



NATIONAL BANK OF KAZAKHSTAN

ASSESSING THE QUALITY OF LOAN PORTFOLIO BASED ON THE LOAN LEVEL DATA

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Assessing the Quality of Loan Portfolio Based on the Loan Level Data

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Abstract

This Paper analyzes the source of information – the Credit Registry – to assess the portfolio of banks at the level of each loan (loan level data). The Paper introduces the concept of default based on indirect indicators using the Credit Registry. Indicators that can be used to assess the dynamics in the status of each loan with the ability to aggregate at the borrower level are being designed. An analytical assessment is conducted to identify refinanced loans and “evergreen” loans. The categories for the distribution of loans within the portfolio are described and introduced in order to identify the deterioration of loan on a timely basis, allowing the application of early response measures by the supervisor as well as the assessment of credit risk at the banking system’s level. The quality of the methodology was checked on the basis of available historical information about the transfer of the portfolio to the Problem Loans Fund and the recognition by the bank of loans past due more than 90 days before the license was revoked; in addition, the volume of false positives detected by the methodology but subsequently submitted to the Credit Registry with zero main debt was assessed. The presented methodology is the first attempt of applying a loan-based analysis in Kazakhstan that can be developed using the new extended loan and borrower data incorporated into the Credit Registry since July 2019. Besides, the next stage after assessing the quality of portfolio will be the assessment of probability of borrower’s default as well as the stress testing.

Key Words: Credit risk, loan review, probability of default, Credit Registry, loan-level review, refinancing, “evergreen” loans.

JEL classification: C81, C83, G21.

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1. Introduction

Creation of the Credit Registry was driven by the need of the regulator and the central bank for the data about the status of bank loans with a high degree of granularity, which would provide an opportunity for a more accurate assessment of the quality of loans, adequacy of provisions and, accordingly, for supervision of reliable maintenance of capital adequacy as the main prudential requirement.

The Credit Registry would allow the regulator to make its own judgment about the effectiveness of each individual bank loan based on the actual data and, therefore, on the financial condition of that bank.

The NBK's Credit Registry acquired its current format at the beginning of 2013, and some fields were additionally included in mid-2019. Some of the fields contain factual information and some of the fields – the judgment of a bank or an appraiser.

The initial analysis of the data in the Credit Registry showed that the servicing of their loans by borrowers, just like the loan accounting practices used by banks, do not fully correspond to the concepts of a standard performing loan. Therefore, the main objective of creating a Credit Registry was realized only partially. As a result, the main difficulty faced by the users of the Credit Registry was the interpretation of actual data in the Credit Registry in such a way so as to give an assessment of events that happened or were likely to occur in the life of the loan.

We tried to apply an approach using all the possibilities and overcoming the existing limitations in the data of the Credit Registry to assess the quality of banks' loan portfolio at the level of an individual loan. The problems we faced were primarily related to the data quality. They can be roughly divided into three reasons. First, poor discipline of filling out the data by banks. Second, there is a discrepancy in the data structure and the ideal data model for describing the loan life cycle. Third, the discrepancy between the objective assessment and the assessment of data provided by banks.

In this paper, we have focused on analyzing the loan level data; although from an economic point of view, it would be more informative to use assessment at the borrower level. Nevertheless, we found it necessary and practically useful in the first stage of data analysis to limit the scope of analysis to questions at the level of each individual loan. In general, any additional data on the loan, the borrower, the class of borrowers and the conditions in which the borrower operates, the borrower's counterparties, the borrower's accounts receivable will certainly significantly improve the assessment of the loan quality. Thus, the improvement of the designed method for analyzing the quality of loans by expanding the range of data can continue indefinitely. However, the primary task in the analysis is to improve the quality of data on an individual loan, including the data on servicing the terms and conditions of the agreement (repayment of the principal debt and accrued interest) and the data on events reflecting a change in the relationship between the borrower and the lender (refinancing, restructuring). This paper is devoted precisely to this initial stage of analysis.

2. Credit Registry in Kazakhstan

2.1 History of the Credit Registry Evolution

In the international practice, the collection of data on loans began at different times. For example, in Germany, the collection began in 1934. However, the data covered only those loans that exceeded the established threshold per borrower. Initially, the threshold was € 1.5 million; at present, the threshold has been lowered to € 1 million and work is underway to lower the threshold further [7]. The countries of Eastern Europe began to introduce state Credit Registries much later: in Latvia – in 2008, in Romania – in 2012. In Latvia, there is no threshold for providing information, and in Romania, it is 4,500 US dollars in the national currency equivalent [8]. Regulators and central banks in various countries are working to lower or remove the threshold. At the moment, credit bureaus, both public and private, operate almost everywhere. At the same time, most countries have a state Credit Registry (Appendix, Table 1).

As is shown by the rate of public credit registry coverage calculated by the World Bank based on data from 264 countries of the world, coverage is growing from year to year and by 2019 it covered more than 15% of the adult population (against 8% in 2011).

The National Bank's Credit Registry began functioning and was used to collect indicators and data in 1996. Banks provided information on credit and contingent liabilities exceeding 5 million tenge, and/or if the borrower's debt on all loans provided to him/her exceeded 5 million tenge (71 thousand dollars) [9]. In 1998, the threshold for liabilities provided was lowered to 3 million tenge (about 36 thousand dollars at the exchange rate of that period). A condition was put in place that the data on small businesses is sent in full, and on individuals – from 1 million tenge.

In 2004, the limits on loan amounts were removed. From that moment on, information was provided on all loans and contingent liabilities, with the exception of guarantees issued for participation in the tender and guarantees secured by money. In 2012, the list of indicators that banks sent to the National Bank was extended.

For the initial collection of a limited number of data from 1996 to 2009, the “Credit Registry” AIS was used, which was updated from 2009 to 2013 into the upgraded “Credit Registry” AIS due to the addition of new indicators. Subsequently, the National Bank developed a concept paper for the transition to a data-centric approach. It involves the transfer of data at the indicator level through a single window and contributes to the improvement in the quality of the information provided. To achieve this goal, in 2013 an automatic information system “Unified Indicator Collection System” (UICS) was developed with 89 indicators. In July 2019, the system was revised and owing to the revision was supplemented with new indicators, whose number was brought to 189. It is planned to improve this system by integrating it with the existing government databases, to reduce the data transmission load on banks and also to introduce an electronic folder system.

2.2 Credit Registry as the Source of Information

The data that allow for a qualitative analysis of the portfolio appeared in the Credit Registry since 01.04.2013, when the number of indicators was increased to 89. Banks provide data on loans, contingent liabilities and reverse repos on a monthly basis, it was agreed that the frequency of data provision will be increased. The data as at the first day of each month is used for the analysis.

Historically, the number of loans for which information is provided has been growing. The database contains data on 38.9 million unique loans that were provided during the period from 1992 to 2020. As at June 1, 2020, the number of loans exceeds 14.6 million (Table 2), where more loans to individuals account for over 90% (Table 3). However, in the structure of banks' portfolios in terms of the principal debt, loans from corporate entities prevail and the bulk of all credit operations is covered by loans and credit cards of banks (Table 4).

