

Socioeconomic determinants of demographic development of the Yamalo-Nenets Autonomous Okrug

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Received 30 July 2020 ♦ Accepted 20 November 2020 ♦ Published 31 March 2021

Citation: Barkova ER (2021) Socioeconomic determinants of demographic development of the Yamalo-Nenets Autonomous Okrug. Population and Economics 1(5): 1-19. <https://doi.org/10.3897/popecon.5.e57105>

Abstract

The study explores the peculiarities of demographic processes in the Yamalo-Nenets Autonomous Okrug and the socioeconomic factors determining them. The author tests hypotheses about the relationship of socioeconomic characteristics of the population with fertility and migration basing on data from 13 municipalities of the region for 2011–2017. The analysis reveals a statistically significant relationship between age-specific fertility rate for women aged 15–49 and such indicators as marriage and divorce rates, wages, the proportion of employed in the working-age population, the enrolment of children in pre-school education, and the proportion of families who received housing or improved housing conditions among those registered in the housing program. Inbound migration rate is statistically related to wages, as well as to proportion of employed in the total working-age population, while outbound migration rate is linked to proportion of those employed in mining, as well as to indicators characterizing situation in the marriage market.

Keywords

Yamalo-Nenets Autonomous Okrug, demographic development, socioeconomic factors, fertility, migration

JEL codes: J11, J13, J18, O15, R23

Introduction

In the context of the large-scale development of the Arctic zone of Russia, issues of demographic development of the northern regions, which are important both as resource areas and geopolitically, gain high significance. The Yamalo-Nenets Autonomous Okrug (YaNAO) is an integral part of the Arctic, and this region is characterized by one of the highest per

capita gross regional product (GRP) in the country, as well as by high level of budgetary provision. These features allow directing significant resources to solving development problems in the region, a necessary prerequisite for which is its stable demographic reproduction. Currently, in all municipalities of the YaNAO, there is a shortage of labour resources, the most realistic way of compensating for which, given special the needs of the region's economy in the working-age population, is to attract temporary labour migrants. At the same time, there are tasks to maintain a positive migration balance in exchange with other regions, to prevent the decline in the total population, as well as to maintain natural population growth. All these tasks actualize the issue of finding new approaches to the implementation of regional demographic policy.

The main purpose of this study is to identify the socioeconomic factors of demographic development in the Yamalo-Nenets Autonomous Okrug. In the first part of the article, the author analyzes modern empirical works in the field of fertility and migration modeling, and then, based on their results, formulates and tests the following hypotheses:

1. the fertility rate in the municipalities of YaNAO is influenced by indicators such as wages, the proportion of employed in the working-age population, the enrolment of children in preschool education, marriage and divorce rates, and indicators characterizing the housing market;
2. labour market indicators in the municipalities of the YaNAO — wages, the proportion of employed in the working-age population, the structure of the local economy, and situation on the housing market — affect population inflows and outflows.

The relationships revealed in the study and the proposed interpretation of the obtained results might contribute to the development of new measures of social and demographic policy.

Fertility studies

Within the macroeconomic approach, fertility theories are based on the factor–phenomenon logic and aim at determining mainly socioeconomic factors that influence fertility.

The macroeconomic approach is rather diverse due to the significant number of factors potentially affecting fertility dynamics. In general, scholars distinguish global (urbanization, growth of population mobility, industrialization) and local determinants (income levels, employment, education, housing, etc.).

Gary Becker (Becker 1960), the founder of the economic theory of fertility, in his works, explored the dependence of the actual and ideal number of children on the income level and social status of the family. The author concluded that one of the factors of human welfare is time, the price of which increases in the process of economic development. Its marginal utility decreases with the birth of each subsequent child, whereby the family has to choose between quality and quantity of *human capital* (Becker and Lewis 1973). One of the most significant findings is the discovery of both a negative (children “reduce” income and reduce the “quality” of already existing children) and positive impact of income on fertility (income growth increases the “quality” of the child, which therefore increases the level of utility for parents), and the direction of connection depends on the utility function of the family and on the role of the child in it.

Becker's ideas were elaborated in the works of Richard Easterlin (Easterlin 1970). Developing the concept of economic rationalism, Easterlin studied the concept of relative cost of

the child, which, in his opinion, depended on fluctuations in the level of income of the family due to potential changes in the level of the woman's earnings. An example of empirical research into this problem is a paper by Miller (Miller 2010), who attempted to calculate the alternative cost of children in terms of unearned income. The author obtained the following results: when a woman's birth timing shifts by 1 year, her potential income increases by 9%, and work experience — by 6%. At the same time, a number of cross-country studies show a negative correlation between total fertility rate and the level of female labor force participation (Kögel 2004; Jeon and Shields 2005; estimates made for OECD countries). The study (Jeon and Shields 2005) also revealed the negative impact of changes in the age structure of the population on the total fertility rate through income and work experience; the authors controlled for indicators such as gross domestic product (GDP) at purchasing power parity (PPP), the level of female employment, infant mortality and urbanization.

The link between women's education and fertility has also been studied thoroughly, and there is no consensus on this issue. According to Becker's ideas, women with high levels of education postpone the decision to have children for economic reasons. However, some studies show a positive link between women's education and fertility rates. Behrman and Rosenzweig's paper (Behrman and Rosenzweig 2002) notes that such women are more likely to marry a man with a high level of education who is most likely to earn a decent income, which increases the likelihood of earlier births, because some of the household chores can be delegated to hired assistants. Some studies (Sobotka 2004; Kravdal and Rindfuss 2008) deny the role of education in fertility determination altogether. According to the authors, there is merely a shift in birth timing among more educated women compared to less educated women, and as a result, there is no difference in eventual fertility between them.

