Implementation LGD model in assessment process of credit risk in regional banks

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Abstract: The importance of risk management of commercial banks and quality of their assessment don't lose the importance in modern conditions as the probability of approach of a risk situation essentially affects the got profit, determines the size of the regulatory and economic capital, and also is one of criteria of financial stability. The capital carries out a role of the stimulating element of development of the credit organization and expansion of its functions, and also promotes confidence in it from persons and entities. In article methodical approach to a risks assessment in a management system by a capital of commercial bank with use of LGD model is proved and recommendations about its adaptation to regional conditions are formulated. Using the device of the structural, dynamic and system analysis, economical, statistical, abstract and logical methods the empirical materials of regional banks in the field of a risks assessment and distribution of capital is carried out. The mechanism of risks assessment and capital allocation of commercial bank which is based on requirements of the Basel III and the experience which is saved up in world practice and attempts of Bank of Russia on its adaptation to domestic conditions is developed. The practical importance of the offered approaches is that they are capable to constitute a basis of the mechanism of development and decision making, directed on implementation in regional banks of a management system by the capital, and also to be useful by optimization of technologies of risk management.
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1. Introduction

The last years the Bank of Russia systematically realizes the project on transition of the Russian credit organizations to the standards of credit risk management provided by the International Convergence of Capital Measurement and Capital Standards (Basel II). It is planned that their implementation will significantly increase the accuracy of an assessment of credit risks and will allow banks to use an equity more effectively.

Meanwhile, according to the project of Bank of Russia published in February, 2014 "About an order of consideration by Bank of Russia of banks` petitions for application of approach on the basis of internal ratings to calculation of credit risk" right to application of approach to calculation of credit risk on the basis of internal ratings it is planned to allocate only banks which size of assets constitutes more than 500 billion rubles. Thus, the majority of the credit organizations of the country, and, first of all, regional banks will be actually debarred from this project.

Nevertheless, implementation the elements Basel II adapted for working conditions in the small regional markets in practice of the credit organizations is advisable. Considering it, offers on application of such components by regional banks as Loss Given Default (LGD) and Exposure At Default (EAD) are developed.

2. Main Part

LGD – the size of economic losses of bank as a result of the client's default expressed percentage of the cumulative size of requirements to it at the time of recognition of a default. Unlike Probability of Default (PD), LGD is the characteristic of the requirement, but not the partner, and is divided into two types:

- forecast LGD – the amount of the expected losses appropriated to requirements to the client at the time of their origin (for example, issues of the loan), or the subsequent monitoring;
- realized LGD – the amount of the losses which were actually taking place as a result of the client's default.

The size LGD depends on availability of providing on the credit, like the used providing, degree of its legal risk, and also efficiency of programs for collection of overdue requirements.

Basel II provides two approaches to determination of LGD: basic and advanced. The first of them assumes determination of losses as a result of a default according to strict requirements of regulating boards. In turn, the advanced approach gives to banks opportunity of an independent assessment of this indicator based on cumulative internal statistics.

Considering the limited financial opportunities of regional banks which aren't allowing each of them to develop independently a technique of an assessment of LGD and EAD we offer the loose

rate assessment model based on statistics of defaults of banks corporate customers in Stavropol Krai.

It consists of the following elements:

1. A recovery level assessment for various types of providing.
2. Determination of fair value of providing.
3. Adjustment on the level of legal risk of providing.
4. Determination of size of requirements to the client at the time of a default (EAD).
5. Determination of level of security of requirements to the client.
6. Determination of a LGD rating and size LGD.

Level of recovery characterizes a providing change in value as a result of a client`s default and is expressed percentage of original cost of providing. It is determined by a formula:

$$U^{rec}i = 100\% - Di, \quad (1)$$

where $U^{rec}i$ – recovery level for i type of providing, %;

Di – the size of the discount established for i type of providing, %.

The size of discount depends on exposure of each type of providing to action of such factors, as:

- decrease in market value of pledge during the period from the moment of the last assessment until implementation;
- need of costs for providing implementation;
- insufficient safety of pledge (high probability of loss, or natural spoil eventually), etc.

On analysis results of cases of a default of the clients who are credited in banks of Stavropol Krai the following system of mortgage discounts (table 1) was developed.

