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MODELING THE IMPACT OF BANK SHARES ON INCOME IN THE FUND MARKET

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ABSTRACT

This article analyzes the changing trends of bank shares in the securities market and the factors affecting them in increasing the income of commercial banks. Models that assess the factors influencing changes in the stock market are analyzed and their impact on changes in bank shares is revealed. A methodological apparatus for assessing the competitiveness of the banking system and financial markets is being developed, the issues of analyzing and evaluating the effectiveness of reengineering processes in the banking business are still being studied, economic and mathematical methods and modern tools in financial institutions are fragmented. Therefore, the process of mathematical modeling of the income that market participants receive is complicated, where ignoring all the factors can lead to its participants becoming unprofitable.

KEYWORDS: *Mathematical Modeling, Bank Income, Securities Market, Stock, Issue, Gaussian Copula And Binary-Copula Models, A.Roy's Model.*

INTRODUCTION

The stability of the banking sector depends primarily on the financial stability of business entities and is determined by the effectiveness of its interaction with market infrastructure organizations. In the context of the development of digital technologies, there is an urgent need to systematically address the problems of deepening economic research in terms of increasing the reliability, stability and competitiveness of credit institutions, the formation of an effective mechanism of interaction between the banking system and financial markets. In the formation and solution of

such problems lies the development strategy of the banking sector in the financial markets as an important element, which allows determining the functional and stimulating role in solving national economic problems. Unfortunately, while the development of such documents that reveal the concept of development of these segments of the economy is limited to a maximum period of 4 to 5 years, in the international community such strategic programs are being developed for the next decades. The problems of the interdependence between the banking system and financial markets have not received enough attention in the economic literature. Increased competition in the market of banking services, aggressive behavior of non-bank credit institutions, mutual funds and other financial institutions, the complexity and rapid development of modern information technologies require the study of the relationship of credit institutions with specific segments of the financial market. In the current state of the economy of the country, the problem of forming an effective mechanism of interaction between the banking system and financial markets remains particularly relevant. In this regard, the development of fundamental rules for the development of the banking system of the republic, the mechanism of its interaction with financial markets can become a dominant factor in the growth of the national economy.

The role of the banking system in the local financial services market remains insufficiently studied in the field of local science. A methodological apparatus for assessing the competitiveness of the banking system and financial markets is being developed, the issues of analyzing and evaluating the effectiveness of reengineering processes in the banking business are still being studied, economic and mathematical methods and modern tools in financial institutions are fragmented. Therefore, the relevance of the article is determined by the issue of studying the impact of increasing the bank's income through mathematical modeling of their activities in the securities market.

MATERIAL AND METHOD

The distinctive feature of the bank's activity is that when attracting financial resources, the credit institution places them on loans and investments on its own behalf. This leads to the ambiguity of the sources of formation of the credit institution's assets: they can be the bank's own funds or any type of resources involved. Prior to the August 1998 crisis, the stock market was listed as one of the most efficient sectors of the local financial market. It is currently experiencing a slow recovery and is expected to continue to operate effectively in the future.

Financial data turns out to be a very important tool in any research. In business, financial data helps users estimate the amount, timing, and inevitability of cash flows to make decisions. The financial statements of developing countries such as the United States of America (USA) contain evidence and facts about the development of banks. Thus, the purpose of financial analysis is to provide evidence of the financial condition, the expected results, and the bank's capabilities, which are important in motivating clients to solve economic problems (Barry & Jamie, 2011) [1]. In the financial statements of commercial banks, banking activities are objectively explained by the evidences and facts related to the success of the bank, the relevant problems and strategies to solve them. Hence, knowledge and skills in financial analysis are essential for a wide variety of people, such as investors, lenders, and regulators (Higgins, 2012) [7].

Changes in the financial statements of stakeholders have consolidated activities identified from time to time in the equity portion of the balance sheet. However, changes in capital are the result of incurring profits or losses, dividends and shares (Ebimobowei, 2012). Thus, dividends are paid to shareholders at their own discretion [3].

Modeling and analyzing daily earnings per share. The results show that the binary Gaussian Copula and the binary t-Copula can very well model the daily stock market return data. The copula function is very important in market risk analysis. The copula function can be used to better model financial data and break down financial risks to reduce the impact of financial risks.

To better understand Copula's role in analyzing financial risks, more representative data should be selected [11].

