Aims & Scope (Economics)

Article

CRYPTOCURRENCY AND BLOCKCHAIN WITHIN DIGITAL TECHNOLOGY

Olga Chatchenko,
PhD in Economics,
State University of Telecommunications, Ukraine;
https://orcid.org/0000-003-0618-339X

Olena Rybak,
PhD in Economics, Associate Professor,
National Aviation University, Ukraine;
https://orcid.org/ 0000-0002-1576-7189

Peter Bago,
PhD, Assistant Professor,
Corvinus University of Budapest, Hungary
https://orcid.org/0000-0002-6929-8437

Received: 21 March 2023; Accepted: 25 March 2023; Published: 27 March 2023

Abstract. In the conditions of a steady surplus of up-to-date information, institutional and value-based tools for reducing the uncertainty of economic activity fade into the background, the paternity that progresses as a result of a combination of the short-term temporal paradigm, historically and institutionally inherent in the Western business traditions and becomes an important structural element, with the fundamental innovation of the information-network economy, the actual manifestation of which is the production of excess information and the creation of conditions for reproduction of uncertainty at the higher level. Cryptocurrencies emphasize the crisis of the banking institutions of financial intermediation as a result of the trust destruction as a natural result of the dominance of the financial component in the system of complementary interaction between financial intermediaries and subjects of the real economy sector, which in turn led to the crisis of financial intermediation and led to the desire of financial services consumers for operating activity without any mediation. Nowadays, the first cases of blockchain technology influence on the processes of reformatting the basic principles of human society development - information asymmetry and trust, which can testify to the depth of the modern transformation transition, are observed. An indirect development effect regarding information-network economy is the intensification of households` credit activity and the development of financial-oriented patterns of behavior , which indicate a prevailing focus on short-term prospects in economic and social activity, an increase in the value of self-interest over the interests of family and immediate surroundings, and a reduction in the impact of long-term hierarchical responsibility (in the generations context) on financial decision-making processes. A striking result of these patterns is an increase in household debt, which leads to a narrowing of economic freedom. Financial culture is gradually losing its role as a basic factor in the development of financial patterns of behavior, that in turn influences financial decision-making process, meanwhile the factors of economic and social conditions, banking marketing tools using client databases are updated.

Keywords: cryptocurrency, blockchain, information and network economy, financial intermediation, mining.

Citation: Olga Chatchenko, Olena Rybak, Peter Bago. (2023). CRYPTOCURRENCY AND BLOCKCHAIN WITHIN DIGITAL TECHNOLOGY. *Conferencii*, (5) 3. http://doi.org/10.51586/Conferencii_5_3_2023

Introduction

The last ten years in the world economic, financial and social spheres are undergoing systemic transformation processes. The financial and economic crisis has opened up to the world

those contradictions that have long been unnoticed and emerged only after the dramatic changes that took place in 2007-2008. Nowadays, it seems that political conflicts have reached a critical point, and unresolved social problems, moved to the global level, are showing more and more manifestations of ethnic, religious, and cultural character. The notions of instability and reality have become synonyms. Imbalances in the system of financial intermediation institutions have played the role of a catalyst for large-scale destabilization processes.

A historical retrospective proves that large-scale bifurcation trends are observed in times of global change. The era of instability showed its first manifestations in the late 1960s, when the post-war synergy effect of the reconstruction process began to disappear and a new basic factor of economic growth should emerge. As a result, globalization began to show its first signs. In the 1970s restructuring of the largest economies of the Western world began, resulting in the emergence of a new dominant economic unit - a global corporation, which influenced the approaches to the organization of production and social development. At the same time, an active innovation process began to produce revolutionary technologies that radically changed the international economic environment, turning it into a coherent whole unit.

As a result of these processes, the global economy has become global not only in terms of organization of production, consumption, liquidity circulation, resources and labor movement, it has become global from the point of view of subjects - not limited by borders, rules, institutions.

The purpose of this work is to reveal the socio-economic content and to develop the theoretical and methodological foundations and mechanisms for the transformation of financial intermediation institutions in the conditions of information-network economy formation.

