# Effectiveness of forbearance measures for Russian commercial banks in the current crisis

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### Abstract

Due to the COVID-19 pandemic, real GDP of Russia is expected to fall by 4-6%. The banking industry provides liquidity to Russian business in times of hardship. On the one hand, the Bank of Russia facilitates lending opportunities for the business and subsidizes the mortgage interest rate for banks and the public in order to prevent business bankruptcies. And on the other hand, it provides liquidity to banks via REPO (repurchase agreement) auctions. Currently, there is not enough demand for REPO transactions from banks, but it might increase after other measures of support begin to be canceled. The article studies the effectiveness of current forbearance measures for Russian banks and provides an insight into the future development of the banking industry after the COVID-19 pandemic.

**Keywords:** banking sector, commercial banks, COVID-19 pandemic crisis, forbearance measures, liquidity, REPO.

**JEL:** G21, G28, G29.

# Introduction

The current economic crisis caused by COVID-19 has put banks in Russia on high alert as banking standards remain the same, but the crisis is undermining lenders' ability to pay off their mortgages and loans. Already in March 2020, the government of Russia came up with a number of supporting measures and recommendations to commercial banks. The goal of the article is to evaluate the effectiveness of the state support measures to Russian commercial banks in the current crisis and recommend further actions and changes to support and develop the banking sector.

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In March 2020, the Bank of Russia recommended commercial banks to soften the conditions of loans to people. At the same time, the Bank of Russia grants indulgences when checking accounts of banks according to the national requirements. All measures are aimed at increasing lending to the economy in a crisis. Initially, the measures of support included the following:

- temporary cancellation of capital premium requirements
- benefits for banks when revaluing shares and bonds in their asset portfolios
- the possibility for banks to use the old ruble rate when calculating portfolios of assets for their basic standards and requirements.

The first challenge for the banks is the loss of capital due to the ruble devaluation after the fall in oil prices. Russian banks that have a large amount of debt securities on their balance sheet bear the greatest risk. The state-owned Otkritie Bank<sup>1</sup> has a volume of securities on its balance sheet exceeding 250% of its own funds under IFRS, and RSHB<sup>2</sup> (Russian Agricultural Bank) is approaching 200% of its own capital. Otkritie and RSHB are the leading banks in Russia and are most vulnerable to the current volatility in the market based on these criteria. These banks could not hedge their debt securities because hedging did not work in this soft market.

The current challenges of banks are clear — oil prices, rubles devaluation, asset revaluation, financial shocks in the global market, business disruptions, and cheap credit. The next challenge is potential credit losses and an increase in reserves due to an increase in bad debts and a decrease in the quality of loans. This paper evaluates how the five largest Russian banks can respond to these challenges and what risks exist in the current crisis. As a result, support measures and their effectiveness will be assessed.

# 1. Materials and methods

The following officially announced by the Bank of Russia measures of support are considered to be the main ones affecting the positions of banks and important for this research:<sup>3</sup>

- the Bank of Russia entitles credit institutions not to recognize loans as restructured for the purpose of creating reserves and not to apply macroprudential add-ons to such loans
- entitles credit institutions not to increase reserves on loans to individual borrowers
  of the Bank of Russia in case of worsening of their financial standing and/or the
  quality of debt servicing
- allows credit institutions to include operations in six foreign currencies (US dollar, pound sterling, Swiss franc, Japanese yen, and Chinese yuan) in their required ratios calculations (excluding calculations of the values (limits) of open currency positions) at the official exchange rate of the respective currency

https://ir.open.ru/reports?from=footer& ga=2.226954717.1726678754.1598033634-140232270.1598033634

<sup>&</sup>lt;sup>2</sup> https://www.rshb.ru/investors/msfo/

<sup>&</sup>lt;sup>3</sup> http://www.cbr.ru/eng/press/pr/?file=23032020\_170800eng2020-03-23t17\_07\_10.htm

- maintains the national countercyclical capital buffer at zero per cent
- limits the application of administrative sanctions primarily for non-compliance with reporting deadlines, violation of corporate legislation, and violation of legislation on credit history bureaus.

