



# Assessment of external factors influence on commercial bank deposit policy formation based on dynamic modeling

## Evaluación de factores externos que influyen en la formación de la política de depósitos bancarios comerciales basada en modelos dinámicos

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Received: 25/02/2018 • Approved: 30/03/2019 • Published 22/04/2019

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#### ABSTRACT:

The purpose is to assess external factors influence on the commercial bank deposit policy formation. The empirical results proved the fact that deposit policy of the commercial banks registered in the Republic of Mordovia is influenced by such external environment factors as gross domestic product and average accrued wage growth rate. Thus, an individual commercial bank, as a rule, has no ability to manage these factors, but should take them into account while developing its deposit policy.

**Keywords:** deposit policy, funding base, commercial bank external factors, dynamic econometric modeling

#### RESUMEN:

El propósito es evaluar la influencia de factores externos en la formación de la política de depósitos de bancos comerciales. Los resultados empíricos demostraron el hecho de que la política de depósitos de los bancos comerciales registrados en la República de Mordovia está influenciada por factores ambientales externos, como el producto interno bruto y la tasa de crecimiento promedio de los salarios acumulados. Por lo tanto, un banco comercial individual, por regla general, no tiene capacidad para manejar estos factores, pero debe tenerlos en cuenta al desarrollar su política de depósitos.

**Palabras clave:** política de depósitos, base de financiamiento, factores externos de los bancos comerciales, modelos econométricos dinámicos

## 1. Introduction

One of the most important features of the banking system is commercial entities' resource

mobilization for their transformation into the investment resources, which eventually provides for the sustainable growth rate in the country (Ahmad and Malik, 2009; Alkhazaleh, 2017; Balago, 2014; Benhabib and Spiegel, 2000).

The authors point out that the Russian banking system was influenced significantly by the world financial and economic crisis of 2008-2009, which caused the financial stability deterioration and bankruptcy of some credit organizations. The latter, alongside with the low bank institutions trust level, influenced the national commercial banks' deposit policy (Vasilyeva and Nikulina, 2011; Vasilyeva and Vysotskaya, 2018; Gavrilin and Tychkova, 2016).

The current banking sector development stage in Russia is characterized by the following negative tendencies in the resources mobilization sphere: (1) banking sector undercapitalization; (2) short-term deposits; early withdrawal and holding money in the foreign currency; (3) commercial banks' revocation licenses increase, caused by their ineffective resource mobilization policy; (4) the liabilities concentration in the biggest Russian banks, showing deterioration in the interbank competition; (5) the possible resource mobilization reduction while mainstreaming the individuals and companies' deposits (as increased influence of alternative bank sources of funds placement complicates the internal resources mobilization for the credit organizations, and the consequent sanctions policy narrows down the potentialities of the external resources mobilization); (6) high proportion of the on-demand deposits, the so-called "hot money" (Bespalova et al., 2017; Vasilyeva and Vysotskaya, 2018; Isakov and Nikonets, 2018; Maslova and Martynenko, 2017).

The aforementioned allows for the conclusion that the Russian banking qualitative development, the specific bank institutions financial improvement is impossible without the competent deposit policy for the commercial banks, providing the funding base stability and private savings into the investment resources transformation improvement. This necessitates the assessment of the external factors influence on its development. The main difficulty of the assessment is the inability of a particular commercial bank to manage them (especially in short term period), but has to take them into account in the deposit policy development.

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## 2. Resources review

In current economics and business practice the problem of the commercial banks deposit policy development as an element of its general policy is regarded as a debatable one. Firstly, it is caused by lack of common approach to the definition of the term "deposit policy". The scientific works in banking analysis distinguished the following approaches to the economic content of the term: 1) the entity aspect regards the deposit policy as the banks' strategy and tactics in the sphere of the necessary resources mobilization (Molchanova et al., 2016; Lavrushina, 2016; Panova, 1997); 2) in the functional aspect it is regarded as a set of measures providing the credit organization with the stable funding base in accordance with its requirements and characteristics (Nikulina and Abalkin, 2015); 3) in applied aspect it is a formal document, which regulates the process of the economic entities' temporarily redundant funds to deposits mobilization. (Beloglazova and Krolivetskaya, 2008; Korobova, 2006; Rykov, 2015).

P.S. Rose declares that the bank's deposit policy is closely connected to the credit one and is regarded as an element of its common credit organization funds system management strategy (Rose, 1998). He considers the asset-liability management as a complicated process of the coordinated bank balance management providing a set of measures for the ultimate banking effectiveness, the credit organization's correspondent liquidity rate support and bank risks minimizing.