At present, the data for the Credit Registry is furnished by 33 organizations. These include 27 second-tier banks, the Development Bank of Kazakhstan, 2 mortgage organizations, and 3 subsidiaries operating in the sphere of agro-industrial complex. Historically, the maximum number of organizations was 48.

2.2.1. Shortcomings of the Credit Registry

As noted above, the main problem we faced when using the Credit Registry data was the quality of information provided by banks. Initially, banks were required to provide the full volume of all indicators on a monthly basis, whereas in fact, indicators for which information was not provided were often identified. For example, in the upgraded Credit Registry, which existed before April 2013, when analyzing the “Collateral value” indicator, a lack of information was revealed, and the users of the Credit Registry did not have an understanding of whether the collateral was sold or the bank simply did not provide information on the value of collateral. At the same time, banks can communicate information at its initial appearance or in case of its change. There are currently no empty values in the database but the accuracy of information is not guaranteed. Therefore, the quality of information is checked using logical controls and post-controls, which are constantly being updated and modified.

Initially, the names of organizations, the surnames and names of borrowers were provided in different spellings, which did not allow matching borrowers between banks. Mandatory provision of BIN and IIN reduced the risk of providing false information and made it possible to track the borrower within the banking system. However, in this case, too, it was necessary to prescribe control, since sometimes an incomplete IIN or BIN was provided. In the existing database, the risk of providing an unauthentic IIN or BIN is minimized. Also, a mechanism for constructing a universal borrower number was developed to compare borrowers. It is based on checking the identity of the BIN/IIN, the name of the organization and the TRN/SIC. As at June 1, 2020, the database contains information on 8 738 thousand bank borrowers.

To understand and better monitor the status of the portfolio, new indicators were added, which are included in the second phase of the UICS and began to be collected from July 1, 2019. This is how the flow indicators appeared: the amount of payments actually received, disbursed and repaid, the present value of future cash flows

(expected value to be received) for heterogeneous loans. Also included are the indicators that allow assessing the stage of completion of the loan: these include refinancing, sale, assignment to organizations that manage distressed assets. Indicators that allow assessing the quality of the pledged property are: the date of collateral appraisal, the market value of collateral, the value of collateral on the bank's balance sheet, documents and the name of the appraiser, the basis for termination of collateral. The following indicators are also added: restructuring performance, a sign of the borrower's impairment, repayment schedules, and an interest rate type: floating or fixed.

The new indicators will allow building models for assessing the level of loss given default (LGD). However, in order to build models based on a monthly data, a history of at least 5 years is required. Given that new indicators are collected only from the beginning of July 2019, the construction of informative models with them will be possible no earlier than the end of 2024.

For an even more extensive analysis, the Credit Registry requires that the accounting information in accordance with IFRS 9 and information about the borrower's financial condition should be provided in addition. However, again, the possibility of in-depth analysis is limited by the banks' discipline in filling out information, as well as by the need to accumulate history. Concurrently, the National Bank is working on accessing additional information from other government sources.

3. Estimates and Assumptions

3.1 Assessing the Discipline of Loan Servicing

The simplest indicator of the discipline of loan servicing is the timely payment in the amount sufficient for the principal debt to decrease after each payment. This indicator is the reduction in the principal debt for the given period. A derived figure from this indicator is a sequence over a longer period of time than one month, that is, a continuous sequence of indicators of reduction in the principal debt.

3.2 Estimating Cash Flows on the Loan

The data field, where the cash flow on the loan is shown, has existed in the current version of the Credit Registry since 2013; however, due to the low discipline of filling out this information, most of the exponents in this field are empty. The absence of such critical piece of information for assessing the condition of the loan forced us to use assumptions in estimating cash flows that reflect the standard practice of banks in calculating interest, choosing loan repayment schedules, as well as accounting requirements.

Our estimate of cash flows is based on the movement of the balance sheet items of the loan: the principal balance and the accrued interest. The assessment of the flow of principal debt repayment was made as the difference between the balances of the principal debt of two consecutive periods. The estimation of the flow directed to the repayment of the accrued interest was based on the assumption that the loan payments are allocated to the repayment of the principal and the interest in accordance with the

principle of primary interest repayment in the amount not exceeding the repayment schedule. The remainder of the payment is used to pay off the principal debt.

This model assumes that each payment includes a non-zero principal repayment every period, just like the fact that the loan does not increase the principal debt, as, for example, in the cases of credit lines, which are an object of a higher hierarchy level in the data model. Credit lines are actually a framework agreement whereunder many individual loans can be concluded. Such examples may include negative amortization loans, loans with capitalization of overdue accrued interest during the period of restructuring of a non-performing loan.

A more difficult stage in the construction of the methodology is the assessment of cash flows aimed at the repayment of accrued interest. The law of motion for this balance sheet item is the addition of accrual for the current period and repayment of the previous period.

The second complication in the assessment was the requirements of international standards prohibiting the accrual of interest for loans that meet the criteria of non-performing loans. Therefore, to assess the fact of payment, that is, without taking into account its size and compliance with obligations according to the repayment schedule, we introduced an additional assumption. In particular, we assumed that any partial repayment or repayment in an amount exceeding the minimum required amount, first of all, is always used to repay the accrued interest in an amount not exceeding the volume according to the repayment schedule, and the remaining amount of payment is used to pay off the principal debt. Thus, the actual reduction in the principal debt is an indication that the payment in the previous period actually took place.

3.3 Default Definition

In the recommendations for defining default, international financial institutions generally recognize as non-performing loans such loans that are past due on the principal debt and/or interest 90 days or more. An additional criterion used in these recommendations is the client's unwillingness to pay and/or a significant deterioration in the financial condition of the borrower. Examples of definitions of default applied prior to the introduction of new standards are given in Table 5 of the Appendix.

In Kazakhstan, the definition of default usually means more than three months delay. This definition is not an arbitrary choice of the duration of delay – it is tied to the definition of past due used in the civil and business law. A past due of more than three months gives a lender the right to start claim work, declare a default, and consider the borrower as defaulting on the loan agreement. For a bank or lender interested in restoring the quality of the loan or in restoring the value, at least partially, recognition of the loan as overdue and, therefore, the timely initiation of a claim work is the most optimal course of action. Since the borrower also has information about the consequences of a past due of more than three months, violation of the terms of servicing a loan with a past due of more than 90 days is also informative for the borrower in terms of his/her ability and willingness to service a loan in the future. For this reason, the minimum overdue period is the dividing line between performing and non-performing loans.

However, if the consequences of past due of more than three months, due to certain reasons, do not have serious consequences for the borrower, then the information value of this cut-off point decreases. Such circumstances may arise, for example, when a bank is more concerned about the consequences of delinquency recognition for capital adequacy and the impact on its ability to comply with prudential requirements.

In such cases, the bank prefers to maintain the appearance of no losses in the event of an actual deterioration in the loan repayment, neglecting to take measures in order to restore the value of this loan. Alternatively, for example, when the borrower of the bank is a related person of the bank and can count on a softer attitude – forbearance instruments are applied to the loan. In all these cases, the deterioration in repayment on the border of three months cannot have grounds for being more significant than at the border of two months, and at the border of four months. In other words, the indicator of duration of the loan delinquency (less than 90 days or more than 90 days) is no longer informative. In such cases, the information value of a loan default already depends on what expectations the borrower has about the bank's actions in relation to him/her, depending on the duration of the past due.