These measures are of primary importance for supporting the economy and commercial banks in the current crisis. The bond market was not affected. The banking system has seen the structural liquidity surplus since 2017 and remained in that position. Nevertheless, the Bank of Russia had to provide markets with extra ruble liquidity through regular short-term fine-tuning REPO to relieve stress from spikes in margin payments and an increase in demand for cash in circulation amidst the lockdown. Even though the banking system retained a structural liquidity surplus, the distribution of this liquidity is uneven, and shifts in the assets and liabilities of banks' balance shits in the conditions of lockdown and loan reprofiling complicate their liquidity management in the interim period.

As noted before, the Bank of Russia terminated capital buffers and introduced a number of temporary regulatory forbearance measures to support debt restructuring and prevent procyclical behavior of the financial system. Currently, macroprudential buffers in the system are sufficient to compensate for losses.

The Bank of Russia introduced REPOs for 1 month and 1 year (with a narrower pool of collateral than its regular operations) to assist banks during this period and reduce the need for the use of fine-tuning operations. However, there were no orders from banks during the first REPO, which confirms that the liquidity conditions in the banking sector are quite normal currently. The Bank of Russia also increased the limit of standing FX swap facility, which was similarly not tapped by the market. Using the Bank of Russia's REPO statistics, statistics of the banking sector, and bad debts statistics in the banking sector, the author analyzes the recent measures and compares them to the past measures introduced during the crisis of 2014–2015.

Despite all this, in 2020 the Moody's rating agency has lowered the outlook<sup>4</sup> for Russia's banking system from stable to negative as banks' asset quality and profitability is expected to deteriorate and real GDP is expected to fall by 4-6%. This desision is continued up to this day. Therefore the situation requires a closer look at the measures which have been introduced to counteract the slump.

# 2. Theoretical approach

There is a lot of literature on the topics of financial crises, but, as Reinhart and Rogoff say in their book, "This time is different," which means that each crisis is special, and we cannot predict the consequences (Reinhart & Rogoff, 2009). The only thing we can do is evaluate the latest financial positions of banks and see how support measures affect the financial situation on a time scale. The Bank of Russia's policy of macroeconomic

<sup>&</sup>lt;sup>4</sup> https://www.moodys.com/research/Moodys-takes-rating-actions-on-four-banks-in-Russia--PR\_422928

regulation and the effectiveness of its implementation are related to the problem of irrational behavior of microeconomic subjects (commercial banks) and the asymmetry of information distribution.

The theoretical prerequisites for the irrationality were highlighted in the work by D. Kahneman and A. Tversky (1979, 1986, 2013). The biological reasoning behind the abundance of irrationality arises as an interdisciplinary field that uses neuroscience tools to describe the state of market bubbles and economic phenomena (Lo, 2011; Rangel et al., 2008, Brennan et al, 2011). J. Zweig links economic irrationality with addiction to predicting. It seems possible to achieve some kind of perfection if you predict the further. Real rationality cannot exist for humans (due to a gap between computers and humans) because of their desire to control random processes (Zweig, 2007). The theory of rational irrationality assumes systemic biases to repetitive decisions (predictably irrational). This leads to a transformation of the meaning from optimal basis to systemic preference (Adland & Cullinane, 2005). Based on rational irrationality, we can explain the unknown and changing part of economic development.

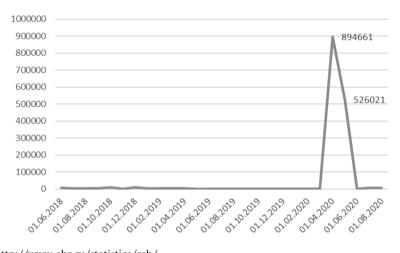
The problem of information distribution asymmetry enhances the irrationality of economic decisions. Signaling theory explains how signals penetrate and are distributed between agents. The essence of signaling theory is that some agent transmits some information to the principal. Signaling theory developed on the basis of empirical data on the incompleteness of the information received (Akerlof, 1970; Stiglitz, 1979). The interdependence of signaling theory and the theory of irrationality is described in a work by L. Weber and K. Meyer. The authors identified the need for agents to take into account the problems of distorted perception of macroeconomic signals when making rational decisions (Weber & Meyer, 2010).