Swiss economist E. Baltensperger distinguishes "partial" and "full" credit organizations' asset-liability management patterns (Baltensperger, 1980). He considers the partial pattern as being the portfolio-theoretical one describing either the liability management policy or the asset management policy of a commercial bank. Correspondingly, the full patterns are regarded as the ones, describing the asset-liability management structure and mechanisms in their correlation. Herewith, the researcher recognizes the both types' rightness, as in their

correlation they present the evolution stages of theoretical approaches to a credit organization asset-liability structural components management.

It is obvious that every commercial bank takes into account not only political, economic and social situation in the country as a whole and in the correspondent region in particular, but its internal abilities, the selected development strategy, approaches to its realization at banking market. That requires more detailed study of the factors influencing the commercial banks deposit policy.

In their works, the economists divide the factors influencing the commercial banks funding base development into two groups, namely: the external environment factors (reveal the influence of the economic, political and social stability in the country) and intrabank factors (are defined by the banking system general condition and the specific bank particular condition) (Gevorkyan, 2015; Bondarenko et al., 2016).

The current economic literature presents the surveys, analyzing a correlation between the bank deposit rate and such factors as: the financial crisis (Ritz, 2015); the population income level (Gevorkyan, 2015); oil and gas prices instability (Saif-Alyousf et al., 2018); interest rate (Maslova and Martynenko, 2017; Ojeaga, 2014); the quantity of the services (Maharana et al., 2015); the technological innovation implementation (Yao et al., 2018); deposit insurance mechanism (Jusairi et al., 2018; Nys et al., 2014); the regulation and control providing by the Central Bank (Al-Badran, 2018).

It should be noted that in the works, devoted to the studying of the external and internal banking environment influence on the deposit policy, the researchers present only the influence significance expert assessment for each factor (Bitkina, 2018; Vorobyova, 2018; Gerasimenko et al., 2011; Prokusheva, 2015). The given assessment is sometimes not objective and gives the opportunity for the initial data ambiguous interpretation. Besides, although the authors point out that the factors influencing the commercial banks deposit policy are correlated and present the mixed influence on their work, they analyze them separately. Each factor in particular does not define the complete object of the survey, but their correlated combination can provide the comprehensive idea of the phenomenon nature.

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### **3. Methods and materials**

In our research the authors focused exclusively on the external environment factors influence on the commercial bank deposit policy studying. This decision was caused by the following ideas:

- Commercial bank is an open system. Its stability in the specific moment, as well as in definite time interval, depends mainly on how promptly the analyzed system reacts exactly on the external irritant, mobilizing its inner forces and resources;
- The external environment factors are of the objective nature and are not influenced by the credit organization management. Thus, when the negative inner factors can be eliminated by the competent management (for example weak client orientation of the staff is removed easily with the training), the external environment factors' negative influence can only be leveled.

We have analyzed with the mathematical modeling tools the external factors' influence on the deposit policy of the regional commercial banks registered in the Republic of Mordovia, one of the subjects of the Russian Federation. In the given study, the authors focus on the dynamic econometric patterns formation, as the effective indicators variables' response on the external factors influence is delayed due to some economic, including financial, system rigidity. The regression equations with the polynomial structure distributed lag formation and autoregression pattern with the instrumental variable are presented as the dynamic pattern.

The dynamic economic patterns themselves make it possible to estimate the effective variable in some moment of time  $t$  with the variables included, which corresponds to the current and the previous moments of time.

The authors also used correlation, component, dispersion, and least-square methods for the regression parameters estimation, statistic hypothesis testing by Fisher and Student's

criteria, method of instrumental variables development to analyze, verify, and indicate the economic patterns.

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## **4. Results**

We use two effective variables to study the external environment factors influence on the regional commercial banks' policy, namely: finance growth rate of the banks, registered in the Republic of Mordovia, brought by the companies (the effective variable Y1) and by the natural persons (the effective variable Y2). The dynamic rate is presented by the empiric data for 2006-2017. The interval between the dynamic timing levels is a quarter. Such significant quantified external environment factors, correlated to the effective variables with the cause-and-effect link and application content, as: gross domestic product, retail turnover, inflation, average accrued wage rate, business confidence index, ease of deposits for the population index, are included into the pattern formation as the independent variables.

