

# Developing a Lead Indicator of Financial Stability in the Russian Federation

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**The objective of this study is the development of a system of early warning indicators of financial instability for Russia, which seems an urgent task given the high level of vulnerability that the Russian economy exhibits *vis-a-vis* various internal and external shocks. The result of our research is, what we have called, the Otkritie-GIEP Index of financial stability.**

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The global economy has faced a number of financial crises during the 1990s - 2000s, significantly inhibiting its development. Crisis episodes were observed in Mexico, Southeast Asia, Russia, and the US, among other areas, and those numerous crises impacted a majority of the world's economies. These developments have encouraged studies designed to ascertain key indicators that could provide timely recognition of the vulnerability of the global economy to financial crises. In such studies, researchers endeavor to select those economic indicators that possess the greatest predictive power, i.e. ones that allow early detection of an upcoming wave of financial instability.

We would like to note that it is important to understand the limitations of the proposed system of indicators. First, this methodology provides only some information on emerging trends of financial instability, while in no way can it show whether or not a financial crisis will actually occur. Second, analysis of indicators/precursors allows researchers to monitor long-term trends of economic development. Thus, some negative long-term trends can be mitigated by factors that are favourable in the short run. However, given a backdrop of deteriorating conditions, accumulated negative developments in the economy could still provoke financial instability.

Finally, the threshold indicators are assessed on the basis of their pre-crisis dynamics as seen in Russia in 1992 - 2011. This allows one to 'tune' the threshold values more accurately in order to identify specific problems in the Russian economy, but makes them less sensitive to the new types of crises. In other words, the use of our proposed methodology cannot reliably predict a financial crisis. At the same time, the system of indicators/precursors provides an opportunity to identify adverse trends in the economy in advance, and then to take measures designed to eliminate them.

To build a system of indicators/precursors of financial instability in Russia, we utilize the so-called 'signal' approach, first proposed in a study by Kaminsky, Reinhart and Lizondo in 1998<sup>1</sup>. A literature review and our experience have allowed us to create a list of indicators with the potential for indicating impending financial instability<sup>2</sup>. The list includes a wide range of macroeconomic indicators for the Russian economy, which were selected based on the following criteria. First, we considered only those indicators that are published at least once a month, which permits updating of monthly estimates. Second, potential indicators/precursors of financial instability include only figures published by the 15-20<sup>th</sup> of the month following the reporting period. This criterion is used to ensure real-time monitoring.

Our indicators/precursor of financial instability can be separated into several categories:

**1. Monetary indicators (monetary aggregate M2, the money multiplier, core CPI, the amount of bank deposits with the RF CB and BBR with commercial banks)**

Often the monetary indicators are very useful in predicting the instability of the financial system. Thus, increased financial sector vulnerability is demonstrated by monetary expansion, reflected in the rapid growth of the money supply and the rise in consumer prices. Rapid price growth makes it difficult to assess credit risk and increases uncertainty.

A key indicator within this category is the money multiplier, a significant increase in which may be a sign of weakening procedures for the selection of borrowers by commercial banks. Reduction of bank liquidity, reflected in falling bank deposits with the CBR and BBR with commercial banks, is also a symptom of financial instability.

**2. Interest rates (the rates in the interbank market, mid- and long-term rates in the GKO-OFZ market)**

Interest rates are fundamental features of financial markets. The most important indicator in this category is the interest rate in the interbank market. The growth of the interest rate may be indicative of increased risk in the financial sector, and of rising distrust of banks toward each other. A sharp decline in interest rates (in our case - the medium-term rates in the GKO-OFZ) is also an unfavorable indicator, since the volatility of interest rates increases the interest rate risk.

**3. Balance of payments indicators and foreign exchange markets (International reserves of the Central Bank of Russia, the ratio of monetary aggregate M2 to international reserves, real ruble exchange rate against the U.S. dollar)**

Balance of payments' indicators allow researchers to track the approach of external shocks and furnish a timely warning of a greater likelihood of problems within the Russian economy, which remains highly dependent on the global demand for energy. An obvious indicator in this category is the price of oil, but its high volatility and the almost instantaneous reaction of the Russian financial system to oil price variations do not allow for its use as a reliable indicator/precursor of financial instability. Meanwhile, factors closely correlated with oil prices indicators, such as the international reserves of the CBR and the real ruble exchange rate against the dollar, are included within our system of indicators.

The sharp increase in the ratio of monetary supply to international reserves is regarded as a clear indication of increasing financial instability. At the same time, the rapid expansion of reserves of the Central Bank may also be a sign of future instability, constituting a warning that the economy is overheating and that inflationary pressures could be on the rise.

<sup>1</sup> Kaminsky G., Lizondo S., Reinhart C. Leading Indicators of Currency Crises // IMF Staff Papers. 1998. Vol. 45 (March). pp. 1-48.

