

DEVELOPMENT OF A MULTIFACTOR FORECASTING MODEL FOR DEVELOPMENT OF GLOBAL CRYPTO CURRENCY MARKET

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Abstract: Accelerated rates of development of the digital money market and their integration into the system of economic, operational, financial and other processes determine the need for a comprehensive study of this phenomenon. Particularly topical is the fact that discussions at the state level over the prospects of legalization of the crypto currency market and the possibilities of using its instruments in the economic activities of economic agents have intensified in recent months. Despite at times polar views and approaches that have been formed at the moment among Russian experts regarding solution of this issue, the development of cryptology is extremely rapid regardless of its regulation. This causes and actualizes the conduct of scientific research in the field of assessing the prospects for the development of this market in order to predict possible effects and risks for the national economic system. Part of this paper is devoted to the solution of these issues aimed at developing a multifactor model for the development of the crypto currency market taking into account the impact of a system of fundamental and conjuncture factors on it. In accordance with the goal, such tasks have been solved as the analysis of the crypto currency market capitalization dynamics and, based on the methods of economic and mathematical modeling, identification of the parameters determining the trajectories and the dynamics of its development. Based on the methods of scenario analysis, the developed econometric model allowed a medium-term forecast to build for the development of the market under study.

Key words: crypto currency, multifactorial analysis, digital money, bitcoin, modeling, scenario forecasting, legalization of the crypto currency market

1 Introduction

Accelerated rates of development of the crypto currency market and its integration into the system of economic, operational, financial and other processes determine the need for a comprehensive study of this phenomenon. The fact that special attention is paid to the issues on the regulation of the crypto currency, the expediency of its legalization in the Russian Federation both from the public regulatory sector and from the business community, gives particular relevance to this issue in the conditions of the Russian economy. Despite the fact that to date, in Russia, as well as in the absolute majority of the countries of the world, there has not been formed an unambiguous legal space regulating the market of crypto currencies and other components of the new reality called "digital economy", the paces of cryptology development are very fast, regardless from its regulation at the level of individual national economies. Suffice it to say that if at the beginning of 2017 the world market of crypto currency was estimated at \$ 14 billion, then by the end of the first quarter of 2018 it was just over \$ 277 billion. A similar situation occurs in Russia's "crypto space". According to the Coin Dance service¹, the weekly turnover of BTC / RUR is 0.2% of all "bitcoin transactions". Such trends should undoubtedly be studied and analyzed, including through the prism of developing forecasting estimations in order to understand the prospects for developing the market under study and making the most adaptive decisions that will not only level out possible negative effects, but also form a system of targeted measures aimed at obtaining macroeconomic, budgetary, social and other benefits (Elshin & Abdukaeva, 2017; Awadallah & Gamal Saad, 2018).

The urgency of these issues predetermines the need for a comprehensive and systematic analysis that reveals the features and prospects for the development of the main components of the digital economy, in particular the crypto currency market.

The world market of crypto currencies is reviewed within the framework of this study based on a multivariate analysis, including an analysis of its components; the parameters of Russian digital money market development are estimated, and scenario forecasts of its development for the period up to 2021 are also being developed.

2 Methodology

Crypto currencies play an increasing role in the world financial system. To date, the global market for crypto currency consists of more than 1,570 digital currencies with a total capitalization of more than 300 billion USD.

For the first time, the term "crypto currency" was used after the appearance of the payment system "Bitcoin" which was developed in 2009 by a person or a group of people under the pseudonym of Satoshi Nakamoto (Nakamoto, 2008).

It was bitcoin that became the foundation of the "world" of digital currencies. This system is a complex calculation process with subsequent encryption and creation of an electronic code. The emission of the number of "coins" is limited to 21 million pieces. It is assumed that the last "coin" will be mined by 2140, what is argued by the settlement system used in the production of the crypto currency (Savelichev, 2017; Kantorovich, 2002).

It should be noted that the dynamics of the market of crypto currencies is exerted by a whole set of factors, with the greatest impact among them from speculative factors which are formed mainly as a result of information impact.

So, for example, one of the most important indicators in the analysis of the crypto currency market is the level of interest shown by the society to the digital currency. This interest is formed by the demand for the crypto currency, and it is also one of the pricing factors (Lo & Wang, 2014; Villalobos Antúnez, 2001).