Table 1. The size of pledge`s discounts for different types of providing

Providing type	Amount of discount, %
The security deposit in bank	0
Securities of bank	0
The affined precious metals in ingots	10
The securities emitted by the persons having BB- rating and above on classification of the international rating agencies (Moody's, Standard & Poor's, Fitch Ratings)	10
Commercial real estate (trade and office)	20
Residential apartments of economy class	20
The vacant parcels of land prepared under construction with the brought communications	20
The securities emitted by the persons having a rating from CCC to B+ on classification of the international rating agencies (Moody's, Standard & Poor's, Fitch Ratings)	30
Commercial real estate (warehouse and other)	30
Residential apartments of a business class, apartment houses of economy class and business class useful life till 20 years	30
The vacant parcels of land prepared under construction without communications	30
Road, air and water transport useful life till 5 years, a rail transport useful life till 10 years	30
Road, air and water transport useful life from 5 to 15 years, a rail transport useful life over 10 years	40
Apartment houses of a premium class, apartment houses of economy class and business class useful life over 20 years	40
Earth of agricultural purpose	40
Easily dismantled industrial equipment useful life till 5 years	40
Goods in turnover	50
Other	50

The following stage is determination of fair value of providing, i.e. the most probable amount of means which will be received by bank as a result of implementation of the rights to this providing.

Fair value of providing for each certain client is determined by a formula:

$$MV^{marc} = \sum(MV_i^{marc} * K_i^{ent} * U_i^{rec}), \quad (2)$$

where MV^{marc} – market value of i providing;

K^{ent} – adjustment coefficient on the legal risk calculated for i providing type.

Depending on the model which is taken over by bank of work market value of providing is determined based on the report of the independent appraiser, or the conclusion of mortgage service of bank.

For guarantees market value is understood as the size of the liabilities assumed by guarantors according to the signed agreements. Thus only guarantees of the persons having BB- rating and above on classification of the international rating agencies (Moody's, Standard & Poor's, Fitch Ratings) are taken into consideration. If these types of providing cover all arising liabilities of the client under the agreement, market value of providing is equated to the total volume of requirements to the client at the time of a default.

Thus market value is adjusted on the level of legal risk of the providing reflected in the conclusion of legal service of bank (table 2).

Further it is necessary to calculate EAD indicator representing the size of requirements of bank expected the client at the time of a default to it. This indicator is determined by specifics of requirements of bank to the client, and also behavior of the last during approach to a default. According to requirements of Basel II calculated value of EAD can't be less, than the current amount of requirements to the partner at the time of calculation.

Table 2. Assessment of legal risk of providing

Characteristic of risk	Class of legal risk	Adjustment coefficient on legal risk
Absence of significant risk	U0	1,0
Availability of risk factors which can slightly drag out process of the address of collection on providing	U1	0,8
Availability of risk factors which can complicate considerably process of the address collection on providing	U2	0,5
Availability of risk factors which with a high share of probability will make the address of collection on providing impossible	U3	0,0

The assessment of the expected requirements is made on the following formula:

$$EAD = R^{cur} + (L^{cur} - R^{cur}) * U^{lim} / 100\%, \quad (3)$$

where R^{cur} – the current amount of requirements to the client;
L^{cur} – the current limit of debt set to the client according to the signed agreements;
U^{lim} – utilization rate of a limit, %.

The utilization rate of a limit represents specific weight of a free remaining balance of a limit which will be used by the client until approach of a default. Its size is determined proceeding from type of the requirement to the client (table 3).

If the general limit on the client includes some various products, this coefficient is calculated on the following formula:

$$K^{lim} = \sum (K_i^{lim} * \frac{L_i^{cur}}{L^{sum}}), \quad (4)$$

where K^{lim} – limit utilization rate for i credit product of the client, %;
L^{cur}_i – the current limit of debt set on i-mu to a credit product;
L^{sum} – the cumulative limit of debt set to the client on all credit products.

The following stage is determination of level of security of requirements to the client (formula 5).

$$L^{secur} = MV^{fair} / EAD*100, \% \quad (5)$$

Further, depending on nature of requirements and level of their security, the LGD rating and the LGD level as a percentage is determined (table 4).