<sup>2</sup> A brief description of the methodology is given in the Appendix. In addition, a full description of the international experience and methodology can be provided on request.

Index of real exchange rate, the growth of which leads to decreased competitiveness of local producers and could cause a slowdown in economic growth, is also closely related to the terms of trade.

#### 4. Stock markets indicators (the RTS index, MICEX index of corporate bonds, government bonds index RGBI)

Investor behavior in stock markets often aids in predicting forthcoming economic problems. We believe that a significant reduction in the Russian stock market is an indicator of possible future problems in the financial sector, reflecting the uncertainty of investors *vis-a-vis* the Russian economy. In addition, growth of the stock market at too rapid a pace is a negative sign of the increased risk of a 'bubble'.

We will demonstrate the state of the set of indicators/precursors of financial instability before the crisis events took place in Russia (see Table below).

**Figure 1. The system of indicators/precursors of financial instability before the crisis events in Russia**

| Crisis event  | Number of indicators on which statistics is available on the verge of the crisis, un. | Number of indicators That were signaling within 3 months before the crisis, un. | Share of indicators that were signaling in the total number of indicators, % |
|---|---|---|--|
| The crisis in the interbank market (August 1995)                  | 3   | 1   | 33   |
| The crisis in the stock market (October 1997)                     | 6   | 1   | 17   |
| The financial crisis (August 1998)                                | 6   | 2   | 33   |
| The crisis of confidence in the Russian banking system (May 2004) | 13  | 6   | 46   |
| The international financial crisis (September 2008)               | 14  | 7   | 50   |

Source: Gaidar Institute for Economic Policy estimates

As you can see from the table above, in 2008 most indicators warned of an impending financial crisis. This was quite expected, since this crisis event is the most significant of all those under review. The 1998 crisis was also severe, but the level of financial development and its connection with the real economy at that time was less than in 2008. In addition, the number of indicators available in terms of statistical data on the crisis of 1998 is half of what is available for the 2008 crisis. As for the other events, about 30% of indicators were showed signals of an approaching crisis.

The results of applying the above methodology for monitoring financial stability in Russia (as of 1 August 2011) are shown in the Table below, which demonstrates the values of the indicators/precursors of financial instability in 2011, the threshold values of those indicators, and whether or not they issued a signal.

**Figure 2. System of indicators/precursors of financial instability in May – July 2011**

| Indicator   | Transformation                | Threshold value  | Indicator value <sup>3</sup> |             |              |
|---|-------------------------------|------------------|------------------------------|-------------|--------------|
|   |                               |                  | May                          | June        | July         |
| Monetary aggregate M2 in real terms   | YoY growth rate               | > 0.39           | 0.12                         | 0.12        | 0.12         |
| The ratio of M2 against international reserves                              | YoY growth rate               | > 0.51           | 0.17                         | 0.21        | 0.19         |
| The ratio of monetary aggregate M2 to monetary base                         | YoY growth rate               | > 0.24           | 0.16                         | 0.19        | 0.21         |
| Core CPI  | YoY growth ratio (%)          | > 114.86         | 108.26                       | 108.43      | 108.4        |
| International reserves of Central Bank (01.1999=100)                        | Period-on-period growth rate  | > 0.35           | -0.01                        | 0.01        | 0.02         |
| Interbank rate in Russia  | Period-on-period growth rate  | > 2.89           | 1.15                         | 0.97        | 1.05         |
| Real exchange rate of ruble to US dollar                                    | YoY growth ratio              | > 1.19           | 1.16                         | 1.18        | 1.16         |
| Medium-term rate of the GKO-OFZ market, % pa                                | Period-on-period growth ratio | > 1.23 or < 0.69 | 0.89                         | <b>1.24</b> | 1.03         |
| Long-term rate of the GKO-OFZ market, % pa                                  | Period-on-period growth ratio | > 1.06           | 0.97                         | <b>1.06</b> | 0.98         |
| RTS Index   | YoY growth ratio              | > 3              | 1.36                         | 1.42        | 1.33         |
| RTS Index   | Period-on-period growth ratio | < 0.61           | 0.93                         | 1.01        | 1.03         |
| MICEX index (corporate bonds)   | Period-on-period growth ratio | < 0.99           | 1                            | 1.01        | 1.01         |
| RGBI index  | Period-on-period growth ratio | < 0.97           | 0.99                         | 1           | 1.01         |
| The amount of bank deposits with the RF CB and BBR with credit institutions | Period-on-period growth rate  | < -0.4           | -0.14                        | -0.19       | <b>-0.65</b> |

