

# Modelling of Client Policy Elements of the Regional Commercial Banks on the Basis of Digital Methods of Data Processing

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**Abstract** — *The concept of the research is based on the assumption that the improvements in the customer policy of a commercial bank should be focused on the development of methodological tools of assessment and modeling of its elements as well as on the implementation of arrangements contributing to higher quality of customer care. Their importance increases in the conditions of economy digitalization in general and bank service, in particular.*

*The authors consider customer policy from the perspective of the polarity of its elements that include banking service processes and customer loyalty and satisfaction indexes. The latter can be assessed taking into account quantitative and qualitative information.*

*The article suggests the algorithm to identify the potential change in the interest rates on loans and deposits with the use of Price Sensitivity Meter (PSM) which enables banks to keep relevant price offers and neutralize mass customer attrition. The suggested algorithm is based on the comparative analysis of the current tariff rates and customers' price preferences as well as their demand for services and solvency. The calculation of CSI (Customer satisfaction index) allowed the authors to assess customer satisfaction levels in commercial banks of the North Caucasian Federal District and identify negative factors influencing the choice of credit organizations by companies and individuals. The methodology of quality control of customer care in the regional commercial banks including computer-aided tools, latent semantic analysis, text mining and other methods of digital data processing was developed. Its implementation resulted in the frame of interrelated concepts through structuring customer feedback and its automatic monitoring, which formed the basis for the organizational and functional model of customer service. The modeling of customer base of a commercial bank based on spatial structuring of information about customers (cross-sectional data) and time-series data analysis allowed the authors to reveal the impact of hidden or unaccounted factors on the activities of bank*

*customers and assess the probability of their bankruptcy accounting for intra-group and individual peculiarities.*

**Keywords** — *customer policy, modelling, commercial bank, digital technologies, North Caucasian Federal District*

## I. INTRODUCTION

For the past decade, the economies of a number of countries have been formed under the influence of a range of negative external factors: a fall in oil prices, increasingly growing geopolitical tension and further imposed sectoral sanctions and also growth of popularity of digital technologies. The situation has become even worse due to the beginning of structural transformations in the domestic economy. Moreover, a limited access to external financial markets and much worse conditions for trade alongside with lower prices for energy resources have caused accelerated capital drain from Russia and a sharp fall in exchange rate of ruble.

The abovementioned problems resulted in the increased tendency among companies and individuals to be with domestic commercial banks, which has substantially raised their competition for a customer. Due to this, banks have concentrated on customer retention and development. These processes are based on the customer policy although credit organizations (especially regional) do not pay enough attention to the consideration of its elements under current conditions.

This raises the importance of theoretic and methodological approaches as well as practical recommendations on modeling the elements of customer policy in a commercial bank aimed at the increase in financial results, higher level of customer loyalty and satisfaction, stronger reputation and higher

competitiveness of a credit organization in the banking market.

General theoretical problems of the banking policy were discussed in the works of A.G. Gryaznova (2002), E.V. Zyuban (2015), G.G. Korobova (2015), L.V. Markevich (2015), K.R. Tagirbekov (2004), et al.

The concept of customer policy and specific features of its formation in credit organizations were considered in works by Yu. M. Vayver (2014), S.A. Dolgova (2010), T.M. Kosterina (2012), O.I. Lavrushin (2016), Yu. S. Maslennikov (2003), A.M. Tavasiev (2015), Yu.N. Tronin (2003), J. Sinka jr. (2007), L.M. Gutu (2015), G. C. Zimmerman (1996), et al.

Some elements of customer policy were researched by V.V. Astrelina (2012), Yu.S. Ezrokh (2015), R.A. Fatnutdinov (2000), M. Treacy (1995), F. Wiersema (1995), T. Herpott (2000), T. Kaningham (2007), F. Crawford (2001), R. Mathews (2001), R. Kaplan (2001), M. Porter (2008), P.S. Rose (2005), and other Russian and foreign authors.