In some areas, especially in relation to credit risk, information is often lacking to model the relationship between random variables. However, there is enough information to model the limit values of each random variable. It is in this context that Copula functions are important for modeling dependence (Cherubini et al. [19]).

Although the methods for estimating the parameters of the Copula function look very well developed, the selection of the Copula function still remains an open problem.

The research was to help practitioners select a specific linear function. In particular, the t -binding as a method of modeling counterparty risk was compared with the Gaussian model. Through modeling, it has been found that the t -binding naturally derives from the structural model of credit risk proposed by D.Cossin and H.Schellhorn and is then abbreviated as the CS model [3].

If the gains are related to Gauss, we assume that t -Copula is better for modeling than the Gaussian limit. This is done with different network configurations. This result has been recognized by various researchers, and the t -bindings have allowed for a more effective evaluation of a positive outcome than the Gaussian model [9].

In the CS model, this velocity is not directly observed. At each point in the market, the bank shares are valued by market participants. The total income of the bank consists of operating income and repayment of loans from borrowers. The main assumptions of our model are to draw conclusions using different models to determine the impact of banks' shares on earnings in the stock market. In realizing this assumption, the factors influencing the shares of banks, the tendency of changes in relation to the nominal value of shares are proportional to the total income of the bank.

$$\hat{a}_i(t) = \hat{v}_i(t) + \sum_k \hat{a}_k(t) \tau_{ki} \quad (1.1)$$

In some studies, the payout ratio shows what percentage of a bank's total costs is allocated to bondholders and shareholders. It is modeled as a geometric Brownian motion with relative displacement and variability. A payment ratio, greater than one corresponds to the bank's capitalization. We think the payout ratio is independent of the cost level. Payment rates of banks may be interrelated. In case of breach of the obligation, the bank suffers a loss. Theorem (1.1) is proved by D.Cossin and H.Schellhorn [4].

$$\hat{a}_i(t) = \hat{v}_i(t) + \sum_k \hat{a}_k(t) \tau_{ki}$$

As mentioned above, one of the main objectives of this article was to compare t-Copula with Gauss Copula as a method of counterparty risk modeling in assessing the financial risks affecting the shares of banks on the stock exchange. Based on the results of this comparison, it was argued that t-Copula's assessment of financial risks affecting stocks had a positive outcome [5].

Stock price information includes information about the characteristics of the company, which reflects the level of market efficiency, affects the distribution of resources in the stock market, and determines the effectiveness of the stock price signaling mechanism. The classical theory of market efficiency assumes that the stock price includes all the information already available, so that market news does not affect the change in the stock price. Many literary sources refute this view, stating that information in the media influences the volatility of stock prices, influencing the trading behavior of investors; that information about corporations is included in the share price together with investor information and thus affects the information content of the share price.

Daily trades on the stock exchange are in different directions, and it is necessary for economists to constantly monitor the analysis of products, funds, currencies, labor exchanges and other indicators here. Therefore, the process of mathematical modeling of the income that market participants receive is complicated, where ignoring all the factors can lead to its participants becoming unprofitable. Therefore, the forecasting of the income that banks receive from their participation in the market is directly related to changes in the stock market under the influence of external factors. Several studies have been conducted with examples of mathematical modeling of forecasting the income of stock exchange participants under the influence of external factors, on which we will briefly dwell.

The model of assessing the status of stock exchange participants in the exchange is evaluated by two conditions.

1. The stock exchange participant must make the right decision on which financial instruments to use in the formation of the investment portfolio of banks. In this case, the banks can make an independent decision or come to a clear conclusion using the information on the stock exchange.
2. A thorough study of the market by a person's psychological approach, conclusion, or selection of the most appropriate of the various financial instruments.

The modeling of stock market participants was discussed by the 1990 Nobel Prize-winning G. Markowitz [13]. In Markowitz's research, two mutually exclusive ideas for building an optimal portfolio are capital growth and maximization, and the second is loss, which is measured by the volatility of the market and the rapid fluctuations in financial instrument prices.

The model proposed by Markowitz:

1. Mathematical modeling of expected portfolio income of the first criterion (capital growth), modeling of variance of portfolio income of the second criterion (risks) (such an approach is called mean-variance);
2. The law of normal distribution of income of each security known to market participants;
3. The share of securities in the portfolio has a positive correlation.