For this reason, during the analysis and initial qualification of the loan status, it is advisable not to proceed from the assumption of the greatest information value of a three-month past due, but to assess the conditional probabilities of continuing deterioration in the quality of loan service for various periods of past due and to identify the boundaries and definitions depending on observations.

The initial analysis revealed a significant proportion of loans that banks do not recognize as non-performing, but which, according to service metrics obtained on the basis of the Credit Registry data, are in fact past due for more than three months. A significant share of such loans in the portfolio indicates that the recognition of all these loans as non-performing and, accordingly, the creation of provisions for them will lead to deterioration in the bank's capital adequacy and potentially to a violation of prudential ratios by such bank. Thus, there is at least one reason to assume the loss of information value of the standard definition of default, as well as the bank's desire to hide a large amount of non-performing loans in its portfolio.

4. Methodology for Assessing the Quality of Loan Portfolio

4.1 Loan Quality Indicators

Taking into account the described limitations in the available data of the Credit Registry, as well as the non-standard behavior of the bank in terms of loan accounting and the borrower's behavior in relation to servicing the loan, we have designed the indicators that allow interpreting the viability of the loan according to the following criteria:

- a monthly decline in the principal debt during consecutive months ($X_{1,t}$ - NDB);
- significance of the amounts of accrued interest ($X_{2,t}$ - AI);
- actual repayment/non-repayment of the loan ($X_{3,t}$).

Sign of a Non-Declining Balance, or NDB. The first indicator of a violation of the loan service discipline is the absence of a reduction in the principal debt, including

the change in the rate of the loan. This indicator is an objective evidence of a non-performing asset with a low payback. Non-declining balance was calculated from the ratio of current value of principal debt to the previous one:

$$X_{1,t} = \frac{PD_t}{PD_{t-1}} - 1,$$

where PD is the principal debt on the loan

t – current period,

t-1 – previous reporting period.

In building this indicator at the level of one period, one must select a parameter: decline or sensitivity. A decline of 0.2% was chosen as the threshold of sensitivity, which roughly corresponds to a decrease in the rate of reduction of the principal debt for loans with an annuity repayment schedule, but mortgage loans with a term of more than 15 years are an exception.

If the value is $X_{1,t} \in [-0.2\%; 0.2\%]$ or $X_{1,t} > 0.2\%$, then the loan has a non-declining principal debt, i.e. it has a sign of NDB. To create a complete picture of deterioration in the quality of a loan, we came up with a derived index that shows the number of NDB periods.

In order to calculate the number of NDB periods, a variable is introduced:

$$Y_t = \begin{cases} Y_{t-1} + 1, & \text{if } X_{1,t} \geq -0.2\% \\ 0, & \text{if } X_{1,t} < -0.2\% \end{cases}$$

The variable is reduced to zero if a payment on the loan is received, i.e. $X_{1,t} < -0.2\%$. If the condition is not met, then from period to period the variable is increased by one, which corresponds to the number of months of NDB on the loan.

Analyzing loans with different numbers of months of NDB and evaluating how many months of non-decline is problematic for a loan, based on the historical data of the Credit Registry the result was obtained that with NDB of ≥ 12 months, the loan will become bad with a 90% probability. Thus, the presence of the NDB sign for 12 consecutive months is the ground for classifying the loan as defaulted with the requirement for full coverage by collateral and/or provisions.

This approach is based on the assumption that the loans in question do not have the conditions for the possibility of the principal debt repayment at the end of the term or according to an individual schedule. However, the presence of a condition for the principal debt repayment at the end of the term implies large amounts of accrued interest, thus already posing risks for the borrower's solvency.

Accrued Interest to the Principal Debt. In the absence of interest repayment on the loan, amounts are accumulated in the accrued interest indicator. In this regard, the second indicator was reviewed – the ratio of the current value of the accrued interest on the loan to the principal debt (PD):

$$X_{2,t} = \frac{AI_t}{PD_t},$$

where AI is the interest accrued on the loan at time t.

The sign of the AI/PD ratio is used in conjunction with the sign of NDB on PD. In case of a monthly repayment, the accrued interest must be reduced to zero, otherwise it continues to accumulate. The threshold level for determining the significance of the accumulated interest in relation to the PD was adopted at the level of 5%. The choice

of this threshold was driven by the presence of a prudential ratio whereunder the interest rate under the agreement should not exceed 60% per annum, which is 5% monthly.

The Balance of Accrued Interest and Estimated Accrual. The change in the balance of accrued interest and the estimated accrual, which is determined according to the terms of the agreement, provides an indicator for assessment of the information value of the AI indicator.

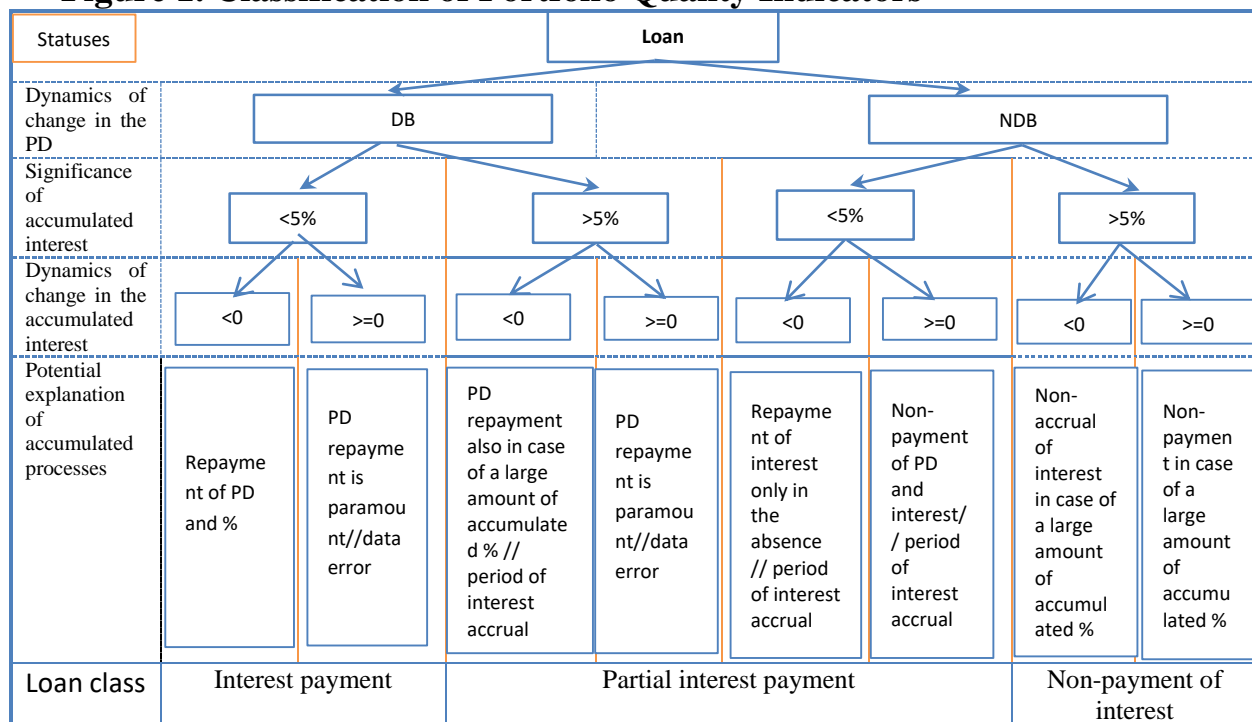
The relationship between the actual change in the balance of accrued interest for the month and the estimated change based on the interest rate and the term of the loan was considered as another indicator. It is an additional indication of the presence of interest repayment/suspension of interest accrual, or a sign of the absence of interest repayment.

$$X_{3,t} = \frac{AI_t - AI_{t-1}}{r/12 * PD_t} - 1,,$$

where r – is an annual interest rate based on the terms of the agreement.