Table 3. Determination of utilization rate of a limit

Type of requirements	Utilization rate of a limit, %
Bank guarantees, credits	100
Credit lines over 1 year	50
Credit lines till 1 year	20
Credit lines on which the right of bank unilaterally is provided to refuse issue of means without prior notice of the client	0

Table 4. Determination of a LGD rating and size LGD

Nature of requirements	Level of security, %	LGD-rating	LGD, %
Risk-free (are provided with pledge of a security deposit and/or securities of bank)	100 and above	0	2
Excessive security	over 150	1	20
	from 120 to 150	2	25
Complete security	90-120	3	30
Partial security	from 70 to 90	4	32,5
	from 50 to 70	5	35
	from 30 to 50	6	37,5
	less 30	7	40
Unsecured	0	8	50
Subordinated	0	9	75
Hopeless	0	10	100

The hopeless type if the bank expected is appropriated to requirements to the client that in case of a default it won't manage to collect the available debt (for example, for the reason in an inadequate way of the arranged credit documentation which isn't allowing to take a legal action).

Except forecast LGD value it is necessary to calculate surely the realized LGD in all occurred default cases. It is determined as the relation of the net cost of losses of bank specified to date of a default to the amount of requirements to the client for date of a default:

$$LGD^{realised} = \sum_{i=1}^{n} \frac{CC_i + SUC_i + HRI_i}{(1 + EIR)^i} / EAD^{de} \quad (6)$$

where CC_i – the costs incurred on collection of the credit;
SUC_i – the amount written off as unreal to collection of requirements to the client;
HRI_i – the half-received interest incomes;
EIR – an effective interest rate according to requirements to the client;
n – number of the years which occurred from the moment of recognition of a default before write-off of requirements to it as hopeless to collection;
EAF^{def} – the amount of requirements to the client at the time of recognition of a default.

Thus the effective interest rate is determined by requirements proceeding from a ratio:

$$\sum_{i=0}^{n} \frac{CF_i}{(1+EIR)^{\frac{d_i - d_0}{365}}} = 0, \quad (7)$$

where CF_I – the amount of i cash flow;
EIR – an effective interest rate, % per annum;
d_i – date of i cash flow;
d_0 – date of initial cash flow;
n – quantity of cash flows.

It should be noted that multidirectional cash flows (cash inflow and outflow) join in calculation with opposite mathematical characters. For example, the amount of the loan granted to the borrower joins in calculation with the sign "minus", the amounts of the principal debt repaid by the borrower and paid interests on the credit – with the sign "plus".

For LGD assessment by requirement LGD ratings on which values of the realized LGD are calculated, are grouped by year of recognition of a default and scores which were assigned to them for date of the announcement of a default.

Application of the offered model will allow regional banks to estimate at a stage of consideration of the credit project with rather high precision the losses in case of the client's default. Therefore it is reasonable to integrate the LGD rating calculated within model into system of acceptance credit decisions and, along with an assessment of a financial position of the borrower, to use as the formalized criteria in case of assessment of conformity of the project to credit policy of bank. Depending on a combination of these factors, the following restrictions on the level of the accepted credit risk (table 5) can be set.

Table 5. A matrix of restrictions on the level of the accepted credit risk

Financial position of a borrower/principal	LGD-raiting			
	0	1-3	4-7	8-10
Good	Without restrictions			
Average		Only according to decision of the Main credit committee		
Bad		The risks which aren't accepted by bank		

It is natural that compliance of the project to these two signs doesn't mean automatic approval of a limit yet. The bank shall be convinced available primary sources of settlement of the loan, their stability, absence of unacceptable business risks. Use of the formalized criteria allows to designate accurately borders of the risks accepted by bank and the bodies authorized on adoption of similar decisions.

For regional banks we made its validation based on internal statistics of the credit organizations of Stavropol Krai for an assessment of applicability of the offered model. Validation performed by comparison of the average realized LGD values with their forecast values in the following directions:

- discrimination capability of model;
- forecast capability of model.

In both directions it is reasonable to use Student's criterion or the t-test. For the purpose of determination of a discrimination model`s capability this criterion is applied when comparing average LGD on two adjacent LGD ratings. Their equality shows a low capability of model to divide losses on adjacent LGD ratings.

