acit.tneu.edu.ua

ACIT 2020

DEGGENDORF, GERMANY
16-18 September 2020

2020
10th International Conference on
Advanced Computer Information Technologies

IEEE Catalog Numbers
ISBN: 978-1-7281-6759-6
Part Number: CFP20S92-PRT

IEEE Germany Section

TNEU

DEGGENDORF INSTITUTE OF TECHNOLOGY DIT

Jihočeská univerzita v Českých Budějovicích
University of South Bohemia in České Budějovice

Analytical Model of Deposit Portfolio Optimization in Ukrainian Banks

Svitlana Luchyk
Department of Accounting and Taxation
Chernivtsi Institute of Trade and Economics of Kyiv National University of Trade and Economics
Chernivtsi, Ukraine
luchiksvitlana@gmail.com

Vasil Luchyk
Department of Economic Cybernetics and International Economic Relations
Chernivtsi Institute of Trade and Economics of Kyiv National University of Trade and Economics,
Chernivtsi,Ukraine
luchik-vasil@ukr.net

Marharyta Luchyk
Finance, Banking and Insuring Department
Kyiv Cooperative Institute of Business and Law
Kyiv, Ukraine
Luchik-margarita@ukr.net

Yulia Manachynska
Department of Accounting and Taxation
Chernivtsi Institute of Trade and Economics of Kyiv National University of Trade and Economics
Chernivtsi, Ukraine
yu_manachynska@ukr.net

Volodymyr Yevdoshchak
Department of Accounting and Taxation
Chernivtsi Institute of Trade and Economics of Kyiv National University of Trade and Economics
Chernivtsi, Ukraine
V_Yevdoshchak@ukr.net

Konon Bagrii
Department of Accounting and Taxation
Chernivtsi Institute of Trade and Economics of Kyiv National University of Trade and Economics
Chernivtsi, Ukraine
kononbagriy@gmail.com

***Abstract*— The article investigates the effect of deposit portfolios of Ukrainian banking institutions on the performance of their activities. The authors present an analytical model of bank deposit activity aimed at maximizing the profit of institutions, taking into account the degree of influence of such factors as the amount of deposits, their terms and interest rates. Factor analysis of interest payments was carried out and the efficiency of deposit activity of Ukrainian banks was evaluated. Measures to improve the deposit policy of domestic banks have been proposed.**

Keywords— Deposit portfolio, analytical model, factor analysis, effectiveness of deposit policy.

I. Introduction

Under the crisis of the financial system of the country, one of the main problems facing the national banking system is the maintenance of its long run profitability.

The profitability of the banking system of Ukraine in recent years was primarily driven by the growth of revenues. In particular, banks' interest income on 01.12.2019 exceeded UAH 16641 million, or 13,4% in 2017, commission income - by UAH 18936 million or 51,0% [1]. This became possible by lowering the cost of financing, primarily, of household deposits, as well as the renewed demand for banking services. The yield of the banking system on profitability also contributed to the positive result from trading operations: at the beginning of December 2019 this figure amounted to UAH 15684 million, while at the beginning of 2018 the result from revaluation and sale and purchase operations amounted to only UAH 1853 million due to the effect of currency revaluation of securities. At the same time, payments to the reserves of solvent banks during the 11 months of 2019 decreased by 5,7 times compared to 2017 and amounted to UAH 8592 million. As a whole, banks expenditures decreased by UAH 41473 million or 20,3% over the same period. The number and proportion of unprofitable banks decreased significantly. Of the 76 solvent banks on October 1, 2019, 66 banks were profitable and made a net profit of UAH 49,6 billion, which covered the losses of 10 banks for a total amount of UAH 1,3 billion, and by the results of 2018 there were 14 of the 77 banks operating at that time [1].