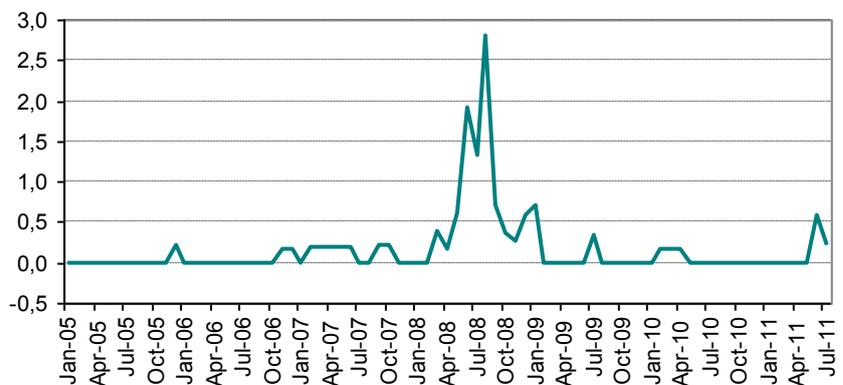
Source: Gaidar Institute for Economic Policy estimates

<sup>3</sup> Values of indicators that showed a warning are highlighted in bold.

Thus, in May-July of 2011 the situation in the Russian financial system was generally stable. Energy prices remained at a level sufficient to support a significant surplus in the country's current account balance. Meanwhile, the slow rate of GDP growth and investment caused concern regarding the prospects for the real sector.

Over the 3-month period under review, 3 of the 15 indicators signaled an increased likelihood of financial instability — interest rates on the OFZ market that showed significant growth, as well as the amount of deposits with the Bank of Russia and the BBR with credit institutions, which by July have declined by 65%. The dynamics of the composite index of financial stability (see Fig. below) suggests that the abovementioned trends have increased the likelihood of financial instability in Russia for August-October. At the same time we would note that the recorded level of the composite index (0.6) remains significantly below the values achieved before the 2008 crisis (2.8). Thus, we believe that the Russian financial system may face signs of financial instability, but in the absence of further adverse shocks, they would not be catastrophic.

**Figure 3. The dynamics of the Otkritie-GIEP Index of financial stability**



Source: Gaidar Institute for Economic Policy estimates

Therefore, our analysis allows investors and researchers to offer a system of indicators/precursors of financial instability that provide an early signal of forthcoming problems in Russia's financial markets. We emphasize once again that any user of our proposed methodology needs to understand its limitations and treat its results only as a potential indicator of the state of the Russian economy.

## Attachment

### Methodology for constructing a system of indicators - precursors of financial instability and the composite index of financial stability.

In the methodology of the 'signal' approach, the signal means some indicator that goes beyond the threshold value estimated on the basis of the algorithm described below. If the indicator issues a signal for a certain period of time before the crisis (called the signal window), that signal will be considered as 'good.' If the indicator issues a signal, but a crisis does not occur within a certain period of time after this, the signal is considered as 'bad.' In our case, we exogenously set the signal window for the 3 months prior to the crisis. We consider a larger signal window inappropriate, as the situation in financial markets is highly volatile and rapidly changing.

When implementing the signal approach, it is assumed that there is a need to test the zero hypothesis (i.e., when the economy is in a normal state) against the alternative hypothesis that within the next 3 months financial instability may arise. As with any statistical test of a hypothesis, we need to select the threshold (critical value) that splits the indicator values into two zones. If the indicator value falls into the critical zone beyond the threshold, we assume that it issues an alarm signal.

Then threshold values are calculated for all indicators, the intersection of which indicates a high probability of short-term financial instability. The thresholds are adjusted, on the one hand, to maximize the number of 'good' signals before the crisis events that took place in modern Russian history. In other words, the purpose is to identify the greatest number of cases in which an indicator crosses a threshold, after which a crisis actually occurs. On the other hand, the selected thresholds provide for a minimizing of signal 'noise'. By noise we mean cases in which the signal appears, but after which a crisis does not occur within a specified period of time. Thus, if it is not possible to select a threshold value for an indicator that ensures an acceptable level of 'good' signals for a given level of 'noise', such an indicator is excluded from consideration.

To select the optimal threshold for each indicator, specific criterion should be set up. The ratio of 'bad' signals versus the share of 'good' signals is used as such a criterion. To illustrate this, we divide all the indicator values into four groups (see Table below). Ideally, the indicator values will fall only in cells A and D.

