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## The use of regression analysis in the financial planning of banks, mathematical formalization of the stages of financial planning in banks

### Abstract

The article deals with the basic principles of the implementation of the financial planning in a bank and formation of system of indicators to assess its effectiveness; the convolution of the relevant indicators related to the integral assessment of the financial condition on the basis of multi-objective optimization; identification of the bank's potential based on the average weighted growth rate characteristics of the current financial situation; the development of strategies for the planning of the bank's activities in the context of the main development areas through the use of a matrix approach; assessment of the efficiency of financial planning in a bank on the basis of regression analysis.

**Keywords:** financial planning, bank, financial condition, potential, planning strategy, regression analysis.

**JEL Classification:** G20, G21.

### Introduction

**Problem statement.** In the conditions of transformational changes in the economy, its sustainable and dynamic development on the market economy principles, there is a growth of the role and importance of an effective system of bank management based on financial planning. Financial planning makes it possible to adjust the goals and objectives of the bank with the available financial resources, optimize the processes of their mobilization, allocation, distribution and use. An effective financial management is one of the main problems of bank management. At the present stage every bank carries out financial planning not on the basis of a common generally accepted system of financial planning, but only on the basis of its individual perception of reality, which, in turn, leads to the lack of a comprehensive, objective assessment of the bank's external and internal environment and its potential financial possibilities. This type of problem necessitates the need to study the basic principles of realization of financial planning in banks and the modeling of quantitative evaluation of their effectiveness as a key element of bank management.

### Analysis of the recent research and publications.

The study of the general peculiarities in the functioning of banks and financial planning is carried out in the works of such authors as Ackoff [1], Barrow [3], Birman [4], Brigham [5], Meskon [10], Rose [13], Sinke [14] Walsh [16], and others.

The domestic research devoted to the theoretical and practical aspects of financial planning in banks (companies) includes the publications of A. Azarenkova [15], A. Vasyurenko [15], N. Pohorelenko [15], M. Bilyk [11], V. Grynyova [5] O. Kalinichenko [7], O. Kolodizyev [8], S. Laptev [9], A. Podyerohin [11], A. Rogovy [12] and others.

**Unsolved aspects of the general problem.** Most of the contemporary scientific works devoted to the

study of financial planning in banks do not pay much attention to the practical aspects in the modeling of the potential and planning strategies of banks in the context of the main development areas. In addition, little attention has been paid to the planning of banks' activities in terms of the efficiency of its implementation.

**The goals of the study.** The main objective of the paper is the determination of the quantitative assessment of the efficiency of bank's financial planning taking into account its potential, the development of planning strategies relating to the bank's activities in the context of the main development areas.

**The main results of the study.** A sustainable development of a bank, its reliability and profitability largely depend on the adequate management system, which makes it possible to evaluate the bank's economic environment, to identify its strengths and weaknesses, quickly adopt sound management decisions.

Feeling the negative effects of the global and internal economic processes leading to the reduced resources and revenues and increased costs, the domestic banks require an improvement in the level of quality of management systems, and in particular, its key element – financial planning.

As a result of the systematization of scientific views on the nature of financial planning it is offered to give it a special role in the management of banking activity, which consists in the provision of the bank's priority areas with the necessary financial resources. The study of theoretical foundations of financial planning in banks demonstrates the lack of a unified approach to the definition of this category. Accordingly, it is proposed to consider the concept of financial planning in banks as a sphere of managerial activity of the bank's senior management regarding the development of financial plans to transform the bank's goals, objectives and activities into the system of financial indicators (standards), which characterize its financial situation to provide the bank's

development with financial resources, and as a consequence – to achieve the main goal of its activities. Unlike the existing interpretations, this definition considers the formation of a system of indicators of the bank's financial condition as a result of financial planning.

