**Spatial autoregressive analysis of the fertility rate in the regions of the Russian Federation**

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**Research problem.**How does the development of institutions affect fertility? On the one hand, spatial effects can be beneficial. If the institution of family and marriage is sufficiently developed and the people around the individual marry and give birth to children, then there is a high probability that the individual himself will marry or, at least, decide to have a child. On the other hand, the relationship can be inversely proportional. If the environment stably marries, then the individual can refuse to marry and focus on free relationships, which, however, does not interfere with his desire to have children and the very process of natural reproduction of the population. In particular, the influence on the propensity to increase the birth rate of such factors as real per capita income, total fertility rate, dependency ratio, demographic stability coefficient, the level of female presence, the marriage rate, and the unemployment rate was assessed. Thus, the special practical role of this article is to identify the prerequisites and factors that affect the birth rate in different regions of the Russian Federation. The results obtained may also be of practical interest for those who implement demographic policy measures.

**Data & Models.**

The work uses data from the Federal State Statistics Service of the Russian Federation [20]. Taking into account the availability and reliability of the necessary data, as well as partial smoothing of the influence of "missing variables" due to the use of econometric methods of spatial regression analysis, some variables were selected, the influence of which on the birth rate indicator will be investigated in the work. Information is given in table 1.

Table 1 - Information about the factors influencing the studied variable.

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Designation** | **Factor** | **Calculation method** |
| 1 | x83 | Total fertility rate | Births per 1000 population |
| 2 | x7 | Morbidity rate | Morbidity per 1000 population |
| 3 | x17 | Presence of women | There are women per 1000 men |
| 4 | x18 | Demographic load factor | How many people of disabled age are there per 1000 people of working age |
| 5 | x19 | Marriage rate | Crude marriage rates per 1000 population |
| 6 | x25 | Unemployment rate | According to data from sample surveys of the labor force; on average per year |
| 7 | x28 | Labor productivity level | Estimation, GRP per one employed |
| eight | x39 | The level of development of financial infrastructure in the region | The number of credit institutions and branches in the subject |
| nine | x41 | Crime level | Number of homicides and attempted murders recorded |
| ten | x53 | Level of motorization | Own passenger cars per 1000 population |
| eleven | x55 | Lending propensity | The ratio of the volume of loans per person (excluding the disabled) to the value of nominal per capita income |
| 12 | x56 | Real income per capita | Nominal income divided by the cost of a fixed set of consumer goods and services |
| 13 | x57 | Educational level | Estimation of the share of the population with higher education in the region |
| fourteen | x80 | Share of the population under working age | Share of the population under working age as a percentage |
| 15 | x84 | Divorce rate | General divorce rates per 1000 population |
| 16 | x87 | Propensity to attend cultural events | Theater attendance and museum visits per 1000 population |

To test previously formed hypotheses, some models will be used, including a linear regression model based on spatial sampling (pooled regression), panel data models with fixed and random effects, models with spatially autoregressive effects (1).

$x83\_{it}=α\_{i}+ρ\*W\*x83\_{it}+β\_{1}\*x7\_{it}+β\_{2}\*x17\_{i}E\_{r}\_{it}+β\_{3}\*x18\_{it}+β\_{4}\*x19+β\_{5}\*x25\_{it}+β\_{6}\*x28\_{it}+β\_{7}\*x39\_{it}+β\_{8}\*x41\_{it}+β\_{9}\*x53\_{it}+β\_{10}\*x55\_{it}+β\_{11}\*x56\_{it}+β\_{12}\*x57\_{it}+β\_{13}\*x80\_{it}+β\_{14}\*x84\_{it}+β\_{15}\*x87\_{it}+ε\_{it}$ (1)