Literature Review

Cryptocurrencies are electronic means of payment that are emitted through a special computer algorithm (Caporale, G. M., Gil-Alana, L., & Plastun, A., 2018). The mining process can be performed by any person by installing the appropriate software on their computer. In certain cases emissions are limited, the occurrence frequency of a new cryptocurrency unit is defined mathematically, no one can accelerate or slow it down.

Normal electronic money, which existed before cryptocurrencies, is a simple physical money deposited into an account (cash deposited through the bank's cash desk or payment terminal; or money deposited on payment cards) (Howell, S. T., Niessner, M., & Yermack, D., 2018). Cryptocurrency is a network currency that has no physical form that stimulates its appearance in the electronic payment system. The state or banking institution does not ensure its circulation and emission.

The money that has existed to these days is the product of an agreement between economic entities seeking cooperation and exchange, certified by the state and secured by financial institutions (ElBahrawy, A., Alessandretti, L., Kandler, A., Pastor-Satorras, R., & Baronchelli, A., 2017).

The active development of information technologies has led to changes in the conditions of exchange, it has become a network, ecosystem, and the structure providing it is too bulky, hierarchical (state + financial institutions = financial system), thus, it needs significant reformatting (Eyal, I., 2017). The emergence of cryptocurrencies has become an example of the creation of a new exchange security system that partially represents the current trends in economic development.

In a certain interpretation, the creation of cryptocurrency is a stage of evolution of monetary forms that corresponds to modern economic processes of "spreading networking" (Hayes, A. S., 2017). At the same time, the possibility of the emergence and provision of cryptocurrency circulation testifies to the profound transformations that have arisen with the advent of information and network technologies not only in economic activity but also in human life. Bitcoin was the first cryptocurrency.

According to the definition of the European Central Bank, bitcoin is unregulated digital money, which is a kind of virtual currency, but with certain particular features (Borri, N., (2019). This position is actively used by the World Bank's analysts (Liu, Y., & Tsyvinski, A., 2018). The main difference between bitcoin and other electronic money is that even before it is launched into

electronic circulation, it already takes the form of a legal, government-backed or supranational body (as in the case of the ECB) of a payment method. The ECB differentiates bitcoin from other virtual currencies that used to exist (Linden Dollar from Second Life or Digital Liberty Reserve) (Hileman, Garrick, and Michel Rauchs, 2017), because these virtual currencies have already had a centralized organization that audited transactions and controlled them.

The bitcoin system is the first decentralized payment system that is not controlled by the state or any other body, and even for some time was considered to be the most secure because of the overly complex algorithm underlying it. (Bouri, E., Shahzad, S. J. H., & Roubaud, D., 2019).

Research shows (Chuen, DLK, Guo, L., & Wang, Y., 2017) that cryptocurrencies are the result of the active development of e-commerce that required a payment method that would most easily connect sellers and buyers, moreover, which would be functionally equivalent to cash in the regular payment system (Yi, S., Xu, Z., & Wang, G. J., 2018) - to exclude a third party from the seller-buyer interaction that provided the calculation process (financial intermediary). This opportunity was realized in 2009.

Thus, Bitcoin developers have considered that having an intermediary in an e-commerce system is not only economically impractical because of significant transaction costs, but even unnecessary, because the problem of fraud can not be solved this way. Because of this, it was concluded that we need an electronic payment system based not on the trust, but on the cryptographic evidence. (Li, X., & Wang, C. A., 2017).

The solution to the double-spending problem was made possible by creating a peer-to-peer network in which all transactions are noted, therefore, information about them can no longer be changed and is also visible to all the system members (Cocco, L., Concas, G., & Marchesi, M., 2017). As soon as the first transaction signal is executed, the rest is rejected, so the same bitcoins cannot be used for two transactions - this solves the problem of dual-usage and creates a mechanism for the fraud prevention. Miners, or more specifically, software on the miner's computers, checks and prevents repeat transactions, which in turn, on the basis of complex mathematical calculations, forms the system of fixation of all previous transactions. This system is called blockchain, and it constantly records more and more bitcoin-related transactions. Miners are rewarded for their activities directly from the system in the form of bitcoins.