However, current publications do not provide a systematic view on the elements of customer policy, their significance and importance in the conditions of economy digitalization are still a subject to discuss. Moreover, the existing methodological approaches cannot be used for modeling factors that influence the relationships between banks and their clients. Due to this fact, economics has a great need for theoretical and methodological guidelines that consider modeling of customer policy elements taking into account its structural and functional transformations, in regional banking subsystems in particular.

## II. MATERIALS AND METHODS

Theoretical research of Russian and foreign scientists (Yu. M. Vayver (2014), S.A. Dolgova (2010), T.M. Kosterina (2012), O.I. Lavrushin (2016), Yu. S. Maslennikov (2003), A.M. Tavasiev (2015), Yu.N. Tronin (2003), J. Sinka jr. (2007), L.M. Gutu (2015), G. C. Zimmerman (1996), V.V. Astrelina (2012), Yu.S. Ezrokh (2015), R.A. Fatnutdinov (2000), M. Treacy (1995), F. Wiersema (1995), T. Herpott (2000), T. Kaningham (2007), F. Crawford (2001), R. Mathews (2001), R. Kaplan (2001), M. Porter (2008), P.S. Rose (2005)) allows us to interpret customer policy in two aspects. On the one hand, it has a philosophic basis which a credit organization considers in its relationship with customers. On the other hand, it is a complex of processes that enable a credit organization follow a chosen philosophy, which is understood to mean an aggregate of intra-bank principles, moral and organizational standards, values and beliefs shared by all bank employees when providing service to their customers.

As one of the crucial criteria of a sustainable customer base is customer satisfaction with the service in the bank, we used CSI (Customer satisfaction index) (C. Fornell, D.V. Amburg, F. Morgeson, E.W. Anderson, B.E. Bryant, M.D. Johnson, 2005) which is based on the analysis of opinions of customers and employees having immediate contacts with them:

$$CSI = ((X1 - 1) * W1 + (X2 - 1) * W2 + (X3 - 1) * W3) / 9 * 100, \quad (1)$$

where X1 is a total of points in “Satisfaction with the service in the bank” category;

- X2 is a total of points in “Expectancy of the service in the bank” category;

- X3 is a total of points in “Comparison of the service in the bank with a standard” category;

W1, W2, W3 is a vector of weighing coefficients in each category (the average of coefficients in the banking industry: W1 = 0.3885; W2 = 0.3190; W3 = 0.2925).

To assess the quality of the customer service in commercial banks digital methods of data processing, computer-aided tools as well as text mining were applied. Transforming customers’ feedback allowed us to create a document-term-matrix, dtm (G. Salton, C. Buckley, 1988). Due to probabilistic thematic model-building based on Latent Semantic Analysis (LSA) the most popular concepts were established. A formal concept model of text collection C = (d1, ..., dn) is presented as a total (Lm, Wk, Hk), where

Lm is a glossary including m terms in a collection;

Wk ∈ R<sup>m\*k</sup> is a conformant between k subjects space and m terms space;

Hk = [H<sup>1</sup>, ..., H<sup>n</sup>] ∈ R<sup>k\*n</sup> is a matrix of documents presentation in the concept space.

Then, through singular value decomposition (SVD) of A ∈ R<sup>m\*n</sup> matrix (if m ≥ n) the scale of dtm-matrix decreases, so it can be used for further analysis (T.K. Landauer, S.T. Dumais, 1997; C.D. Manning, P. Raghavan, H. Schutze, 2008):

$$A = U * \Sigma * V, \quad (2)$$

where U ∈ R<sup>m\*n</sup> is a matrix which columns represent an orthonormal system and are called left singular vectors (ui);

Σ = diag(σ1, ..., σn) ∈ R<sup>m\*n</sup> is a diagonal matrix, диагональная матрица, whereby σ1 ≥ ... ≥ σr > 0 = σr + 1 = ... = σn, r = rank(A) ≤ min(m, n) is a rank of A matrix, σi are singular numbers of A matrix;

V ∈ R<sup>m\*n</sup> is an orthonormal matrix which columns are called right singular vectors (vi).

