

Candidate of Economic Sciences,

Andrey V. Zubarev

Moscow – 2026

Relevance of the study. Cryptocurrencies represent a relatively new and notable phenomenon of the twenty-first century. Emerging in 2009 as an experimental project developed by a rather narrow group of IT specialists, Bitcoin became the starting point for the formation of an entirely new class of financial assets. Over the past fourteen years, the cryptocurrency market has evolved substantially. Despite persistent skepticism expressed toward cryptocurrencies by a broad range of economists, financial professionals, investors, and financial regulators across different countries, as well as their uncertain regulatory status in many jurisdictions, the market capitalization of cryptocurrencies in recent years has generally remained above USD 1 trillion (having approached approximately USD 3.7 trillion at its peak and around USD 0.8 trillion during downturns). These figures are broadly comparable with the capitalization of other asset markets. For comparison, the global equity market capitalization at the beginning of 2025 was approximately USD 125 trillion, of which about 50% (USD 63 trillion) accounted for the U.S. equity market; the capitalization of the gold market was estimated at USD 17.9 trillion, while the Russian equity market amounted to roughly USD 0.56 trillion.

By 2025, a consensus had largely emerged within the fields of economics and finance that cryptocurrencies constitute a new type of financial asset. However, the precise mechanisms underlying their price formation remain the subject of ongoing debate. The unambiguous identification of these mechanisms is complicated by at least two factors.

First, the market for digital assets is undergoing continuous development, and both its characteristics and structural features differ substantially today from those observed even five years ago.

Second, when cryptocurrencies are discussed as a single asset class, their homogeneity is often implicitly assumed—that is, the notion that most cryptocurrencies are broadly similar in their underlying nature. In many discussions, Bitcoin occupies the central position, while other digital assets are frequently treated as analogous to it. Only relatively recently (around 2021–2022) has academic literature begun to demonstrate growing interest in other categories of cryptocurrencies, such as tokens associated with decentralized finance projects (DeFi) and non-fungible tokens (NFTs). Nevertheless, relatively limited attention has been devoted in the literature to the systematic categorization or classification of the wide variety of existing cryptocurrencies. In particular, such categorization is rarely approached not merely through technical characteristics—such as consensus mechanisms, cryptographic algorithms, or blockchain block sizes—but through the lens of economic and financial logic, as well as the specific functional roles performed by the digital currencies under consideration.

It is therefore reasonable to assume that the price formation mechanisms of cryptocurrencies performing different economic functions may also differ. Moreover, given that the digital asset market has passed through several stages of development, the return factors of these groups of cryptocurrencies may also vary over time. Identifying such factors would make it possible, first, to trace the evolution of

cryptocurrencies as a class of investment assets and, second, to assess their current position within the broader universe of financial instruments. In addition, an econometric analysis of return models for different categories of cryptocurrencies may help address another important question—whether the cryptocurrency market is inherently heterogeneous, or whether the dynamics of most cryptocurrencies are largely driven by overall market sentiment.

For a considerable period of time, academic discussions have also focused on the extent to which Bitcoin can perform the functions of money, whether it can be regarded as an analogue of "*digital gold*", and whether it possesses hedging properties against inflation and monetary expansion. In light of the launch of exchange-traded funds (ETFs) linked to Bitcoin and the establishment in the United States of a government cryptocurrency reserve, taking stock of this debate and reassessing the monetary properties attributed to Bitcoin appears particularly timely today.

Degree of development of the research topic. Despite the relative novelty of the subject under consideration, a substantial body of research on cryptocurrencies has already accumulated within the field of economics. Most of these studies are empirical in nature; however, a number of scholars have also addressed theoretical aspects of cryptocurrency price formation. Among them are M. Sockin, W. Xiong, D. Hans, G. Halaburda, B. Biais, C. Bisière, M. Bouvard, C. Casamatta, A. Menkveld, L. Cong, Y. Li, N. Wang, A. Hayes, J. Kroll, L. Kristoufek, Y. Ayaoagi, P. Hazlett, W. Luther, D. Adachi, S. Athey, E. Pagnotta, A. Buraschi, and others.