For this article, the author analyzed policy measures introduced by the Bank of Russia and the reaction of banks to these measures.

REPO as a means of support. Since the 2014 crisis, the first long-term REPO auction designed to stabilize liquidity in the banking sector with a minimum interest rate equal to the central bank's key rate plus 0.1 percentage points was held on May 25, 2014. The first REPO auction for 500 billion rubles (with interest rate 5,6% per annum) did not take place due to lack of demand from banks, which suggests that banks had enough liquidity by that time. The second attempt of a one-year REPO auction was held on June 22, 2014, with a floating rate equal to the key rate plus 0.25 percentage points. Since then, long-term REPO auctions were held every month to support bank liquidity. The collateral for these REPOs was government bonds and municipal bonds with the highest credit rating.

Liquidity vs. profitability. Banks have to sacrifice profitability to have enough liquidity. The "liquidity cushion" in banks is mainly formed by the assets of legal entities in bank accounts. Credit institutions, especially medium-sized and small ones, are forced to support their liquidity rather than place their assets for profitability. According to the Central Bank, on May 22, 2014, the structural liquidity surplus in the banking sector was 1.54 trillion rubles. This is equal to the April liquidity surplus after banks experienced a serious outflow of deposits in March.

The monthly REPOs were not in sufficient demand among banks, but one-year REPOs can become a source of additional marginal profitability for banks instead of funding classic lending operations. In the current crisis, the number of new loans is decreasing as risk management is tightening. It is highly possible that the funds attracted in the framework of REPO auctions will not become a driver of a decrease in lending growth rates. But they will support the banks' income base, taking into account the reduction in interest income on traditional lending operations.



Source: http://www.cbr.ru/statistics/rcb/

**Figure 1.** Debt securities owned by Russian banks transferred as part of REPO transactions with the Bank of Russia (million rubles) from 2018 to 2020

The REPO volume has decreased significantly compared to 2016. In 2018, the total amount of REPO was small and the banks had enough liquidity, but in 2020 and 2021, due to the crisis, they had to go for long-term REPOs in April 2020 and May 2020. Meanwhile these figures are not comparable with the REPO volume back in 2013–2017 when it reached 4,173 billion rubles in May 2015 (Figure 2).

REPO is intended to provide liquidity to Russian commercial banks<sup>5</sup> through tri-party REPO trades with the Bank of Russia, involving NSD's collateral management services (CMS). The purpose of the REPO is to offer more trading and settlement opportunities to market participants and help them reduce their costs.

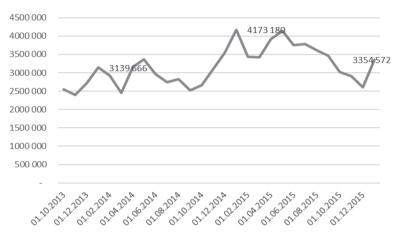
The Bank of Russia's REPO trades with a securities basket were launched on April 15, 2013, and any Russian credit institution that satisfies the Bank of Russia's eligibility requirements can use the service. REPO trades can be made only on behalf and at the expense of the credit institution itself, and only the owner's securities accounts can be used for allocation and settlement of securities.

With effect from January 1, 2017, the Bank of Russia introduced a new standard form of a universal master agreement, according to which it is possible to enter into on-

National Settlement Depositary. Bank of Russia's REPO trades with a securities basket. https://www.nsd.ru/en/services/collateral-management/cbr/

exchange REPO trades with the Bank of Russia with a basket of RUB/USD-denominated securities. On June 19, 2017, the Bank of Russia's REPO trades using NSD's collateral management services were launched on the Moscow Stock Exchange.

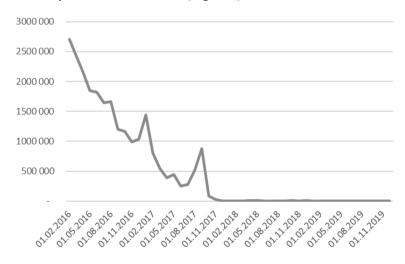
The volume of REPO trades was 2,554 billion rubles in October 2013 and reached 3,354 billion rubles in January 2016, then the volume of REPO began to decrease (Figure 2).