**Figure 4. Distribution of the indicator values, when signals of a crisis are issued**

|                    | Crisis occurs within 3 months | Crisis does not occur within 3 months |
|--------------------|-------------------------------|---------------------------------------|
| There is a signal  | A                             | B                                     |
| There is no signal | C                             | D                                     |

Source: Gaidar Institute for Economic Policy estimates

The methodology for the selection of thresholds can be explained with the help of the Table. We define the unconditional probability of the occurrence of financial instability for each indicator as the ratio of observations that were followed by financial instability within 3 months, against all observations:

$$P(C) = \frac{A + C}{A + B + C + D}$$

If the indicator gives a large number of 'good' signals (i.e., has a high working capacity), we can expect that the probability of financial instability, if the alarm  $P(C | S)$  (conditional probability) is greater than the unconditional probability  $P(C)$ . Herewith

$$P(C | S) = \frac{A}{A + B}$$

In other words, in order to make the indicator meaningful for forecasting the onset of financial instability, it is necessary to satisfy the ratio:

$$P(C | S) > P(C)$$

We consider this condition as essential for optimal threshold selection. In addition, in the selection of threshold values we minimized the ratio of 'bad' signals against 'good' ones, which is expressed by the following ratio:

$$N / S = \frac{B / (B + D)}{A / (A + C)}$$

We examined all possible thresholds for each indicator for the maximum periods of time and then chose the threshold value at which the ratio of 'bad' signals to 'good' ones was minimal and the necessary condition was satisfied. In addition, in our view it makes sense to establish a limit for exceeding the probability of conditional financial instability over unconditional if there is an alarm signal, so that such excess would be beyond the scope of statistical error. We established this limit at 15 ppts.

In most cases we have examined the growth ratios (rates) against the corresponding period of the previous year or previous period.

Application of the signal approach to select indicators/precursors of financial instability in Russia yields the results shown in the Table below. We note that there may be a situation in which the indicator gives a signal in case a certain threshold value is exceeded (upper limit), as well as a situation in which the signal is given in case an indicator value is below the threshold (lower limit).

**Figure 5. Indicators - precursors of financial instability in the RF**

| Indicator   | Transformation                | Upper threshold | Relevance <sup>4</sup> | Lower threshold | Relevance |
|---|-------------------------------|-----------------|------------------------|-----------------|-----------|
| Monetary aggregate M2 in real terms   | Year-on-year growth rate      | 0,39            | 0,18                   |                 |           |
| The ratio of M2 against international reserves                              | Year-on-year growth rate      | 0,51            | 0,93                   |                 |           |
| The ratio of monetary aggregate M2 to monetary base                         | Year-on-year growth rate      | 0,24            | 0,44                   |                 |           |
| Core CPI  | Year-on-year growth ratio (%) | 114,86          | 0,94                   |                 |           |
| International reserves of Central Bank (01.1999=100)                        | Period-on-period growth rate  | 0,35            | 0,92                   |                 |           |
| Interbank rate in Russia  | Period-on-period growth rate  | 2,89            | 0,26                   |                 |           |
| Real exchange rate of ruble to U.S. dollar                                  | Year-on-year growth ratio     | 1,19            | 0,16                   |                 |           |
| Medium-term rate of the GKO-OFZ market, % pa                                | Period-on-period growth ratio | 1,23            | 0,26                   | 0,69            | 0,93      |
| Long-term rate of the GKO-OFZ market, % pa                                  | Period-on-period growth ratio | 1,06            | 0,33                   |                 |           |
| RTS Index   | Year-on-year growth ratio     | 3,00            | 0,22                   |                 |           |
| RTS Index   | Period-on-period growth ratio |                 |                        | 0,61            | 0,44      |
| MICEX index (corporate bonds)   | Period-on-period growth ratio |                 |                        | 0,99            | 0,37      |
| RGBI index  | Period-on-period growth ratio |                 |                        | 0,97            | 0,94      |
| The amount of bank deposits with the RF CB and BBR with credit institutions | Period-on-period growth rate  |                 |                        | -0,41           | 0,21      |

Source: Gaidar Institute for Economic Policy estimates

As the number of indicators analyzed is large enough, a question arises about the aggregation of information that comes from a study of the dynamics of these indicators, i.e., modeling a composite index of financial stability.

<sup>4</sup> By relevance we mean the excess of the conditional probability of financial instability in the case of the alarm over the unconditional, that is  $P(C | S) - P(C)$



Let us designate as  $X$  the vector consisting of the 14 values of our indicators (actually 15, as one of the indicators has both upper and lower thresholds). Please recall that we assume that the indicator  $X^j$  gives a signal in period  $t$  (dummy  $S_t^j$  takes the value 1) if during this period it goes beyond the threshold

value calculated by us, which we denote by  $\bar{X}^j$ :

$$\{S_t^j = 1\} = \{S_t^j, |X_t^j| > |\bar{X}^j|\}$$

To take full advantage of information obtained during the construction of the threshold values of indicators/precursors, and in constructing the composite index of financial stability, it is necessary to take into account the forecasting accuracy inherent in each of them. The logical way to use this information in full is weighing the indicators with values equal to the excess value of conditional probability of the occurrence of financial instability over the unconditional probability in case a signal is issued:

$$I_t = \sum_{j=1}^{15} S_t^j (P^j(C|S) - P^j(C))$$

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