We applied «Price Sensitivity Meter» (P.H. Van Westendorp, 1976) to establish if current tariffs for banking services match consumers’ expectations.

The potential of interest rate change was calculated by the assessment of customers’ needs and their solvency according to A.M. Smulova and E.I. Abdyukova (2014) procedure:

$$\begin{cases} \pi_k = \frac{S_n \lambda_k \beta_d + 2\delta S_b \mu_d \alpha_k}{2(S_n \lambda_k \beta_d + S_b \mu_d \alpha_k)}, \\ \pi_d = \pi_k - \delta \end{cases}, \quad (3)$$

where π<sub>k</sub> is the average interest rate on loans;

π<sub>d</sub> is the average interest rate on deposits;

S<sub>n</sub> is the customers’ need for loans;

- $\lambda_k$  is the rate of loan granting;
- $\beta_d$  is the rate of deposit withdrawals;
- $\delta$  is the spread;
- $S_b$  is the possibility of customers' investments;
- $\mu_d$  is the rate of a reception of deposits by a bank;
- $\alpha_k$  is the rate of loan repayment by customers.

As commercial banks' clients are different in segments, industries, sizes, forms of ownership, etc. econometric approaches to modeling customer base structure must be applied including panel data analysis.

In the course of the research we tested (Breush-Pagan and Hausman tests) (J.M. Wooldridge, 2013) pooled, fixed-effect and random effect models. Next, the optimal of them was chosen – the model with least squares dummy variable estimator accounting individual features of each client of the bank:

$$\begin{bmatrix} y_1 \\ (T, 1) \\ \vdots \\ y_N \\ (T, 1) \end{bmatrix} = \begin{bmatrix} X_1 \\ (T, K) \\ \vdots \\ X_n \\ (T, K) \end{bmatrix} * b + \begin{bmatrix} \vec{v}_T & 0 & \dots & 0 \\ (T, 1) & (T, 1) & & (T, 1) \\ 0 & \vec{v}_T & & \vdots \\ (T, 1) & (T, 1) & \dots & \vdots \\ \vdots & & & \ddots \\ 0 & & & \vec{v}_T \\ (T, 1) & \dots & & (T, 1) \end{bmatrix} *$$

$$\begin{bmatrix} a_1 \\ \vdots \\ a_i \\ \vdots \\ a_N \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ (T, 1) \\ \vdots \\ \varepsilon_N \\ (T, 1) \end{bmatrix}, \quad (4)$$

if  $\vec{v}_1 = \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix}$

- where  $X_{it}$  is a row vector of determined regressors values;
- $a$  and a column bit vector  $b$  are regression coefficients equal for all observations;
- $\varepsilon_N$  are standard model errors.

### III. RESULTS AND DISCUSSION

Approbation of the offered methodical approaches is carried out on materials of the regional banks registered in the North Caucasian Federal District. More detailed researches are conducted in PJSC Stavropolpromstroybank (Stavropol Krai), JSC Teksbank (Karachay-Cherkess Republic), LLC Maysky Bank (Kabardino-Balkar Republic).

Practical application of price sensitivity meter revealed (figure 1):

- IDPP – indifference price point, which is the price the majority of customers consider neither expensive nor cheap;
- OPP – optimum price point, at which the fewest number of consumers reject the product;

- PMC – point of marginal cheapness is the point where “too expensive” and “not cheap” curves intersect;
- PME – point of marginal expensiveness is the intersection point of “too expensive” and “not expensive” curves.

Therefore, according to PSM-method, interest rates on loans are between 5.8% and 14.2%. Outside this price range, the sales will be rare. In this case, the recommended interest rate is 8.8%.