In the context of this study the analysis of the bank's current financial condition grows in importance. Having the accurate, objective and comprehensive assessment of the bank's current financial

condition it is possible to draw up the real financial plans and make recommendations regarding the further development of the bank's activities. Consequently, we propose the methodological approach to determine the current financial position of the bank and its financial potential according to 4 groups of indicators and their subsequent convolution to integral indicators, the values of which are used in the formation of the competitive strategy of the banking institution (Figure 1)

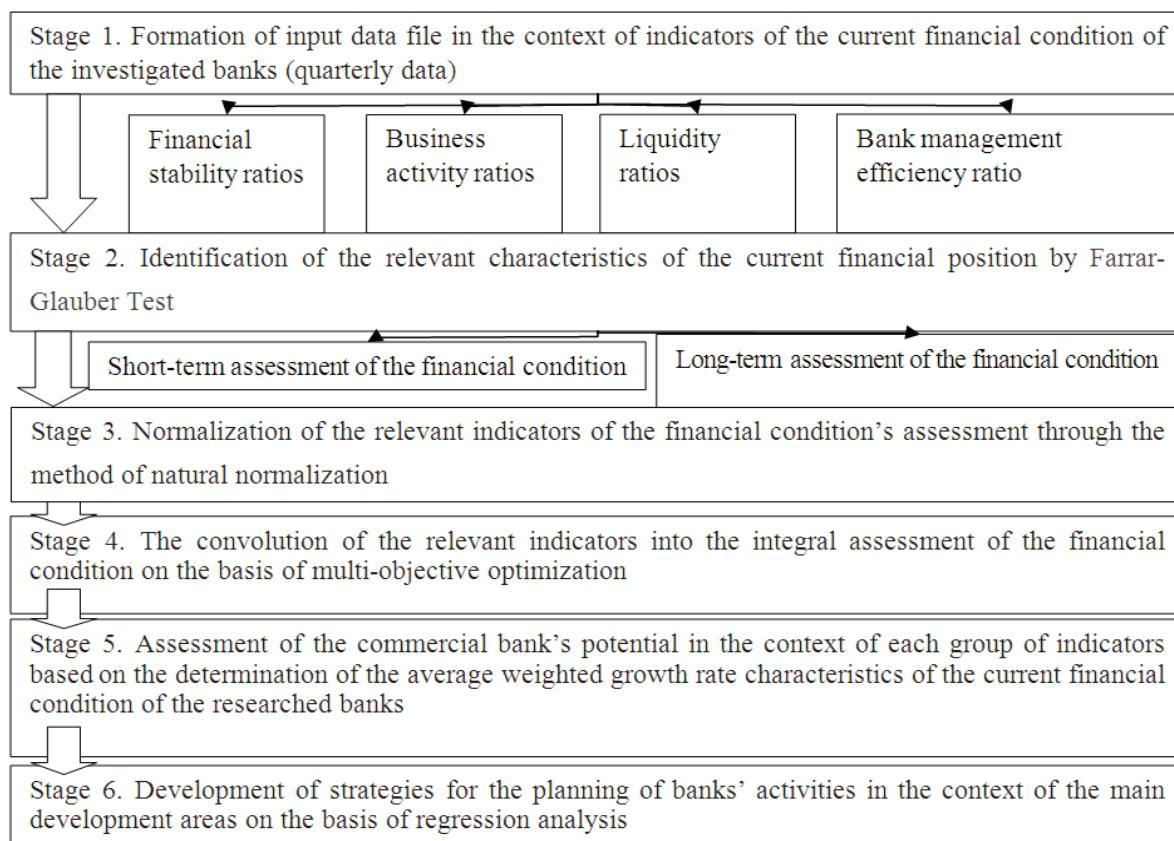


Fig. 1. Methodological approach to the assessment of financial planning of banks' activities

The first stage of the methodological approach to assessing the financial planning of the bank's activities is the creation of input data file, which includes the indicators for the assessment of the current financial position of the investigated banks (quarterly data). The expediency of implementation of the first stage is caused by the necessity to ensure the information provision of economic and mathematical modeling of the banks' financial planning.

The essence of this stage consists in the formation and calculation of the complex system of indicators for the assessment of the current financial condition of the following banks: JSC "UkrSibbank", JSC "MEGA-BANK", JSC "REGION-BANK" and JSC "REAL BANK" according to 4 groups of factors: financial strength, business activity, liquidity and profitability (efficiency of bank management) for the period of 2000-2013 with quarterly data breakdown.

The second stage of the methodological approach is the identification of relevant indicators to assess the bank's current financial condition for each of the four groups by means of the Farrar-Glauber Test, whereby a complex system of indicators for the assessment of the bank's financial condition is examined for multicollinearity, i.e. the existence of a linear relationship between financial indicators (factor variables).