Another controversial issue is the direction of the link between marriage rates and fertility levels. If Becker's model considers the family as a sustainable element, later studies (due to the transformation of the value of the institution of the family) are devoted to the factor of the spread of unregistered partnerships (Bumpass et al. 1991; Mills 2004) and marriage postponement to a later date (Corijn 2001). The obtained estimates vary widely depending on the sample and observation period. Thus, in France in couples who are not officially married, the probability of having a child is the same as in those who are (Toulemon and Testa 2005). The results of the study on American data show that the former have a much lower probability of having a child (Heaton et al. 1999).

Summing up, we can highlight the main world trends in fertility, which are characteristic of the sociodemographic process that has been gaining momentum for over a decade, the *second demographic transition*. Firstly, it is a dramatic decline in the number of children in the family. This fairly stable trend is due to the development of health care systems (reduction in infant and child mortality), freedom to choose a partner and form of cohabitation, spread of birth control methods, and development of public pension systems in which children have ceased to be regarded as a source of income and support in old age. Secondly, it is a shift to a new fertility model, where the contribution of older age groups to fertility increases. This shift could be explained by the increasing time of education, the increasing role of women in the labour market, and more equitable remuneration for women; however, there is no clear answer to the question of the link between women's education, employment and fertility processes.

These trends are also relevant for Russia: in recent decades we have seen a decline in the number of children in the family, postponement of first births to later ages, an increase in the number of unregistered partnerships.

The body of domestic studies devoted to the dynamics and factors of fertility in Russia is rather large.

For example, a monograph by Vladimir Arkhangelsky (Arkhangelsky, 2006) is notable for the fact that the author considers fertility dynamics basing on aggregated data and paying special attention to matrimonial status and indicators reflecting living conditions. A study by Roshina and Boykov (Roshina and Boykov 2005) concludes that reproductive behaviour is determined by demographic (age, presence of children) and cultural and value factors, while economic factors (level of education, employment, position, income amount) do not play a significant role. In a study (Sinyavskaya et al. 2009), the authors find an ambiguous relationship between fertility and employment rates for women. This is especially true for second and subsequent births: the employment status of a woman turns out to be a statistically insignificant regressor when modeling births of the second and higher orders. The work (Maleva and Sinyavskaya 2006) confirms the hypothesis that the position of a woman in the labor market (employment itself and a job position) does not affect either the actual fertility rate or her reproductive intentions. This work also shows that the barrier to the birth rate growth in Russia is the poor housing provision of citizens. Estimates by Zakharov (Zakharov 2010) suggest that the critical conditions of housing provision sharply reduce the likelihood of second births. The fundamental influence on the birth rate in Russia is exerted by demographic factors, such as presence of a partner, living in rural areas and absence of children, while a woman's employment and her higher education provoke the postponement of reproductive plans to a later period (Zhuravleva and Gavrilova 2017).

In the context of this work, studies of fertility factors at the regional level are of special interest. Mironova and Tyrnova (Mironova and Tyrnova 2014), on the basis of the sociological survey conducted in the Astrakhan region, conclude that the spread of cohabitation leads to an increase in the number of extramarital births. There is a gradual institutionalization of unregistered marital unions, which means that the number of children born into such unions will grow. At the same time, an analysis of the sociological survey data gathered in 2009 in Moscow and Kazan shows that the growing prevalence of unregistered partnerships leads to a decrease in fertility, since cohabiting partners have very limited reproductive intentions (Tikhomirov 2009). Similar conclusion is given in a study based on the statistical information from demographic yearbooks for the Republic of Komi, where the birth rate in unregistered marital unions depends on many factors, first of all, on the traditions existing in society in marriage and family behaviour (Popova 2007). In (Zyryanova 2018), an analysis of the relationship between fertility and socioeconomic determinants in four regions of Siberia finds a positive statistical relationship between the birth rate and the dynamics of average prices in the secondary housing market, which, however, can be interpreted in the opposite direction: an increase in the birth rate could cause an increase in housing prices due to growing demand.

The majority of the mentioned studies are based on econometric analysis, where various demographic and socioeconomic factors act as explanatory variables.

Migration studies

The factor analysis is also common in the field of migration research. One of the representatives of the factor approach is Everett Lee, who proposes a *Push/Pull factor* scheme (Lee 1966). Lee attributed various socioeconomic characteristics of the departure region to push

factors: high levels of structural unemployment and poverty, low wages, large tax burdens among them. The presence of labour demand, high income and generally high level of economic development, as well as unhindered access to the labour market were the main pull factors in the region of arrival. At the same time, the author believed that the pull factors have a greater influence on highly skilled migrants, who might be offered better living conditions in another region. Negative push factors of the region of departure are relevant for people with low skill levels.

Existing studies focusing on separate countries or areas make it possible to identify the most frequent factors influencing migration.

Mulhern and Watson's study (Mulhern and Watson 2009) examines the determinants of internal migration between Spanish provinces in 1999–2006. The findings show the significance of disparities in income, unemployment rates and house prices between provinces.

Napolitano and Bonasia (Napolitano and Bonasia 2010) investigated internal migration in Italy. The authors used dynamic models on panel data from 1985 to 2006, which included the cost of migration (difference in house prices), non-economic determinants of migration, such as the state of the environment, crime rate and population density. As a result, the authors noted the significant impact of differences in income, unemployment rates and housing prices on the intensity of migration flows in Italy.