In the Russian Federation, public interest in crypto currencies can be traced using the Google Trends tool (Fig 1). Dynamics of popularity is estimated on 100 points system. Numbers indicate the level of interest in a topic for a certain period of time. 100 points mean the highest level of popularity of the request, 50 - the level of popularity of the request is twice lower than in the first case, 0 - the level of popularity of the request is not higher than 1% of the level in the first case².

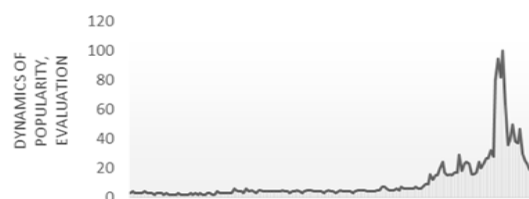


Fig 1. Google requests for bitcoins in Russia in the period from 2015 to 2018

Important impact on stock quotes of "digital money" is caused by the dynamics of global legalization of the market under investigation.

To date, we can unequivocally state that a single (unified) approach to the legal regulation of crypto currency relations in the world community has not yet been worked out. At the same time, the crypto currency is considered by many world regulators as a promising tool in the monetary and credit policy of national economies.

¹ Statistical information service CoinDance: <https://coin.dance>

² <https://trends.google.ru/trends/>

In order to identify trends that demonstrate the attitude of countries to the crypto currency, and also to obtain a more detailed info about its legal status in different countries, an analysis was made reflecting the status of crypto currency for each quarter from 2013 to 2017 in 29 countries.

The following system of legal status assessments for crypto currencies was adopted as a basis:

- 1- negative attitude to crypto currencies / complete ban;
- 0 - the status of crypto currencies is not defined;
- 0.5 - the question of legalization is being considered;
- 1 - recognized as private money, commodity, asset;
- 2 - legally recognized, taxed.

The results are shown in Fig 2, in Table 1.

The realized analysis shows that in most states the legal status of crypto currencies is debatable and unsettled. At the same time, despite the heterogeneity of the attitude of national governments to the crypto currency market, the latter, judging from the data in Figure 1, shows a progressive positive trend due to the growing

trends of its legalization in various countries of the world (the average of the estimates for each quarter form a time series with a pronounced linear trend). This allows us to conclude that with each analyzed period the level of confidence of the world community in crypto currencies is growing.

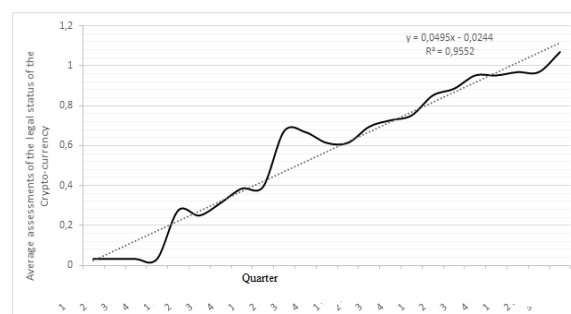


Fig 2. Average assessments of the legal status of crypto currency (the schedule is formed on the basis of the data from Table 1)

Table 1. Analysis of the legal status of crypto currencies

Country	2013				2014				2015				2016				2017		
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
Russian Federation	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0.5	0.5	0.5	0.5	0.5
Germany	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Croatia	0	0.5	0.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Sweden	0	0.5	0.5	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
South Korea	0	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	2
Thailand	0	0	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
China	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
USA	0.5	0.5	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Singapore	0	0	0.5	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bulgaria	0	0	0.5	0.5	0.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Norway	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ukraine	0	0	0	0	0	0	-1	-1	-1	1	1	1	1	1	1	1	1	1	1
France	0	0	0	-1	-1	-1	0.5	0.5	0.5	1	1	1	1	1	1	1	1	1	1
India	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Australia		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
Belgium	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Canada	0	-1	-1	-1	-1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
Cyprus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Denmark	0	-1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hong Kong	0	0	0	-1	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0
Israel	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1
Japan	0	0	0	-1	-1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	2	2	2	2	2	2
New Zealand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1

Slovenia	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Spain	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
United Kingdom	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
Bulgaria	0	0	0	0.5	0.5	2	2	2	2	2	2	2	2	2	2	2	2	2

Thus, the analysis of key factors affecting the global digital money market and presented in a concentrated form allows us to conclude that the crypto currency market is a multistructural system of economic relations with respect to the exchange of the crypto currency formed as a result of generation of many factors of technical, speculative, legal, and other nature.