In the context of the Farrar-Glauber Test: (1) the normalization of input data for 48 financial indicators is performed; (2) by using the Pearson criterion the presence of multicollinearity in the statistical input data file is examined showing a strong relationship between the studied indicators; (3) based on the comparison of the actual and tabular levels of the Fisher criterion conclusions are made about the expediency of including into the mathematical

model of the bank's financial planning not of all indicators, but only the most informative (significant) ones: for example, for JSC "UkrSibbank" 23 financial indicators are the most informative. It should be noted that for each object of the study the composition of financial indicators will be different from one bank to another; (4) short-term and long-term assessment of the current financial condition by adjusting the number and the composition of indicators is carried out.

To identify multicollinearity the Farrar-Glauber Test uses three types of statistical criteria: the entire array of independent variables (criterion  $x^2$ ); each independent variable with all others ( $F$ -test); each pair of independent variables ( $t$ -test). By comparing these criteria with their critical values we can draw specific conclusions about the presence or absence of multicollinearity between the financial ratios of the complex system of indicators (independent variables).

The algorithm of the second stage of the methodological approach to assess the financial planning in banks is represented in the form of the following sequence.

**Stage 1.** The choice of the research object: banks in the 1st, 2nd, 3rd and 4th group according to the size of their assets, the regional level.

**Stage 2.** Justification of the 4 groups of financial indicators:

- ◆ Financial stability ratio: reliability ratio ( $x_1$ ); financial leverage ratio ( $x_2$ ); the ratio of equity's participation in the formation of assets – capital adequacy ( $x_3$ ); fixed capital adequacy ratio ( $H_3$ ) ( $x_4$ ); solvency ratio (regulatory capital adequacy ratio ( $H_2$ )) ( $x_5$ ); maneuvering coefficient ( $x_6$ ), the ratio of authorized capital to balance capital (brutto capital) ( $x_7$ ); equity's security ratio ( $x_8$ ), earning assets security ratio ( $x_9$ ); the ratio of equity capital concentration ( $x_{10}$ ); capital multiplier ratio ( $x_{11}$ ).
- ◆ Liquidity ratio: instant liquidity ratio ( $H_4$ ) ( $x_{12}$ ); current liquidity ratio ( $H_5$ ) ( $x_{13}$ ); the ratio of general liquidity of liabilities ( $x_{14}$ ), the ratio of general liquidity of the bank's liabilities ( $x_{15}$ ); the ratio of highly liquid assets to working assets ( $x_{16}$ ); the ratio of resource liquidity of liabilities ( $x_{17}$ ); the ratio of liquid correlation of loans and deposits (to determine unbalanced liquidity) ( $x_{18}$ ); short-term liquidity ratio ( $H_6$ ) ( $x_{19}$ ).
- ◆ Business activity ratio: the ratio of involvement of the lent and borrowed funds (fundraising activity) ( $x_{20}$ ); the ratio of interbank loans ( $x_{21}$ ); the ratio of time deposits involvement ( $x_{22}$ ); the ratio of the use of borrowed funds in profitable assets ( $x_{23}$ ); the ratio of the use of borrowed funds in loan portfolios ( $x_{24}$ ); the ratio of the use

of time deposits in loan portfolios ( $x_{25}$ ); earning assets ratio ( $x_{26}$ ); credit activity ratio ( $x_{27}$ ); the ratio of the lending activity of investment in loan portfolios ( $x_{28}$ ); the ratio of general investment in securities ( $x_{29}$ ); the level of time deposits in liabilities ( $x_{30}$ ); the ratio of NPLs ( $x_{31}$ ); investment activity coefficient ( $x_{32}$ ); the ratio of the level of loan and investment portfolio to total assets ( $x_{33}$ ); the ratio of investments in earning assets ( $x_{34}$ ).

- ◆ The ratio of bank management efficiency (profitability): the general level of profitability ( $x_{35}$ ); recoupment of expenses through profits ( $x_{36}$ ); net interest margin ( $x_{37}$ ), operating income ( $x_{39}$ ); "dead point" of bank's profitability ( $x_{40}$ ); labor productivity ( $x_{41}$ ), profit margin ( $x_{42}$ ); profitability of earning assets ( $x_{43}$ ); return on aggregate capital ( $x_{44}$ ); return on authorized capital ( $x_{45}$ ); profitability of activity according to expenses ( $x_{46}$ ); labor productivity of average worker ( $x_{47}$ ); return on assets ( $x_{48}$ ).

