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 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.


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


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^{m*n} is a conformant between k subjects space and m terms space;
- Hk = [H^1, ..., H^n] ∈ R^{m*n} is a matrix of documents presentation in the concept space.

Then, through singular value decomposition (SVD) of A ∈ R^{m*n} 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):

\[ A = U * \Sigma * V^T, \]

where U ∈ R^{n*m} is a matrix which columns represent an orthonormal system and are called left singular vectors (ui);

\[ \Sigma = \text{diag}(\sigma_1, \ldots, \sigma_n) \in R^{m*n} \]

is a diagonal matrix, diagonal matrix, whereby \( \sigma_1 \geq \cdots \geq \sigma \geq 0 = \sigma + 1 = \cdots = \sigma_n, \ r = \text{rank}(A) \leq \min(m, n) \) is a rank of A matrix, \( \sigma_i \) are singular numbers of A matrix;

\[ V \in R^{m*n} \]

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:

\[ \pi_e = \frac{\pi_{e} \alpha_{e} \beta_{e} \gamma_{e} + 2 \delta_{e} \pi_{d} \alpha_{e} \beta_{e} \gamma_{e}}{2 \pi_{e} \alpha_{e} \beta_{e} \gamma_{e}}, \]

\[ \pi_d = \pi_e - \delta, \]

where \( \pi_e \) is the average interest rate on loans;

\( \pi_d \) is the average interest rate on deposits;

\( Sn \) 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;
\( S_v \) 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:

\[
\begin{bmatrix}
  y_1 \\
  \vdots \\
  y_N \\
\end{bmatrix}
\begin{bmatrix}
  \lambda_k \\
  \vdots \\
  \lambda_K \\
\end{bmatrix}
= \begin{bmatrix}
  X_1 \\
  \vdots \\
  X_N \\
\end{bmatrix}
\begin{bmatrix}
  b \\
  \vdots \\
  b \\
\end{bmatrix}
+ \begin{bmatrix}
  \varepsilon_1 \\
  \vdots \\
  \varepsilon_N \\
\end{bmatrix}
\begin{bmatrix}
  \alpha_1 \\
  \vdots \\
  \alpha_N \\
\end{bmatrix}
\]

if \( \bar{y}_i = 1 \) then \( \bar{x}_i = 1 \)

where \( X \) is a row vector of determined regressors values;
\( a \) and \( b \) are regression coefficients equal for all observations;
\( \varepsilon \) are standard model errors.

III. RESULTS AND DISCUSSION

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

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

- 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%.
Regarding this, it is advisable to decrease the interest spread to neutralize mass customer attrition in commercial banks of the North Caucasian Federal District.

322 individuals (Russian citizens aged above 18 using bank services) and 78 companies (the employees of client organizations whose responsibility is the interaction with a bank) took part in the questionnaire for assessment of the customer satisfaction level and calculation of CSI (Customer satisfaction index) (table 1). The questionnaire was carried out through telephoning, face-to-face interviewing and social networks (VK, Instagram, Facebook).

TABLE 1. The assessment of customer satisfaction level using CSI method in commercial banks of the North Caucasian Federal District for the period of 2013-2017*

<table>
<thead>
<tr>
<th>The criterion of customer satisfaction**</th>
<th>Entities</th>
<th>Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Convenient location of banks / self-service terminals</td>
<td>7.4</td>
<td>7.5</td>
</tr>
<tr>
<td>2. Convenient and comfortable customer service zone in banks</td>
<td>7.5</td>
<td>7.5</td>
</tr>
<tr>
<td>3. Working hours</td>
<td>8.8</td>
<td>8.6</td>
</tr>
<tr>
<td>4. Availability and quality of promotional items on the bank’s website and in customer service zones</td>
<td>7.5</td>
<td>7.4</td>
</tr>
<tr>
<td>5. Personnel’s appearance</td>
<td>8.5</td>
<td>8.5</td>
</tr>
<tr>
<td>6. Personnel’s expertise</td>
<td>8.3</td>
<td>8.5</td>
</tr>
<tr>
<td>7. Personnel’s discipline</td>
<td>7.5</td>
<td>7.6</td>
</tr>
<tr>
<td>8. Level of advisory service</td>
<td>7.6</td>
<td>7.6</td>
</tr>
<tr>
<td>9. Availability of technical resources</td>
<td>7.6</td>
<td>7.6</td>
</tr>
<tr>
<td>10. Correspondence of the range of operations and customers’ needs</td>
<td>7.4</td>
<td>7.3</td>
</tr>
<tr>
<td>11. Access to bank operations and services</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>12. Duration of operations</td>
<td>7.4</td>
<td>7.3</td>
</tr>
<tr>
<td>13. Speed of operations</td>
<td>7.6</td>
<td>7.6</td>
</tr>
<tr>
<td>14. Errors and inaccuracies in the process of operations and deals</td>
<td>7.6</td>
<td>6.8</td>
</tr>
<tr>
<td>15. Cost of banking products</td>
<td>7.6</td>
<td>6.7</td>
</tr>
<tr>
<td>CSI in the segment, %</td>
<td>72.8</td>
<td>70.0</td>
</tr>
<tr>
<td>CSI, %</td>
<td>71.4</td>
<td>61.6</td>
</tr>
</tbody>
</table>