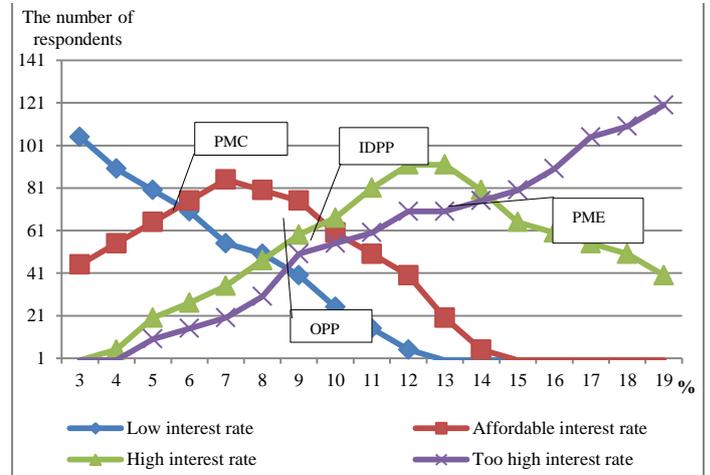


Fig. 1. Cumulative curves of determination of interest rates on loans by PSM-method (January 2018 г.)

The assessment of A.M. Smulov and E.I. Abdyukova methodology led to the conclusion that interests computed on the deposits of commercial banks of the North Caucasian Federal District (from 2.63 % to 4.11 %) are extremely low (figure 2), especially under the increasing demand for the alternative ways of investment such as personal investment accounts (they become more attractive not only due to declared yield of 10 % but also to higher possibility of tax deduction) and stocks with the yield up to 8.6%.

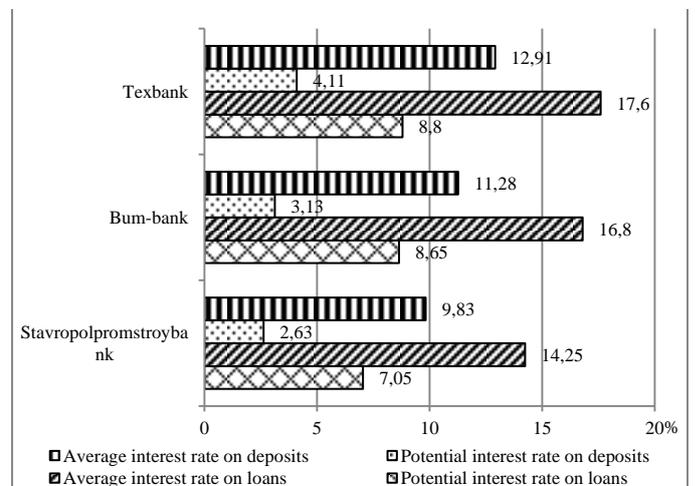


Fig. 2. Determination of the optimal interest rate on loans



$A_i$  is the number of authors.

All kinds of feedback with 1 – 3 grades were considered as negative, with 4 – 5 grades – as positive (table 2).

Thus, despite the increase in the quality of service by 0.95 points, its level still remains negative (-4.35 points). Therefore, in general, customers are unsatisfied with the service in commercial banks, which must be reflected in the customer policies developed by credit organizations.

TABLE 2. Calculation of the customer service quality in commercial banks of the North Caucasian Federal District

Index	Period				Deviations	
	2014		2018			
	<i>in abs. values</i>	<i>share, %</i>	<i>in abs. values</i>	<i>share, %</i>	<i>in abs. values</i>	<i>percentage point</i>
The amount of feedback with grade 1	147	60.00	154	55.60	7	-4.40
The amount of feedback with grade 2	26	10.61	27	9.75	1	-0.86
The amount of feedback with grade 3	7	2.86	11	3.97	4	1.11
The amount of feedback with grade 4	2	0.82	4	1.44	2	0.63
The amount of feedback with grade 5	63	25.71	81	29.24	18	3.53
Total number of all kinds of feedback	245	100	277	100	32	–
Service quality	-5.3		-4.35		0.95	–

\*Расчитано авторами

We applied spatial structuring of information about customers (cross-sectional data) and time-series data to calculate the bankruptcy probability of 40 customers – legal entities taking into account the 5-year dynamics. Through the elimination of multicollinearity effect the final set of factors included: capital and reserve value of organizations (KiR); the total of their long-term (Dob) and short-term (Kob) obligations; the amount of net profit (P), the size of key interest rate (Kst); the inflation rate in the country (Inf); the average cost of energy resources (Ben). The individual effect includes multiple factors influencing the variable being explained. However, taking into account the industrial, ownership and other differences of consumers, it reflects the quality of management as it helps to react to internal and external affecting factors. For example, for customer 4 the individual effect is positive (1.16) and it reduces the bankruptcy probability. Therefore, the level of its management is high enough, which proves the ability to react and neutralize immediately the negative consequences of emergencies. On the contrary, the individual effect for customer 30 is negative (-1.52). Consequently, the management system in the organization needs to be transformed as it has a negative impact on its performance.