**Stage 3.** The selection of statistically significant financial indicators:

$$x_{ij}^{KN} = \begin{pmatrix} x_{11}^{KN} & x_{1j}^{KN} & x_{123}^{KN} \\ x_{i1}^{KN} & x_{ij}^{KN} & x_{i23}^{KN} \\ x_{531}^{KN} & x_{53j}^{KN} & x_{5323}^{KN} \end{pmatrix}, \quad (1)$$

where  $K$  is the number of bank;  $N$  is a group of indicators,  $i$  is the number of indicator;  $j$  is time period.

**Stage 4.** The bringing of statistically significant financial indicators to comparable form:

$$x_{ij}^{KN} = \frac{x_{ij}^{KN} - \min_j \{x_{ij}^{KN}\}}{\max_j \{x_{ij}^{KN}\} - \min_j \{x_{ij}^{KN}\}}. \quad (2)$$

**Stage 5.** The current assessment of the financial condition of banks:

$$PEFB_j^k = \frac{1}{4} \times \left( \frac{\sum_{i=1}^{11} x_{ij}^{KL}}{11} + \frac{\sum_{i=12}^{27} x_{ij}^{K2}}{15} + \frac{\sum_{i=28}^{36} x_{ij}^{KL}}{18} + \frac{\sum_{i=37}^{48} x_{ij}^{KL}}{11} \right). \quad (3)$$

where  $PEFB_j^k$  is the current assessment of financial condition of bank  $k$  over period  $j$ .

The result of applying the Farrar-Glauber Test is a system of indicators for the assessment of the current financial condition, which is individual for each bank. Thus, for JSC "UkrSibbank" the formed system consists of 23 financial indicators, for JSC "MEGA-BANK" – of 23 financial indicators, for JSC "REGION-BANK" – of 22 financial indicators and for JSC "REAL BANK" – of 23 financial indicators (Table 1).



Table 1. Identification of relevant indicators for the assessment of the current financial condition of JSC “UkrSibbank”, JSC “MEGABANK”, JSC “REGION BANK” and JSC “REAL BANK”

| JSC “UkrSibbank”  | JSC “MEGABANK”  | JSC “REGION BANK”   | JSC “REAL BANK”   |
|---|---|---|---|
| 1   | 2   | 3   | 4   |
| X4, X5, X6, X7, X8, X9, X11, X17, X23, X27, X28, X29, X31, X34, X36, X37, X38, X39, X40, X41, X45, X46, X47 | X4, X5, X6, X7, X8, X11, X12, X13, X20, X23, X27, X28, X29, X31, X34, X35, X37, X38, X39, X40, X41, X45, X47, X48 | X4, X5, X6, X7, X8, X16, X18, X22, X23, X27, X28, X29, X31, X34, X35, X36, X37, X38, X39, X40, X41, X46 | X4, X6, X7, X8, X11, X12, X13, X16, X17, X20, X23, X27, X28, X29, X31, X34, X35, X36, X37, X38, X39, X40, X41, X47, X48 |

The third step of the methodological approach to assessing the current state of the financial planning of the bank's activity is the normalization of relevant indicators for the assessment of the bank's current financial condition through the method of natural normalization. The essence of the method is to bring the indicators into comparable form (the formula is presented during the 4th stage of identification of relevant indicators in assessing the bank's current financial condition by means of the Farrar-Glauber Test).

The fourth stage of the proposed methodological approach is the convolution of relevant indicators to assess the bank's current financial condition based on multi-objective optimization.

During this stage we bring the indicators to a single integral evaluation for each of the four groups of indicators: financial strength, business activity, liquidity and profitability, with further generalization of these groups and performing a convolution to a generalized indicator for the assessment of the bank's current financial condition. This stage is based on the assumption about the equal priority of indicators of the bank's current financial condition both within the designated groups and in the context of defining the generalized characteristics.

It should be noted that there is not a common universal criterion of economic efficiency. Therefore, researchers often use multiobjective optimization. These are mathematical methods that make it possible to build diverse plans, that is, to implement multi-objective optimization. For our model the general criterion of optimality is the sum of individual efficiency indicators with the corresponding criteria.

As for the qualitative interpretation of the obtained results (the fifth stage of identification of relevant indicators for the assessment of the bank's current financial condition by means of the Farrar-Glauber Test), namely, the assessment of the bank's current financial condition, first of all, it is necessary to determine the upper and lower limits for the intervals of the bank's current financial condition. This study offers to use 4 equal intervals for the assessment of the bank's current financial condition. The qualitative

interpretation of the assessment of the bank's current financial condition is presented in Table 2.