In Ghatak's paper (Ghatak et al. 2008), the authors study the factors of migration in Poland. The results have shown that GDP per capita, unemployment and distance between regions have a strong impact on regional migration. Human capital is also an important explanatory factor, as is the provision of key public goods such as transport networks. Lack of housing is a factor of the low level of internal migration. In another paper, also on the determinants of migration in Poland (Sarra and Signore 2010), the authors obtained the following results: migrants preferred regions with higher levels of economic development and lower unemployment. Housing provision has also proved to be a significant factor.

Chen and Coulson carried out a study of urban migration in China (Chen and Coulson 2002). The authors used model with fixed effects using migration data for 1995–1999 and concluded that the most significant determinant is the structure of the city's economy. Migrants favour cities dominated by the industrial and service sectors in the economy; factors such as housing market and transport infrastructure indicators (a proxy for quality of life in the city) have not had a significant impact on the intensity of migration flows.

In Russia, the study (Gerber 2000) is considered a breakthrough in the field of empirical research of migration processes. The author compiled a data panel of migration growth in the regions of Russia in the period from 1993 to 1997 and showed that economic factors have a determinant effect on migration, i.e. if the regional economy performance is low, people will seek a new place for living, looking for higher wages and lower unemployment. Since Gerber evaluated a model with random effects that may correlate with regressors, the obtained estimates might be inconsistent (Andrienko and Guriev 2004). In their study, Andrienko and Guriev attempted to eliminate this shortfall by evaluating the model with fixed effects on regional data for 1992–1999. According to the results, people migrate from poorer regions with job shortages and low social benefits to richer and more promising regions with less unemployment and better public goods provision (Andrienko and Guriev 2004). At that, differences in wages themselves are less significant than differences in their purchasing power: the higher the latter, the more attractive the region would be for migrants. The authors of this study come to the traditional conclusion about a negative correlation between

population inflow and unemployment rate in the region, and also point out the need to control for unobservable factors in such studies.

In Gerber's later work (Gerber 2006) the author also uses the data panel of migration dynamics in the regions of Russia, extending the time range to 2002. The results of the previous study were confirmed: estimates show a direct link between migration growth and high earnings and trace an inverse relationship between migration and the level of unemployment. Additionally, the author considers the dynamic effects of these indicators: the increase in wages has a positive effect on the migration balance, while the change in the unemployment rate has no significant impact. In his models, Gerber controls for environmental pollution indicators, the number of employees in the private sector and foreign-capital enterprises, as well as for crime rates, life expectancy of men, number of visits to museums and theatres. Among the shortcomings of the study by Andrienko and Guriev, Gerber notes that only internal migration was taken into account, the analysis of external migration factors was left without attention.

In Aleshkovsky's study (Aleshkovsky 2007), based on estimates of regression equations compiled on a sample of 88 regions in the period from 2000 to 2004, the author identifies the main determinants of the process of migrant inflow, which are: the number of population of the host region and the level of income. Among the factors that affect migration indicators adversely are the high level of poverty in the region, as well as an unsatisfactory environmental situation.

In (Berger et al. 2008), the authors assessed the quality of life in Russian cities and analyzed compensating differences in wages and housing prices. The empirical basis for the study was RLMS data. Using the MLS method, the researchers found a positive correlation of the obtained urban quality of life indices with regional net migration growth rates.

The analysis of interregional migration flows based on Russian data from 1990 to 2006 in the work *Interregional migration: an equilibrium approach* by Oshchepkov showed that regional migration indicators are influenced not only by wages and unemployment rates, but also by their dynamic effects. This study confirms the conclusions of a number of previous works on the impact of differences between regional labour markets, climatic conditions, regional infrastructure indicators on migration flows between regions (cit. by Vakulenko 2013).

In the paper (Vakulenko et al. 2011) the authors evaluated the gravitational model for 73 Russian regions on panel data for 2001–2008. The study shows that socioeconomic factors determine the magnitude of migration flows, primarily at close distances (under 500 km). The significant determinants are the indicators characterizing the labour market (the share of unprofitable enterprises, the ratio of wages in the regions of arrival and departure, the coefficient of tension in the region of arrival) and the housing market parameters (amount of new housing put in use and its affordability).

Thus, the bulk of the work on factor analysis of migration shows the importance of labor market indicators (wages, unemployment rate), as well as the provision of housing. Indicators of health, education, infrastructure, environment in the region, as well as industry specificity are often used as control variables in these studies.

Research on Russian data, however, has a number of disadvantages.

First of all, many studies fail to take into account the change in the methodology of accounting for migrants in 1995 and 2011, as a result of which the obtained estimates might be invalid. Unfortunately, including dummy variables in the model does not always solve this issue.

Another problem is the heterogeneity of Russian regions. The inclusion of control variables assumes that all factors have the same effect on migration in each region, which is unlikely. There are a number of papers in which authors divide regions into clusters according to differences in migration rates; however, specific factors for each of these clusters are not singled out. This predetermines the demand for special demographic studies at regional level.

Finally, most of the mentioned studies are based on regional data. No quantitative studies were found on data from municipalities in individual regions. At the same time, local labor markets and other indicators may have their own specificity, different from the regional one.

In this study, when modeling migration processes in the YaNAO, author attempts to take into account these remarks.