The correlation analysis results revealed the dominant influence of such external environment factor as gross domestic product growth rate ( $X_{1t}$ ) (paired correlation index  $r_{Y_{1t}X_{1t}} = 0.39$ ) on the finance, brought by the companies, growth rate, which is the commercial bank's funding base ( $Y_{1t}$ ).

Let us present the dynamic economic pattern of  $Y_{1t}$  to  $X_{1t}$  correspondence as a polynomial structure distributed lag pattern by Almon's method (The Almon Polynomial Distributed Lag) (26):

$$Y_{1t} = \delta + \beta_0 X_{1t} + \beta_1 X_{1t-1} + \beta_2 X_{1t-2} + \dots + \beta_l X_{1t-l} + \varepsilon_t \quad (1)$$

The Almon Polynomial Distributed Lag (1) starts with the definition and includes the following procedure:

- Estimating the max lag  $l$ .
- Determining the degree  $k$  of polynomial  $\beta_j = c_0 + c_1 j + c_2 j^2 + \dots + c_k j^k$ , which describes the lag structure.

In an experimental way (that is by the regressive patterns construction and the effective and lag variables' correlation estimation) the necessity of polynomial of degree 3 for the regression index  $\beta_j$  estimation has been proven (2).

$$\beta_j = c_0 + c_1 j + c_2 j^2 + c_3 j^3, \quad (2)$$

In its turn (2) transforms into (3):

$$\begin{aligned} \beta_0 &= c_0, \\ \beta_1 &= c_0 + c_1 + c_2 + c_3, \\ \beta_2 &= c_0 + 2c_1 + 4c_2 + 8c_3, \\ \beta_3 &= c_0 + 3c_1 + 9c_2 + 27c_3 \\ \beta_4 &= c_0 + 4c_1 + 16c_2 + 64c_3, \end{aligned} \quad (3)$$

Applying formula (3) into formula (1), and making the correspondent transformations, using the grouping method, the authors get the equation (4):

$$\begin{aligned} Y_{1t} &= \delta + c_0 (X_{1t} + X_{1t-1} + X_{1t-2} + X_{1t-3} + X_{1t-4}) + c_1 (X_{1t-1} + 2X_{1t-2} + 3X_{1t-3} + \\ &4X_{1t-4}) + c_2 (X_{1t-1} + 4X_{1t-2} + 9X_{1t-3} + 16X_{1t-4}) + c_3 (X_{1t-1} + 8X_{1t-2} + 27X_{1t-3} + \\ &64X_{1t-4}) + \varepsilon_t \\ &= \delta + c_0 Z_0 + c_1 Z_1 + c_2 Z_2 + c_3 Z_3 + \varepsilon_t, \end{aligned} \quad (4)$$

Here the summands in brackets where  $c_i$  ( $i = 1, 2, 3$ ) are taken as the new variables  $Z_0, Z_1, Z_2$  (5):

$$\begin{aligned} Z_0 &= X_{1t} + X_{1t-1} + X_{1t-2} + X_{1t-3} + X_{1t-4}, \\ Z_1 &= X_{1t-1} + 2X_{1t-2} + 3X_{1t-3} + 4X_{1t-4}, \\ Z_2 &= X_{1t-1} + 4X_{1t-2} + 9X_{1t-3} + 16X_{1t-4}, \\ Z_3 &= X_{1t-1} + 8X_{1t-2} + 27X_{1t-3} + 64X_{1t-4}, \end{aligned} \quad (5)$$



This model (9) is useful for the studying and forecasting, as  $R^2 = 0.71$ , i.e. the deviation share of the effective variable  $Y_{2t}$ , caused by the instrumental variables regression (9) and is up to 71%. The regression parameters are of the statistical significance according to Student's criterion with the significance rate  $\alpha=0.01$ , the regression equation is reliable according to Fisher's criterion with significance rate  $\alpha=0.01$ . The authors calculate the distributed lag parameters (1) with the formula (3):  $\beta_0 = 0.546, \beta_1 = -0.024, \beta_2 = -0.118, \beta_3 = -0.120$  и  $\beta_4 = -0.409$ . Thus, the distributed lag pattern is written as (10):

$$Y_{2t} = 114.210 + 0.546X_{1t} - 0.024x_{4t-1} - 0.118X_{1t-2} - 0.120X_{1t-3} - 0.409X_{1t-4} + \varepsilon_t, \quad (10)$$

The constructed pattern analysis (10) allows for the conclusion that gross domestic product growth increase for 1% in the current period will cause the finance, brought by the private persons, growth rate, which is the regional commercial bank's funding base, averagely by 0.55% in a year, and by 0.52 % in two years and by 0.40% in three years.