In finding a solution to the problem, Markowitz argued that it would be expedient to implement Pareto theory of finding the optimal limit. He concludes that participants in any market make a profit based on certain mathematical models regardless of the situation. However, the second aspect of the problem is that the sequence of factors that need to be taken into account in determining the variance of the emerging situation may not allow it to achieve a definitive result. However, the model presented by Markowitz allowed creating a source of mathematical modeling of investment in the stock market. The model proposed by G. Markowitz does not fully reveal the

possibility of forecasting the income of banks on the basis of an assessment of the situation on the stock market. Because of some shortcomings of the model it does not allow a complete assessment of these cases. Therefore, several models have been proposed to further develop this hypothesis. These include the mean semi-variance model (mean-semi variance) [12], the average absolute deviation model [10], the risk-weighted average attraction model VaR [8], and the mean-CvaR [15]. also a high-reliability criterion model (Safety-first) presented by A.Roy [17]. Based on this model, not all market participants aim to make a profit, but prefer "caution". The main content of the Roy's study is as follows. If m and σ are the bank's recent expected return on investment and standard deviation. In this case, the upper limit of the "bad" message can be assessed by Chebyshev's inequality:

$$P(W \leq d) \leq \frac{\sigma^2}{(m-d)^2}$$

To minimize the likelihood of a "bad" message coming, it is advisable to replace $\frac{\sigma^2}{(m-d)^2}$ to minimize the upper limit or to change the high confidence coefficient $\frac{m-d}{d}$ to Safety-First Ratio.

According to Roy's theory, a commercial bank will be able to analyze the price of financial instruments based on the information obtained from the stock exchange and determine the future price change s_1, \dots, s_n and the standard deviation variance $\sigma_1, \dots, \sigma_n$ of the future price of n financial instruments and the correlation coefficient R_{ij} , $i, j = \overline{1, n}$ of all securities. If the bank has x_i number of $i = \overline{1, n}$ securities in the initial "quiet" state of time W_0 , then

$$m = \sum_{i=1}^n x_i s_i, \quad \sigma^2 = \sum_{i=1}^n \sum_{j=1}^n x_i x_j p_{ij} \sigma_i \sigma_j \quad \text{BA} \quad W_0 = \sum_{i=1}^n x_i$$

Roy proved that the optimal limit of Pareto is the hyperbola under the law of the correct distribution of future prices of securities and the most "safe" portfolio formula under the law of normal distribution. The formula is as follows:

$$x_i = \frac{\tau}{\sigma_i} \sum_{j=1}^n \frac{\left(P_j - \frac{d}{W_0} \right)}{\sigma_j} \cdot \frac{P_{ij}}{|R|}, \quad i = \overline{1, n}$$

Based on this, the probability of a decrease in the bank's expected income is below the critical point d :

$$P(W \leq d) = \frac{|R|}{\sum_{i=1}^n \sum_{j=1}^n \frac{\left(P_i - \frac{d}{W_0} \right)}{\sigma_i} \cdot P_{ij} \cdot \frac{\left(P_j - \frac{d}{W_0} \right)}{\sigma_j}}$$

Here is the matrix for determining the correlation coefficient $|R| - R = (P_{ij})$, the normalization coefficient under the condition $\tau - W_0 = \sum_{i=1}^n x_i$.

The model presented by Roy, i.e. minimizing risk in a “bad” market situation, allowed investors to create the concept of “risk assessment” (VAR) and other risk identification models. Through the development of these models, new concepts of portfolio management have been introduced by scientists [2]. In this case, the assessments were carried out by modeling in an arbitrary case [20] or the distribution by the law of "critical condition" [14]. Based on the above models, a “CAMP for Valuing Financial Assets” has been developed for financial asset management [18].

Like other models mentioned above, this model also has shortcomings, which are as follows:

1. It is wrong for all market participants to have the same information, earnings, and stock risk assessments.
2. Many factors affecting stock earnings have not been taken into account.
3. The fact that the value of β in the formula is evaluated differently in different countries does not allow it to come to a definite conclusion.

One of the classic approaches to forecasting future earnings based on market conditions is the Arbitrage pricing theory (APT) proposed by S. Ross [16].