Methods

The study used general scientific and specific methods according to the formulation of the topic. Logical and historical approach to the analysis and conceptual reproduction of the evolution processes regarding the economic system of society have become methodological basis for the theoretical study of the transformation processes of financial intermediation institutions, which in turn made it possible to obtain a comprehensive theoretical description of the current stage of financial intermediation development.

Results

Digital technologies in the process of financial intermediation create ecosystems based on the distant entities identification. Such ecosystems include online stores, financial institutions, logistics structures; they also allow making any purchase via the Internet remotely and provide the necessary financial resources through lending, so it is a very convenient and promising direction for the development of financial services. The existence of such systems means the full integration of financial institutions into the personal lives of clients, that is, when information about economic, social and consumer behavior enables a financial institution to determine the right direction for the customers. Digital financial services are one of the main mechanisms for monopolizing information, and as a consequence of the manipulative potential of anonymous subjects in the digital financial system.

In the context of the new economy, the production of new information has become the basic pattern in the system of economic and social interaction. This phenomenon with the characteristic dominant innovation of the information and network economy, becomes the basis for institutional bifurcation as a particular transition state in the process of new economy development. The gradual

leveling of the capitalism institutions is also accompanied by the loss of their social context. The comparative ratio of institute and the pattern is presented in Table. 1.

Table 1. Comparative ratio of institute and pattern

Indicator	Institution	Pattern
Tense conditions	Long-term phenomenon	Short-term
Spatial conditions	Institutionalized (national, supranational) space	Space of a defined network (may be global, national, and locally restricted (school, professional network)
Base	Values	Regulation, network protocol
Reaction on innovation	Bifurcation	Creation of new information
Purpose	The mechanism for hierarchy and network harmonization	The dominance mechanism of the network over the institute

Source: author's own development

Nowadays, we observe conflicting forms of hierarchical-network phenomena interconnection with the advantage of hierarchy, as well as dominant-network phenomena. They are manifested during the interaction of government and transnational corporations, the real sector and financial markets, as well as develop during the implementon process of the state regulatory measures. The ability to instantly change the deployment of political and economic forces in the global arena is a major risk resulting from the information mobility of the modern world. At this stage, society is threatened by the permanence of uncertainty.

The emergence of cryptocurrencies has become an illustrative example of the network principles development of economic activity in the financial markets.

Information surplus and monopolization of information have become the main features of modern society. The result of these processes has become cryptocurrencies. They support the transactions` anonymity and independence from any state and non-state financial institutions. Cryptocurrencies are an example of an open network that operates by its own rules, accepting any number of potential participants, aiming to move beyond the institutionalized space provided by the state and traditional financial institutions, as well as to participate in the creation of their own operational space.

The principles of operating activity offered by the cryptocurrency payment system transform, in a certain way, the basic principles of operation of modern financial and institutional systems.

For instance, the motivation for launching a payment instrument such as cryptocurrency is direct, anonymous trading, where the parties have all opportunities to settle all the basic components of the transaction through the Internet in the shortest period. Thus, theoretically, cryptocurrency calculations have considerable liquidity, but, unfortunately, the reality differs from this statement.

Money is the most liquid of all assets in a market economy; their content is realized through the circulation function. In order to simplify and speed up the process of monetary exchange as much as possible, it is necessary to conclude a public exchange agreement, and also to determine a responsible issuer that certifies and guarantees the exchange process (state, bank) in open exchange systems.

The cryptocurrency payment system has features of open-access mining and payments structure, however, it is internally closed to institutionalized payment space (it is not regulated, taxed, has no consumer protection mechanism, etc.). At some point, the investment demand for cryptocurrencies has made them a rather aggressive innovation that has begun to move beyond its parent system and spread over the global payment space.

Protecting own operational space of global and national payment systems demonstrates the limited liquidity of cryptocurrencies in the global financial space, which in turn demonstrates its

network-based, contradictory nature in terms of interaction with existing financial and institutional systems and proves the institutional character of its liquidity. In a market economy, it emerges and is implemented in an institutionalized space where there is some certain responsibility. Non-established means of payment are ephemeral in nature compared to established monetary systems.