We constructed the autoregression pattern (11) where endogenous lag variable  $Y_{2t}$  (finance growth rate of the banks, registered in the Republic of Mordovia, brought by the natural persons, %) is selected as an exogenous variables, and also the factor variable  $X_{2t}$  ( an average accrued wage growth rate in the region, %), where the regression parameters are influenced by the effective variable  $Y_{2t}$  transformation caused by the exogenous variable  $X_{2t}$  ( $\alpha_0$ ) and its variations in the previous moment ( $\beta_1$ ).

The intermediate multiplier (the common absolute index variation in the moment (t+1)) defines the indexes  $\alpha_0\beta_1$  product of the autoregression pattern.

$$Y_{2t} = \delta + \alpha_0 X_{2t} + \beta_1 Y_{2t-1} + \varepsilon_t \quad (11)$$

$$\alpha = \alpha_0(1 + \beta_1 + \beta_1^2 + \beta_1^3 + \dots) = \frac{\alpha_0}{1 - \beta_1}, \quad (12)$$

where  $\alpha$  is a long-term multiplier (an absolute endogenous variable  $Y_{2t}$  variation in the long-term peiod).

The unknown parameters of the autoregression pattern (11) were received with the instrumental variables method, as the perspectives of the least square method applying for the endogenous lag variable  $Y_{2t-1}$  are failed.

New (instrumental) variable  $Z_t$  must meet two requirements:

it must be closely correlated to  $Y_{2t-1}$ , (13):

$$cov(Y_{2t-1}, Z_t) \neq 0, \quad (13)$$

it must not be correlated to the model  $\varepsilon_t$  (14):

$$cov(Z_t, \varepsilon_t) = 0, \quad (14)$$

The autoregression pattern (11), formed with the instrumental variables, is described with the formula (15):

$$Z_{2t-1} = d_0 + d_1 Y_{2t-1} + u_t = 50.00 + 0.52 y_{2t-1} + u_t, \quad (15)$$

(2.97)

$$F = 8.83,$$

With that, new variable  $Z_{2t-1}$  meets the requirements (13) and (14) for the instrumental variables.

The autoregression pattern (11) transforms to (16) и (17):

$$Y_{2t} = 90.62 + 0.53 X_{2t} + 0.41 Z_{2t-1} + u_t, \quad (16)$$

$$Y_{2t} = 70.20 + 0.53 X_{2t} + 0.21 Y_{2t-1} + \varepsilon_t, F = 5.32 \quad (17)$$

The economic interpretation of the given autoregression pattern (17) allows us to make a conclusion that an average accrued wage growth rate in the region (independent variable  $X_{2t}$ ) by 1% in the current period causes the finance growth rate of the banks, registered in the Republic of Mordovia, brought by the natural persons by 0.53%, in the following period by 0.11 (0.53\*0.21)%.

The long-term multiplier is described with the formula (18):

$$\alpha = \frac{\alpha_0}{1 - \beta_1} = \frac{0.53}{1 - 0.21} = 0.67\%. \quad (18)$$

Thus, an average accrued wage growth rate in the current period by 1% causes the finance growth rate of the banks, brought by the natural persons, by 0.67% on average in long-term perspective.

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## 5. Discussion

With the distributed lag economic patterns and autoregression patterns construction the authors point out that the deposit policy of the commercial banks, registered in the Republic of Mordovia, are influenced by the following external environment factors as gross domestic product and an average accrued wage growth rates. Thus, in particularly, it is defined that the gross domestic product growth rate by 1% in the current period will cause: (a) the finance growth rate of the regional banks, brought by the companies, by 0.76% in a year, by 0.98% in two years; (b) the finance growth rate of the regional banks, brought by the natural persons by 0.55% in a year, by 0.52% in two years, by 0.40% in three years. Also, it is concluded that the average accrued wage growth rate in the current period by 1% causes the finance growth rate of the regional commercial banks, brought by the natural persons, by 0.53%, in the following period by 0.11% and by 0.67% on average in long-term perspective.

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## 6. Conclusion

Thus, the given analysis proves the hypothesis of the external environment factors' significant influence on the commercial banks' deposit policy. The further investigations should be devoted to the reasoning of the effective methods and tools of the deposit policy realization in accordance with the external factors that will provide the commercial banks' funding base stability and private savings into the investment resources transformation improvement.

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Revista ESPACIOS. ISSN 0798 1015  
Vol. 40 (Nº 13) Year 2019

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