The positive side of this model is that it covers all factors in estimating future income.

$$r_i = a_i + b_{i1}F_1 + \dots + b_{ik}F_k + \varepsilon_i$$

Factors F_k in the APT model include stock market indices, interest rates, inflation, GDP, and other indicators. Here, the coefficient b_{ik} determines the sensitivity of income of financial instruments i to F_k factors.

The shortcomings of this model are identified by the followings:

1. This model is designed for very large markets.
2. Many factors need to be covered when forecasting stock returns.

Hence, we analyzed that the models discussed above were designed to study the impact of external factors on the expected income of its participants as a result of changes in the market situation. However, the above circumstances do not indicate that the market is sufficient to fully describe or change its position under the influence of any external factors.

Results

On the basis of the above models, we evaluate the commercial banks of the republic on the basis of factors influencing their activities in the securities market. In the above models, it can be seen that the factors influencing the increase in the income of commercial banks through the stock market are based on the followings: changes in the stock market, the impact of various news on bank shares, changes in financial markets and the impact of various risks.

The participation of Uzbek banks in the securities market is very weak, as evidenced by the fact that the share of investments in the assets of banks is 1.5%. However, commercial banks are the

most active among the participants of the securities market of our country, which can be seen from the data in the table below (Table 1).

TABLE 1 THE ROLE OF COMMERCIAL BANKS IN THE SECURITIES MARKET OF UZBEKISTAN [21]

Indicators	01.01.2016 y.		01.01.2017 y.		01.01.2018 y.		01.01.2019y.		01.01.2020y.	
	In bln. soums	In %	In bln. soums	In %	In bln. soums	In %	In bln. soums	In %	In bln. Soums	In %
Total stock exchange trading volume	161	100	299,8	100	298,6	100	687,3	100	438,8	100
Banks	141,4	87,8	151,7	50,6	257,6	86,3	591	86	319,5	72,8

According to the table, the share of commercial banks in the stock exchanges of the country is more than 70%.

Based on the above models, if we analyze the activities of 5 commercial banks participating in the stock exchange of the republic as issuers the largest volume of shares issued by them was in the primary market in 2003.

TABLE 2 PLACEMENT OF SHARES OF COMMERCIAL BANKS ON THE PRIMARY MARKET AS ISSUERS ON THE STOCK EXCHANGE¹

Issuer	Listing Date	Nominal value	Number of listed shares	Market price at trading date (UZS)
JSCB "Uzpromstroybank"	03.09.2003	19	243 551 784 442	15,5
JSCB "Agrobank"	06.09.2003	1168	4 201 369 030	797,0
ATIB "Ipotekabank"	14.11.2003	1	2 861 787 259 906	0,79
JSCB "Qishloq Qurilish Bank"	05.12.2003	119,25	15 548 065 844	120,0
ATB Mikrokreditbank "	12.02.2008	1068	1 537 063 929	1068,0

In particular, the nominal value of shares of Uzpromstroybank amounted to 19 soums.

The authorized capital of the Bank (number of placed shares) amounted to 4,634,513,904,398 soums and it was divided into the following shares: 243,551,784,442 ordinary shares with the total value of 4,627,483,904,398 soums; - 370,000,000 preference shares with a total value of 7,030,000,000 soums².

The price of the bank's shares in the secondary market had sharp fluctuations in 2020 in the context of a pandemic. The market price of the bank on the lowest trading day in 2020 was on December 28 and amounted to 14 soums. According to the results of 2016-2020, if we pay attention to the data on the payment and calculation of dividends of JSCB "Uzpromstroybank" for 2016-2020, it will be 3.13% in 2016, 2% in 2017, 3.30% in 2018, 2019. The highest paid in the

year was 7.6%. The bank paid its shareholders a dividend of 3.3% per share in 2020 compared to the nominal price³. The return on the authorized capital of the bank was 0.216.