Source: http://www.cbr.ru/statistics/rcb/

**Figure 2.** Debt securities owned by Russian banks transferred as part of REPO transactions with the Bank of Russia (million rubles) from 2013 to 2016

The volume of REPO trades was 2,600 billion rubles in October 2016 and began to decrease to very low volumes in 2017 (Figure 3).



*Source*: http://www.cbr.ru/statistics/rcb/

**Figure 3.** Debt securities owned by Russian banks transferred as part of REPO transactions with the Bank of Russia (million rubles) from 2016 to 2019

No need to say that in 2014–2015, the crisis REPO was a very valuable source of eliminating the liquidity disbalance. In 2020, the banking sector was handling the situation with its own liquidity surplus, keeping clients' assets in access rather than investing them for marginal profits, and as a result, the volume of repos traded was significantly lower than during the 2012–2015 crisis, which showed that Russian banks had enough liquidity by that time.

How can indirect non-banking measures affect the banks? In crisis times, risk management becomes the most vulnerable sphere of the banking industry. The consequence of higher standards when approving loan decisions is a decrease in loan volumes provided by financial institutions to public and legal bodies. Higher standards of risk management lead to lower margins and profitability during a crisis. Meanwhile, the quality of banks' credit portfolios is declining as customers suffer from low demand, and as a result, banks have to add reserves for their financial statements. That is why financial aid provided to corporates and different sectors of the economy indirectly affects the banking sphere and increases its financial strengths if the measures are adequate and effective.

Lower borrower rate. The key instruments of financial support are bank loans at reduced interest rates for SMEs and other borrowers. The state partially compensates banks for interest losses via subsidies. The Bank of Russia has introduced regulatory reliefs for credit institutions in order to encourage loan restructuring and has expanded its refinancing programs for SME loans.

If a person is diagnosed with Covid-19, the bank at which this person has a credit is now allowed to charge him extra fee till the end of 2020, and banks must not use his or her property for a repayment scheme. Meanwhile, the bank may receive money and subsidies for restructuring its own portfolio.

Bank loans for systemically important companies at reduced rates. Bank loans for working capital can be provided to systemically important companies for up to 12 months and for no more than 3 billion rubles per each borrower. The interest rate cannot exceed 5%. The state will cover the banks' loss of interest through subsidies. Borrowers can also apply for state guarantees to secure repayment of the loan.

The government plans to support systemically important companies on an individual basis and will provide individual support to systematically important companies when their owners and banks exhaust their own ability to support the company for the first time.

Interest-free bank loans to cover wage payments in SMEs. Companies can apply for a credit to pay wages to their employees for a period of six months. Banks are entitled to state subsidies to compensate for the loss of interest on such loans for a six-month period. The amount of the loan depends on the minimum statutory monthly wage and the number of employees. But SMEs are not allowed to dismiss more than 10% of their employees during this six-month period.

Credit holidays for individuals and SMEs. This project has previously been widely discussed by the Bank of Russia. The main reason that stopped this project was: Who will compensate for the credit holidays while people are not paying? COVID-19 pushed the project forward without much further thought. Lenders suspended payments

on mortgages and other loans for up to six months — until September 30, 2020. Instead of a deferral, entrepreneurs can seek a reduction for payments during the grace period. Penalties are not accrued during credit holidays. In order to be eligible for credit holidays, individuals had to lose more than 30% of their income compared to their average monthly income in 2019.

Subsidies to banks to support grace periods for SMEs. The state provides subsidies to banks that have granted SMEs operating in the most affected sectors a grace period for up to six months (in relation to loans granted before April 1, 2020). The number of subsidies is limited to one third of the interest payments due from a SME-borrower during the grace period. The borrower is to pay one third of the interest payments due for the grace period and is released from paying the remaining two thirds.

Bank loans to support the construction sector. The construction sector is less reliable but it is one of the most profitable in Russia. Meanwhile, it has the highest percentage of bad debts among other sectors of the economy. It was expected that many construction companies could go bust, as the process of construction stopped during COVID-19. But the construction sector sacrificed marginal returns and started to sell apartments online, which eventually left main constructors and building companies with the same credit ratings, and support measures for mortgages implying lower interest rates brought sales to a high level. Covid-19 could have negatively affected sales, but the state subsidized mortgage interest rates so that banks could provide them at reduced rates, and this helped the industry and banks maintain the level of mortgages and long money.