Among empirical contributions, a number of studies examine Bitcoin as a means of payment. These include works by F. Glaser, K. Zimmermann, D. Baur, K. Hong, A. Lee, K. Lückner, C. Reinhart, K. Rogoff, S. Foley, D. Karlsen, and T. Putniņš.

A considerable body of literature has also focused on the financial characteristics of cryptocurrencies. Research on the efficiency of cryptocurrency markets includes studies by N. A. Kyriazis, E. Mnif, A. Yarbi, A. Noda, W. Feng, Y. Wang, C. Zhang, A. Bariviera, A. Braunais, R. Mestel, L. Kristoufek, J. Chu, A. Urquhart, D. Vidal-Tomás, A. M. Ibáñez, J. Farinós, and K. Al-Yahyaee.

The relationship between cryptocurrency markets and traditional asset markets, as well as the identification of return factors for digital currencies, has been examined by A. H. Dyhrberg, D. G. Baur, T. Dimpfl, K. Kuck, T. Klein, T. H. Pham, T. Walther, S. J. H. Shahzad, D. Bianchi, E. Bouri, D. Roubaud, A. Braunais, L. Kristoufek, P. Ciaian, B. Lucey, A. Urquhart, H. Zhang, F. Bahloul, M. A. Naeem, M. Hasan, M. Arif, Y. Liu, A. Tsyvinski, J. Chu, S. Chan, H. Li, C. A. Wang, S. Nadarajah, Y. Osterreider, H. A. Aalborg, P. Molnár, J. E. de Vries, S. Corbet, L. Yarovaya, C. Larkin, A. Meegan, J. Goodell, S. Shanaev, F. Kjærland, and P. Wang.

The development of factor models for cryptocurrencies and the construction of investment portfolios incorporating digital assets have been studied by E. Bouri, B. Lucey, D. Roubaud, W. Liu, E. Platanakis, C. Sutcliffe, A. Urquhart, B. Schellinger, Y. Liu, A. Tsyvinski, S. Wu, D. Shen, P. Wang, S. Shanaev, L. W. Tsang, G. A. Károlyi, K. Tang, W. Zhao, V. Dobrynskaya, and M. Dubrovsky.

Research on the decentralized finance sector and the pricing of non-fungible tokens (NFTs) has been conducted by I. Makarov, A. Schoar, T. Xu, J. Xu, D. Metelski, J. Soberaj, N. Borri, Y. Liu, A. Tsyvinski, M. Dowling, I. Yousaf, R. Nehli, M. Gubareva, S. Karim, B. M. Lucey, M. A. Naeem, G. S. Uddin, J. Chu, S. Chan, and Y. Zhang.

Relatively few studies on cryptocurrencies—either empirical or theoretical—have been produced in the Russian academic literature. Among the authors who have published on this topic in leading economic and financial journals are E. Sinelnikova-Muryleva, M. Stolbov, V. Zyamalo v, V. Manevich, A. Peresetsky, P. Pogorelova, M. Malkina, V. Ovchinnikov, E. Fedorova, V. Bauer, V. Smirnov, A. Mikhailov, Y. Belousov, D. Kochergin, S. Andryushin, and A. Kuslyaikin.

Research objectives and tasks. The objective of this dissertation is to systematize cryptocurrencies according to their classes and the economic functions they perform, and to identify the return factors of cryptocurrencies.