In general, it should be noted that the capitalization of the global crypto currency market is characterized by an exponential trend (Fig 3). Significant momentum to the market capitalization growth occurred in the second and third quarters of 2017 is associated with the activation of investors from China and India in this period of time, as well as with the legalization of crypto

currency in Japan, which equaled it with a payment facility (Luther, 2016; Aivazyan, & Mkhitarian, 1988). The fall of the same market in early 2018 is due, according to most expert assessments, to a number of negative news. First, this was regulatory tightening in South Korea. Second were the claims of the US Commodity Futures Trading Commission in relation to the exchange Bitfinex (Vranken, 2017; Elshin, & Abdukaeva, 2017).

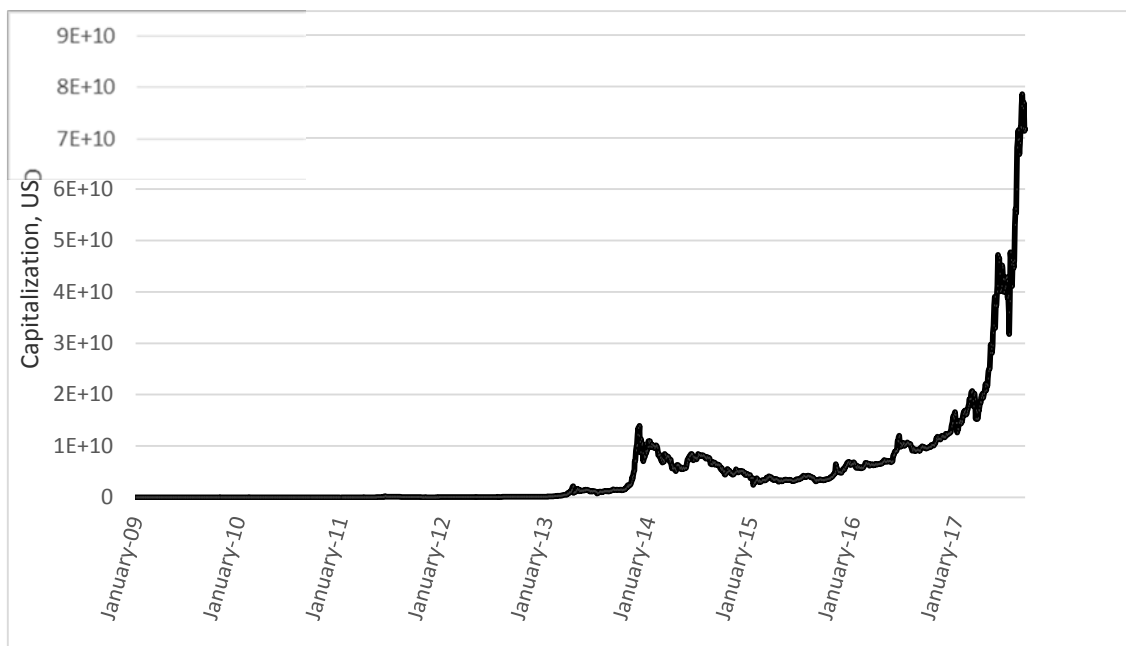


Fig 3. Dynamics of bitcoin market capitalization, USD

Continuation of the formed tendencies in the future means essential reorganization of the established institutes of regulation of economic-operational processes in the world. Within the framework of the present study, predictive assessments for the development of the world crypto currency market in the medium-term period have been carried out confirming the proposed assumption.

The basis for the development of forecast estimates was the developed regression model that reveals the relationship between the volume of market capitalization of bitcoin and the parameters characterizing the directions and features of the

development of the crypto currency market. The following features were attributed to them: the difficulty of mining coins, gh / sec.; the number of Google queries about crypto currency; legal status of bitcoin; number of transactions in bitcoins, units.

The content of the main model parameters which reveals the peculiarities of the relationship between the world bitcoin market capitalization and the parameters that determine its generation, is presented in Table 2.