Responsibility is a phenomenon of subjectivity that arises and develops through the process of interaction. Moreover, responsibility, evolving in the process of socio-economic development, forms complex structures, and in order to achieve the maximum effect of interaction the mediation of institutions is necessary.

One of the functions of a financial intermediary is to maintain the required level, or even to increase the liquidity level of its clients, that is, their ability to fulfill their monetary obligations in a timely manner, which takes the physical form of liquid resources.

In all historical times, the financial intermediary had to organize the optimal liquidity of the transaction, both by facilitating the contact of counterparties, providing payment facilities, and assisting in the emergence of their new forms, based on credit relations. However, with the development of capitalism, financial intermediation is reaching a new level - the level of assisting economic development. At the same time, the original functions of financial intermediation are maintained and are the basic principles of its purpose to ensure creative destruction. In an active credit and investment process, financial intermediaries are involved into the creation process of new liquidity: an increase in money supply, which is reflected by a money multiplier. Financial innovation has played a major role in the process of creating and providing liquidity. Revenue growth in the process of liquidity growth is the basic motivation for financial innovation. The attention and activities of intermediaries are focused on the processes of artificial liquidity creation. In the process of gaining liquidity, financial intermediaries have detached themselves from their market fundamentals - the real sector, there was a process of financialisation that demonstrated the economic and institutional inefficiency of financial intermediation. That is why the idea of creating liquidity in a non-institutionalized space arose, in which liquidity is created by the direct interaction of the entities.

Thus, we can prove that cryptocurrencies are a natural step in the financialization tendencies that emerge and develop in the global financial space as a result of the activities of financial intermediaries aimed at ensuring maximum liquidity of their transactions. This activity has the historical contradiction nature that develops from providing liquidity to trading operations in pre-capitalist societies through creating liquidity in a market economy to the financialisation tendencies in the process of becoming an information-network economy, in which the provision and creation processes of artificial liquidity becomes the main goal of a financial intermediary, creates the conditions for its crisis and the basis for its leveling in the new coordinates of network finance.

It is accepted that the information recorded in the blockchain is accurate. It cannot be controverted, it cannot be changed. Theoretically, this fact can solve many problems: from preventing raiding and misappropriation of property to fixing intellectual property rights. Blockchain can help with organizing new registry forms, assigning ownership, and arranging transactions in the sphere of real estate. The recorded blocks in the blockchain system will certify the process of ownership change, as well as confirm the money transfers, contracts and data of the owner. But from a practical point of view, it should be noted that any technology in the modern world can be damaged by viruses and attacked by hackers.

The blockchain system in the financial markets creates many benefits, greatly expanding opportunities for many participants in financial transactions: exchanges, brokers, banks. First of all, it significantly accelerates and settles all calculations, reducing transaction costs, guaranteeing a transaction, excluding fraud cases. Secondly, it enables consolidation of information across large financial institutions, simplifying reporting process. Thirdly, blockchain generates a history of movement of financial assets and property. Fourthly, blockchain technology is the basis for standardizing accounting globally, not just in the financial markets, but in any system that requires consolidated information.

The advent of blockchain technology demonstrates important processes that testify about the creation of an effective system of fixing and securing information that will greatly influence the

future global economic development in the modern information world. Moreover, there is a precedent in the world economy, which can be interpreted as the formation of a fundamentally new society, which is significantly different from the previous stages of economic and social human development. Blockchain demonstrates a precedent for relationships in which the basic social institute of trust tries to refute.

We support these arguments, but the problem is much deeper, it is not just about the loss of confidence in a formal institute - the central bank, theoretically, the need for an informal institute of trust can be eliminated, through a technological progress, which in turn, not only distorts public space, it can also radically change the basic foundations of human evolutionary capacity.