To achieve this objective, the study addresses the following tasks:

1. to examine and classify existing cryptocurrencies according to their functional purpose (i.e., the economic functions they perform), considering the historical development of the digital asset market;

2. to analyze the monetary nature of cryptocurrencies and the extent to which they perform the functions of money;

3. to conduct a systematic review of theoretical and empirical academic literature devoted to cryptocurrencies as a new class of financial assets and to the factors determining their returns;

4. to formulate substantive hypotheses regarding the return factors of cryptocurrencies at the level of individual assets—specifically Bitcoin and Ethereum—as well as at the level of broader categories of cryptocurrencies;

5. to identify the return factors of Bitcoin and Ethereum through the estimation of econometric models;

6. to conduct an econometric estimation of return models for cryptocurrency portfolios constructed according to category membership and to identify common cryptocurrency market return factors;

7. to substantiate and qualitatively assess the structural changes that have occurred in the cryptocurrency market after 2018.

Object and subject of the research. The object of the study is cryptocurrencies as a new type of financial asset. The subject of the research comprises the economic functions of cryptocurrencies, the structure of the cryptocurrency market, and the return factors associated with these assets.

Field of research. The study corresponds to the following areas of the official research classification for academic specialty 5.2.4 *Finance* established by the Higher Attestation Commission of the Russian Federation: 6. «Non-bank financial institutions»; 7. «Valuation of financial assets. Financial portfolio management. Investment decisions in the financial sector»; 19. «Financial risks. Financial risk management»; 24. «Financial markets: typology, specific characteristics, and features of functioning. Regulation of financial markets»; 29. «The role and functions of money in the economic system»; 34. «New technologies in the financial sector and their impact on financial services markets. Digital financial technologies (fintech). Digital financial assets.».

Methodology and research methods. The study employs a range of analytical methods, including retrospective, systemic, comparative, and causal analysis, as well as generalization and classification. At the empirical level, statistical and econometric methods are applied, including correlation analysis, regression analysis, and time-series analysis, together with approaches for constructing aggregated market factors and cryptocurrency investment portfolios.

Information base of the study. The empirical data used in the dissertation were obtained from several data platforms that aggregate cryptocurrency prices and various metrics related to the use and functioning of blockchain networks, including CoinDesk, CoinGecko, Coin Metrics, CoinMarketCap, Etherscan, and DeFiLlama. Certain aggregated on-chain indicators were retrieved from the *crypto_ethereum* dataset available through Google BigQuery.

Price data for traditional financial assets were obtained from Yahoo Finance and Investing.com, while the risk-free rate was taken from the database of the Federal Reserve Bank of St. Louis (FRED).

Scientific novelty and main research results. The scientific novelty of the dissertation and its principal findings can be summarized as follows.

1. An original author-developed taxonomy (classification) of cryptocurrencies is proposed based on their essential characteristics and the economic functions they perform. The proposed classification encompasses the main currently relevant categories of cryptocurrencies, including payment cryptocurrencies, tokens of blockchain platforms, governance tokens of decentralized projects and communities, utility tokens, meme coins, and various derivative tokens. The development of this classification from a historical perspective also clearly reflects the evolutionary trajectory of the digital currency industry over the past sixteen years and highlights the highly dynamic nature of this field.

2. It is demonstrated that the thesis describing Bitcoin as "digital gold" is well substantiated. Through an analysis of the extent to which Bitcoin performs two core functions of money—namely a

medium of exchange and a store of value—it is shown that, in the perception of investors today, Bitcoin is closer in nature to gold than to fiat currencies, even though the cryptocurrency was initially conceived and perceived primarily as a form of "digital cash".

3. Underexplored areas in the academic literature on cryptocurrencies as financial assets are identified. In particular, the relatively limited prevalence of empirical analyses of cryptocurrency returns from the perspective of their fundamental differences and distinct economic functions is highlighted. The dissertation is directly aimed at addressing this gap in the scientific literature.

4. A quantitative assessment of the contribution of internal blockchain-related factors to the variation in returns of the leading cryptocurrencies—Bitcoin and Ethereum—is obtained. The results, based on the estimation of a large set of return model specifications using more than fifteen indicators for each cryptocurrency, indicate that internal factors possess relatively weak explanatory power in accounting for cryptocurrency return dynamics.