Table 2. Initial data for econometric analysis

Period, quarter	Factors				
	Y	X1	X2	X3	X4
	Bitcoin market capitalization	Hashrate, GH / s	Number of Google queries	Legal status of bitcoin	Number of bitcoin transactions
1 qr. 2012	46591410.7	1475555.0	1.7	0.0	6694.2
2 qr. 2012	48991055.0	1620088.5	2.0	0.0	19992.8
3 qr. 2012	101781510.5	2263459.3	2.3	0.1	32307.1

4 qr. 2012	128450830.1	3226971.6	2.7	0.2	32745.4
1 qr. 2013	367230158.0	4150878.7	5.7	0.2	52434,7
2 qr. 2013	1332012692,8	13293059.8	16.3	0.3	53333,7
3 qr.2013	1247923200.0	69969221.1	9.0	0.3	49075.3
4 qr. 2013	6072328393.1	595629505.5	40.3	0.3	60055.5
1 qr. 2014	8544263836.3	3028207019.0	41.0	0.6	63994.9
2 qr. 2014	6696937303.0	10305771340.6	18.7	0.6	62786.4
3 qr. 2014	6931102599.3	24509552066,7	19.3	0.6	67325.5
4 qr. 2014	4797617690.7	38713987923,7	19.0	0.6	81849.1
1 qr. 2015	3453208694.2	45088238804.3	17.0	0.7	95974.2
2 qr. 2015	3349374573.8	48416574424.8	14.0	0.7	108648,7
3 qr. 2015	3695976654.1	54434023929.2	18.0	0.7	131465.3
4 qr. 2015	5177198177.8	74869182537,9	22.7	0.8	164427.8
1 qr. 2016	6230291537.6	147395899339.4	25.3	0.9	199751,4
2 qr. 2016	8144581893.4	195688280160,7	23.7	0.9	222032.2
3 qr. 2016	9726831786.9	217928657422.9	22.0	0.9	220648,7
4 qr. 2016	11961989119.5	280452874631,6	26.0	0.9	264025.1
1 qr. 2017	16703072992.6	432703451040.1	37.3	1.0	281798.0
2 qr. 2017	32234283384.5	598188897868.2	67.3	1.0	291787.4

Undoubtedly, this list of factors is not complete, but, in our opinion, it forms to a significant extent the basic foundations that reveal the parameters and trends in the development of the digital money market. It is also important to note that this list of factors was formed based on the results of econometric analysis and filtration of a wider range of statistical indicators. However, the correlation dependencies found between them predetermined the list of factors used in this paper (Wilson, & Yelowitz, 2015).

3 Results and Discussion

As a result, the following regression model was obtained; it reflects the relationship between the global crypto currency market and the analyzed parameters:

$$MC = a + 0,047X_1 + 176834636.6X_2 + 6953481977X_3 - 53146.4X_4$$

Where:

MC - market capitalization of bitcoin in the world (Market Cap);

X1 - Complexity of coin mining, gh / sec.

X2 - The number of Google requests for crypto currency

X3 - Legal status of bitcoin.

X4 - The number of transactions in bitcoin, units.

The resulting statistical significance parameters for the obtained model are presented in Table 3, 4.

Table 3. Parameters of model regression statistics

Regression statistics	
Multiple R	0.990998295
R-square	0.98207762
Adjusted R-square	0.977860589
Standard Error	1077250094
Observations	22

Table 4. Estimated parameters of regression model coefficients and their statistical significance

	Coeff.	St. Error	t-statistic	P-val
Intercept	268565991.9	558787138.1	0.480623074	0.636911306
Hashrate, GH / s	0.046687555	0.004841087	9.644023492	2.62681E-08
Number of Google queries	176834636.6	25640540.82	6.89668123	2.58,655E-06
Legal status of bitcoin	6953481977	2052492505	3.387823323	0.003498766
Number of transactions in bitcoin	-53146,41939	11562,90567	-4.596285823	0.000257086

The data presented indicate that the calculated regression substantially high approximates the initial series to a significant degree. The corresponding coefficient of determination R^2 is 0.98. Consequently, the equation obtained within the framework of implementation of multi-iterative calculations and actions, adequately describes the initial data. Therefore, it seems reasonable and justified to use the constructed model in the

process of creating predictive models on the crypto currency market development.

Based on the data of scenario programming for the transformation / development of the presented factors (Table 5), Figure 6 presents scenario forecasts of the bitcoin market capitalization for the period up to 2021.