Blockchain technology, through which turnover of cryptocurrencies is realized, allows to conduct all transactions exclusively between the parties, even without the involvement of intermediaries, which guarantee the accuracy of transaction information. Blockchain theorists affirm that while using this technology, the standard interaction condition that makes it necessary to verify the information about the parties and the basic terms of the agreement becomes obsolete, because the need for intermediaries is eliminated. This is achieved by the special form of storing transaction information directly on each system computer - in distributed registers or databases.

In other words, the entity entering the bitcoin payment system perceives the information in that system as authentic. Moreover, all members of this system have the same authentic information stored in the archive - in the blockchain system.

The exclusion of information asymmetry from the system of factors influencing decision-making processes is extended in connection with the introduction of digital technologies into the system of financial institutions. Transport telematics enables insurance companies to obtain complete information about the behavior of vehicle drivers - thus forming comprehensive perceptions of possible risks, this gives insurers the opportunity to form their business models more accurately. In other words, in the context of transparency and minimization of information asymmetry, risks can be avoided.

At the same time, it should be noted that information asymmetry is a key factor in the evolution of social forms of human being. All human life is connected with the process of overcoming information asymmetry through cognition. However, this cognition is indirect - through the medium of information. Information mediators (parents, teachers, professionals) provide accurate information which is basic for further development. Human evolutionary capacity is a function of having accurate information about the outside world. Cognition through the trust is the process of eliminating the contradictions regarding information asymmetry in the social space, information acquirement and expanding the knownledge.

Table 2. Bitcoin cryptocurrency changes

Month	Indicators, USD	Absolute deviation	Growth rate
January	982,43		
February	1222,66	240,23	124,453
March	1086,12	-136,54	88,8325
April	1415,81	329,69	130,355
May	2492,6	1076,79	176,055
June	2520,61	28,01	101,124
July	2703,38	182,77	107,251
August	4866,51	2163,13	180,016
September	4371,54	-494,97	89,8291
October	6372,4	2000,86	145,77
November	6891,34	518,94	108,144
December	10911,04	4020,08	158,335

Source: author's calculations

The process of cognition is an appeal to a trusted professional mediator who also possesses more information than the subject of cognition.

This intermediary, having exceptional information, provides and guarantees the accuracy of information. The guarantee – is a process of decreasing information asymmetry.

We propose to consider changes in the dynamics of the cryptocurrency. First, it should be noted that all cryptocurrencies depend on the source code of bitcoin. That is why Bitcoin is leading the wave of events in the cryptocurrency market.

The Table 2 shows the dynamics of changes in Bitcoin exchange rate in 2021.

From the analysis of the Table 2 it can be determined that the highest growth rates of cryptocurrency for 2021 were in August and December, the growth rate compared to previous months was 73% and 50% respectively. The most unprofitable was September, during which the value of cryptocurrency decreased by $ 494.97.

One of the common methods of forecasting the market indicators dynamics is trend models that allow to find out "what will happen, if what has already been comes back".

The Microsoft Excel automates the process of building trend models and analyzing them. There are different types of models, such as linear, degree, exponential, logarithmic and polynomial. The determination coefficient can be used to estimate the adequacy of the model (is indicated as R^2) - statistical indicator, which indicates how well the received observations confirm the model.

Table 3. Determination coefficients of trend models

Model`s name	Equation	R^2
polynomial of the third degree	$y = 43,636x^3 - 628,02x^2 + 2881,9x - 2085,4$	0,9572
exponential	$y = 610,38e^{0,2503x}$	0,9425
polynomial of the second degree	$y = 222,88x^2 - 1721,x + 3870,9$	0,8834
degree	$y = 518,96x^{1,0744}$	0,7628
linear	y = 1175,8x - 2889,8	0,6615
logarithmic	y = 4517,1 Ln(x) - 2770,8	0,4241

Source: author's calculations

The Table 3 shows that the best observations correspond to the third-degree polynomial model and the exponential model. The determination coefficient for both of them is close to the confidence interval limits (0.95), which in statistics is considered to be an indicator of a good accordance between the actual and the calculated data.

