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« Demographic determinants of the economic dynamics of Russia »

Projet de thèse

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Introduction

Population is a primary resource of any nation. Therefore, all changes that it undergoes produce a significant influence on the country's economy. The value of population as a basic resource becomes especially evident under conditions of an economic crisis and a decrease in energy prices.

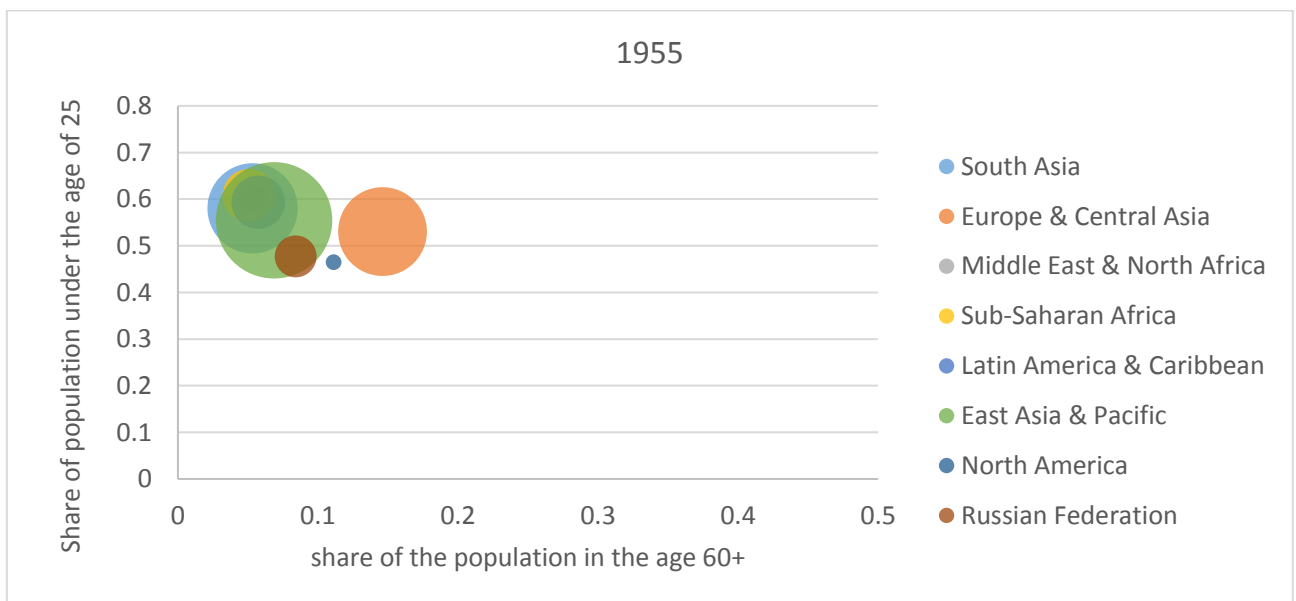
Despite many contradictory studies, it was a generally accepted point of view for a number of years that a change in the size of the population does not influence per capita income. The view of this problem has recently changed. An opinion has recently arisen that the welfare of a population is influenced by its age composition. Representatives of the youngest age groups are mostly consumers while people of active working age are the primary productive force and the elderly population occupies an intermediate position between the first and second groups. Consequently, a large number of people of active working age in a population contributes to an increase in the speed of economic development. For example, in the opinion of Bloom and Williamson [10], the economic miracle of South-East Asia is closely related to the demographic shift that took place there. On the other hand, the lack of significant demographic changes in Africa is also one of the reasons for the economic lag of this region [8].

The Problem

Now let me formulate the problem. At the current stage there are very few attempts to build a model that describes the connection between population structure and the economic performance of the country. Moreover there are no reliable researches, which concern Russian economy. Exclusion of such an important factors can mislead decision-makers in Russia, especially taking into account current demographic trends (see Problem Context).