The demographic situation in the Yamalo-Nenets Autonomous Okrug

The formation of the modern population structure of the region took place during the 1970–1980s and was closely associated with the tasks of developing the rich resources of the region’s oil and gas complex. At the beginning of the 21st century, the population of the YaNAO exceeded 0.5 million people for the first time. At present, the demographic situation in the YaNAO is promising compared to other regions of the Russian Federation. The absolute number of the population has been increasing over the past years, primarily due to natural growth (Fig. 1). As of the beginning of 2020, the population of the YaNAO amounted to 544.0 thousand people. Over the past 30 years (compared to the beginning of 1989), it has increased by 46.6 thousand people, or by 9.4%.

The YaNAO is characterized by low population density (0.71 people per 1 square km), high level of urbanization, concentration of population in large cities (40% of the population live in the cities of Novy Urengoy and Noyabrsk, and another share of over 40% in the remaining 6 cities), and by significant transport remoteness of thinly populated settlements, especially in rural areas.

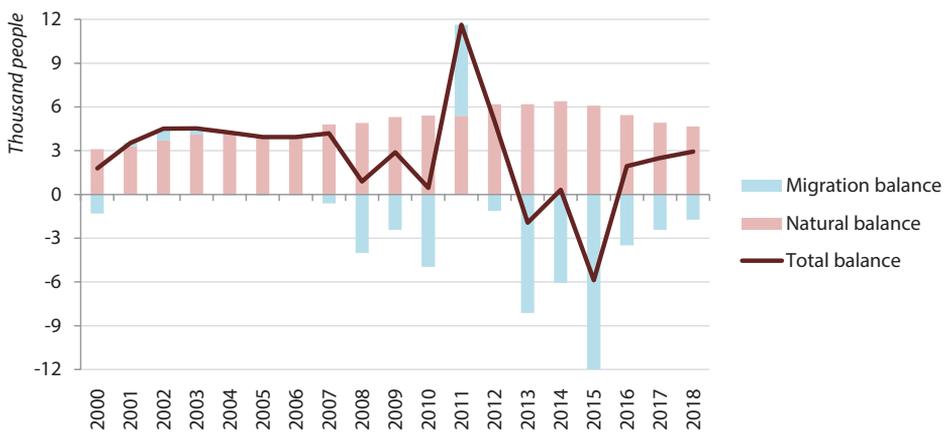


Figure 1. Components of population change of the YaNAO for 2000–2018. *Source:* compiled by the author according to Rosstat data

Generally, the population of Yamal can be divided into three categories:

1. those living in cities (mostly people who have come to work and remain permanent residents for quite a long time);
2. small indigenous nations of the North, mainly engaged in agriculture (they divide into two types — those living in sparsely inhabited territories, keeping nomadic and semi-nomadic lifestyles, and those living in rural areas and cities);
3. population working via shift method (approximately 20% of the labour force), short-term migrants, mainly intending to work in the fuel extraction and energy sector of economy.

Assessment of the demographic situation usually bases on the analysis of three main processes — fertility, mortality, and migration. Taking into account the climatic and socio-economic features of the YaNAO, it can be assumed that mortality rates are significantly distorted by migration. This is because people, having completed their work activities upon reaching a certain age, are most often willing to spend the rest of their days in their historic homeland (the *salmon bias*) or in places with a more favourable climate. This issue requires special study, and therefore here author eliminates mortality from the analysis and focuses on fertility and migration.

Fertility dynamics

In 2018, crude fertility rate in the YaNAO was 13.4‰, which is significantly higher than average Russian level (10.9‰). This is determined by relatively higher age-specific birth rates and a higher proportion of women of active reproductive age in the population of the region.

Total fertility rate (TFR), which more adequately characterizes the fertility dynamics, since its magnitude does not depend on the characteristics of the age structure of the population, also exceeds average estimates for the country. Fig. 2 shows that in 2018 TFR in the YaNAO reached 1.895, while average country indicator levelled at 1.579. Even higher levels of TFR were registered only in the republics of Altai, Buryatia, Tyva and Chechen Republic, in the Sakhalin Oblast, Nenets and Chukotka autonomous regions. In general, TFR in the YaNAO has been exceeding that for Russia as a whole for the past two decades.

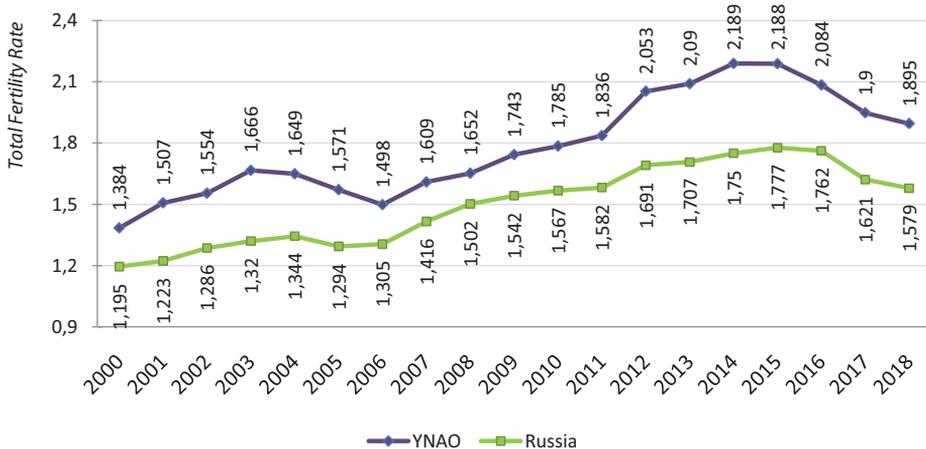


Figure 2. Dynamics of the total fertility rate in the YaNAO and in the Russian Federation in 2000–2018. *Source:* compiled by the author according to Rosstat data

The main features of the fertility in the YaNAO are as follows:

- relatively young age model of fertility;
- higher, compared to the average for Russia, birth rates due to the powerful demographic resource of previous years and favourable age structure of the population;
- a higher proportion of second and subsequent births (since second and subsequent babies are born to women of relatively older ages, this results in a higher average age of the mother at the birth of the child);
- a decrease in the number of women aged 20 to 30 years, and therefore, the number of births would be reduced if conditions remain unchanged.