Thus the reliable model also shall perform correctly ranging of LGD, i.e. to higher LGD ratings there shall correspond smaller values of the realized losses.

As zero hypothesis in this case the following statement acts: average LGD value on a LGD rating of *n* is less or to equally average LGD value on *n+1* LGD rating.

Check of this hypothesis begins with calculation of average LGD values for two adjacent LGD ratings (formula 8 and 9).

$$\overline{x_n} = \frac{\sum_{i=1}^{N_n} x_{i,n}}{N_n}, \quad (8)$$

where $x_{i,n}$ – LGD value in supervision of *i* in *n* LGD rating;

N_n – number of supervision in *n* LGD rating.

$$\overline{x_{n+1}} = \frac{\sum_{i=1}^{N_{n+1}} x_{i,n+1}}{N_{n+1}}, \quad (9)$$

Further values of dispersion on each LGD rating are calculated:

$$\sigma_n^2 = \frac{\sum_{i=1}^{N_n}(x_{i,n} - \overline{x_n})}{N_n} \quad (10)$$

$$\sigma_{n+1}^2 = \frac{\sum_{i=1}^{N_n}(x_{i,n+1} - \overline{x_n})}{N_{n+1}} \quad (11)$$

If dispersions on both LGD ratings are close, for check of a hypothesis the following statistics is calculated:

$$t^1 = \frac{\overline{x_n} - \overline{x_{n+1}}}{\sqrt{\frac{(N_n-1)\cdot\sigma_n^2 + (N_{n+1}-1)\cdot\sigma_{n+1}^2}{N_n+N_{n+1}-2}\cdot\left(\frac{1}{N_n}+\frac{1}{N_{n+1}}\right)}} \quad (12)$$

If dispersions on two LGD ratings differ, for check of a hypothesis the statistics determined by a formula 13 is used.

$$t^2 = \frac{\overline{x_n} - \overline{x_{n+1}}}{\sqrt{\frac{\sigma_n^2}{N_n}+\frac{\sigma_{n+1}^2}{N_{n+1}}}} \quad (13)$$

If implementation of LGD on both LGD ratings has normal distribution and average values are equal, the t-statistics has Student's distribution.

However, if this condition isn't satisfied, but number of supervision rather big, this statistics (on condition of equality of averages), also meets to Student's distribution. In case of equality of dispersions the number of degrees of freedom constitutes $N_n + N_{n+1} - 2$.

If dispersions are differ, the number of degrees of freedom is determined as follows:

$$df = \frac{(\sigma_n^2/N_n + \sigma_{n+1}^2/N_{n+1})^2}{(\sigma_n^2/N_n)^2/(N_n-1) + (\sigma_{n+1}^2/N_{n+1})^2/(N_{n+1}-1)} \quad (14)$$

For check of a hypothesis the unilateral quantile of distribution of Student (the right test) is used. The zero hypothesis is accepted if the settlement statistics is less than distribution quantile with the level of trust of 95%.

Validation of the offered model with use of data on the actual losses as a result of defaults of enterprise customers of banks of Stavropol Krai over the last 5 years (table 6) showed a high discrimination capability of model.

Table 6. Assessment of a discrimination capability of LGD model with use of Student`s criterion

LGD-rating	Forecast LGD, %	Average value of the realized LGD, %	Number of supervision	Dispersion	t-statistics	Number of degrees of freedom	Trust level, %	Quantile of Student`s distribution	Check
0	2,00	2,07	3	4,2956	-3,3670	8	95	0,0647	TRUTH
1	20,00	13,73	3	31,7222	-0,5942	5	95	0,0659	TRUTH
2	25,00	16,20	3	19,9800	-2,8902	4	95	0,0668	TRUTH
3	30,00	25,49	24	87,9928	-1,0907	63	95	0,0629	TRUTH
4	32,50	28,18	15	36,4176	-1,2779	123	95	0,0628	TRUTH
5	35,00	31,63	4	19,3569	-2,3305	4	95	0,0667	TRUTH
6	37,50	37,15	2	1,5625	-1,9301	2	95	0,0708	TRUTH
7	40,00	43,00	2	16,8100	-1,4313	4	95	0,0667	TRUTH
8	50,00	49,05	2	18,9225	-5,0171	2	95	0,0708	TRUTH
9	75,00	68,00	2	9,6100	-10,1378	2	95	0,0708	TRUTH

So, in all 10 cases of comparison of adjacent LGD ratings average value of the realized LGD for a rating *n* appeared less similar indicator for rating *n+1*, i.e. the zero hypothesis completely proved to be true.