The threshold level for the indicator is taken at the level of -0.07. This feature is used in conjunction with the paragraph above, forming the feature of payment/partial payment/non-payment of interest. (Figure 1).

Figure 1. Classification of Portfolio Quality Indicators



Based on the above indicators, 6 loan quality statuses were created (in the order of deterioration): A, B, C, D+, D, F (non-performing loan).

Y_t	$X_{2,t} < 5\%$		$X_{2,t} \geq 5\%$	
	$X_{3,t} < 0$	$X_{3,t} \geq 0$	$X_{3,t} < 0$	$X_{3,t} \geq 0$
0	A	data error	B	B
1-2	C	C	C	C
3 - 11	D+	data error	D	D
≥ 12	F	F	F	F

Further analysis showed that the ratio of the actual change in the accrued interest to the estimated one ($X_{3,t}$) does not add much information value since there was no data about the starting point and the number of days for calculating interest, therefore, the decision was made to exclude it. And the statuses were reclassified into the following:

Y_t	$X_{2,t} < 5\%$	$X_{2,t} \geq 5\%$
0	A	B
1-2	C	C
3 - 11	D+	D
≥ 12	F	F

Based on the analysis of the data and the construction of intersections, we have given a new definition of default, which corresponds to category F in the table, that is, when the duration of the NDB is equal to or exceeds 12 times (months), the current date exceeds the repayment date under the agreement by 3 or more months, or if the loan was completely written off by the bank itself at time T. Additionally, status F includes loans with overdue debt over 90 days as recognized by the bank. Further in the paper, such loans are indicated as 90+ (bank's opinion).

Differentiation into categories allows tracking the gradual deterioration of the loan depending on the number of periods of non-decline of the principal debt and the accumulation of accrued interest. The categories are based on quantitative indicators, which are objective data and do not take into account the opinion of the bank. In addition, based on the data about the transition from other categories to the default category F, it is possible to estimate the probability of default taking into account historical data.

4.2 The Analytical Indicator of a Refinanced Loan

When, in order to maintain the level of capital adequacy, some banks prefer not to recognize loans as bad so as not to accrue additional provisions for them, and in cases where the borrower of the bank is its related person, such banks use forbearance instruments. One of these instruments is loan refinancing, which creates easing conditions for the loan and allows the bank to create a record with a new good history of such borrower.

If the bank decides to repay the borrower's loan by refinancing his/her old debt with a new loan, then the historical data (including the NDB indicator) on the previous loan ends at the time of refinancing. To exclude the possibility of improving the NDB indicator due to the loan refinancing, we created an analytical indicator that allows identifying the refinanced loans at the level of each borrower. The indicator is calculated as the ratio of the principal debt amount on new loans opened in the period t to the principal debt amount in the period t-1 of the loans closed in period t for the same borrower.

$$Ref_i = \frac{\sum_{j=1}^k PD_{jit}}{\sum_{m=1}^l PD_{mit-1}},$$

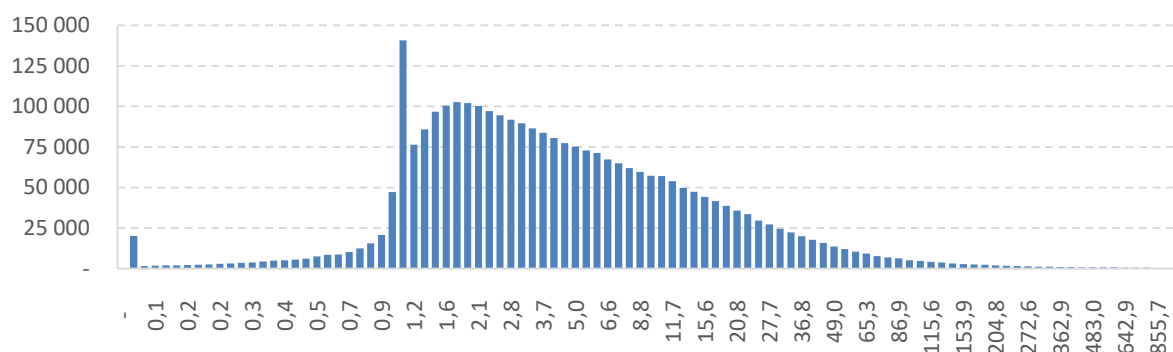
where i – borrower's identifier,

PD_{jit} – principal debt on new loans opened in the period t, of borrower i

PD_{mit-1} – principal debt on closed loans at the time $t-1$, of borrower i .

To analyze the refinancing, the sample was created from the data on loans and contingent liabilities provided to corporate entities and individuals and transferred to the Credit Registry from 01.04.2013 to 01.06.2018. The unit of calculation is a borrower who, in the same period, closes and opens one or more loans. The principal amount on closed loans is calculated for the previous period, the principal amount of opened loans is calculated for the current period, and their ratio is assessed. The calculated Ref_i ratios according to the above formula are shown in Figure 2.

Figure 2. Ref_i Distribution Calculated per Each Borrower

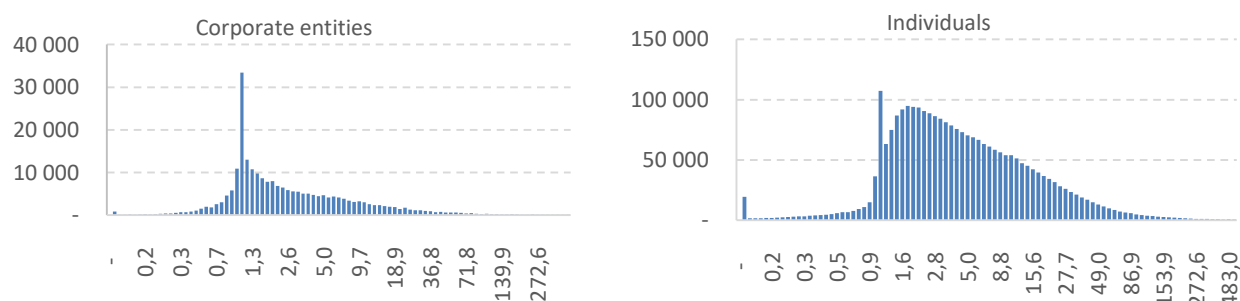


Source: NBK's Credit Registry

The figure shows that the largest number of loans falls on the ratio of about 1.1. To expand the sample, we decided that a loan can be regarded as refinanced if the value of the ratio belongs to the interval $[0.8; 2]$. In terms of the number of loans, about 30% fit this interval, and in terms of the principal debt amount – over 60%.