In the context of decreasing number of women in active reproductive ages, maintaining natural population growth requires an active demographic policy. To develop such a policy, it is necessary to know the factors affecting fertility and promoting the realization of the reproductive potential of the inhabitants of the region.

Migration dynamics

Migration flows are of high importance in the demographic development of the region. Due to the high variability of migration indicators for municipalities, it is rather difficult to trace the trends, which is why the author of this study considers the overall results for the period of 2012–2018. Over this period, natural population growth in all municipalities was positive — against the background of significant migration losses in almost all regions except for the city of Salekhard and the Gubkinsky district; an increase in the total population number occurred in three urban districts — Salekhard, Gubkinsky, and Novy Urengoy.

In other municipalities, the population for the period 2012–2018 decreased due to the excess of negative migration balance over natural population growth. The most significant decrease in population due to migration outflow was observed in the Noyabrsk, Nadymsky, Purov, Tazovsky and Shuryshkar districts.

In general, for the YaNAO the crude inbound migration rate in 2012 was 82‰, and by 2017 this indicator went down to 65‰. In the municipalities of the district, there is a significant differentiation in the numbers of arrivals per 1,000 population. The highest indicators are noted in the cities of Gubkinsky (100–140‰) and Novy Urengoy (87–130‰). The lowest inbound migration rates were registered in the Yamalsky and Priuralsky districts, in Noyabrsk and Labytnangi (32–50‰, Fig. 3).

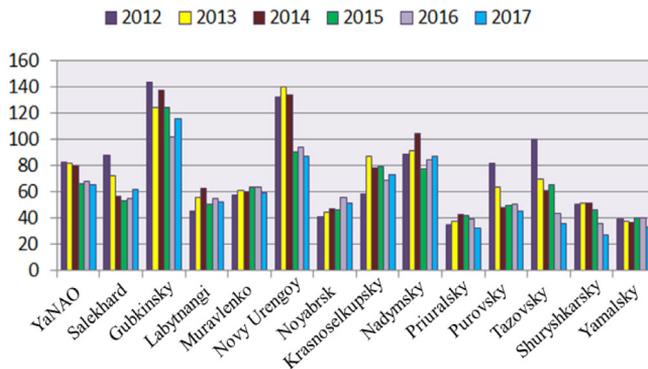


Figure 3. Inbound migration rates in YNAO by municipalities, 2012–2017, ‰. *Source:* compiled by the author according to Rosstat data

The outbound migration rate per 1,000 population for the entire period (2012–2017) outnumbered the inbound and mounted up to 75–97‰. The largest values of these coefficients were noted in Gubkinsky, Novy Urengoy, and Nadymy district — 80–140‰ (Fig. 4).

In 2012–2017, the YANAO as a whole had a negative migration balance. Particularly significant migration losses occurred in 2013–2015 — rates of depopulation due to migration losses were 11–22‰. Negative migration balances were typical for most municipalities.

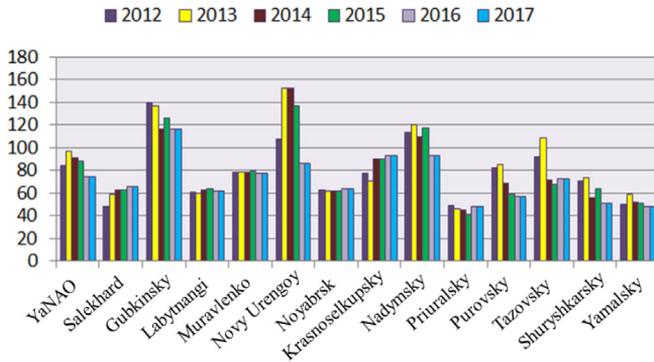


Figure 4. Outbound migration rates in YNAO by municipalities, 2012–2017, ‰. *Source:* compiled by the author according to Rosstat data

The main features of the migration processes in the YaNAO are as follows:

- absolute indicators largely depend on the rules and practices of registration of migrants, and these have changed several times in recent years;
- statistics shows increased intensity of migration flows in both directions;
- most municipalities are characterized by a migration decline in the population;
- outbound migrants mainly head to other regions within the Russian Federation;
- migration exchange with most CIS member States has positive balance;
- the main motives of the inbound migrants in the YaNAO are personal issues, family circumstances, and job search;
- employment in the YaNAO is attractive primarily for migrant workers from neighbouring countries.

Taking into account the existing migration processes, it can be assumed that the migration balance at the YaNAO will remain at the level of recent years, i.e. negative (minus 3–7‰). At the same time, in conditions of labour shortage the region is likely to be forced to attract population from other regions and CIS countries. The shortage of local skilled personnel for the growing challenges of economic development of the region increases the region's dependence on the influx of highly skilled migrants and shift workers. Migration outflows can be reduced only if there is a favourable situation in the socioeconomic sphere and changes in the sphere of migration policy.