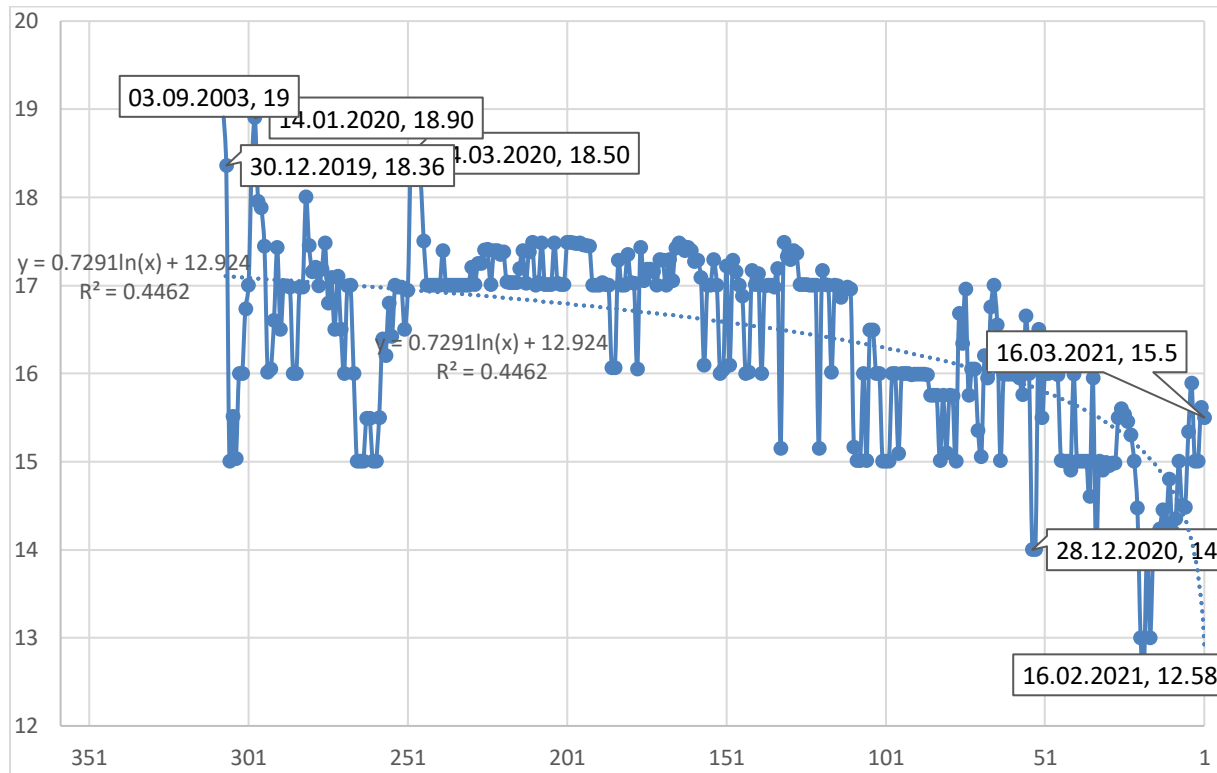


Figure 1 Diagram of changes in the share price of JSCB "Uzpromstroybank"⁴

However, when analyzing the bank's reports for 2020, the share of non-performing loans in total loans was 1.0%, while non-performing loans amounted to 379 billion. soums.

TABLE 3 NON-PERFORMING LOANS OF COMMERCIAL BANKS INFORMATION AS OF JANUARY 1, 2021 (BILLION SOUMS)⁵

№	Bank name	Loans	Non-performing loans (NPL)	Share of NPL in total loans
1.	Uzpromstroybank	39 898	379	1,0%
2.	Agrobank	24 997	308	1,2%
3.	Ipotekabank	24 304	548	2,3%
4.	Qishloq Qurilish bank	13 823	210	1,5%
5.	Microcreditbank	8 540	87	1,0%

Assets of Uzpromstroybank accounted for 13.4% of state-owned banks, 14.4% of loans, 11.5% of capital and 10.0% of deposits.

Despite the positive position of the bank in the banking market, in the analyzed years, the share price was not sold above the nominal value. The occurrence of this condition has led to an inverse imbalance if we analyze on the basis of the above models.