The Ref_i distribution by type of an entity is not the same (Figure 3). So, for corporate entities, the maximum number of borrowers falls on the ratio of 1.1 – over 33 thousand borrowers, the remaining values are much lower and do not exceed 13.5 thousand borrowers. Whereas for individuals, the maximum value also falls on 1.1 – over 107 thousand borrowers but about 90 to 95 thousand borrowers account for a ratio of 1.7 to 2.

Figure 3. Ref_i Distribution by the Type of an Entity



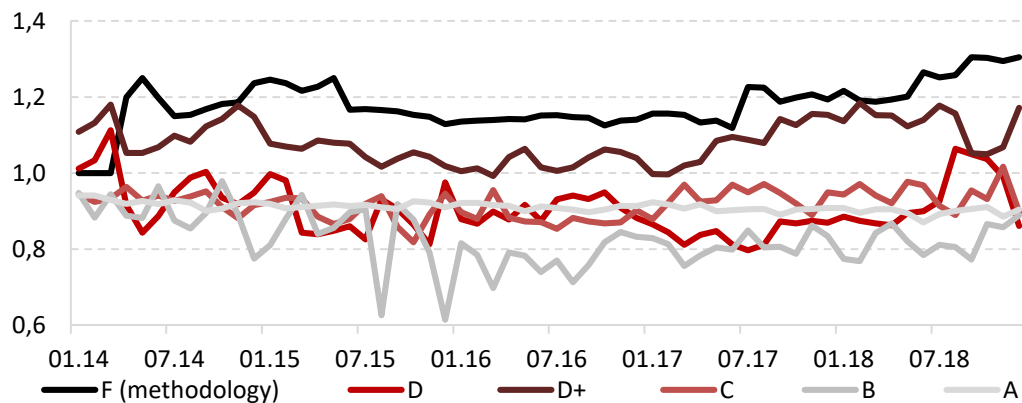
Source: NBK's Credit Registry

The number of unique borrowers among corporate entities in the specified period is 96,630, and among individuals – 7,403,621. The number of unique borrowers for whom the Ref_i ratio was calculated among corporate entities makes up 16,210, and among individuals – 530,942. However, during the reviewed period, one borrower

could have its loans closed and opened several times, and, accordingly, each of them has its own Refi ratio. The number of Refi for corporate entities in the sample is 245,528, and for individuals – 2,680,421.

To assess the real status of new loans (refinanced loans), we continued to accumulate NDB periods, taking into account historical values. When several loans were closed at the same time, the maximum value of the NDB periods selected from the values for closed loans was taken to calculate the number of NDB periods. If several loans were opened for this borrower, then all new loans were assigned the maximum

Figure 4. Categories with Refinancing/Categories without the Use of Refinancing Indicator



Source: NBK's Credit Registry

value of NDB periods. Thus, reclassification of the loan is conducted, which takes into account the entire history of the old loan (before the refinancing).

Without the use of the analytical refinancing indicator, the newly opened loan would look like a performing one and, in our estimation, would belong to category A, whereas if the new indicator is used its category may be worse. Figure 4 illustrates these intra-category loan movements when the refinancing ratio is applied to them.

If the borrower continues not to pay for a new loan, his category will shift to the worse if the analytical refinancing indicator is not applied. If we apply the refinancing indicator, then the NDB sign continues to accumulate.

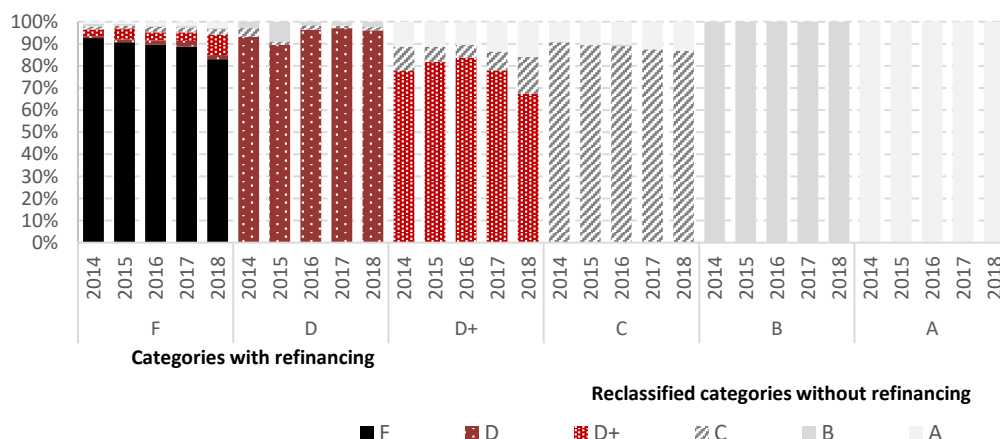
If the refinancing indicator is applied, loans are in category D until 12 NDB periods are accumulated. Category D + includes loans that had 1 or 2 months of NDB before refinancing, and then the borrower did not pay PD, but repaid the interest

Classification by groups was conducted based on the analytical refinancing indicator. The stage of the new loan was determined based on the number of NDB periods that the closed loans had. However, if there was a decrease in the level of principal debt for 12 consecutive months, the quality of the refinanced loan was recognized as improved according to the recommendations of the Basel Committee [1] and the regulator of European banks [2]. At the same time, the quality of portfolio using the refinancing indicator in the banking system is worse than without using it (Figure 5).

As can be seen from the Figures, the default category F according to our method is significantly higher than the bank indicates in its reports. So, for example, at the end of 2018, according to the banks' statements, loans 90+ (the bank's opinion) accounted for 7.5% of the portfolio, while category F (the methodology) without the use of the

refinancing indicator included 15% of the portfolio, and with the use of the refinancing indicator – 19.6%. Thus, based on the group of indicators developed in the methodology, it is possible to assess the quality of portfolio and apply both in the supervisory practice and in assessment of the system’s financial stability as well as to identify loans that require detailed analysis by both the off-site supervision and inspection oversight.

Figure 5. The Change in the Loan Category after the Use of the Refinancing Indicator



Source: NBK’s Credit Registry

Additionally, other types can be used as categories, which are also calculated on the basis of periods of consecutive non-decline of the balance and the analytical refinancing indicator.

4.3 Methodology Validation

Assessing Type 1 Error

The quality control of the methodology was carried out on the basis of available information in the Credit Registry using historical data. In 2017 and 2018, Kazakh banks cleaned up their portfolio by assigning potentially impaired claims to the “Problem Loans Fund” JSC (the PLF) that was established to develop the market for distressed assets and is managed by the government. In addition, some banks, prior to revocation of their licenses, recognized a large volume of their loan portfolio as troubled portfolio i.e. classified it as loans past due 90 days or more. Based on the dates on which the assignment of claims took place and loans were recognized as past due over 90 days, the unloading from the Credit Registry was generated. The data as at June 1, 2017 were used as the date of recognition of the maximum amount of principal debt past due over 90 days. The data provided as at 01.01.2018, 01.10.2018 and 01.02.2019 were used as the date for assessing the transfer to the PLF.