As cost minimization cannot act as an independent goal of a bank to increase its income and profitability, it is advisable to develop directions for increasing the bank's profitability, which are complex and include various aspects of its activities. Therefore, the profitability of the bank depends on the efficiency of using its own and external funds. The issues of determining the bank's deposit resources for their transformation into credit investment and, accordingly, the assessment of possible deposit risks for the bank, in our opinion, require careful attention in terms of planning of the bank's activity, formation and adaptation of its deposit policy, risk management of the institution

II. Statement of the Problem

There has been made a significant contribution to development the modelling of deposit activities of commercial banks by many national scientists, such as I. Blagun, V. Vitlitsky, N. Dyubanovskaya, O. Ivashchuk, R. Rusin, I. Tkachenko, as well as by foreign scientists like D Cox, M. Xoc, S. Zedda, Ansori, Moch & Sidarto, Kuntjoro & Sumarti, Novriana.

Thus, V. Akinina, E. Zolotova, and P. Strakhov developed a mathematical model of financial operating of the bank that provides an opportunity to analyze countless options for building deposit portfolios as well as evaluate income and expenses of the bank [2]. As a result of such modeling, an optimal portfolio of attracted and allocated financial resources is formed, and the optimal financial plan of the bank meets the regulatory requirements of the National Bank. However, this approach does not always allow you to evaluate the sensitivity of model's parameters to their changes.

A. Momot presented a simulation model that described the relationship between the size of the financial resources attracted by the billing banking services and the competitiveness of commercial bank's credit products [3]. However, the submitted simulation model does not allow bank to determine an extent to which deposit activities affect an overall financial result of the bank. The simulation tools for optimization of the deposit activities of the bank has been developed by N. Dzyubanovska [4]. The author claimed that the model takes into account the peculiarities of the depositors' behavior and helps to forecast the usage of the estimated bank's deposit portfolio.

M. Gorsky developed a two-level parametric model for optimizing credit and deposit portfolios of the commercial bank that helps to optimize portfolios during the certain time interval, monitors the generated portfolios and selects the parameters for the following monitoring during the coming time interval [5].

Aligned with the results of domestic and foreign scientists' studies, it is worth mentioning that modeling bank's deposits is an extremely challenging task because a bank is a system where deterministic and random processes occur simultaneously, which are interconnected in a very complex way. Also banks interact with financial markets which volatilities are unforeseen. Those factors lead us to create an analytical model of the bank's deposit, which can be also used for creating a bank's deposit policy.

It is known that bank profits are calculated by the equation (1):

$$f(A,P)=\sum_{i=1}^{n}\alpha_i A_i-\sum_{j=1}^{m}\beta_j P_j-\sum_{i=1}^{n}\sum_{j=1}^{m}\gamma_{ij}V(A_i,P_j), \quad (1)$$

де $f(A,P)$ – bank profit function;

A_i – amount of investments in i – bank assets;

α_i – profitability ratio at i – bank assets;

n – number of bank assets;

P_j – amount of involvement into j – liabilities in the liability portfolio;

β_j – interest of expenses in j –bank liability;

m – number of bank liabilities;

$V(A_i,P_j)$ – production expenses of the bank.

γ_{ij} – production expenses for i –bank asset and j – bank liability.

The task of each bank is to maximize the function $f(A,P)$ with legislative and economic constraints, which leads to the solution of the classical problem of mathematical programming. If we try to manage the rate of profitability α_i or interest expenses β_j, then we get the task of managing – by changing the rates of deposits or loans (you can also make these changes simultaneously), we choose exactly their values that provide the maximum of the function $f(A,P)$.

If we try to manage the rate of return or interest expenses in this task, - (you can also make these changes at the same time), we choose exactly their values that provide the maximum of the function.

More practical is the task of establishing dependencies of the rate of profitability α_i on interest expenses β_j, when the bank is non-profit and break-even at the same time, that is

$$f(A,P)=0 \quad \text{or} \quad \sum_{i=1}^{n}\alpha_i A_i-\sum_{j=1}^{m}\beta_j P_j-\sum_{i=1}^{n}\sum_{j=1}^{m}\gamma_{ij}V(A_i,P_j)=0$$

Therefore, the main task of the bank is to choose such a dependence of the rate of profitability on interest of expenses, when the profitability function of the bank is positive, that is $f(A,P)>0$.