Thus, from the conducted research it is possible to conclude that in spite of the fact that recently cryptocurrencies show impressive dynamics of growth, however, this is a consequence of the growing interest in cryptocurrencies, which is stimulating demand on the market, while limiting supply. Probably the peak of demand has already been reached or will be reached in the nearest future. We should expect a significant decline in demand in the future.

However, cryptocurrency and its core blockchain technology have already become a significant player in today's financial market and the target of investing for many market subjects that have some means to support it. Therefore, after the inevitable decline, the development of cryptocurrencies will continue, however, their volatility may decline.

Historically, economic and social interaction is the result of the activities of intermediaries which declare their relationship. Parents guarantee its authenticity as the first intermediaries between the known and the unknown world. Passport services confirm the person, acting as the main mediator in the implementation of any human activity during his or her life (without a passport it is impossible to enter a university or get a job, etc.). Notaries institutions confirm the

implementation of civil relations. Banks and payment systems are the guarantors of money transfers.

The argumentation mentioned above gives us reason to state that modern technologies have led out the evolution of human society to a new level, in which the subjects of social and market interaction without adequate institutional protection of the classic elements that structure society and the economy are at risk of losing adaptive capacity to the interaction environment. The mediator was a leader in the world of information asymmetry. A blockchain-oriented society is a society where the impact of information asymmetry and trust can be de-actualized.

Blockchain-oriented systems are directed against formal institutions and don`t need any informal trust institution. In the context of information surplus, trust is leveled and a society of patterns is built - a society outside of institutions.

Conclusion

Blockchain technologies and digital financial assets based on them are a logical but pivotal step in the development of information technology, the evolution of value and exchange. By forming an uninstitutionalized space of operational activity, new financial entities are aggressive innovators who, at the present stage, disorganize the activity of formal payment systems. In response, attempts have been made to legally institutionalize the unregulated cryptocurrency trading space, as well as the spontaneous market institutionalization by excluding cryptocurrencies from standard payment systems can be observed.

Meanwhile, the active usage of blockchain technological innovations in formal institutionalized financial spaces is developing. Over time, as blockchain technology becomes widespread, it will become commonplace for direct operators, market operators, and the state, the current uncertainty will be structured and take the form of risks for the relevant entities. The institutionalization of these risks will take some time, and as a result, society will move to a new system of socio-economic structuring and new ways of interaction that will meet new technological possibilities.

The growth cryptocurrencies potential in comparison to world currencies allows it to be a highly profitable investment object, which increases the interest of new miners. However, like other investment objects, cryptocurrency has certain risks, including legislative, insider, fraud, which cannot be detected in advance due to cryptocurrency anonymity. The processes of centralization are becoming more noticeable in the pricing process of cryptocurrencies, through which cryptocurrency exchanges are more actively influencing the exchange rate, as well as production centers controlled by a limited number of individuals.

The main factors influencing the exchange rate of such currency are the activities of cryptocurrencies and speculative transactions; the cost of mining; exchange value of cryptocurrencies; interest of users; degree of trust to the currency; political factors. Today there are over 1300 cryptocurrencies with a market capitalization of $ 1 million to $ 100 million. The emergence of many small cryptocurrency markets means that price manipulation still exists in reality.

The trends of cryptocurrency development were analyzed using mathematical statistics methods. It has been determined that nowadays this trend is described by exponential equations. At the same time, an analysis of economic history shows that no exponential trend lasted long, and most often it ended with a crisis. The only factor supporting this growth is the particular demand in the limited supply market. We should expect a significant drop in the cryptocurrency market after users' interest will reach its peak.

Despite its revolutionary feature, cryptocurrency payment system is a logical result of the evolution of financial intermediation, which, in the process of developing its functional focus regarding providing liquidity to operations, created the basis for negative financialization trends in the context of globalization, demonstrated the inefficiency of financial intermediation and, moreover, formed the basis for the emergence of spaces without any mediation.