5. Cryptocurrency portfolios constructed according to category membership are introduced for the first time in the academic literature. Applying a multifactor asset pricing model for cryptoassets, built on the principles of the Capital Asset Pricing Model, to these category-based portfolios made it possible to estimate their exposure to cryptocurrency market risk and to evaluate the role of the size factor in explaining return variation. The successful empirical application of this crypto-CAPM framework demonstrates that traditional asset pricing methodologies can be adapted to a new asset class—cryptocurrencies—constituting a significant scientific and practical contribution of the study.

6. It is shown that cryptocurrency return dynamics are to a large extent driven by the overall return dynamics of the cryptocurrency market. For example, approximately 70% of the variation in returns of Ethereum is explained by market-wide movements, while for different categories of cryptocurrencies this value generally ranges between 48% and 93%. At the same time, categories that exhibit comparatively weaker connections to the overall market (approximately 22–28%) are identified—namely meme coins and decentralized finance (DeFi) tokens. This finding indicates the potential for intra-sector diversification within the cryptocurrency market and suggests the presence of category-specific factors affecting these assets.

7. Substantial structural changes in the cryptocurrency market following the 2017–2018 bubble are theoretically justified and empirically confirmed. It is shown that beginning in 2018 the previously highly fragmented cryptocurrency space evolved into a more integrated market characterized by internal segments and common risk factors. The analysis also demonstrates that after 2018 a statistically significant relationship emerged between the cryptocurrency market and the traditional equity market.

Statements submitted for defense:

1. The cryptocurrency market is continuously evolving, with new types of cryptocurrencies regularly emerging that differ substantially in their essential characteristics and economic functions. The developed taxonomy reflects the principal classes of digital currencies currently present in the market. The existence of fundamentally different groups of cryptocurrencies in terms of their economic nature implies the necessity of applying different approaches to modeling their price formation.

2. It is demonstrated that Bitcoin partially performs two functions of money—a medium of exchange and a store of value. As a medium of exchange, Bitcoin provides certain transactional advantages, although these advantages may vary geographically across countries and across different sectors of the economy. As a store of value, Bitcoin has in recent years strengthened its position as "digital gold." Consequently, Bitcoin currently occupies an intermediate position between fiat currencies and gold: in terms of convenience for payments it is significantly inferior to traditional money but superior to gold (particularly with respect to transfer and storage), while in terms of value preservation Bitcoin may be more reliable than unsecured fiat currencies, although it does not possess the centuries-long trust traditionally associated with gold.

3. The cryptocurrency market is continuously evolving, with new types of cryptocurrencies regularly emerging that differ substantially in their essential characteristics and economic functions. The proposed taxonomy reflects the principal classes of digital currencies currently present in the market. The existence of fundamentally different groups of cryptocurrencies in terms of their economic nature implies the necessity of applying different approaches to modeling their price formation.

4. It is demonstrated that Bitcoin partially performs two functions of money—a medium of exchange and a store of value. As a medium of exchange, Bitcoin provides certain transactional advantages, although these advantages may vary geographically across countries and across different sectors of the economy. As a store of value, Bitcoin has in recent years strengthened its position as "digital gold." Consequently, Bitcoin currently occupies an intermediate position between fiat currencies and gold: in terms of convenience for payments it is significantly inferior to traditional money but superior to gold (particularly with respect to transfer and storage), while in terms of value preservation Bitcoin may be more reliable than unsecured fiat currencies, although it does not possess the centuries-long trust traditionally associated with gold.