**Results.** The results of the evaluated models are shown in Table 2.

Table 2 **-** Results of the evaluated models.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | (1)  | (2)  | (3)  | (4)  | (5)  |
| VARIABLES  | pooled  | FE  | RE  | SAR\_FE  | SAR\_RE  |
| x7\_  | -0.000  | -0.002\*\*  | -0.001  | 0.000  | 0.000  |
|   | (0.000)  | (0.001)  | (0.001)  | (0.000)  | (0.000)  |
| x17\_  | -0.021\*\*\*  | 0.015\*\*  | -0.017\*\*\*  | 0.011\*\*  | -0.004  |
|   | (0.001)  | (0.007)  | (0.002)  | (0.004)  | (0.003)  |
| x18\_  | 0.006\*\*\*  | -0.008\*\*\*  | -0.002  | 0.002  | 0.002  |
|   | (0.001)  | (0.002)  | (0.002)  | (0.001)  | (0.001)  |
| x19\_  | 1.429\*\*\*  | 0.444\*\*\*  | 0.739\*\*\*  | 0.271\*\*\*  | 0.291\*\*\*  |
|   | (0.067)  | (0.062)  | (0.069)  | (0.041)  | (0.043)  |
| x25\_  | 0.299\*\*\*  | 0.208\*\*\*  | 0.275\*\*\*  | 0.173\*\*\*  | 0.187\*\*\*  |
|   | (0.015)  | (0.019)  | (0.018)  | (0.012)  | (0.013)  |
| x28\_  | 0.000  | -0.000\*  | -0.000\*\*\*  | 0.000  | 0.000  |
|   | (0.000)  | (0.000)  | (0.000)  | (0.000)  | (0.000)  |
| x39\_  | -0.002  | -0.009\*\*\*  | -0.007\*\*\*  | -0.005\*\*\*  | -0.005\*\*\*  |
|   | (0.001)  | (0.002)  | (0.002)  | (0.001)  | (0.001)  |
| x41\_  | 0.000\*\*  | -0.000\*  | 0.000  | -0.000\*\*  | -0.000\*\*\*  |
|   | (0.000)  | (0.000)  | (0.000)  | (0.000)  | (0.000)  |
| x53\_  | -0.008\*\*\*  | 0.002  | -0.006\*\*\*  | 0.002\*\*  | 0.001  |
|   | (0.001)  | (0.002)  | (0.002)  | (0.001)  | (0.001)  |
| x55\_  | 0.448\*\*\*  | 0.325\*\*\*  | 0.407\*\*\*  | -0.030  | -0.005  |
|   | (0.032)  | (0.044)  | (0.041)  | (0.030)  | (0.031)  |
| x56\_  | 1.522\*\*\*  | 2.722\*\*\*  | 2.161\*\*\*  | 1.092\*\*\*  | 1.070\*\*\*  |
|   | (0.212)  | (0.284)  | (0.260)  | (0.189)  | (0.193)  |
| x57\_  | 5.949  | 88.026\*\*\*  | 61.597\*\*  | -44.277\*\*  | -42.682\*  |
|   | (22.552)  | (32.288)  | (30.962)  | (21.219)  | (22.018)  |
| x84\_  | -1.466\*\*\*  | 0.025  | -0.756\*\*\*  | -0.025  | -0.132\*  |
|   | (0.090)  | (0.116)  | (0.111)  | (0.075)  | (0.079)  |
| x87\_  | -0.000  | 0.002\*\*\*  | 0.000\*  | 0.001\*\*\*  | 0.000\*\*\*  |
|   | (0.000)  | (0.000)  | (0.000)  | (0.000)  | (0.000)  |
| Constant  | 23.418\*\*\*  | -11.391  | 24.910\*\*\*  |   | -0.810  |
|   | (1.581)  | (7.629)  | (2.605)  |   | (3.585)  |
| Spatial rho  |   |   |   | 0.902\*\*\*  | 0.906\*\*\*  |
|   |   |   |   | (0.024)  | (0.024)  |
| Observations  | 747  | 747  | 747  | 747  | 747  |
| R-squared  | 0.815  | 0.613  |   | 0.077  | 0.360  |
| AIC  | 2546  | 1664  |   | 1159  | 1652  |
| BIC  | 2616  | 1733  |   | 1233  | 1736  |
| Number of REGION  |   | 83  | 83  | 83  | 83  |

**Conclusions.** The key conclusion is that the birth rate depends on a large number of factors that must be considered together to implement an effective demographic government policy. The high dependency ratio shows that the number of children and pensioners practically correlates with or exceeds the level of the able-bodied and able-bodied population, which significantly reduces the birth rate.

The propensity to lend has a close relationship with the birth rate, as well as a favorable investment climate, mutual trust of credit institutions and the population, contributing to the creation of a sense of security among the population. However, the level of education negatively affects the desire of people to have children. This is due to the fact that people with education are focused on developing their careers and do not think about the urgent creation of a family. The divorce rate decreases the birth rate. However, this factor is closely related to the marriage rate, and, in fact, compensates for it.

The research results can be used to design policies that will create the institutional conditions and the right incentives to increase the birth rate.