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## Revisiting the calculations techniques of the optimal planning methods for the local authority activities (on the Republic of Tatarstan example)

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## Revisiting the calculations techniques of the optimal planning methods for the local authority activities (on the Republic of Tatarstan example)

A M Shikhalev <sup>1</sup>, I A Akhmetova <sup>2</sup>, D P Vorontsov <sup>1</sup> and A F Khananova <sup>1</sup>

<sup>1</sup> Kazan Federal University, 18 Kremlyovskaya street, Kazan, 420008, Russian Federation, Engineering institute

<sup>2</sup> Kazan Federal University, 18 Kremlyovskaya street, Kazan, 420008, Russian Federation, Institute of management, economy and finance

128\_dmitri@mail.ru

**Abstract.** The indicators of Savrushinsky local municipal structures development in the Republic of Tatarstan (RT) are defined on the basis of creation, receiving and the analysis of the production function (PF). For the PF creation were collected the input statistical data for 2013 - 2017 on revenues of the studied local municipal district, fixed assets volumes and the staff number. After the logarithmation and receiving the simple multiple regression equation with the potentiation method was received the PF in a multiplicative look that allowed to estimate the degree of intensive and extensive development of the studied municipal structures and also to define its ratio. For the mathematically correct results obtaining beforehand was made the component analysis of future equation, and after its receiving was estimated the residuals autocorrelation existence. As a result was specified that the Savrushinsky local municipal office in the studied period was mostly developed due to the production efficiency increase, than from the production scale growth in which increase consists the positive experience of this municipal structures.

The research purpose is the ratio of innovative character development and scale development (due to the mechanical production scale expansion) for the studied municipal office assessment. However before the PF receiving as variant of the proposed goal achievement it is necessary to make the component analysis for the purpose of prevention in using the general view (1) PF equation according to [1] the existence of the explanatory variables possible collinearity which was realised according to the requirements [2].

$$X = f(K, L), \quad (1)$$

where X is the enterprise revenues (roubles), K is the fixed assets volume, roub., and L is the management staff number.

The component analysis purpose is the compliance degree ascertaining to the complete correlation matrixes requirements among the operating variables [2] for the case if the required PF type look like (1): 1) the X dependent variable must have the strong correlation with the explanatory variables (the coefficient of correlation has to be more than 0.70; 2) the independent variables K and L shouldn't correlate with each other more than on 0.70 [2]. As at the time of the research there were opened only the last five years data the normality test due to the clear reasons for the studied statistical sets



elements (see tab. 1) wasn't possible to realise, so we calculated the nonparametric coefficients of pair rank correlation [3] and received the following results: 1) the relations between the dependent variable and the capital and staff -  $\rho_{X-K} = 0,90$ ;  $\rho_{X-L} = -0,87$  – were rather high on in modulus exceeding the boundary value 0.70; 2) on the relation between the independent variables between themselves  $\rho_{K-L} = -0,87$  that exceeds in modulus the value 0.70 (but on a few) and nevertheless is proposed to be considered further.

Next, for the PF receiving are required the data given in the tab. 1:

Table 1 - Input data for the Savrushinsky local municipal office.

Counter i	Years	Income, roub., X	Fixed assets (capital) K, roub.	Employees, people, L
		j = 1	j = 2	j = 3 = n
1	2013	2754,8	207,9	7
2	2014	2998,5	228,1	7
3	2015	3531,8	250,4	6
4	2016	3779,3	268,9	6
5 = m	2017	3713,7	322,5	6

After the preliminary logarithmation of the data provided in tab. 1 we have received:

$$\ln X = \ln A + \alpha_1 \ln K + \alpha_2 \ln L. \quad (2)$$

Then, after potentiation from (2) we received a required multiplicative variant:

$$X = A \cdot K^{\alpha_1} \cdot L^{\alpha_2} = 9202,3005 \cdot K^{0,2272} \cdot L^{-1,2267}, \quad (3)$$

where A is the neutral technical progress coefficient of;  $\alpha_1$  and  $\alpha_2$  are the elasticity coefficients on for the fixed assets and work (the equation (3) is received as a result of the A.M. Shikhalev author's computer program using).

As the regression equation type (3) connects the the average values it is easy to be convinced that its left-hand and right members are the almost identical:  $3355.62 \equiv 3326.51$  (a difference is less than 1%). Moreover the reliability of the received PF (3) equation according to Fischer is 90.6% whereas the equation( coefficients) significance on Student's coefficient has an insufficient size, i.e. 57.1% and 88.4%. At the same time the multiple correlation coefficient R is 0.97 and the determination coefficient  $R^2 = 0.95$  (i.e. about 95% of all really operating factors are included); the general relative error of approximation is only 1.40%. However the Durbin-Watson's criterion is 3.02 instead of expected variant which proposed to be at about 2.0.