Methodology of construction of the econometric model and calculations

Within this study, author builds models of fertility and migration for the municipalities of the YaNAO. The author evaluates three regression equations based on municipal statis-

tics, in which age-specific fertility rate for women aged 15–49 (1), inbound migration rate (2) and outbound migration rate (3) act as dependent variables. A set of socio-economic characteristics of the territory is included in the list of explanatory variables, and its description is given in Table 1. The econometric specification of the model is as follows:

$$K_{i,t} = \sum_{n \in N} \beta_n X_{n,i,t-1} + \gamma_t + \varepsilon_{i,t}, \quad (1)$$

where $K_{i,t}$ is age-specific fertility rate for women aged 15–49 in municipality i in period t in the first model, inbound migration rate — in the second, outbound migration rate — in the third model respectively; $X_{n,i,t-1}$ is explanatory variables describing the peculiarities of socio-economic development of the municipality i during period $t-1$; β_n is the vector of estimated coefficients for the explanatory variables; γ_t are dummy variables for time periods taking into account the time effect; $\varepsilon_{i,t}$ are autocorrelated residuals (as an assumption, correlation between residuals in observations relating to municipality i is possible).

Author makes an attempt to eliminate endogeneity in equation (1) by including explanatory variables with a lag, that is, separating regressors and the dependent variable in time. A similar method is used in other studies (Guriev and Andrienko 2006; Vakulenko 2013). Endogeneity arises from the existence of uncertainty of causal relationships between the dependent variable and the regressors, as a result, we might face correlation of explanatory variables with random errors.

Table 1. List of variables selected by the author for constructing regressions

Designation in models	Unit of measurement	Indicator
<i>SpFR</i>	promille	Age-specific fertility rate
<i>MarriageRate</i>	promille	Crude marriage rate
<i>DivorceRate</i>	promille	Crude divorce rate
<i>Wage</i>	rubles	Average monthly salary of employees of organizations
<i>Education</i>	percent	Percentage of children aged 1–6 years receiving pre-school educational services and/or accommodation services in municipal educational institutions in the total number of children aged 1–6
<i>ShareWomenActive</i>	percent	Proportion of women in active reproductive age (25–34 years) in the total number of women of reproductive age (15–49 years).
<i>VvedenoZhilya</i>	square meter	Total amount of the newly introduced housing stock in the municipality
<i>SquarePP</i>	square meter	Total amount of housing, average per resident
<i>FamReceived</i>	percent	Proportion of families who have received accommodation and improved housing conditions during the year among those who are registered for receiving housing
<i>ImmigrationRate</i>	promille	Number of inbound migrants per 1,000 population

Designation in models	Unit of measurement	Indicator
<i>EmigrationRate</i>	promille	Number of outbound migrants per 1,000 population
<i>WorkersExtraction</i>	percent	Percentage of those employed under section C “Mining” in the average number of employees of organizations
<i>WorkersBuilding</i>	percent	Percentage of those employed under section F “Construction” in the average number of employees of organizations
<i>WorkersTransport</i>	percent	Percentage of those employed under section I “Transport and communications” in the average number of employees of organizations
<i>EmploymentRate</i>	percent	Employment rate among the working-age population

Source: compiled by the author

Total fertility rate is a more accurate indicator of fertility if compared to crude rate. However, to calculate it, we have to know the age-specific birth rates for all age groups of women in reproductive ages. Due to the scarcity of such data, the age-specific fertility rate for women aged 15–49 has been calculated as a dependent variable (*SpfR*), which displays the number of births per 1,000 women of reproductive age. The main drawback of this coefficient is that its value depends on the age structure of women in this group. To prevent biased results, we shall introduce the control variable *ShareWomenActive* — the proportion of women in active reproductive age (25–34 years) in the total number of women of reproductive age (15–49 years).

Author assumes that demographic parameters are always important for reproductive intentions, and therefore includes a marriage rate (*MarriageRate*) and a divorce rate (*DivorceRate*) in the model.

The provision of housing is measured by the variable *SquarePP* — the total area of housing in the municipality per one inhabitant. Also, the situation on the housing market is reflected by the variable *VveDenoZhilya*, which indicates the total area of residential housing put into use in the municipality (in square meters). Finally, the model includes an indicator showing the situation in the region with social assistance in housing and housing conditions issues — the proportion of families who received accommodation and improved housing conditions in the reporting year among those registered in the housing program (*FamReceived*).

To assess the availability of places in childcare facilities, the *Education* variable is used — the gross pre-school enrolment rate, as a percentage of the number of children aged 1–6. The disadvantage of this ratio is that it does not show real demand for pre-school services.

The average monthly salary of employees (*Wage*) is used to estimate the income level, but due to lack of data, social benefits and other income which could affect the fertility situation are not taken into account. This indicator can be falsely overestimated since it takes into account the salaries of employees coming to work in shifts.

To determine the factors affecting the intensity of migration flows, author uses independent variables *ImmigrationRate* — arrivals per 1,000 population and *EmigrationRate* — number of departures per 1,000 population.

In addition to the average monthly wages, author accounts for the structure of the economy of each municipality. For this purpose, the shares of those employed in the main sectors for the YaNAO, such as mining — *WorkersExtraction*, construction — *WorkersBuilding*, transport and communications — *WorkersTransport* were calculated (the ratio of the employees in the sector to the average number of employees in the municipality).

The employment ratio of the working-age population — *EmploymentRate* — is calculated as a proxy for the level of employment; it is estimated as the ratio of the average number of employees to the number of working-age population. Its disadvantage is that it overestimates the real level of the employed population in the economy, since the average number of employees includes working teenagers and pensioners who are not counted in the working-age population.