Problem Context

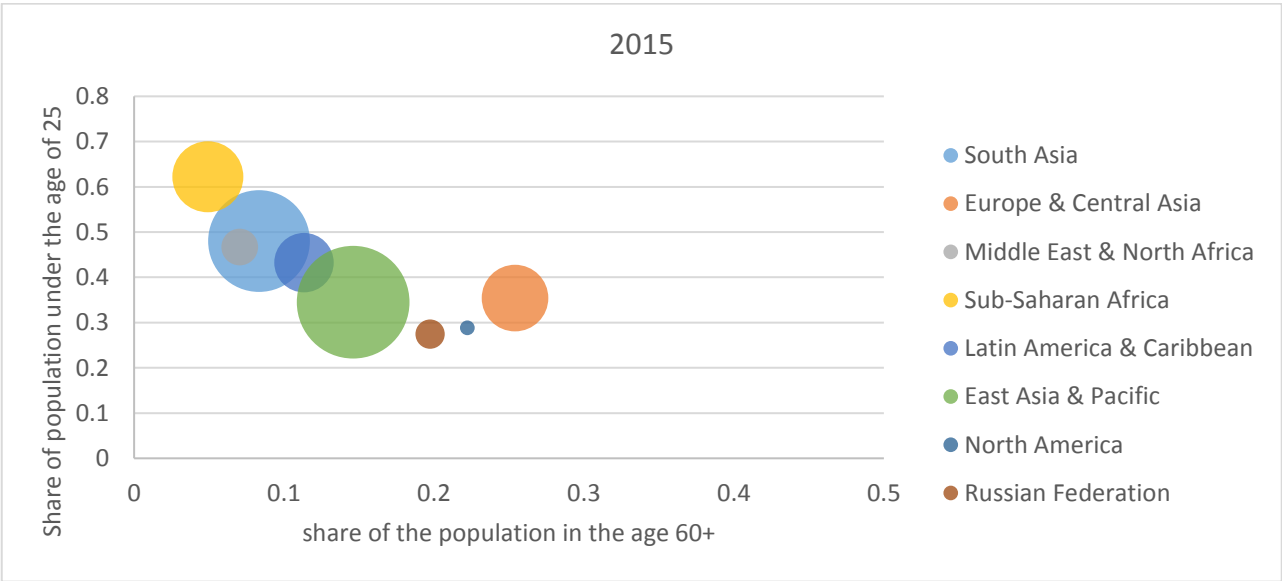
If you review the changes in the composition of the world population for the past 60 years and analyze UN forecasts, you can see noticeable shifts in the sizes of age groups starting as early as 1955. Let us look at graph 1. The share of the population under 25 years of age is marked on the vertical axis, the share of the population older than 60 years is marked on the horizontal axis while the size of the bubble reflects the total population of the region. You can see that over half of the population was younger than 25 years and the share of the population older than 60 years did not exceed 15%. The prevalence of young population is one of the main features of all the world's regions. As early as 1955, however, we can see two regions that stand out from the others – North America and Europe. A distinguishing feature of these regions is their relatively high level of economic development so we can assume that these regions are at one of the final stages of the demographic transition according to the concept introduced by Frank Notestein.



Graph 1. Age structure of the world population in 1955

Source: author's calculations based on UN data (<http://data.un.org/>)

The situation had changed by 2015: the share of the young population started to continuously decline and the share of the elderly population began to grow. This effect is especially noticeable in European countries in which the share of population younger than 25 years has decreased by around 10% and the share of elderly people has grown by the same amount. The demographic situation in the world is becoming more differentiated. Different regions of the world are at different stages of the demographic transition. This change is primarily related to the improvement of living conditions, development of medicine and, as a result, an increase in average lifespan. The only region in which we do not observe a considerable change in age composition is Africa. The low level of the region's economic development may be a possible consequence of this phenomenon. Hence, according to the World Bank the average GDP per capita in Africa was 3,700 US dollars while it was 39,629 US dollars for the EU countries and 23,162 US dollars for Russia.



