BANKING SCORE METHODOLOGY: PROBABILTY OF DEFAULT

VITRUAL ANALYTICS PROJECT

Banks Score Approach

A complex algorithm for scoring the financial condition of the bank, involves a set of steps to determine the financial condition in the form of a determined value - the probability of bank default.

We analyze two basic factors due to financial profile of the bank and qualitative additional characteristics:

Financial profile		
Factor 1	Solvency/Liquidity	Excess of net cash flow from operating activitiy compare to cash flows from financial and investment activities of the bank (O>I+F)
Qualitative additional characteristics		
Factor 2	Financial Management	Quality of financial assets governance

The basic approach to assess the financial condition of the certain bank based on the probability of default (PD) of the bank corresponding to the segmentation, segment that the bank belongs. Segmentation of banks based on their share in the banking services market and dynamics of their NCF (net cash flow), including of assessment of the quality of financial management of the bank.

The proposed segmentation provides following segments for banks clustering:

- bankrupt banks;
- banks with a high probability of bankruptcy;
- banks with mixed financial stability;
- banks with a low probability of bankruptcy.

We have the following correspondence between the segment and the financial stability of the bank:

Conditional compliance of the segment and the financial stability of the bank

Segmentation	Financial stability of the bank	Quality of financial assets governance
Banks with low probability of bankruptcy	Excellent	Excellent
Banks with mixed financial stability	Good	Normal
Banks with a high probability of bankruptcy+	Tolerate	Low
Banks with a high probability of bankruptcy-	Crisis	Low
Bankrupt banks	-	-

Financial stability of the bank based on composition of financial, operating and investing activities.

Financial stability approach

Financial stability of the bank	F	I	O	NCF	Formula
Excellent	F+	I+	O+	NCF+	F+I+O+NCF+
Good	F	I	O+	NCF+	FIO+NCF+
Tolerate	F	I	O	NCF+	FIONCF+
Crisis	F	I	O	NCF-	FIONCF-

where:

F – financial activity

I – investing activity

O – operating activity

NCF – Net cash flow (as solvency factor)

Next step is determining the class of the bank depending on the segment (hereinafter K_d) from 1 to 5 (the number of bank classes can be arbitrary).

Determination the class of the bank for PD interval depending on the segment

Class	Segmentation	Interval of PD {minPD, maxPD}
$K_d = 1$	Banks with low probability of bankruptcy	(0;0.2]
$K_d = 2$	Banks with mixed financial stability	(0.2; 0.4]
$K_d = 3$	Banks with a high probability of bankruptcy+	(0.4; 0.6]
$K_d = 4$	Banks with a high probability of bankruptcy-	(0.6; 0.8]
$K_d = 5$	Bankrupt banks	(0.8; 1]

Determining the probability of default (PD) of an individual bank involves assigning a bank rank (R_i) within the population included in the segment where i is the bank number of the population. We will use the method of direct ranking, where points are assigned from the worst element of the population to the best. Within the framework of this algorithm, it is proposed to use the indicator of Net Cash Flow (NCF) from the bank activity, the lower the indicator - the higher score is assigned to the bank and, accordingly, the lowest rank.

Thus, the probability of default (PD) is:

$$\mathrm{PD}_{bank} = \min\left(\mathrm{PD}_{\mathrm{segm}}\right) + \frac{\mathrm{R_i}}{\sum \mathrm{R_i}} * \left(\max\left(\mathrm{PD}_{\mathrm{segm}}\right) - \min\left(\mathrm{PD}_{\mathrm{segm}}\right)\right), \quad (1)$$

where $R_i = f(NCF)$ - function of the bank's net cash flow, expressed by the bank's rank in the relevant aggregate;

$\max(PD_{segm})$ – the maximum value of the risk indicator for the segment;

$\min(PD_{segm})$ – the minimum value of the risk indicator for the segment.

Formula (1) determines PD_{bank} within the bank's segment and takes into account the probability that a default event will occur for the bank in this segment, but it does not take into account the risk that the bank will change segment as a result of some events, including the default event for its direct competitors in another segment.

Therefore, we need to assess Risk (G), to determine the possibility that the value of the default risk for the bank will be above the threshold level G set by previous calculations:

$$\mathrm{Risk(G)}=\begin{cases} 0 \text{ , at } PD_{bank}=\mathrm{PD_{max}} \\ \frac{\mathrm{PD_{max}}-\mathrm{PD_{bank}}}{PD_{\mathrm{max}}-\mathrm{PD_{min}}},\ \mathrm{PD_{min}} \geq PD_{bank} \leq \mathrm{PD_{max}}, \\ 1 \text{ , at } PD_{bank}=\mathrm{PD_{min}} \end{cases} \quad (2)$$

where $\mathrm{PD_{min}}$ – lower value $min(PD_{\text{сегм}})$;

$\mathrm{PD_{max}} = 1$ – upper value of the interval PD.

Accordingly, if $\mathrm{G=PD_{max}}$ it means that the bank is already in a state of bankruptcy and liquidation, so the risk is realized and the state of the bank can not get worse. If $\mathrm{G=PD_{min}}$, it means that the bank is in a state of uncertainty and in case of re-segmentation, it can get any other state, including bankruptcy. In this way, we take into account any other factors not related to the bank's activities (for example, possible force majeure events that the bank cannot directly influence).

Analysis of the dynamics of re-segmentation of banks during a statistically significant period. In this context, we propose a monthly analysis of resegmentation, this value is denoted by Q_{BB}, the ratio (3):

$$\mathrm{P(A)} = \frac{\mathrm{Q_{BB}}}{\mathrm{m}}, \quad (3)$$

where $P(A)$ – the probability of a random event - the default of an individual bank in any market segment, then Q_{BB} – dynamics of the number of bankrupt banks in the study period; m – the total possible number of cases of transition from one state to another during the study period, depending on the total number of banks (the main condition is one bank and the transition to one market segment).

Given this condition, the probability of default of a particular bank will take this final form:

$$\mathrm{PD}_{bank} = \min(\mathrm{PD_{segm}}) + \frac{\mathrm{R_i}}{\sum \mathrm{R_i}} * (\max(\mathrm{PD_{segm}}) - \min(\mathrm{PD_{segm}})) + (\mathrm{PD_{max}} - \max(\mathrm{PD_{segm}})) * \mathrm{PD_{max}} * \mathrm{P(A)} * \mathrm{Risk(G)}, \quad (4)$$

where, $R_i = f(NCF)$, function of the bank's net cash flow (NCF), expressed by the rank of the bank in the relevant population;

$\max(PD_{\text{сегм}})$ – the maximum value of the risk indicator for the segment;

$\min(PD_{\text{сегм}})$ – the minimum value of the risk indicator for the segment;

PD_{max} – the upper value of the interval of the i-th factor, is adjusted to artificially reduce the dimension of the total interval PD;

$P(A)$ – probability of a random event - the default of an individual bank in any market segment;

$Risk\ (G)$ – assessment of the risk of erroneous determination of the level of default of the bank in the interval $[\max(PD_{\text{сегм}});1]$.

Thus, the probability of default of a particular bank depends on the probability of default within a particular segment, which includes the bank, taking into account the cash flow of each bank in the aggregate, the risk of erroneous determination of financial condition of the bank.