(five banks out of 62).

On the contrary, a large share of individuals' funds, regardless of currency and terms, puts the bank in the "hazardous" zone. Thus, 252 banks were included in the cluster built on the map of "Funds of individuals, total", of which 72 became insolvent (28.5%).

**Conclusion:** The Kohonen self-organizing neural networks and maps allow efficiently segmenting data samples according to various criteria, including bank solvency. The "hazardous" zones with a bankruptcy rate of 43.6% and 49.2% and the "safe" zone with a bankruptcy rate of 6.3% were highlighted on the constructed map. It can also be concluded that during the 2014-2017 banking crisis in Ukraine, the bank's resource base was the main factor of its stability.

**References**


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PhD (Economics)  
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**Dyatlenko A.O.**  
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**FORECASTING THE BITCOIN RATE BASED ON THE GRANGER CAUSALITY TEST**

The rapid development of IT and computerization not only affects the automation of our daily lives, but also makes significant adjustments to the economy of the country, modifying its components. That is why cryptocurrencies are increasingly consolidating their position in the foreign exchange market – analogous to traditional means of payment.

The question of how cryptocurrencies work is a new scientific issue not only nationally but also internationally [1]. The main features of cryptocurrencies include the following: complete anonymity, lack
of emission centers and limited number of units. Continuous monitoring and forecasting of cryptocurrency helps not only to respond quickly to financial changes, but also to use them for their own purposes.

However, given the high degree of volatility of cryptocurrency exchange rates, the issue of their forecasting is an urgent one. Despite the large amount of research on this topic, the primary goal of researchers is to identify a system of criteria and indicators that affect the course. However, it is better considering not only correlation relationships but also which of the selected indicators are the primary ones, that is, the reason for the change in rates.

Thus, in the framework of this study, it is proposed to select the following key indicators and investigate their impact on the cryptocurrency exchange (on the Bitcoin example):

1) the dollar exchange rate;
2) the price of gold;
3) MSCI World – is a weighted market cap index designed to broadly measure market performance at the level of joint stock companies worldwide;
4) S&P 500 – a stock index, which includes the 500 elective US joint-stock companies with the highest capitalization. This index is also called the barometer of the American economy;
5) CBOE Volatility Index (VIX) – an indicator of market volatility expectations. VIX, also called the "fear index", reflects the expectations (sentiment, heartbeat) of the market, not what exactly is going to happen. The VIX value is a generalized assumption, based on the price of premiums that investors are willing to pay for the right to buy or sell an option on the S&P 500 index. Thus, the VIX is the weighted average across all prices of the S&P index options [2];
6) NVIDIA Corporation (NVDA) course – an American company, one of the largest developers of graphics accelerators and processors, as well as system logic kits. The course of this company is important for research, because the mining process itself is energy-intensive and requires the powerful GPUs that this company offers;
7) Google search statistics for keywords – we, consumers, influ-
ence the amount of demand and supply of any product or service in the market. The cryptocurrency is not the exception, the demand for which is increasing with less of its number in the system. Using Google Trends statistics for keywords, we have the ability to express consumer interest in this topic in quantitative categories.

A Granger test is suggested to identify causal relationships between dedicated indicators and cryptocurrency rates.

Granger's test of causality is the procedure for verifying cause and effect relationships between time series [3]. The idea of the test is that the value (change) of the time series \( x \) represents the reason for the change of the time series \( y \). Thus, having conducted this test, we can distinguish those indicators whose change is the cause of change in the rate of cryptocurrency.

The final stage of the study is the calculating an autoregressive model and providing a forecast for Bitcoin rate for future periods. Autoregressive models are widely used to describe stationary random processes [4]. The construction of a model of this type is explained by the fact that, in our opinion, the value of cryptocurrency in previous periods may affect its current value. That is, given that \( t \) is the value of the selected indicators, we can predict the value of the cryptocurrency rate for the period \( t+n \), where \( n \) is determined by the order of the autoregressive model.

The calculated forecasting model can be used by consumers to compare different cryptocurrencies, to forecast exchange rates for future periods, in order to make further decisions about buying and selling and investing in a particular cryptocurrency.

References