## 3. Results

The REPO instrument was a very valuable source of eliminating liquidity disbalance. In 2020, the banking sector was handling the situation with its own liquidity surplus, maintaining access to clients' assets rather than investing them to obtain marginal profits, and as a result, the volume of REPO transactions was significantly lower than in the 2012–2015 crisis, which showed that Russian banks currently had enough liquidity. But the situation is changing in 2021.

As for indirect measures, such as support for the public, SMEs and corporates, we can conclude that the banking industry compensates for its returns via subsidies for lower interest rates. These indirect measures are essential to prevent the economy from falling, but at the same time they will lead to a long-term recovery period.

Now all sectors of the economy share the economic downturn, and the rise of the economy will be gradual but slow. Measures of support help all industries remain safe and credible.

So far, Russian support measures have been valuable for banks and the corporates that have indirectly influenced the banking sector. Subsidized mortgages did not allow the banking sector to significantly reduce the number of operations. At the end of March 2020, the Bank of Russia stopped bank checks due to COVID-19 and continued them from July 1. Thus, already on July 15, the Bank of Russia revoked the 5<sup>th</sup> license in 2020

from the People's Bank of the Republic of Tyva.<sup>6</sup> This was the first bank to lose its license after COVID-19. The main reason was that the bank had a small loan portfolio, which had 40% of bad debts. A significant share of the bank's assets (over 80%) consisted of real estate objects, including unused in its core activity. The bank's activity has been unprofitable for more than five years, which proved the inefficiency of the business model of the credit institution and resulted in the revocation of the license. Another 10 banks may lose their licenses as a result of the crisis and the reduction of the banking industry. The People's Bank of the Republic of Tyva took the 416<sup>th</sup> place among other banks in Russia.

The current crisis has shown that the main risk concerns small banks outside the top hundred, banks specializing in lending to SMEs and individuals and having insufficient capital reserves. It is expected that during the current 5 years many small banks will leave the market and the concentration of the banking sector will increase owing to the big players.

This means that the government support of banks is insufficient for small and medium-sized banks that mainly operate on the basis of the business model of commercial credits to public and legal bodies. This model is too risky in the current crisis and not subsidized by the state support. As soon as small banks report, their financial situation with bad debts will be obvious, and we expect that such banks will become the objects of investigations by the Bank of Russia, which usually lead to the revocation of licenses. Large and strong systemic banks will retain their competitive advantages, while weak banks will become weaker.

State support measures in the form of subsidized interest rates for mortgages help businesses in large banks that deserve the trust of clients, while the rest of the population, who cannot afford mortgages in large reliable banks, turns to smaller credit organizations, which in crisis time leads to an increase in the number of bad debts as the unemployment rate rises.

The measures of state support applies only to large banks giving them confidence that there will also be customers tomorrow, while small and medium-sized banks have to sacrifice their marginal profits in order to leave the assets of legal bodies for liquidity purposes and follow the requirement and regulations. Large banks have liquidity thanks to state support, while small banks go bust or lose profit — this is the expected scenario.

# 4. Discussion

What can be changed in the government support measures to benefit not only large banks but also to redistribute support to medium and small players? The answer to this question, on the one hand, depends on the uncertainty about the duration of the pandemic and its impact on the global economy. When the pandemic ends, the economy will recover and banks will be able to restore their activity in line with economic growth.

<sup>&</sup>lt;sup>6</sup> Bank of Russia. News. https://www.cbr.ru/press/pr/?file=14072020\_050410bank.htm

If the pandemic does not end in the next 2–3 years the current state aid to the banks and the population will lead to the bankruptcy of small and medium banks and their life cycle will depend on how much these banks have managed to save in terms of capital.

The increase of volume of bad debts in the banking industry amounted to 20% y-o-y by January 1, 2020, which proves that the banking sphere had a very high risk before COVID-19. By April 1, 2020, the increase of volume of bad debts for 3 months was +4% and by August 1, it was +14% from January 1, 2020 (Figure 4). Now there is a positive upward trend in the growth of bad debts in the banking sector, which is also confirmed by an increase in the volume of bad debts in the total amount of credits.