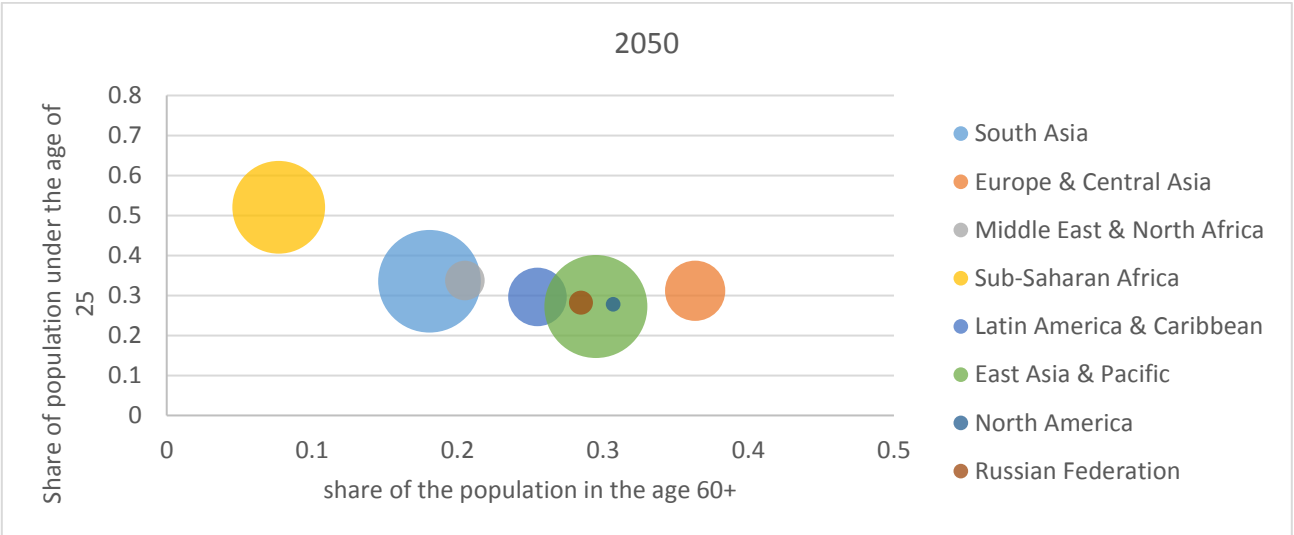
Graph 2. Age structure of the world population in 2015.

Source: author's calculations based on UN data (<http://data.un.org/>)

In accordance with the UN forecast, this trend will continue in the 2050s and 2100s. Europe is still one of the leaders in the share of the population older than 60 years. However, the countries of South Asia, East Asia and the Pacific region along

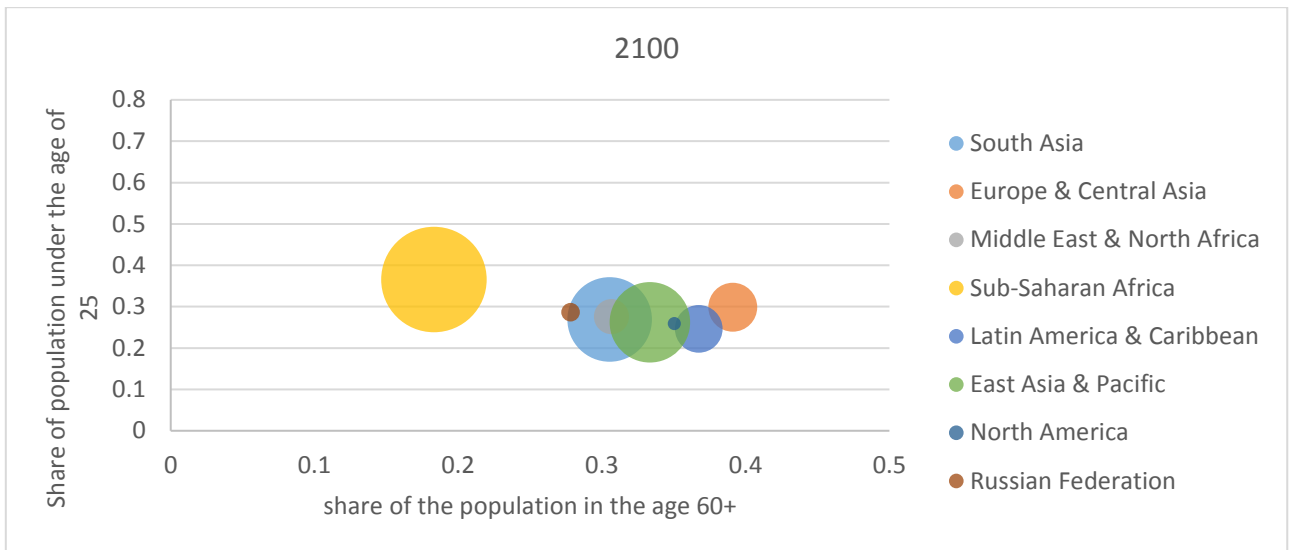
with Latin America will approach European countries in this parameter – the fractions of the population younger than 25 and older than 60 will become equal and will reach 30%.