III. Empirical Analysis

The deposit portfolio is an important component of the banking institution's resource base. The deposit portfolio should be considered as total funds on the deposit accounts of clients attracted by the bank on a contractual basis. The creation of a deposit portfolio should be considered as a continuous cyclical process, consisting of the following stages:

analysis - study of "behavior" of funds on clients' accounts;

planning - focus on attracting certain customer groups and types of deposits;

work on customer engagement - introduction of new products, flexible tariff policy and individual work with clients;

control [6].

By category of depositors, deposits are divided into corporate deposits; individual deposits; at the expense of budgetary funds; bank deposits. By maturity date, deposits are divided into deposits on demand; term deposits (too short-term - up to 3 months, short-term deposits - from 3 to 12 months, long-term deposits - more than 12 months). The classification of bank deposits requires the selection of appropriate approaches to the methods of valuation and analysis of deposits to make appropriate management decisions on the implementation of these operations, as well as the degree of responsibility for the results obtained.

Let us analyze the deposit portfolio of Ukrainian banks by composition and structure of deposits for the period 2015-2018 and for the 11 months of 2019 to identify reserves for improving the efficiency of its use.

The largest share in the structure of deposits of Ukrainian banks belongs to the demand deposits, which on 01.12.2019 counted for 53,3%. In the structure of deposits on demand, 61,9% is occupied by funds of economic entities, while in term deposits – 69,7% is made up of individuals [1]. This structure of deposits has been quite typical in recent years for domestic commercial banks. During the analyzed period, the structure of deposits as a whole has not changed significantly, except for the reduction of the share of deposits on demand for legal entities.

The efficiency of deposit operations is characterized by two indicators of deposit turnover:

the amount of deposit turnover;

the duration of one deposit turnover for the period (term of deposit storage).

The average deposit period for a year characterizes the average duration (in days or years) of one deposit turnover and is an inverse characteristic of the rate of deposit circulation. The number of deposit turnovers shows how many times the depositors' funds have rotated over the period and is a direct characteristic of the deposit turnover. The

more deposits you make over a certain period, the more efficient they are.

Data in table 1 indicate an increase of the average balance of bank deposits in 2016-2018 by 16,2%. During the same period, by type of deposits, the largest increase in the average balance occurred in the category of deposits on demand provided by individuals – 50,1%. Trends persisted for 11 months of 2019.

TABLE 1 Deposits turnover ratio of Ukrainian banks

Deposits	Average balance of deposits per year, UAH billion				Average term of deposits per year, days				Number of deposits turnover			
	2016	2017	2018	Dated on 01.12.2019	2016	2017	2018	Dated on 01.12.2019	2016	2017	2018	Dated on 01.12.2019
Bank customers' funds, incl.	810,2	894,8	941,3	991,2	130	148	134	141	2,77	2,42	2,68	2,55
On demand incl.	381,5	437,2	471,8	517,3	151	178	142	165	2,38	2,02	2,54	2,18
funds of economic entities and non-banking financial institutions	270,0	302,9	304,5	321,9	184	226	184	201	1,96	1,59	1,96	1,79
funds of individuals	111,4	134,3	167,3	195,4	134	142	125	128	2,69	2,54	2,88	2,81
Term funds of clients, incl.	428,7	457,6	469,5	474,0	114	131	144	135	3,16	2,75	2,50	2,67
funds of economic entities and non-banking financial institutions	122,3	122,9	124,7	120,7	79	86	95	77	4,56	4,19	3,79	4,68
funds of individuals	306,4	323,4	327,4	331,9	135	174	161	169	2,67	2,07	2,64	2,13

Regarding the average storage period, the time deposits have shown the highest increase, for both legal entities and individuals. Overall, the average deposit term is short, so banks' deposit policies require further adjustment. The largest number of turnovers is made by time deposits provided by economic entities and non-bank financial institutions – 4,6-4,7 turnovers.