Table 2. Qualitative interpretation of the assessment of the bank's current financial condition

| The scale of intervals for the integral assessment of the bank's current financial condition | Description of the interval of the bank's current financial condition |
|--|---|
| [0.269; 0.339]   | Low   |
| (0.339; 0.408]   | Average   |
| (0.408; 0.478]   | Sufficient  |
| (0.478; 0.548]   | High  |

According to the calculated scale of intervals JSC “UkrSibbank” has an average level of the current financial condition, JSC “MEGABANK” – a high level of the current financial condition, JSC “REGION-BANK” – an average level of the current financial condition and JSC “REAL BANK” – an adequate level of the current financial condition.

The next fifth and sixth stages of the methodological approach to assessing the bank's financial planning include the evaluation of the bank's financial potential for each group of coefficients based on the average weighted growth rate indicators in assessing the current financial condition of banks and the development of competitive strategies based on the aggregate assessment of the bank's current financial condition and its financial potential based on the regression analysis.

On the basis of the obtained results relating to the calculation of financial planning in the surveyed banks it is offered to determine the bank's potential on the basis of taxonomic approach. The developed methodical approach makes it possible (on the basis of an integral assessment of the bank's current financial condition) to determine its potential and select the best strategy for financial planning. We will consider the stages of this approach in more details:

**Stage 1.** Evaluation of the commercial bank's potential.

Assessment of the bank's current financial position in terms of its financial stability:

$$\sum_{i=1}^{11} x_{ij}^{KN} / 11. \quad (4)$$

Assessment of the bank's current financial position in terms of its business activity:

$$Tl_j = \sum_{i=12}^{27} x_{ij}^{KN}. \quad (5)$$

where  $Tl_j$  is the chain growth rate of the current financial condition of studied banks over period  $j$ .

Assessment of the bank's current financial position in terms of its liquidity:

$$\sum_{i=28}^{36} x_{ij}^{KN} / 8. \quad (6)$$

Assessment of the bank's current financial position in terms of the efficiency of its management.

$$\sum_{i=37}^{48} x_{ij}^{KN} / 11. \quad (7)$$

Calculation of the chain growth rates of the indicators of the current financial condition of the surveyed banks:

$$Tl_j = (\sum_i x_{ij}^{KN} - \sum_i x_{ij-1}^{KN}) / \sum_i x_{ij-1}^{KN}. \quad (8)$$

Determination of the average weighted growth rate indicators of the current financial condition – the potential of a commercial bank according to each of the selected groups of coefficients.

**Stage 2.** Development of strategies for the planning of the bank's activities in the main areas of its development:

- ◆ Calculation of target indicators for assessing the bank's financial condition on the basis of adjustment of normalized statistical data to average growth rates.
- ◆ Evaluation of the strength and direction of impact of variations in the indicators of financial stability, business activity, liquidity and profitability as well as fluctuations in the current financial condition.
- ◆ Verification of the adequacy, accuracy and reliability of the economic and mathematical model for the dynamics of the bank's activity planning process.

- ◆ Identification of problem areas in the bank's financial activity, adjustments in tactical and strategic areas of development.

The following strategies of financial planning in banks are offered: (1) "regional leader", (2) "accumulation" and (3) "imitative behavior". The strategy of "regional leader" is characterized by the high/sufficient assessment of the bank's current financial condition and potential level that does not exceed 20%. Within this strategy two trends are distinguished depending on the assessment of the current financial condition – "active" (high estimation of the current financial condition) and "adaptation" (high/adequate assessment of the current financial condition). The strategy of "imitating behavior" is typical for banks with average/low assessment of the current financial situation and the potential level not lower than 20%. Within this strategy two trends are distinguished depending on the assessment of the current financial condition – "passive" (average/low assessment of the current financial condition) and "leader" (low estimation of the current financial condition). The strategy of "accumulation" is characterized by adequate/average assessment of the banks' current financial condition and the level of potential that is not higher or lower than 20%. Within this strategy two trends are distinguished – "external" (sufficient assessment of the current financial condition and the level of potential do not exceed 20%) and "internal" (average assessment of the current financial condition and the level of potential not lower than 20%).

Based on the results regarding the current financial condition of the surveyed banks we calculate the potential of these banks in terms of four groups of indicators (Table 3).