The increase in the volume of bad debts in the entire amount of credits is due to the weakening of requirements for bank portfolios during the COVID-19 period , but as soon as the measures of support stop and banks have to face real situations with portfolio revaluation and bad debts provisions, the situation may become worse.

Elvira Nabiulina, head of the Bank of Russia, said that the economy had a substantial buffer to counteract the pandemic, but she thought that not all measures had yet been taken to maintain policy space in case the pandemic had a longer duration. Therefore, the Bank of Russia has not yet used all the ammunition at once and is ready for potential future shocks. "As a sizable permanent loss of potential GDP is inevitable, but it is hard to judge with confidence how large that could be in the long-run. Moreover, sizable structural shifts in the composition of economic activities, and hence employment, are also almost predetermined." <sup>7</sup>

Most likely, a shock for small banks is inevitable. If we talk about captive banks that service production companies or factories in terms of giving credits to employees of these companies, then we can say that such banks will survive.

Small banks that are working on business models of commercial loans or car loans for the public or SMEs are likely to faced very big difficulties in 2020–2021, as the state support measures simply went against them — they could not charge clients if they did not pay on loans, the margins were low, clients left and created deposits in large reliable banks. Nowadays, the shrinking of the banking sector is an inevitable consequence of the economic slump.

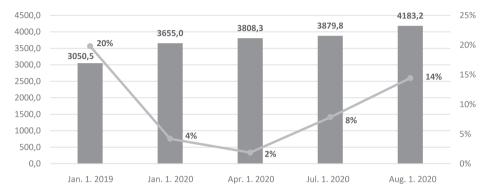
# **Conclusion**

Russia's banking industry suffered in 2020–2021 due to the coronavirus lockdowns and the country's economy is expected to gradually shrink. After the government stops supporting to the public and businesses, banks will be able to see the results when the bad debts in the banking sector increasys what may affect small and medium banks.

Large banks receive sufficient state support and REPO auctions should support them if the situation becomes worse. To date, REPOs have not been used to the same extent as in the 2014–2015 crisis.

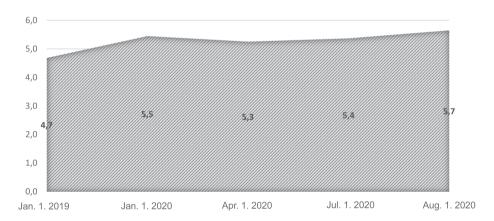
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The increase in the volume of bad debts in the banking industry amounted to 20% y-o-y by January 1, 2020, which proves that the banking sphere had a very high risk before COVID-19. By April 1, 2020, the increase in the volume of bad debts for 3 months was +4% and by August 1, it was +14% from January 1, 2020 (Figure 4). The trend is positive for the increase in the volume of bad debts in the banking sector, which is also confirmed by an increase in the volume of bad debts in the total amount of credits from 5,5% on January 1 to 5,7% on August 1 (see Figure 5).



Source: https://www.cbr.ru/statistics/macro\_itm/dkfs/

Figure 4. Bad debts in the banking sector of credit assets (billion rubles)



Source: https://www.cbr.ru/statistics/macro\_itm/dkfs/

**Figure 5.** The volume of bad debts in the total amount of credits in the banking sector in 2019–2020 (%)

The increasing volume of bad debts in the entire amount of credits is due to the weakening of requirements for bank portfolios during the COVID-19 period, but as soon as the measures of support stop and banks have to face real situations with portfolio revaluation and bad debts provisions, the situation may become worse by the end of the year.

Measures of government support proved to be very helpful for SMEs and people with loans who received credit "holidays," for construction companies and large banks that managed to capitalize on the boom in mortgage which was incentivized by subsidizing the interest rate.

Small and medium-sized banks could get the support of REPO auctions to provide liquidity, but currently the demand for this instrument is low as banks rely on their own capital buffer.