5. The returns of the leading cryptocurrencies—Bitcoin and Ethereum—are weakly explained by internal (fundamental) factors related to various blockchain metrics (such as transaction activity, the number of active addresses, mining difficulty, and others). This conclusion is based on the estimation of a large number of possible econometric model specifications using more than fifteen potential factors for each cryptocurrency. The results indicate that only about 15% of the variation in weekly returns of Bitcoin and between 2.9% and 9.4% of the variation in weekly returns of Ethereum can be explained by

their internal factors. At the same time, the composition of statistically significant factors differs between the two cryptocurrencies. For Bitcoin, indicators associated with the concentration of supply on "wealthy" addresses appear to be particularly important: an increase in the concentration of the cryptocurrency on such accounts is positively associated with changes in the price of Bitcoin, which may reflect the "digital gold" narrative. In contrast, for Ethereum, significant factors include the number of transactions and the volume of funds locked in DeFi protocols (TVL), highlighting its role as a blockchain platform for decentralized applications.

6. The effectiveness of applying a cryptocurrency asset pricing model based on the principles of the Capital Asset Pricing Model and the Fama–French three-factor model is demonstrated for analyzing the returns of cryptocurrency categories. All examined categories of cryptocurrencies exhibit some degree of exposure to systematic crypto-market risk. Given the relatively weak linkage between the cryptocurrency market and traditional financial markets, this risk is largely unique and specific to the cryptocurrency market itself. In addition to crypto-market risk, the size factor also plays a significant role in explaining cryptocurrency returns, although its influence is weaker than that typically observed in traditional financial markets.

7. The cryptocurrency market exhibits conditions conducive to cross-category (inter-sectoral) diversification. At least two categories of cryptocurrencies—DeFi tokens and meme coins—were identified whose returns are explained rather weakly by the CAPM-type model employed in the study (with the explained share of variation amounting to approximately 22–28%). This indicates a relatively high degree of idiosyncratic risk for these categories of cryptocurrencies. At the same time, their returns demonstrate limited correlation with the broader cryptocurrency market (as well as with traditional financial markets), which makes them potentially attractive from the perspective of portfolio diversification.

8. The cryptocurrency market is shown to have undergone substantial structural changes following the bursting of the 2017–2018 bubble. Beginning in 2018, the cryptoasset market became more interconnected and began to exhibit common market-wide return factors. In the earlier period (2014–2017), the cryptocurrency market was fragmented and weakly interconnected, whereas in the subsequent period of heightened interest (after 2018) it transformed into a fully-fledged class of financial assets. This transformation is evidenced by the emergence of a statistically significant common market factor across all cryptocurrency categories, as well as a significant size factor that had not been present in the earlier stage. Consequently, the contemporary cryptocurrency market differs qualitatively from its pre-2018 state, which should be taken into account in its analysis and statistical modeling.

Theoretical significance of the research. The theoretical significance of the study lies primarily in advancing the understanding of cryptocurrencies as a heterogeneous class of financial assets,

consisting of different categories that perform fundamentally different economic functions. The cryptocurrency taxonomy developed on this basis provides a new analytical framework for examining digital currencies not merely as a homogeneous phenomenon but with explicit consideration of their functional heterogeneity. This framework can be applied in the development of asset pricing models for digital currencies.

Another important contribution is the analysis of the extent to which Bitcoin performs the functions of a medium of exchange and a store of value, which contributes to further development of approaches for assessing its valuation and its role in investment portfolios.

In addition, the study demonstrates for the first time the dynamic nature and temporal evolution of cryptocurrency return factors. The existence of different stages in the development of the cryptocurrency market is substantiated—an early stage of formation and a later stage following the 2017–2018 bubble—each characterized by distinct patterns of price behavior and risk factors. This conclusion is important for financial market theory, as it highlights the necessity of accounting for temporal context when analyzing emerging asset classes: factors and relationships are not static but evolve alongside market growth, regulatory changes, and technological progress. This finding contributes to the broader theoretical understanding of how new asset classes develop over time.

Practical significance of the research. The results of the study have practical relevance for academic researchers, professional market participants, investors, and regulators.