For a deeper analysis of the deposit portfolio, we use the factor analysis method and the index method. They are well combined and complement each other, because complex indicators can be broken down into simpler (elemental), thus expanding the possibilities of analysis. Using factor relationships, the sum of interest payments on deposits can be represented as the product of three factors: the amount of deposits, the term of deposits expressed in parts of the year, and the interest rate on deposits, which is determined in ratios. The latter figure may be expressed as the product of the annual interest rate and the number of deposits turnover during the year.

The calculation of interest payments on deposits showed that on January 1, 2017, the index of change in interest payments by 11,4% was due to the absolute increase in interest payments in the amount of UAH 37920,5 million on all types of deposits. The largest impact on the dynamics of the index was the increase in interest payments on deposits at the request of economic entities and non-banking financial institutions – 31,1% and term deposits of individuals – 27,5%, respectively. On 01.01.2018 there was a decrease in interest payments by 2,3% with an absolute decrease of UAH 1191,6 million. The decrease was due to a decrease in deposits on demand of legal entities by 18,5% and time deposits of legal entities by 15,9%. During 2018, the situation with the deposit portfolio of banks in Ukraine improved and interest payments increased by 17,0% to the amount of UAH 3048,3 million. This was mainly due to deposits by both economic entities and non-banking financial institutions, both on demand and on time. In the first 11 months of 2019, the trends of increase in interest payments strengthened and the growth amounted to UAH 4957,8 million (an increase by 1,083 times). The active deposit portfolio was supplemented by the entities that invested on demand and on time. The term deposits of individuals increased significantly.

The degree of factors influence on the change in the amount of interest payments on bank deposits can also be determined by the method of absolute difference. The calculation is based on the consistent replacement of baseline values of factor indicators for their deviation, and then on the actual level of these indicators. The analysis is performed using the same factors: the amount of payment, the term and the interest rate of the deposit (Table 2).

TABLE 2 Results of factor analysis of interest payments of Ukrainian banks, thousand UAH

Factors of influence	2016	2017	2018	Dated on 01.12.2019
Increase in deposit attraction amounts	4786394,84	1885685,66	118743,97	2291563,18
Change in terms of deposits	2584958,93	8679317,87	-4036641,9	1768068,01
Change in interest rate	-2224660,89	-11756563,52	5966233,42	898125,06
The total impact of factors	5146692,88	-1191559,99	3048335,49	4957756,26

The analysis of the factor impact on interest payments on deposits showed that the main factor is an increase in the amount of deposits attracted, in particular, term deposits. Due to this factor, interest payments in 2016 increased by UAH 2585,0 million, in 2017 - by UAH 1885,7 million, in 2018 - by UAH 118,7 million, in 11 months of 2019 - by UAH 2291,6 million With regard to the shortening of term deposits and a reduction in interest rates, here, on the contrary, one can observe a worsening situation. Thus, the change in terms of deposits in 2018 resulted in a decrease of

interest payments by UAH 4036,6 million. The decrease in interest rates in 2016 and 2017 resulted in a decrease in interest payments by UAH 2224,7 and UAH 11756,6 million respectively. However, in 2019, we can observe an improvement in trends. Most banks try to attract long-term deposits. O. Andrenko and L. Voronin noted that if a bank aims to lower its interest rate on higher quality loans in order to beat its competition during high-quality periods, it should make base deposits during low-risk periods would reduce the cost of cash so that the bank can trade and receive less risky loans [7]

Changes in interest rates on deposits indicate their growth during 2018 and during the 11 months of 2019 by 20,4% and 2,7%, respectively (Fig. 2).

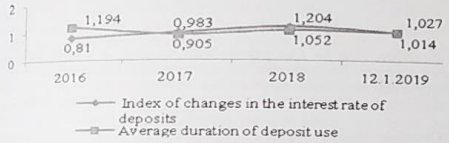

Fig. 2. Dynamics of changes in interest rates on deposits and average duration of deposits

The terms of attraction vary considerably by types of deposits and types of clients, which can be directly related to the goals of depositors and the attractiveness of deposit storage conditions for different clients, the specifics of the deposit policy of a particular commercial bank, the changing economic situation and other reasons. That is why the bank should know and study these factors and trends, manage them and be an active participant in the deposit market. The duration of resource mobilization as a whole in the deposit portfolio in 2016 increased by 24 days (19,4%) under the influence of changes in the structure of deposits, as well as due to differences in deposit conditions. In 2018 and for the 11 months of 2019, the maturity of deposits increased by 7 and 2 days, respectively 5,2% and 1,4%. In 2017, the term of use of deposits decreased by 14 days or by 0,95%.