The models are estimated basing on statistics from the Database of indicators of municipal formations for 13 municipalities of YaNAO for 2011–2017. Data for later periods in the database for some variables are not available, which justifies the selected time period. Statistics characterizing dependent variables cover the period 2012–2017, and regressors cover 2011–2016. In connection with Rosstat’s transition to a new methodology for statistical accounting of migrants, author considers the period from 2012 to 2017 in order to avoid incomparability.

The descriptive statistics of dependent variables are presented in Table 2. On average, for the municipalities under consideration, age-specific fertility rate was 63.17‰ in 2012–2017. The minimum and maximum values of this coefficient were observed in the city of Gubkinsky (43.19‰ in 2016) and the Priuralsky municipality (102.29‰ in 2014). Average inbound migration rate was 66.69‰. The minimum (27.61‰) was recorded in Shuryshkarsky municipality in 2016; the maximum value (143.81‰) — in the city of Gubkinsky in 2011. The average outbound migration rate was 76.81‰. The minimum value (41.58‰) was recorded in the Priuralsky municipality in 2014, the maximum (153.13‰) was observed in the city of Novy Urengoy in 2012.

Three regression models were evaluated by a combined sample via the method of least squares (MLS, pooled regression), which does not take into account the individual effects of municipalities, since we assume that in the municipalities of the YaNAO, the influence of missed or unobserved variables that characterize their individual characteristics is random. A logarithmic model specification is used for simpler interpretation of coefficients. The results are presented in Table 3.

The results of the first regression have shown significance of demographic parameters for reproductive behaviour. Thus, an increase in divorce rate by 1% reduces age-specific fertility rate by 0.35%. At the same time, the estimate of the coefficient for the marriage rate is statistically significant only at the 10% level, which can be explained by the decline in the value of the institution of registered marriage and greater tolerance for unregistered partnerships.

Table 2. Descriptive statistics of dependent variables

	Average	Minimum	Maximum
Age-specific fertility rate (‰)	63.17	43.19 (city of Gubkinskiy, 2016)	102.29 (Priuralsky municipality, 2014)
Inbound migration rate (‰)	66.69	27.61 (Shuryshkarsky municipality, 2016)	143.81 (city of Gubkinskiy, 2011)
Outbound migration rate (‰)	76.81	41.58 (Priuralsky municipality, 2014)	153.13 (city of Novy Urengoy, 2012)

Source: compiled by the author on the basis of [Database of indicators of municipalities].

Table 3. Regressions estimates (robust standard errors are given under coefficients in parentheses)

Variables	Dependent variable					
	I_SpFR Age-specific fertility rate		I_ImmigrationRate Inbound migration rate		I_EmigrationRate Outbound migration rate	
Const	12.53 (2.41)	***	-12.78 (3.81)	***	0.47 (4.37)	
I_Education	-0.30 (0.13)	**	-	-	-	-
I_VvedenoZhilya	0.04 (0.03)		-	-	-	-
I_SquarePP	-	-	0.30 (0.31)		0.24 (0.25)	
I_FamReceived	-0.08 (0.03)	*	-	-	-	-
I_MarriageRate	0.31 (0.15)	*	-	-	0.94 (0.32)	**
I_DivorceRate	-0.35 (0.11)	***	-	-	-0.52 (0.33)	
I_Wage	-0.61 (0.19)	***	1.66 (0.39)	***	0.21 (0.42)	
I_EmploymentRate	0.14 (0.05)	**	-0.42 (0.21)	*	-0.15 (0.14)	
WorkersExtraction	-	-	0.78 (0.54)		1.60 (0.64)	**
WorkersBuilding	-	-	0.89 (0.74)		0.13 (0.51)	
WorkersTransport	-	-	-0.98 (1.08)		0.83 (0.93)	
time effects	Yes		Yes		Yes	
R ²	R-squared	0.749	R-squared	0.566	R-squared	0.638
	Adjusted R-squared	0.698	Adjusted R-squared	0.494	Adjusted R-squared	0.565
	R-squared		R-squared		R-squared	
Number of observations	78		78		78	

asterisks to the right of the coefficients mark the significance of the estimates:

*** p-value < 0,01; **p-value < 0,5; * p-value < 0,1

Source: author's calculations

The first model reveals statistically significant relationship between average monthly wages in municipality and fertility. At the same time, the negative coefficient indicates that the decline in fertility is associated with higher incomes of the population. In particular, the

value of a high income for a woman may be greater than having a child, as the price of her time increases.

Among the significant explanatory variables are those that describe the situation in the housing market: with a 1% increase in the share of families who received housing among those registered in the program, age-specific fertility rate potentially decreases by 0.08%. A similar effect was also found in (Korel I. and Korel L. 1999). The authors suggested that the occurrence of such an effect is due to the fact that for each municipality its own standards for registering families are possible, which forms queues of different lengths. Among the criteria required for registration, there may be different indicators of housing provision. In this case, with relatively small amounts of housing input per capita in the municipality, which is typical for the northern regions, the queue for those in need of housing and improvement of housing conditions will move more slowly. According to this logic, the less favourable the situation in the housing market in the municipal entity, the more time the population will be queuing for housing, hence the inverse correlation between the proportion of families who received housing among the needy and fertility. Also, this result can be explained in general by the small proportion of families who have received housing among those in need (this indicator on average fluctuated at 10% in different municipalities). In general, the negative ratio obtained may also indicate that there are other criteria for granting housing to the needy, other than those related to the presence of children.