The first unloading to determine the volume of identified problem loans was made using the data on banks that recognized problem loans as well as transferred problem loans to the PLF. For this purpose, loans that banks recognized as troubled at certain dates were identified as well as those loans that were canceled (repaid) in the Credit Registry at the time of assignment of claims to the PLF. The second unloading was made using the assessment of those loans that were recognized by the methodology as troubled loans but at some point were repaid by clients. To do this, we used the data on loans from banks that meet capital adequacy ratios after applying a quality review of their portfolios according to our methodology. Using our indicators for assessing the

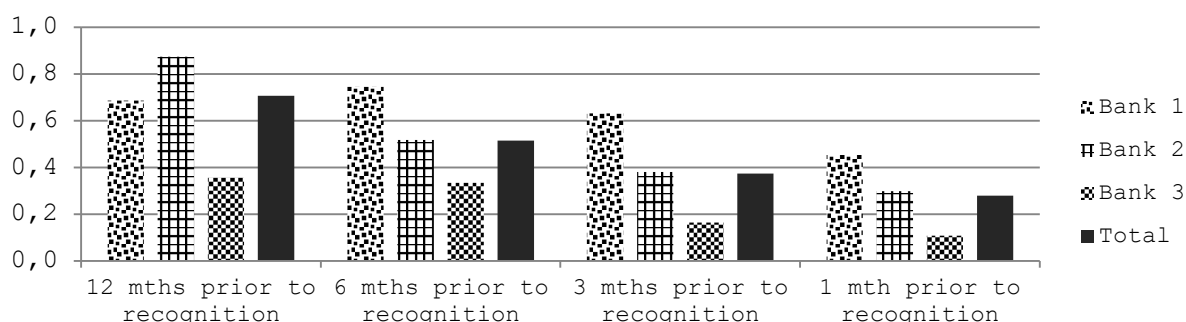
quality of portfolio, a new level of non-performing loans and the required level of provisions were calculated. An assumption was made that provisions are created from the bank's profit for the corresponding period and accordingly reduced the capital level. The capital adequacy ratio was calculated based on the new capital. Banks that did not violate capital ratios, taking into account the original adjustments, were included in the second sample. The number of banks in the first and in the second case is the same.

In order to determine the percentage of loans identified under the methodology, the following sums of principal debt were used:

- a principal debt amount on loans recognized as non-performing (past due more than 90 days, the bank's opinion (90+)) and transferred loans – the amount repaid on the date of recognition;
- an amount of principal debt on the portfolio at a certain date – total principal debt for a certain period before the recognition of loans as troubled or transferred to the PLF.

As the time interval for the metrics, we used the periods before the bank recognized loans as troubled or transferred to the PLF: 1 month, 3 months, 6 months and 1 year before the corresponding dates indicated above. Figure 6 shows the shares of category F and 90+ of the principal debt amount of loans that were recognized by the bank as 90+ or were transferred with a value of 0 at the time of the portfolio assignment to the PLF.

Figure 6. Shares of Loans Not Recognized by the Methodology as Defaulted among Loans “Objectively Recognized” as Non-Performing



Source: NBK's Credit Registry

To exclude repayment in the current periods of standard performing loans according to the schedule, we adjusted it by the median of repayments, which was calculated for the previous 6 months using the analytical refinancing indicator. The largest value falls on 1 month before the recognition by the bank, but given that 12 months of the NDB of the principal debt on a loan are recognized as default, once can say that, based on the categories preceding the default, the methodology enables to identify loans that need to be focused on when assessing the bank's credit risk, in advance, since other categories are determined by a smaller number of months of NDB.

As can be seen from the figure, before the write-off or assignment of the claim to the PLF, banks recognized only 1.6% of the total amount of problem debt as troubled loans (90+). According to our estimates, in 1 month before the date of recognition, 72% of loans were troubled loans, and in 1 year before the date of recognition - about 30%. Therefore, the indicators used in the methodology help identify troubled loans not basing on the bank's opinion and in a larger volume.

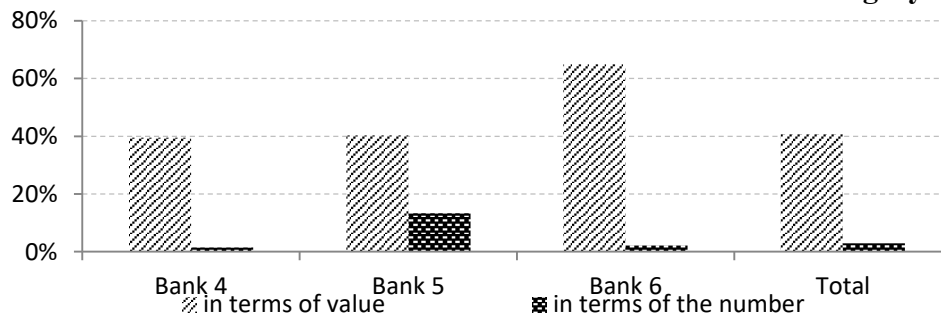
Assessing Type 2 Error

However, type I error in our methodology is relatively big (30-40%), but it is by two orders less than in the banks' records (98%). The inclusion of categories D and C in the diagnostics, with an appropriate probability of non-repayment, can reduce type I error (Figure 7). However, it is also possible that the loans, which were classified by us as Type II diagnostic error in this calculation are not actually a diagnostic error. These loans were categorized as F, and after some time the debt balance on them was reduced to zero. The balance can be reduced to zero not only as a result of repayment of the loan by the borrower, but also as a result of its sale to the ODAM (Organization for Doubtful and Bad Assets Management). Since the ODAM is a related company, the sale can be made at a nominal, that is, inflated price. Such sale does not in any way affect the economic adequacy of capital on a consolidated basis, since it does not change the prospects for repayment on the part of the borrower; however, since banks in Kazakhstan are not regulated on a consolidated basis, the bank's losses on non-performing and bad loans can be hidden by selling it to the ODAM's balance sheet.

Therefore, our estimate of the type 2 error can be significantly exceeded. At present, we do not have the capacity to separate loans sold to the ODAM, since the loans sold to the ODAM are disappearing from the visibility of the Credit Registry. We do not see a possibility to solve the analytical problem of assessing the type 2 error without transiting to regulation on a consolidated basis or the obligatory transfer of reports to the Credit Registry from the ODAM.

Figure 7. Loans Classified as Defaulted a Month before Repayment

The Share of Loans that Have Ever Been Classified as Category F among Repaid Loans



Source: NBK's Credit Registry

Additionally, an analysis was carried out in respect of loans that were recognized as defaulted but were repaid by the borrowers on their own. The evidence of transfer to the Credit Registry with zero on the principal debt and the absence of write-off was recognized as repayment. As described above, the banks that have a sufficient level of capital were selected for the analysis, after the portfolio assessment on the basis of the methodology.

The sample consists of loans of three well-capitalized banks that have been repaid and had Category F during the life of a loan. The number of loans meeting these criteria was 235 800 with a face value of 1 161 billion tenge.

In their loan portfolio, loans that are classified as default F (under the methodology) are sorted out. The date when the loan was removed from the Credit Registry was taken as the repayment date. Loans written off by the bank to off-balance sheet accounts or loans with a partial principal and/or interest write-off were excluded from the sample. The share of loans was calculated by the number of loans that had

category F but were repaid. The total number of such loans in the sample was 235,821. The category of false positive loans, as can be seen from the figure, mainly consists of loans classified by the bank as past due more than 90 days (90+ (the bank's opinion)) - 55% a month before closing.