We will complete the analysis of the calculations of the efficiency ratios of deposit activity of banks of Ukraine during 2015-2019 (in 2019 dated on 01.12.2019). The results are presented in table 3.

TABLE 3 Performance indicators of deposit activity of Ukrainian banks

Indicator	2015	2016	2017	2018	Dated on 01.12.2019
Deposit base ratio	0,661	0,759	0,793	0,790	0,867
Ratio of term deposit base	0,552	0,521	0,522	0,497	0,482
Deposit using rate	0,878	0,888	0,884	0,880	0,886
The ratio of the funds of individuals and legal entities	1,109	1,027	1,122	1,184	1,199
Ratio of deposits and equity funding	7,331	6,948	5,770	6,150	5,216

The deposit base ratio shows the share of deposits in the total amount of funds attracted by the bank, and this share increased significantly in 2019 to 86,7% versus 66,1% in 2015. Base ratio of terms deposits shows that the share of term deposits in banking institutions decreased slightly to 48,2% in attracted funds. Over the same period, we observed an increase in the ratio of funds of individuals and economic entities from 1,109 to 1,199. The deposit usage ratio indicates a sufficiently stable share of bank deposits placed in loans, 88%. Ratio of deposit funds and bank equity indicates an increase in coverage of deposits at the expense of the bank's own funds. Thus, if in 2015 only 13,6% of deposits could be covered by equity funding, then in 2019 – 19,2%.

IV. Conclusion

Therefore, effective deposit activity of the bank in the financial services market should satisfy the needs of clients to the maximum. When forming a deposit policy, banks should take the following measures:

whereas most depositors prefer deposits without early termination of deposits and interest payments at the end of the period, so seek to determine the most attractive interest rates for such deposits;

while maintaining the downward trend in the NBU interest rate, a gradual decrease in interest rates on deposits is likely. To maintain and expand the number of depositors and increase the amount of deposits, banks need to ensure a high level of reliability of their activities, develop individual approaches to providing customers with special benefits;

expansion of cooperation with corporate business will allow to attract new clients and increase the amount of banking resources, in particular, deposits on demand, salaries, etc.;

apply new marketing measures to offer new deposit products, advertise various forms of incentives for regular customers of banks;

keep on working on improving customer service for banks, monitoring risks in the process of attracting deposits.

References

[1] National Bank of Ukraine. Data. Available at: https://bank.gov.ua/statistic/supervision-statist/data-supervision#1

[2] V. Akinina, E. Zolotova and P. Strakhov "Modeling the optimal deposit portfolio of a commercial bank with specified criteria for financial stability", Finance and Credit, vol. 7(391), 2010, pp. 51-55.

[3] O. Momot "Simulation modeling in the analysis of expediency of introduction of settlement banking services", Economic analysis, Vol. 7, 2010, pp. 159-161.

[4] N. Dzubanovskaya "Simulation model of bank deposit activity in iThink 9.0", Modeling the regional economy, Ivano-Frankivsk: Play, Vol. 1(23), 2014, pp. 117-123.

[5] M. Gorsky "Choosing the optimal loan and deposit portfolio based on the parametric model of the bank", Bulletin of the Altai Academy of Economics and Law, Vol. 1, 2020, pp.48-57.

[6] V. Matveev, O. Gaydarzhiyska and V. Vasilenko, "Investigation of deposit portfolio as a tool of bank resource policy", Molody vcheny, vol. 3(2), 2018, pp.660-664.

[7] O. Andrenko, L. Voronina "Problems of deposit operations development of banking institutions", Bulletin of NTU "KPI", vol. 47(1323), 2018, pp. 37-41.