Thus, the application of panel data analysis methods in banking provides a breakthrough description of factors and their influence on the customers' activities including individual results, which may enable managers to plan their reaction to these factors in more details while the top management of a bank will be able to develop a more flexible customer policy.

#### IV. CONCLUSION

1. Practical implications of the results is the possibility of their use by commercial banks for the formation and the development of their customer policy, the improvement of customer service as well as for the development of intrabank provisions, regulations and job instructions.

2. The suggested monitoring algorithm of the relevance of interest rates on loans and deposits revealed that the existing price level does not conform to customer preferences. The calculation of the potential of changes in interest rates based on the assessment of customers' of commercial banks of the North Caucasian Federal District needs and their solvency led to the conclusion that the banks under research are able to offer the products at a price that meets customers' expectations. However, in most cases it might lead to losses as the interest rates do not meet the real demand.

3. The calculation of the integral index CSI determined the level of customer satisfaction in regional commercial banks of the North Caucasian Federal District and reveal the factors that negatively affect the quality of customer service. They are high cost of banking services, low level of their availability, insufficient range and slow service.

4. The research applied the methodology of customer service quality assessment in the regional banks based on the unstructured text information with the help of computer-aided learning and text mining tools. Its practical implementation revealed that customers consider the level of service quality as negative despite its growth.

5. The methods of panel data analysis provided the basis for modelling the structure of a customer base in a commercial bank that can be used to identify bankruptcy probability for customers and individual management quality effect for each of them.

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#### References

- [1] ACSI (American Customer Satisfaction Index) Score & Its Calculation. URL: <http://blog.vovici.com/blog/bid/18135/ACSI-American-Customer-Satisfaction-Index-Score-Its-Calculation>
- [2] Astrelina V.V., Bondarchuk P.K. (2012). Assessment of business reputation of bank. Money and credit: Problems and judgments. 12. 16-23.
- [3] Crawford F., Mathews R. (2001) The Myth of Excellence: Why Companies Never Try to Be the Best at Everything. New York: Crown Business. URL: [search.rsl.ru/record/01000381698](http://search.rsl.ru/record/01000381698)
- [4] Dolgova S.A. (2010). Theoretical bases of formation of credit policy of commercial banks. Management of public and economic systems. URL: <http://umc.gu-unpk.ru/umc/arhiv/2010/2/dolgova.pdf>
- [5] Duda R, Khart P (1976). Recognition of images and analysis of scenes. Moscow: World. 509 p.
- [6] Ezrokh Y.S. (2015). Modern theory of the bank competition and competitiveness of the bank environment. Banking. 6(630). 27-37.
- [7] Fatkhutdinov R.A. (2000). Competitiveness: economy, strategy, management. Moscow: INFA-M. 312 p.
- [8] Financial and credit encyclopedic dictionary (2002). Under the editorship of A.G. Gryaznova. Moscow: Finance and statistics. 527 p.