Table 3. Evaluation of the potential of banks in the Kharkiv region in terms of four sets of indicators in 2000-2013, %

| Bank              | Assessment of the banks' potential |                   |           |               |
|-------------------|------------------------------------|-------------------|-----------|---------------|
|                   | Financial stability                | Business activity | Liquidity | Profitability |
| JSC "UkrSibbank"  | 10.7                               | 14.6              | 24.8      | 18.7          |
| JSC "MEGABANK"    | 8.3                                | 10.8              | 21.8      | 29.5          |
| JSC "REGION BANK" | 24.0                               | 20.2              | 27.9      | 26.0          |
| JSC "REAL BANK"   | 14.5                               | 26.4              | 11.2      | 36.5          |

The results of calculations lead the authors to the conclusion about the high level of potential of banks in group 4 according to the classification of the National Bank of Ukraine (JSC "REGION BANK" and JSC "REAL BANK") and low potential of JSC "UkrSibbank" and JSC "MEGABANK", which belong to groups 1 and 3 according to the classification of the National Bank of Ukraine. This shows the practical significance of the proposed approach, as the potential of "small" banks is not fully realized and, therefore, must be much higher than that of "big" banks who fully realize their potential.

The combination of the results regarding the assessments of the banks' current financial condition and the level of their potential makes it possible to determine the optimal strategy for financial planning of these banks for the period of 2000-2013 (Stage 6), including JSC "UkrSibbank" – the strategy of "regional leader" ("adaptation"), JSC "MEGABANK" – the strategy of "regional leader" ("adaptation") or the strategy of "accumulation" ("external"), JSC "REGION-BANK" – the strategy of "imitating behavior" ("passive") and JSC "REAL BANK" – the strategy of "imitating behavior" ("passive").

To assess the effectiveness of financial planning of the bank's activities it is proposed to use the methodological approach, which determines the impact of indicators of financial stability, business activity, liquidity and profitability on financial condition and, consequently, on the financial planning in banks (Figure 2). This methodological

approach is based on the comparison of the bank's financial condition before and after its potential is taken into account, making it possible to give not only a quantitative assessment on the efficiency of the bank's financial planning in the context of the four groups of indicators, but also to form the priorities of the bank.