For an assessment of a forecast capability of model with using t-statistics average values of the realized LGD were compared to average forecast values. This test is unilateral as it is expected that the values calculated according to model shan't be less implemented.

Zero hypothesis in this case is the following statement: average actual LGD value on a LGD rating *n* is less or to equally forecast value.

For its check at the first stage average value and dispersion of LGD is determined by a LGD rating *n* (formula 8 and 10).

Further for check of a hypothesis the following statistics is calculated:

$$t = \frac{\overline{x_n} - y_n}{\sqrt{\frac{\sigma_n^2}{N_n}}}, \qquad (15)$$

where y_n – forecast LGD value in LGD rating *n*.

If implementation of LGD on a LGD rating has normal distribution and average value is equal y_n, the t-statistics shall have Student's distribution. However, if this condition isn't satisfied, but number of supervision rather big, this statistics (on condition of equality of an average and y_n) also shall meets to Student's distribution. The number of degrees of freedom in this case will be $N_n - 1$.

For check of a hypothesis the unilateral quantile of distribution of Student (the right test) is used. The zero hypothesis is accepted if the settlement statistics is less than distribution quantile with the level of trust of 95%.

Results of validation of model with use of data on the actual LGD values in banks of Stavropol Krai (table 7) allowed to recognize high qualities of a forecast capability of model.

So, from 11 LGD ratings only for two ratings (0 and 7) value of settlement statistics was positive: 0,0557 and 1,0348 respectively.

Thus for a LGD rating 0 size of settlement statistics didn't exceed a quantile of Student`s distribution that allows to recognize positive result of test.

Results of testing for a LGD rating 7 became the unique significant deviation. Average value of the realized LGD (43,0%) for it significantly exceeded forecast value (40,0%) therefore settlement statistics there was more quantile of Student`s distribution and the zero hypothesis wasn't confirmed. This fact has a talk small amount of information on the actual losses as a result of a default of requirements with such rating (only 2 cases over the last 5 years).

Thus, it is possible to recognize high quality of both a discrimination, and forecast capability of the offered model allowing regional banks to predict with high precision the expected loose rate according to the credit requirements.

Except receipt of additional profit, application of model of calculation of forecast LGD and matrix of restrictions of level of credit risk will allow regional banks to increase significantly quality of the credit portfolios, having reduced the size of the created allowances, and, as a result, load of an equity.

Table 7. Assessment of a forecast capability of LGD model with use of Student`s criterion

LGD-rating	Forecast LGD, %	Average value of the realized LGD, %	Number of supervision	Dispersion	t-statistics	Number of degrees of freedom	Trust level, %	Quantile of Student`s distribution	Check
0	2,00	2,07	3	4,2956	0,0557	2	95	0,0708	TRUTH
1	20,00	13,73	3	31,7222	-1,9272	2	95	0,0708	TRUTH
2	25,00	16,20	3	19,9800	-3,4099	2	95	0,0708	TRUTH
3	30,00	25,49	24	87,9928	-2,3567	23	95	0,0634	TRUTH
4	32,50	28,18	15	36,4176	-2,7725	14	95	0,0638	TRUTH
5	35,00	31,63	4	19,3569	-1,5342	3	95	0,0681	TRUTH
6	37,50	37,15	2	1,5625	-0,3959	1	95	0,0787	TRUTH
7	40,00	43,00	2	16,8100	1,0348	1	95	0,0787	FAILS
8	50,00	49,05	2	18,9225	-0,3089	1	95	0,0787	TRUTH
9	75,00	68,00	2	9,6100	-3,1934	1	95	0,0787	TRUTH
10	100,00	97,04	5	17,0024	-1,6052	4	95	0,0668	TRUTH

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