Table 5. Scenario parameters for generation of factors determining the bitcoin market capitalization value

Factors	The quarterly rate of change factors in the quarterly average for the II quarter of 2017, %	
	Inertia scenario	Pessimistic scenario
Hashrate, GH / s	136.30%	110%
Number of Google queries	122%	100%
Legal status of bitcoin	103.20%	100%
Number of transactions in bitcoin	98.10%	100%

According to the inertial scenario, growth rates are determined on the basis of the quarterly growth rate for the period of 2016-2017. It was in this period of time when crypto currency began to increase dramatically in the world market, forming a trend for

its development for future periods of time. The growth dynamics of the indicators used in the pessimistic scenario are determined on the assumption of stabilization of key factors determining the dynamics of the crypto currency market.

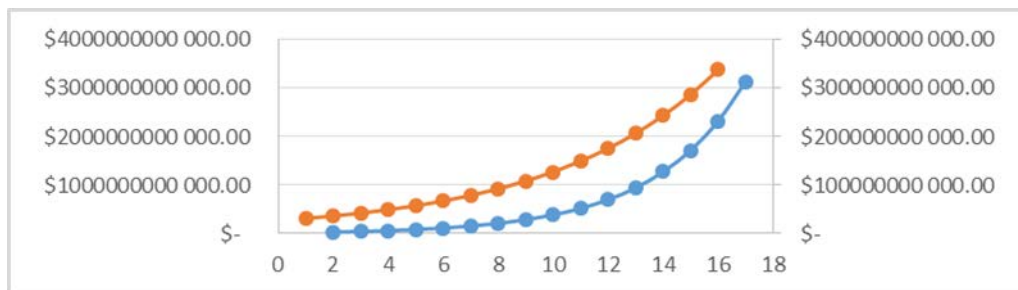


Fig 4. Scenario forecast of the bitcoin market capitalization for the period up to 2021, billion dollars

4 Conclusions

Thus, proceeding from the predictive assessments of the crypto currency market development in the world, it should be noted that regardless of the current positions of different countries to the crypto currency, the growth rates of this market will be significantly increased. The "integration" of national economies into this process will largely determine their competitiveness through the degree of integration into the system of international operations in the economic and financial spheres. At the same time, this degree will be determined by the speed of decision-making aimed at determining the status of the crypto currency and its legalization in the regulatory and legal field of the state.

5 Summary

In accordance with the received data, it is expected that by the beginning of 2021 (by the 1st quarter) in accordance with the inertial scenario of development, the volume of market capitalization of bitcoin will reach the level of 3.1 trillion \$, in accordance with the pessimistic - \$ 338.0 billion, which, nevertheless, is almost 3 times higher than current values.

It should be noted that, in accordance with the inertial scenario, bitcoin's capitalization is estimated as extremely significant. This is due to the fact that, methodologically, within this scenario it is assumed that the market growth parameters that have been formed in 2017 will remain the same in the future. At the same time, it should be noted that in 2017 the growth of BTC's market capitalization amounted to about 600% in the period from the first to the third quarter, which, in our opinion, was based on increased excitement and, accordingly, the active growth of speculative demand. In all likelihood, in the future, the increased growth in demand will decrease, and growth will stabilize, which will lead to more even trajectories of the crypto currency market development in the future. In this connection, it seems

appropriate to define a pessimistic scenario as a basic one proceeding from the conservative rates of development of the underlying factors in the market under study, and which is the scenario largely conforming to the logic of the stagnant growth rates of the BTC exchange rate that outlined in early 2018.

The presented data which reveal the prospects for the development of the global crypto currency market, demonstrate a very significant growth rate of the market capitalization of crypto currency in the world. Based on the information that the bitcoin share in the total volume of the crypto currency market is about 45%, and also being guided by the hypothesis that the altcoins generate their development dynamics being in the fairway of the BTC exchange value, the forecast parameters of the global crypto currency market could be determined. Thus, in the pessimistic scenario which provides for limiting the dynamics of the factors determining the parameters and prospects for the development of the crypto currency market, the market volume by 2021 will reach 707.1 billion US dollars, which is 4.7 times higher than the current value. Within the framework of the inertial scenario, the expected volume of crypto currency market capitalization in the world will reach the level of 6.6 trillion dollars. It is important to emphasize that in the case of the inertial scenario of the crypto currency market development, its share in the total volume of global transactions will reach about 5%, and in the case of the pessimistic (baseline) scenario - 1%³.

6 Acknowledgements

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³ McKinsey, Global Payments Industry Study (2016): the global market volume of global transactions is estimated at 155 trillion\$ <https://ripple.com/use-cases/>

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