- [9] Fornell C., Amburg D.V., Morgeson F., Anderson E.W., Bryant B. E., Johnson M.D. (2005). The American Customer Satisfaction Index at 10 Years. A summary of findings: Implications for the Economy, Stock Returns and Management. Ann Arbor, MI: The Stephen M. Ross School of Business. 140 p.
- [10] Gerpott T.Y. (2000). Empirical researches of loyalty of the client. Problems of the theory and practice of management. 6. 73-77.
- [11] Gutu L.M. (2015). Microeconomic factors affecting banks' financial performance: the case of Romania. Practical Application of Science. 3(1). 39-44.
- [12] Hsiao C. (2002). Analysis of Panel Data. Cambridge University Press. 384 p.
- [13] Kaplan R.S., Narayanan V.G. (2001). Measuring and managing customer profitability. Journal of Cost Management. 5. 5-9.
- [14] Keyninhham T.L., et al. (2007). Myths about marketing and loyalty of consumers. URL: <http://www.twirpx.com/file/1680207/>
- [15] Korobova G. G. (2015). Banking. Moscow: Master, Infra-M. 592 pages.
- [16] Kosterina T.M. (2012). Credit management in bank: educational and methodical complex. Moscow: Eurasian open institute. 270 p.
- [17] Kunitsyna N., Britchenko I., Kunitsyn I. (2018) Reputational risks, value of losses and financial sustainability of commercial banks. Entrepreneurship and Sustainability. 5(4): 943-955.
- [18] Landauer T.K., Dumais S.T. (1997). A solution to Plato's problem: The latent semantic analysis theory of acquisition, induction, and representation of knowledge. Psychological review. 2. 211-240.
- [19] Lavrushin O.I., Valentseva N.I., et al. (2016). Bank risks. Moscow.: KNORUS. 292 p.
- [20] Manning C.D., Raghavan P., Schutze H. (2008). Introduction to information retrieval. Cambridge: Cambridge university press. 496 p.
- [21] Maslanchenkov Y.S., Tronin Y.N. (2003). Work of bank with corporate clients. Moscow: UNITY-DANA. 358 p.
- [22] Porter M. (2008). The Five Competitive Forces that Shape Strategy. Harvard Business Review. 86.
- [23] Rose P.S., Hudgins S.C. (2005). Bank Management and Financial Services. McGraw-Hill/Irwin. 782 p.
- [24] Salton G., Buckley C. (1988). Term-weighting approaches in automatic text retrieval. Information Processing and Management. № 24(5). 513-523.
- [25] Sinki J. (2007). Financial management in commercial bank and in the industry of financial services; The Lane with English Moscow: Alpina Business Books. 1018 p.
- [26] Smulov A.M., E.I. Abdyukova (2014). A complex technique of creation of the balanced percentage policy of commercial bank in the sphere of the credit relations. Banking. 48 (624). 2-13.
- [27] Tagirbekov K.R. (2004). Organization of activity of commercial bank. Moscow: Whole world. 848 p.
- [28] Tavasiyev A.M. (2015). Banking. Management and technologies. Moscow: UNITY-DANA. 663 p.
- [29] Treacy M., Wiersema F. (1995). The Discipline of Market Leaders. Cambridge (Mass.): Perseus Books. 224 p.
- [30] Vayver Y.M. (2014) Problems of strategic management of the system of interaction with corporate clients in commercial bank. Bulletin of Academy. 3 (40). 39-42.
- [31] Web site of Prime Business news agency and Analytics of an information field of the Brand Analytics brand. URL: <http://1prime.ru/projects/banks/>
- [32] Web site of provider of financial information "Bloomberg L.P.". URL: <https://www.bloomberg.com/businessweek>
- [33] Web site of the Information portal "Банки.ру". URL: <https://www.banki.ru/>
- [34] Westendorp Van P. H. (1976). NSS Price Sensitivity Meter (PSM). A New Approach to study Consumer-Perception of Prices. Proceedings of the 29th ESOMAR Congress, Venice. № 5-9. 139-167.
- [35] Wooldridge J.M. (2013). Introductory Econometrics: A Modern Approach. Cengage Learning. 912 p.
- [36] Wooldridge J.M. (2002). Econometric Analysis of Cross Section and Panel Data. Massachusetts: MIT Press Cambridge. 741 p.
- [37] Zimmerman G.C. (1996). Factors influencing community bank performance in California. Federal Reserve Bank of San Francisco Economic Review. 1. 26-42.
- [38] Zyuban E.V., Markevich L.V. (2015). Policy of bank for corporate clients. Economy and modern management: theory and practice. 47. 6-10.