Econometric analysis conducted on subsamples reveals substantial structural changes in the cryptocurrency market. Based on these findings, a practical recommendation can be formulated: when conducting econometric modeling, developing risk-management systems, or performing backtests of investment strategies, it is advisable not to rely on the entire available price history of cryptocurrencies but to restrict the sample at least to the period beginning in 2018.

The identified differences between categories of cryptocurrencies in terms of their exposure to cryptocurrency market risk also have practical implications for portfolio construction. The results indicate that diversification within the cryptocurrency market may reduce portfolio risk: certain categories—such as DeFi tokens and meme coins—exhibit relatively weak correlation with overall market dynamics, meaning that their inclusion in cryptocurrency portfolios may improve risk–return characteristics. At the same time, these findings also indicate a higher degree of idiosyncratic risk in these categories, which requires careful analysis.

There are also categories of cryptocurrencies that display stronger correlations with the market—such as tokens associated with gaming and NFT projects, as well as privacy-focused cryptocurrencies—but exhibit lower sensitivity to crypto-market risk (with beta coefficients below one) while showing

sensitivity to the size factor. These results are relevant for the development of factor-based investment approaches in cryptocurrency markets.

The findings also have implications for regulatory policy in the field of cryptocurrencies, as they provide empirical justification for the heterogeneity of this asset space. This may serve as a basis for designing more differentiated and risk-oriented regulatory approaches.

Finally, the results have practical value for educational and outreach activities. The proposed cryptocurrency classification, the analysis of the monetary characteristics of Bitcoin, and the empirical models developed in the study can be used in the design of academic courses and educational programs in finance, economics, and financial technology.

Approbation and implementation of the research results. The main provisions of the dissertation were presented and received positive evaluations at several international and Russian academic conferences. The approbation and implementation of the research results are documented by relevant materials, including conference programs and records of the defense of research projects conducted within the framework of state-funded research assignments.

Reliability of the research results. The reliability of the results submitted for defense is supported by the correct application of contemporary quantitative methods of factor and regression analysis, the representativeness and high quality of the empirical data used in the study, and the consistency of the obtained conclusions with current scientific understanding in the fields of economics and finance, including recent publications by Russian and international scholars studying cryptocurrencies.

Publications. The main findings and conclusions of the study are reflected in five publications by the author with a total volume of five printed sheets (author's contribution: five printed sheets). All five articles were published in peer-reviewed academic journals recommended for dissertation defense by the dissertation council of the Russian Presidential Academy of National Economy and Public Administration under the President of the Russian Federation (RANEPA) for specialty 5.2.4 «Finance». Among these publications, three articles are indexed in international citation databases (three in Scopus and one in Web of Science) and included in the list of journals approved by the Academic Council of the Academy. All five articles were published in journals classified as Category 1 (K1) by the Higher Attestation Commission (VAK) under the Ministry of Science and Higher Education of the Russian Federation.

Structure and volume of the dissertation. The dissertation consists of an introduction, three chapters, a conclusion, and a list of references. Chapter 1 examines the development of the cryptoasset market through the lens of cryptocurrency categorization based on their essential and economic characteristics. Chapter 2 provides a review of academic literature in finance and economics devoted to

cryptocurrencies. The first section of the review analyzes the extent to which Bitcoin performs the functions of a medium of exchange and a store of value; the second section focuses on theoretical approaches to modeling cryptocurrency price formation; and the third section reviews empirical studies of cryptocurrencies, with particular emphasis on research examining cryptocurrency return factors. The concluding section of Chapter 2 formulates the substantive hypotheses of the study. Chapter 3 presents econometric modeling of the returns of Bitcoin and Ethereum, as well as the construction of category-based portfolios and the estimation of factor models for their returns, which are used to test the proposed hypotheses.

The dissertation comprises 203 pages, including 23 figures, 36 tables, no appendices, and a bibliography containing 200 sources.