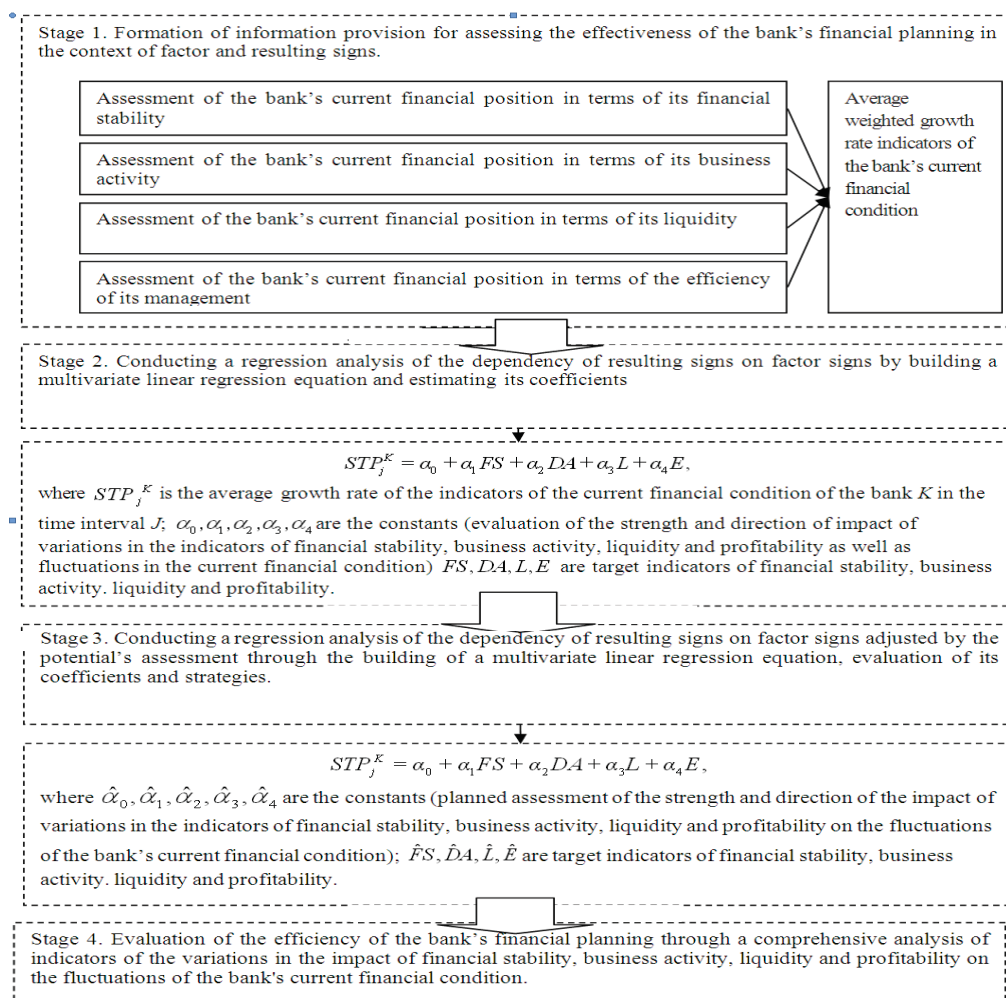


Fig. 2. Methodological approach to assessing the effectiveness of the bank's financial planning

Verification of the methodological approach to assessing the effectiveness of the bank's financial planning is implemented in practice (Table 4).

Table 4. Assessment of the impact of indicators of financial stability, business activity, liquidity and profitability on the financial position (with and without the assessment of potential) of banks in Kharkiv region in 2000-2013

| JSC "UkrSibbank"   |  |
|--|--|
| $STP_j^K = -18.31 + 16.36 * FS + 18.52 * DA + 11.73 * L - 4.50 * E$  | $STP_j^K = -18.31 + 16.36 * \hat{FS} + 18.52 * \hat{DA} + 11.73 * \hat{L} - 4.50 * \hat{E}$  |
| Current financial condition  | Financial condition and potential  |
| JSC "MEGABANK"   |  |
| $STP_j^K = -40.99 + 55.58 * FS + 5.80 * DA - 0.50 * L + 55.61 * E$   | $STP_j^K = -40.99 + 51.57 * \hat{FS} + 5.24 * \hat{DA} - 0.41 * \hat{L} + 42.96 * \hat{E}$   |
| JSC "REGION BANK"  |  |
| $STP_j^K = -65.41 + 26.52 * FS + 75.66 * DA + 24.76 * L + 57.61 * E$ | $STP_j^K = -65.41 + 21.40 * \hat{FS} + 62.94 * \hat{DA} + 19.36 * \hat{L} + 45.74 * \hat{E}$ |
| JSC "REAL BANK"  |  |
| $STP_j^K = 36.06 + 28.90 * FS + 8.90 * DA - 9.47 * L + 81.48 * E$    | $STP_j^K = -36.06 + 25.24 * \hat{FS} + 7.04 * \hat{DA} - 8.52 * \hat{L} + 59.71 * \hat{E}$   |

The results of evaluation of the efficiency of the banks' financial planning lead to the conclusion about the disparity between the current indicators of banks' financial condition and the potential ones. This causes the relevance and necessity of the proposed methodological approaches.

In addition to the introduction of methodological approaches, some promising areas for the improvement of financial planning in banks have been identified: (1) the need to draw up financial plans based on the comprehensive, real and accurate statistical information; (2) taking into account the potential financial capabilities of banks during the preparation of financial plans; (3) ensuring the complete realization of financial plans; (4) functional unity of departments and their focus on achieving the bank's main objectives; (5) balanced goals. The implementation of these measures will improve the overall efficiency of banks by making informed management decisions to strengthen the bank's financial condition and determine the optimal priorities of its further development on the basis of quality financial planning.

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## Conclusions

The conclusions of the study and recommendations regarding further research in this field. The study carries out the selection of statistically significant financial indicators of the current state and the effectiveness of planning of banks' activities; develops economic and mathematical model for regression analysis of the dependency of planning efficiency on factor signs adjusted by the potential's assessment through the building of a multivariate linear regression equation, evaluation of its coefficients and strategies; calculates the assessment of the effectiveness of financial planning of the Ukrainian banks through a comprehensive analysis of indicators of the variations in the impact of financial stability, business activity, liquidity and profitability on the fluctuations of the current financial condition. The calculations were performed for specific banks in Kharkiv region of Ukraine. However, the proposed algorithm that consists of information gathering, analysis of factor signs and methodology for assessing the effectiveness of planning of banks' activities may be used for the analysis of the banking market's functioning in any country.