The calculations in the author's computer program for the autocorrelation (a/c) received the following results:  $r_a^{\text{calc}} = -0.695$ ;  $d_a^{\text{calc}} = 3.022$ , which in comparison with the tabular data in [4. - Appendices 7, pp. 133 and 5, p. 132] allow to make the conclusions that:  $r_a^{\text{calc}} = -0.695 > r_a^{\text{table}} = -0.753$ , therefore, autocorrelation here is presented. On the other hand for such conclusion specification it is necessary to use for example the Durbin-Watson's criterion at the same 5% p-level [5].

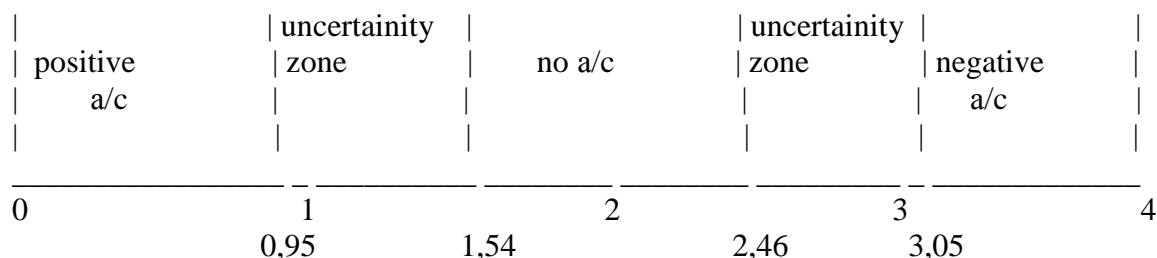


Fig. 1. The graphic interpretation of the autocorrelation residuals existence assessment

However, though the calculated value received  $d_a^{\text{calc}} = 3.022 < 3.050$ , they differ from each other within also no more than 1% which is possible to neglect according to fig. 1.

For the estimation of the goal degree achievement it is necessary to calculate firstly the next data:

1) The income in the studied organisation increased in the  $X^* = (X_{2017}/X_{2013}) = (3713.7 \text{ roub.} / 2754.8 \text{ roub.}) = 1.3481$  times;

2) The fixed business assets increased in  $K^* = (K_{2017}/K_{2013}) = (322.5 \text{ roub.} / 207.9 \text{ roub.}) = 1.5512$  times;

3) The workers number (production staff) in the  $L^* = (L_{2017}/L_{2013}) = (7.0 \text{ peop.} / 6.0 \text{ peop.}) = 1.1667$  times, and we could express the PF (3) as the Cobb-Douglas function:

$$X = a \cdot K^\alpha \cdot L^{(1-\alpha)}, \quad (4)$$

where  $\alpha = \alpha_1 / (\alpha_1 + \alpha_2) = 0.2272 / [(0.2272 + (-1.2267))] = -0.2273$ ; then  $(1 - \alpha) = [(1 - (-0.2273))] = 1.2273$ , and the PF expression in the Cobb-Douglas form function (4) will take a form:

$$X = a \cdot K^{-0.227341} \cdot L^{1.227341}. \quad (5)$$

For the research purpose achievement which is the verification of a working hypothesis about the internal reserves dynamics (negative or positive) of the studied enterprise we need to determine the particular resources effectiveness for the capital productivity ( $E_K$ ) and for the labour productivity ( $E_L$ ) with the following formulas (6) and (7):

$$E_K = X^* / K^* = 1,3481 / 1,5512 = 0,8691; \quad (6)$$

$$E_L = X^* / L^* = 1,3481 / 1,1667 = 1,1555, \quad (7)$$

whereas it was already noted,  $X^*$  is the incomes growth (as the organic part of the total production output) for 2013 - 2017;  $K^*$  is the increase of productive assets volume for the same period and  $L^*$  is the staff number rise for the people which were working for the same period.

Further on the basis of the such type (5) function the generalized efficiency factor  $E$  could be calculated as the geometric average of particular indicators as the average dynamic is estimated (taking into account (6) and (7)) in a look

$$E = E_K^\alpha \cdot E_L^{(1-\alpha)} = 0,8691^{-0.227341} \cdot 1,1555^{1.227341} \approx 1,23 \text{ (times)} \quad (8)$$

Then the average production scale in dynamics also could be determined as the geometric average proceeding from the resources growth rate on formula (9):

$$M = K^{*\alpha} \cdot L^{*(1-\alpha)} = 1,5512^{-0.227341} \cdot 1,1667^{1.227341} \approx 1,09 \text{ (times)}. \quad (9)$$

Therefore, the general incomes growth of the studied production (organization) from 2013 to 2017 in 1.09 times was concerned mostly with the production scales increase whereas the rise by 1.23 times is received due to the production efficiency increase. Then the ratio of scale growth and the effectiveness increase could be expressed (with the expressions (19) and (20)) as their relation like:  $S = E / M = 1.23/1.09 = 1.128 \approx 1.13$  times. In other words, during the 2013 - 2017 generally the local municipal office growth rate concerned with the production efficiency share was higher than a share related to its scale rise that could be estimated as the generally positive variant for the studied production (organization).

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