The type II error, false positive detection of default, amounted to 3% of the number of repaid loans and 41% of the face value. This means that among small loans, type 2 error is insignificant. Almost the entire error in terms of volume occurs due to large loans.

A big mistake among large loans can be explained by the transfer to the ODAM; loans to state-owned companies (among the 15 largest loans (20% of the volume of each bank), 5 were provided to state-owned companies, or 45% of the volume); relatedness (realization of risk in case of loss of a shareholder's share in the capital); project financing (high risk) and non-standard repayment schedule.

Identifying default on large loans requires consideration of information about the borrower, its relationship with the bank (ODAM), the repayment schedule, and a lot of other data. Lack of this information overestimates Type 2 error for large loans.

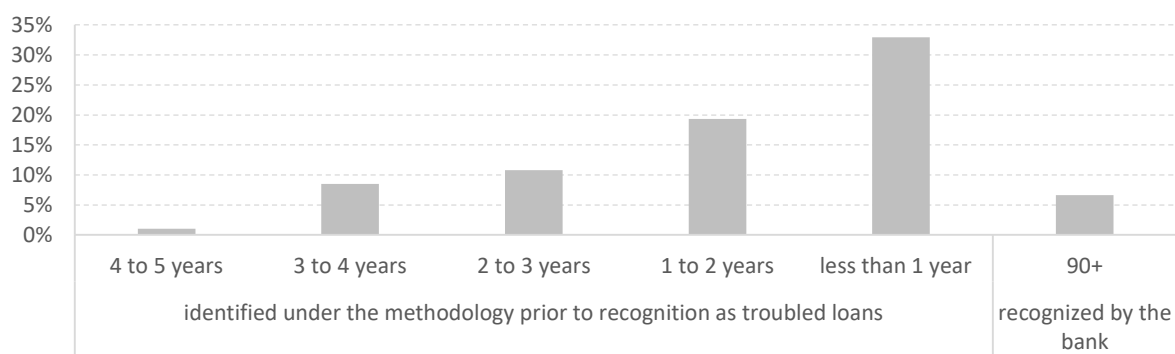
Estimating the Prediction Horizon

In order to estimate the prediction horizon for troubled loans, the sample similar to the first analysis was used.

For each loan, the date was set at the time of its recognition as defaulted and the value was calculated before the date of the claim assignment to the PLF and/or before the date of recognition of default by the bank. At the same time, for loans that had their status changed from default towards improvement and vice versa, the value of the first default was taken as the date according to the methodology.

Based on the analysis and using the methodology, about 20% of loans can be identified 1-2 years before the transition to default and over 30% during the year before default (Figure 8).

Figure 8. Time Frames for Identification of Defaulted Loans



Source: NBK's Credit Registry

Consequently, based on the methodology, it is possible to identify in advance the range of loans for which supervisory oversight is required. So, 1 year before problems arise, almost a third of troubled loans can be identified.

5. Practical application

Our methodology enables to assess the quality of a bank's portfolio both at the level of each bank and at the system level. It allows dividing the portfolio into a performing portfolio on which the bank receives cash flows and a non-performing portfolio with no receipts of funds, not basing on the bank's judgments. In the future, it can be used for supervisory purposes and in assessing systemic risk at the level of the banking system.

For supervisory purposes, based on the methodology, it is possible to identify loans with no cash flows on an off-site basis and request information on them, use it in the portfolio valuation and calibrate the valuation using the SREP method, and then apply such data in supervisory judgment. In addition, the methodology can be applied in the process of inspections at the bank in order to formulate an independent objective judgment regarding the volume of troubled loans, and then check the credit files of these loans, borrowers and collateral.

As part of the systemic risk assessment at the banking system's level, the developed methodology enables to analyze the overall level of non-performing loans and potential losses when creating additional provisions, which will subsequently be attributed to the capital of banks. After dividing the portfolio into performing and non-performing portions, it is possible to estimate the amount of potential losses in case of changes in macroeconomic conditions affecting the quality of the performing portfolio by conducting the stress testing. Using the stages of loans described above, it is possible to construct a transition matrix from each stage for the corresponding class of loans and to determine the probability of transition to the stage of default. For non-performing loans, a 100% probability of default is assumed and the required level of provisions is estimated with a further revaluation of the capital level.

6. Conclusions and Further Research

Application of the developed methodology will enable to analyze the quality of bank loan portfolios not based on their subjective opinion, and to identify doubtful and defaulted loans in advance. However, there are certain restrictions associated with the fact that until mid-2019 there is no information on repayment schedules. Keeping track of repayment schedules is the area for expanding the methodology and conducting further research.

The current methodology prioritizes monthly loan repayments, and individual schedules are not taken into account. At the same time, an individual schedule may assume the repayment of most of the PD at the end of the term, which, in the absence of objective evidence of a high probability of debt repayment, may indicate a high risk and justify the application of a unified approach. Criteria are also required for classifying a loan as an investment one, taking into account the assessment of risks and feasibility, including the terms of the loan and legal aspects. For example, the condition for the provision of tranches, the order of the bank's priority to receive (expected) cash flows of the debtor, to collateral, etc.

The next step in using the methodology is to assess the probability of borrower's default by using the concept of default described above, as well as to build matrices for

the transition from each category to the category of default and assess the necessary provisions for the corresponding loans.

In addition, after dividing the portfolio into a default and non-default one, it is planned to conduct the stress testing with a forecasting horizon of 1 year or more. In this case, the forecast will be built only for the performing portfolio, and the level of required provisions will be calculated for the estimated default portfolio. These efforts are areas of studies that are intended to be carried out in the coming years.

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Appendix

Table 1. Examples of Countries with the State Credit Registry

Countries	Date of Establishment	State Credit Registry	Minimum Amount
Ireland [17]	2013	+	500 €
Russia [18]	2015	+	0 Corporate entities only
Belarus [19]	2007	+	0
Latvia [20]	2008	+	0
Armenia [21]	2003	+	0
Germany [7]	1934	+	1mln. €
Romania [22]	2012	+	4500\$
Slovenia [23]	2014	+	0
Ukraine [24]	2018	+	1500 €
AnaCredit ECB [25]	2018		25000€
Kazakhstan	2009	+	0

Source: Internet resources

Table 2. The Number of Loans Transferred by Organizations (thousands)

At the beginning of the period

Organization Type	Liability Types	2Q2013	2014	2015	2016	2017	2018	2019	2019	2019	2020	2H of 2020
Banks	active	4 675	6 001	6 787	7 061	7 408	8 869	10 648	11 138	9 320	10 198	9 397
	contingent	535	856	1 452	2 644	2 180	896	976	1 042	3 314	4 075	5 120
Other organizations	active	32	46	51	54	64	76	81	41	118	162	33
	contingent	9	14	23	33	25	51	56	0	35	20	121
Total		5 251	6 916	8 314	9 792	9 676	9 893	11 761	12 221	12 788	14 455	14 670