Only one bank lost its license due to COVID-19 with low capital adequacy and high bad debts which turned out to be an unprofitable business model. How many banks will face the same result in 2021–2022? It's just a matter of time before we get an answer to this question. Experts predict that, most likely, very soon we will see the revocation of banking licenses from 15–30 banks.

Our proposal on measures to support small and medium-sized banks will be to prevent the death of business and consumption as small and medium-sized banks traditionally work with SMEs and the bond between them is very strong. As long as SMEs survive, small and medium-sized banks will be alive, but what business model banks will choose during the crisis — it is another story. The orientation should now be reset from profit to following bank requirements.

Meanwhile, the Bank of Russia may temporarily soften its approach to bank risk management and continue support measures. Subsidized mortgages help construction companies continue to conduct their business in the regions and prevent local banks from defaulting. Recommendations on measures to support the banking sector should include the following:

From the regulator's side:

Access to immediate liquidity, which is already provided by the Bank of Russia.
 During banking crises, liquidity runs out. In this case, the central bank either funds for a short time, or does not give anything at all. In the crisis of 2020–2021, there are good chances for banking liquidity through REPOs.

From banks' side, it is expected that banks should pay attention to:

- 2. Bad debts decrease and enhanced risk management, which implies fewer loans to questionable business activities.
- 3. Revision of prices for the main products in the bank's portfolio, changes in interest rates and negotiations with the central bank on the revision of reserve requirement rates this allows to increase the amount of cash and strengthen the bank's liquidity.
- 4. Restructuring of doubtful debts and revision of the credit portfolio.

# References

Adland, R., & Cullinane, K. (2005). A time-varying risk premium in the term structure of bulk shipping freight rates. *Journal of Transport Economics and Policy*, 39(2), 191–208.

Akerlof, G. A. (1970). The market for «Lemons»: Quality uncertainty and the market mechanism. *The Quarterly Journal of Economics.* 84(3), 488–500.

- Boyd, J., Ringold, P., Krupnick, A., Johnson, R., Weber, M., and Hall, K. (2015) Ecosystem Services Indicators: Improving the Linkage between Biophysical and Economic Analyses. *Resources for the Future Discussion Paper*, 15–40.
- Brennan, T., & Lo, A.W. (2011) The Origin of Behavior. *The Quarterly Journal of Finance, 1*(1), 55–108.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk, *Econometrica*, 47(2), 263–291.
- Kahneman, D., & Tversky, A. (1986). Rational Choice and the Framing of Decisions. The Journal of Business, 59(4), 251–278.
- Kahneman, D., & Tversky, A. (2013). Choices, Values, and Frames. World Scientific Handbook in Financial Economics Series, Handbook of the Fundamentals of Financial Decision Making, 269– 278.
- Lo, A.W. (2005). Reconciling Efficient Markets with Behavioral Finance: The Adaptive Markets Hypothesis. *Journal of Investment Consulting*, 7(2), 21–44.
- Lo, A. W. (2011). Fear, greed, and financial crises: A cognitive neurosciences perspective. In J. Fouque and J. Langsam (Eds.), *Handbook on Systemic Risk*, Cambridge University Press.
- Rangel, A., Camerer, C., & Montague, P. R. (2008). A framework for studying the neurobiology of value-based decision making. *Nature Reviews Neuroscience*, 9(1), 545–556.
- Reinhart, C. M., & Rogoff, K. S. (2009). This time is different: Eight centuries of financial folly. *Princeton University Press*. https://doi.org/10.1515/9781400831722
- Reinhart, C. M., & Rogoff, K. S. (2013). Banking crises: An equal opportunity menace. *Journal of Banking & Finance 37*(11), 4557–4573.
- Sargent, T. J. (1993). Bounded rationality in macroeconomics. Oxford (pp. 21–22).
- Stiglitz, J. E. (1979). Equilibrium in product markets with imperfect information. *The American Economic Review*. 69(2), 339–345.
- Weber, L., Meyer, K., & Hall, B. (2010). Expanding the concept of bounded rationality. In *Implications* of perceptual uncertainty for hybrid governance. Atlanta Competitive Advantage Conference.
- Zweig, J. (2007). Your money and your brain: how the new science of neuroeconomics can help make you rich. *Simon & Schuster*.