* Created by authors

According to the results received, in all researched banks of the North Caucasian Federal District the assessment of the most criteria “expectancy” is higher than “satisfaction”. Therefore, customers expect higher quality of service that they receive de facto in the bank, which should be taken into account by managers for improved customer-oriented approach, customer retention and reduced number of detractors.

As the result of primary processing of customers’ feedback on commercial banks of the North Caucasian Federal District placed on the official pages of credit institutions and also in resources of the information portal "Банки.рф", a set of documents were collected to conduct text mining. A document-term-matrix (dtm) was formed through their transformation.

Figure 3 shows a visual representation of identified concepts and their interrelation. Their semantic network does not include the edges with the correlation less than 20 %. The concepts were grouped as follows: 1) settlement and cash service (employee, servicing, office, customer, operation, cash machine, money, cards, account); 2) lending (service, contract, loan, interest rate, payment operation, debt, payment, currency); 3) telephone calls (complaint, telephone, call); service denial (denial, application); 5) service in the office (problem, office).

Fig. 3. A semantic network and interrelation of the topics identified through LSA method

As the feedback web-scraping of “Banki.ru” online portal revealed that not all customers’ feedback were assessed according to 5-grade ranking system (only 288 out of 522 feedback included graded assessment), style, character and content of feedback were transferred into grades. We identified text style within the approach based on supervised learning using K-Nearest Neighbors method. Thus, a new document \((X_\text{n}(N+1))\) belongs to the same Qk class \((k = 1, \ldots ,K)\) as its nearest neighbor \((X_j^{*})\). The decision rule is represented as (R. Duda, P. Khart, 1976):

\[
\mathbf{d}(X_j^*, X_{N+1}) = \min \mathbf{d}(X_j^*, X_k), \text{ for } j = 1, ..., N, \quad (5)
\]

where \(d\) is a proximity measure.

The processing of 288 graded feedback allowed us to receive PMML-code of the model (Predictive Model Markup Language is a predictive model interchange language).

The intergrated calculation of the customer service quality in commercial banks of the North Caucasian Federal District was done by the formula suggested by the “Prime” economic agency and “Brand Analytics”:

\[
S_j = \frac{0.35 \cdot (TP_{i(100)} \cdot TN_{j(100)}) + 0.45 \cdot C_{I(100)} + 0.2 \cdot A_{j(100)}}{3}, \quad (6)
\]

where \(S_j\) is a satisfaction index;

\(TP_i\) is the number of positive types of feedback;

\(TN_j\) is the number of negative types of feedback;

\(C_i\) is a total of feedback;
Advances in Economics, Business and Management Research, volume 83

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.

Acknowledgment

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References


IV. CONCLUSION

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 provisions, regulations and job instructions.

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

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

<table>
<thead>
<tr>
<th>Index</th>
<th>Period</th>
<th>Deviations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2014</td>
<td>2018</td>
</tr>
<tr>
<td></td>
<td>in abs.</td>
<td>values</td>
</tr>
<tr>
<td>The amount of feedback with grade 1</td>
<td>147</td>
<td>60.00</td>
</tr>
<tr>
<td>The amount of feedback with grade 2</td>
<td>26</td>
<td>10.61</td>
</tr>
<tr>
<td>The amount of feedback with grade 3</td>
<td>7</td>
<td>2.86</td>
</tr>
<tr>
<td>The amount of feedback with grade 4</td>
<td>2</td>
<td>0.82</td>
</tr>
<tr>
<td>The amount of feedback with grade 5</td>
<td>63</td>
<td>25.71</td>
</tr>
<tr>
<td>Total number of all kinds of feedback</td>
<td>245</td>
<td>100</td>
</tr>
<tr>
<td>Service quality</td>
<td>-5.3</td>
<td>-4.35</td>
</tr>
</tbody>
</table>