However, the development of such spaces indicates that the economic system has reached a new stage, which may be fundamentally different from all previous ones without adequate institutional support. Previously, the interaction of subjects developed on the basis of information

asymmetry and trust, with the mediator being a mediating link in the world of information asymmetry. Blockchain technology has become a case of interconnection without information asymmetry and trust. Therefore, the endogenous uncertainty of blockchain will become a decisive factor, demonstrating the limited social reserve of human and society variability. Further development towards full exploitation of new technological capabilities, including artificial intelligence capabilities, can lead humanity to a post-social model based on transhumanism, that do not exclude attempts to preserve traditional value-institutional and technological focuses.

Thus, virtual currency is a huge amount of computing power and digital assets. The cryptocurrency is gaining a stable positions in the international market at this stage of humanity's technological development. The rapid development stimulates further capacity growth and interest, but it can eventually lead to failure. However, it can be used in international transactions, not just for speculative profit, if the price stability of the cryptocurrency is achieved. However, this question will be related to the legalization process of a new currency and recognizing it as a means of exchange, or of keeping the value of money.

Funding: Please: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.

References

Borri, N. (2019). Conditional tail-risk in cryptocurrency markets. Journal of Empirical Finance, 50, 1-19. https://www.sciencedirect.com/science/article/abs/pii/S0927539818300781

Bouri, E., Shahzad, S. J. H., & Roubaud, D. (2019). Co-explosivity in the cryptocurrency market. Finance Research Letters, 29, 178-183. https://www.sciencedirect.com/science/article/abs/pii/S1544612318302976

Caporale, G. M., Gil-Alana, L., & Plastun, A. (2018). Persistence in the cryptocurrency market. Research in International Business and Finance, 46, 141-148. https://www.sciencedirect.com/science/article/pii/S0275531917309200

Chuen, D. L. K., Guo, L., & Wang, Y. (2017). Cryptocurrency: A new investment opportunity? The Journal of Alternative Investments, 20(3), 16-40. https://jai.pm-research.com/content/20/3/16.short

Cocco, L., Concas, G., & Marchesi, M. (2017). Using an artificial financial market for studying a cryptocurrency market. Journal of Economic Interaction and Coordination, 12(2), 345-365. https://link.springer.com/article/10.1007/s11403-015-0168-2

ElBahrawy, A., Alessandretti, L., Kandler, A., Pastor-Satorras, R., & Baronchelli, A. (2017). Evolutionary dynamics of the cryptocurrency market. Royal Society open science, 4(11), 170623. https://royalsocietypublishing.org/doi/full/10.1098/rsos.170623

Eyal, I. (2017). Blockchain technology: Transforming libertarian cryptocurrency dreams to finance and banking realities. Computer, 50(9), 38-49. https://ieeexplore.ieee.org/abstract/document/8048646

Hayes, A. S. (2017). Cryptocurrency value formation: An empirical study leading to a cost of production model for valuing bitcoin. Telematics and Informatics, 34(7), 1308-1321. https://www.sciencedirect.com/science/article/abs/pii/S0736585315301118

Hileman, Garrick, and Michel Rauchs. "Global cryptocurrency benchmarking study." Cambridge Centre for Alternative Finance 33 (2017). https://www.crowdfundinsider.com/wp-content/uploads/2017/04/Global-Cryptocurrency-Benchmarking-Study.pdf

Howell, S. T., Niessner, M., & Yermack, D. (2018). Initial coin offerings: Financing growth with cryptocurrency token sales (No. w24774). National Bureau of Economic Research. https://www.nber.org/papers/w24774

Li, X., & Wang, C. A. (2017). The technology and economic determinants of cryptocurrency exchange rates: The case of Bitcoin. Decision Support Systems, 95, 49-60. https://www.sciencedirect.com/science/article/pii/S0167923616302111

Liu, Y., & Tsyvinski, A. (2018). Risks and returns of cryptocurrency (No. w24877). National Bureau of Economic Research. https://www.nber.org/papers/w24877

Yi, S., Xu, Z., & Wang, G. J. (2018). Volatility connectedness in the cryptocurrency market: Is Bitcoin a dominant cryptocurrency? International Review of Financial Analysis, 60, 98-14. https://www.sciencedirect.com/science/article/abs/pii/S1057521918304095.