Source: NBK's Credit Registry

Table 3. The Number of Loans Provided to Borrowers, by Entity Type

Organization Type	Entity Type	Apr. 2013	Jan. 2014	Jan. 2015	Jan. 2016	Jan. 2017	Jan. 2018	Jan. 2019	Jun. 2019	Jul. 2019	Jan. 2020	Jun. 2020
Banks	Banks/non-bank organizations	34	59	201	196	90	64	39	32	0	0	0
	Individual	5.04 mln.	6.6 mln.	7.86 mln.	9.3 mln.	9.14 mln.	9.57 mln.	11.43 mln.	11.96 mln.	12.12 mln.	13.54 mln.	13.6 mln.
	Corporate entity	169 919	260 835	380 934	407 150	446 061	195 667	197 720	222 672	513 156	734 114	911 553
Other organizations	Individual	35 869	53 693	66 246	53 077	46 977	50 811	499 17	40 728	109 203	134 204	105 655
	Corporate entity	4 752	5 829	7 866	33 961	41 643	76 761	86 564	175	44 542	48 102	48 219
Total		5.25 mln.	6.92 mln.	8.31 mln.	9.79 mln.	9.68 mln.	9.89 mln.	11.76 mln.	12.22 mln.	12.79 mln.	14.46 mln.	14.67 mln.

Source: NBK's Credit Registry

Table 4. Types of Loan Operations reported to the Credit Registry by Banks

Type of operation	Apr. 2013	Jan. 2014	Jan. 2015	Jan. 2016	Jan. 2017	Jan. 2018	Jan. 2019	Jun. 2019	Jul. 2019	Jan. 2020	Jun. 2020
loans	2 704 074	3 448 910	3 640 367	3 482 862	3 354 310	3 915 994	4 617 420	4 653 289	5 232 662	5 152 856	4 585 610
loans under trust	181	174	22 423	14 516	9 246	9 362	12 584	24 044	16 082	242 670	31 193
investment loan	276	424	454	42	38	174	157	46	49	52	52
working capital loan	6 484	3 958	4 265	3 091	2 481	1 846	1 428	1 119	420	542	471
credit card	1 927 237	2 514 992	3 075 661	3 531 023	3 996 309	4 847 095	6 068 341	6 469 731	4 160 405	4 868 652	4 776 100
credit line	2	4	0	0	0	1 260	1 076	697	467	39	17
Overdraft	67 974	76 797	93 655	80 899	99 864	153 430	9 981	10 122	8 757	7 952	3 266
Overnight	1	1	1	0	2	0	1	11	1	0	0
Repo operations	91	288	288	248	532	1 557	337	398	432	869	1 633
Factoring	80	60	53	64	28	850	114	1 282	937	1 554	867
Financial leasing	584	639	685	2 614	8 565	14 033	17 581	17 905	18 192	36 800	18 667
Forfeiting	56	68	0	0	0	0	0	0	0	10	11
Islamic instruments	59	49	54	68	53	80	121	165	174	254	287
Other asset types	6	28	11	1	2	1	0	0	6	48 407	11 039
Contingent liabilities	543 756	869 405	1 475 727	2 676 980	2 204 958	947 210	1 031 730	1 042 517	3 349 707	4 094 780	5 240 721

Source: NBK's Credit Registry

Table 5. The NPL Definition by Countries

Country	Definition of a Non-Performing Loan
Russia [10]	<p>Individual loans: <i>minor deterioration of the borrower's financial condition</i></p> <ul style="list-style-type: none"> + 5 days of past due on corporate loans / 30 days of past due on retail loans; <p><i>moderate deterioration of the borrower's financial condition</i></p> <ul style="list-style-type: none"> + 30 days of past due on corporate loans / 60 days of past due on retail loans. <p>Homogenous loans:</p> <ul style="list-style-type: none"> Over 90 days of past due on secured loans, Over 30 days of past due on unsecured loans
Turkey [11]	<p>Doubtful loans:</p> <ul style="list-style-type: none"> - Loans past due at least 180 days, if they are not fully secured. - Debt recovery in full, which is very doubtful or unlikely. - The possibility of loss, but there are some factors that may improve the situation . - Permanent overdraft in excess of the limit, minimum activity across the account and collateral are not sufficient to cover the overdue debt. <p>Non-performing loans (loss):</p> <ul style="list-style-type: none"> - Loans are considered as bad. - Loans past due at least 365 days, if they are not fully secured. - Loans that can have some recurrent value but it is not practicable and not desirable to postpone their writing-off.
European Banking Authority (EBA) [2] Used for standardization of reporting in the European Union member countries	<p>Non-performing loans:</p> <ul style="list-style-type: none"> - 90-days past due (significant risk) - It is unlikely that the debt will be repaid in full without the sale of collateral (irrespective of any overdue amount or the number of days past due) - Impaired or allowed to default in accordance with the applicable accounting or regulatory framework. <p>In respect of an individual borrower or debtor, all of its debt is recognized as non-performing if here is debt past due more than 90 days and its amount is > 20% of the borrower's total debt</p>
Czech Republic ⁴ [3]	<p>Doubtful loans Loans past due from 180 to 360 days</p> <p>Non-performing loans (loss) Loans past due more than 360 days</p>

⁴ From the first quarter of 2018, definitions recommended by the EBA are used

Ireland [12]	Non-performing loans: Loans past due more than 90 days The debtor is assessed as “unlikely to pay” in full without the sale of collateral on the loan.
Romania ⁵ [3]	Non-performing loans: The combination of past due days and the assessment of creditworthiness that should be conducted by the financial institution is used. All loans past due more than 90 days. The bankruptcy or any other financial reorganization of the borrower is taken into account
Belarus [13]	Interbank loans - past due over 31 days or more Corporate loans - unsecured with the signs of financial unsoundness past due from 8 days and more -unsecured from 31 days and more - secured from 91 days and more Retail loans: - past due from 91 days and more Microcredits: - past due from 91 days and more In classifying a loan, banks may use their own judgment but only towards the increase in credit risk
Latvia ² [3]	Doubtful loans Loans past due from 91 to 180 days Non-performing loans (loss) Loans past due from 181 days or more
Armenia [14]	Non-performing loans: - full or partial repayment of the principal or interest is past due 90 days or more, or - interest payment for 90 days or more is capitalized (added to the amount of unpaid loan), or the repayment terms are adjusted (refinanced)) or is transferred to the amount of a new loan.
Germany [15]	Non-performing loans: - 90-days past due (significant risk) - It is unlikely that the debt will be repaid in full without the sale of collateral (irrespective of any overdue amount or the number of days past due) ³
Slovenia ² [3]	Doubtful loans Loans past due from 91 to 180 days Non-performing loans (loss) Loans past due more than 360 days

⁵ At present, the definitions recommended by EBA are used

Ukraine [16]	Non-performing loans: <ul style="list-style-type: none"> - Loans past due from 90 days or more (30 days for debtor banks) - It is unlikely that the debt will be repaid in full without the sale of collateral (irrespective of any overdue amount or the number of days past due)⁶
Kazakhstan ⁷ [4]	Non-performing loans: <ul style="list-style-type: none"> - Loans past due from 90 days or more

Source: Internet resources, regulations in the countries

⁶ This definition complies with recommendations of the International Monetary Fund

⁷ The definition is used in the supervisory practice