**TABLE 4 KEY PERFORMANCE INDICATORS OF COMMERCIAL BANKS
INFORMATION AS OF JANUARY 1, 2021⁶**

№	Bank name	Assets		Loans		Capital		Deposits	
		Amount	%	Amount	%	Amount	%	Amount	%
1.	Uzpromstroybank	49 045	13,4%	39 898	14,4%	6 704	11,5%	11 437	10,0%
2.	Agrobank	31 211	8,5%	24 997	9,0%	5 371	9,2%	9 037	7,9%
3.	Ipotekabank	32 410	8,9%	24 304	8,8%	4 274	7,3%	9 499	8,3%
4.	Qishloq Qurilish bank	15 923	4,3%	13 823	5,0%	2 414	4,1%	3 777	3,3%
5.	Microcreditbank	10 283	2,8%	8 540	3,1%	1 738	3,0%	2 383	2,1%

Similarly, if we analyze the situation of Qishloq Qurilish Bank, the number of shares issued by the bank in 2003 amounted to 15,548,065,844, with a par value of 119.25 soums. The trend of changing the market price of the bank's shares in 2020 can be assessed as positive to a certain extent. The lowest price of the Bank's shares in the secondary market was 100 soums on February 28, 2020, while the highest price (relative to the nominal price) was 122 soums on January 27, 2021.

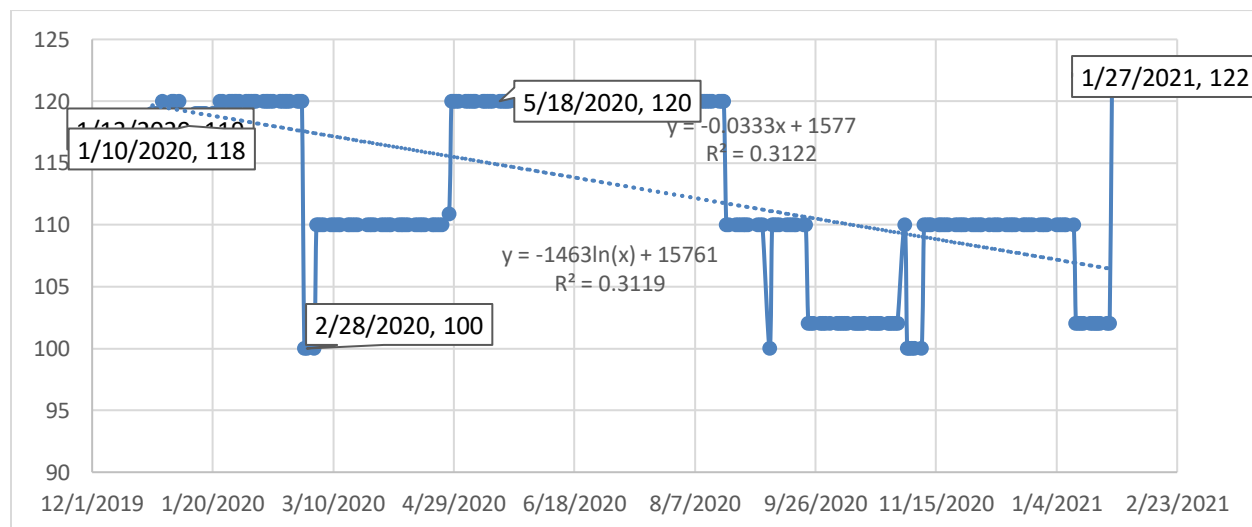


Figure 2 Diagram of change in share price of Qishloq Qurilish Bank⁷

Dividends paid by the bank to shareholders in 2016 amounted to 8.71% on ordinary shares, unpaid in 2017, 2.52% in 2018, and unpaid in 2019, while in 2020 the amount of dividends on ordinary shares was only 6.79%⁸.

Among the state-owned banks QQB accounted for 4.3% of assets, 5.0% of loans, 4.1% of capital and 3.3% of deposits. Return on equity was 2.8%. The solvency ratio was 175.8%, the absolute liquidity ratio was 79.7%, the ratio of own funds to borrowed funds was 21.3% and the ratio of the issuer's own funds to borrowed funds was 24.3%.

The next bank analyzed was Agrobank, which in 2003 had 4,201,369,030 shares with a par value of 1,168 soums. The bank's shares in subsequent years were sold at prices lower than their face value. In particular, the lowest figure was 424 soums on November 9, 2020, and the highest figure was 1150 soums on January 3, 2020.