The variable characterizing an amount of housing put in use, based on the obtained estimates, does not affect age-specific birth rate, which contradicts the hypothesis of the study. In some intermediate versions of the model, author tested variable *average housing area per one inhabitant*, which also turned out to be statistically insignificant. This result gives grounds to assume that the housing policy in the period under study was fairly unsuccessful and did not affect the decision to have children.

Share of the employed was found to be positively associated with the birth rate. Unfortunately, based on the proposed model specification, it is impossible to estimate whether an increase in the share of employed women or men may have a positive effect on fertility.

The link between the indicator of preschool enrolment and fertility is quite controversial. With a 1% increase in preschool services enrolment, age-specific fertility rate decreases by 0.3%. Similar results are found in other studies: in the work (Rosen 2004) authors obtain a similar result on data for Finland and Norway, which are close to the YaNAO in terms of climatic parameters. Anderson et al. (Anderson et al. 2004) found that in Sweden women living in municipalities with low childcare enrolment were more likely to have subsequent children because women tend to accelerate the birth of a second child in order to minimize the total length of interruptions in employment. As noted above, in case of this study, the explanatory variable itself has its disadvantages: it does not reflect the real demand for preschool services (high fertility rates are typical of municipalities with high proportion of rural population, which has low demand for services of this kind). In general, in order to obtain more realistic estimates, it is necessary to include the rate of enrolment with greater lag in the regression, since on average 3–4 years pass between the decision to give birth and the child's attendance at preschool facility. Due to the small number of observations and the lack of necessary data, it could not be taken into account in this study. Also, for more profound analysis, it is necessary to introduce two groups of children enrolled at preschool institutions into the model (aged 1–2 years and 3–6 years), since the interpretation of the behaviour of parents with children under 3 years of age should be different in the conditions of a three-year long parental leave. Unfortunately, author does not have necessary data.

The second model revealed statistical relationship between the dependent variable and the average monthly wages. This supports the thesis that it is the high level of wages in the region that is the most attractive factor for migrants. Another significant variable is the proportion of employed in the total working-age population. Due to the fact that the YaNAO has relatively low unemployment rates compared to the average for Russia, municipalities with lower employment rates may be more attractive to migrants (this assumption is based on the analysis of migration modelling). The per capita housing variable is not statistically related to the number of arrivals, which contradicts the hypothesis of the study. Some intermediate versions of the model also included the variable characterizing the number of residential houses put in use, and it also turned out to be statistically insignificant. It can be assumed that the incoming population prefers to buy housing outside the region, probably, in their historical homeland. According to the regression results, the structure of municipal economy also is not statistically related to the number of arrivals.

In the third model we find marriage rates among the statistically significant variables. This may suggest that with high rates of marriage in municipalities, a person's chances of marriage are diminishing, which may prompt them to move. On the other hand, a reverse dependence here is quite likely, when the marriage itself can induce the spouses to change their place of residence. It is worth noting that one of the limitations of these indicators is the peculiarities of collecting statistics for their calculation: statistics on marriages are collected at the place of registration of the marriage itself, and not at the place of residence of the spouses, therefore in some cases there may be discrepancies in this aspect.

Another significant variable was the one that reflected the share of those employed in mining: the highest number of departures is typical of municipalities with a high proportion of those employed in this industry. One of the possible explanations may be high and specific qualification requirements for workers in the industry, in connection with which the local population, which does not have the necessary skills, is forced to migrate to look for work even in the conditions of formal availability of open vacancies in the place of residence. The increase in wages may also indicate an increase in labor requirements, which the local population often does not meet, but this variable was not significant. Also, among the statistically insignificant variables were the average area of per capita residential housing and the share of those employed in construction, transport and communications. The insignificance of the variable reflecting the situation in the housing market can be explained by the fact that in this region this issue is not so acute due to the low density of the living population and its very high mobility.

Conclusion

The study revealed the presence of a statistical relationship between age-specific fertility rate and such indicators as the marriage and divorce rates, the level of wages, the share of employed in the working-age population, the coverage of children with preschool education, as well as the share of families who received housing or improved housing conditions among those registered within housing program. The inbound migration rate turned out to be statistically related to the level of wages and the share of employed in the total working-age population, and the outbound migration rate — to the share of those employed in the mining sector, as well as indicators characterizing the situation in the marriage market.

These results must be taken into account when adjusting the existing and developing new measures of regional demographic policy.

Among the limitations of this study, the following points can be noted:

- some variables can gain both underestimated and overestimated coefficients due to their shortcomings associated with the peculiarities of collection and availability of municipal statistics;
- working with the data of municipal statistics without reference to specific individuals, the author is deprived of the opportunity to investigate the directions of causal relationships, and therefore there is a variability in the interpretation of the obtained results;
- the estimates of the coefficients obtained in the work may be biased due to the small number of observations, and therefore their values must be interpreted with caution;
- official statistics do not keep records of migrants working in shifts; in this regard, the estimates obtained can also distort the real situation in relation to the entire contingent of migrants.

Despite this, the results of the study are of practical and scientific interest. The research hypotheses that have not been confirmed, although intuitively clear, deserve attention. Thus, in all three models considered in the study, the indicators characterizing the housing market turned out to be statistically insignificant. This result may indicate limited effectiveness of the housing policy in the period under review. It can also be interpreted as the lack of interest of the local population in the regional housing policy when buying housing, its insignificance when deciding whether to come or leave, since people prefer to buy housing outside the region. These questions should be the subject of more detailed research.

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