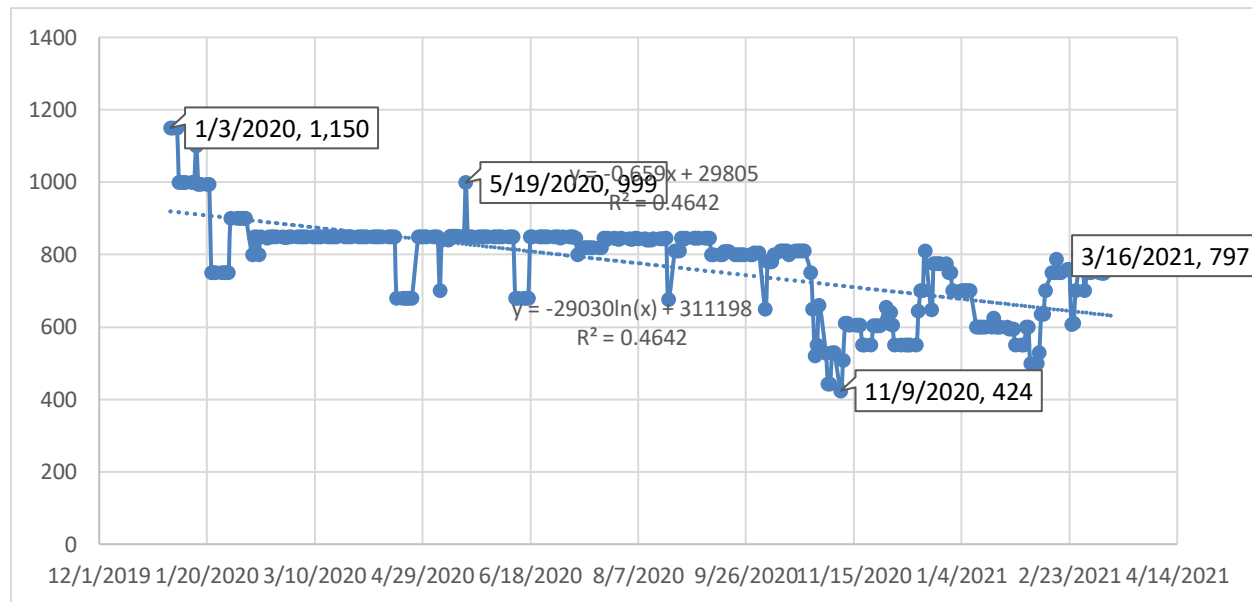


Figure 3 Diagram of changes in the share price of Agrobank⁹

Among the state-owned banks Agrobank accounts for 8.5% in terms of assets, 9.0% in terms of loans, 9.2% in terms of capital and 7.9% in terms of deposits.

Despite the positive performance of the bank in the banking market, the stock price on the stock market was sold at a lower level than the nominal price.

DISCUSSION

Based on the analysis, the following controversial cases were observed.

Firstly, based on the t -Copula model, Uzpromstroy and Agrobank had a high level of sensitivity to financial risks affecting them in 2020 based on the price fluctuations of their shares. As a result, the bank's shares were sold at a lower price than the face value.

Secondly, based on the Safety-first model presented by A.Roy, the share prices were decreased by market participants on the basis of the bank's "Bad" news. According to Roy's rule for the correct distribution of future securities prices, the Pareto optimal limit is logarithmic and, according to the law of normal distribution, is "the safest". For Uzpromstroybank it is $y = 0,729 \ln x + 12,924$ with the reliability coefficient of $R^2 = 0,4462$. For Agrobank accordingly $y = -29030 \ln x + 311198$ and $R^2 = 0,4642$. As a result, the probability of a decrease in the expected income of banks was below the critical point d .

Thirdly, the weak demand for bank shares issued in 2003, as a result of the fact that the shares were not freely traded in the secondary market for many years, has lowered the bank's image in the market.

Fourthly, the stock market rule was reversed. Despite the fact that the banks have a high share in the banking market on all indicators, its shares were sold at prices below par.

CONCLUSION

Based on the analysis and controversy, the following conclusions were drawn.

1. Increasing the demand for shares of commercial banks by further developing their activities in the secondary securities market.
2. Expanding the bank's sphere of influence and attracting new customers by participating in the capital of enterprises and organizations.
3. Based on the *t*-Copula model, it is necessary to assess the financial risks that affect the change in the price of shares of banks in the stock market.
4. Based on the model of high reliability (Safety-first) presented by A. Roy, it is expedient to assess the impact of any information in the market on the image of the bank.
5. It is necessary to expand the participation of banks in the capital of non-bank credit institutions, as well as in the capital of legal entities that are part of the financial market infrastructure or provide information and advisory services to banks.

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