According to the UN forecast, the population will continue to age worldwide. By 2100, however, the countries of South Asia and Latin America will overtake Russia in terms of the size of the elderly population. This is accounted for by the fact that according to the UN forecast, the birth rate in the countries of South Asia and Latin America for the period under consideration will grow at a slower rate than in Russia. Therefore, the Russian Federation will become a country with a relatively young population.



Graph 3. Age structure of the world population in 2050.

Source: author's calculations based on UN data (<http://data.un.org/>)

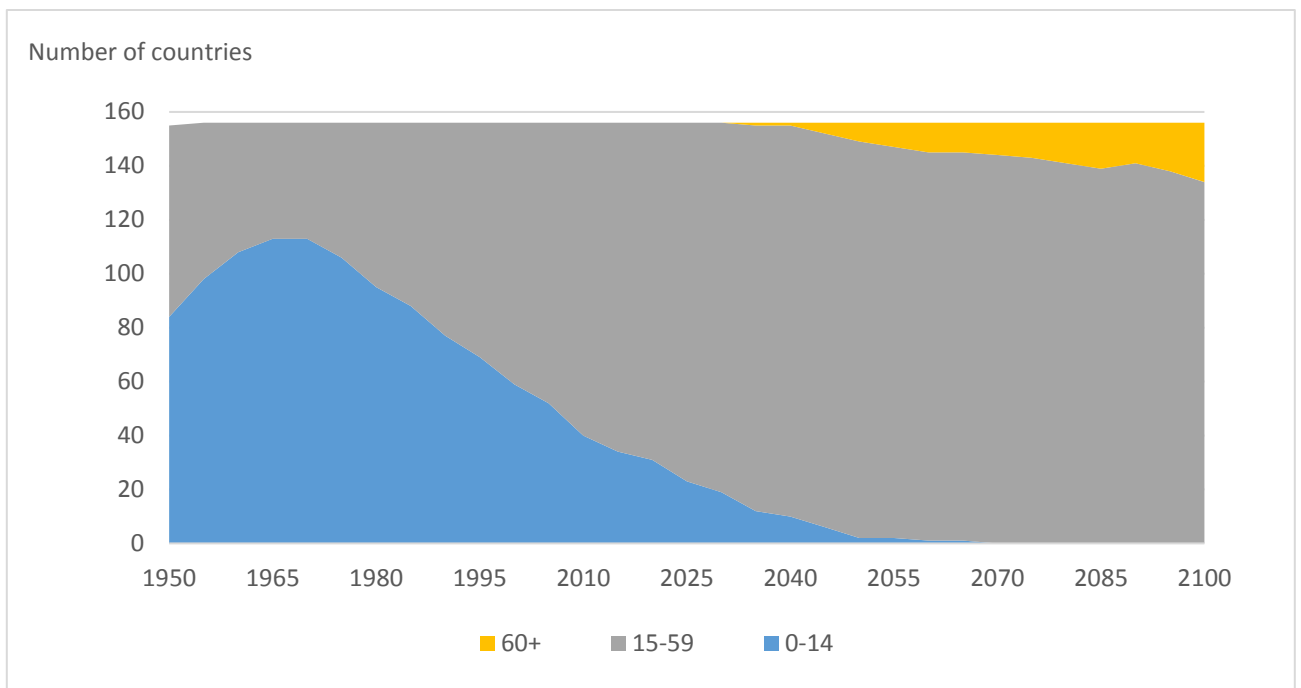


Graph 4. Age structure of the world population in 2100.

Source: author's calculations based on UN data (<http://data.un.org/>)

We can see that according to the UN data, the size of Russia's population will decrease by 15% and will be about 120 million people and by 2100 the country's population will decrease by another 13% and will approach 101 million people. The share of the population older than 60 years will grow by approximately 10% with an unchanged fraction of young population (0.3).

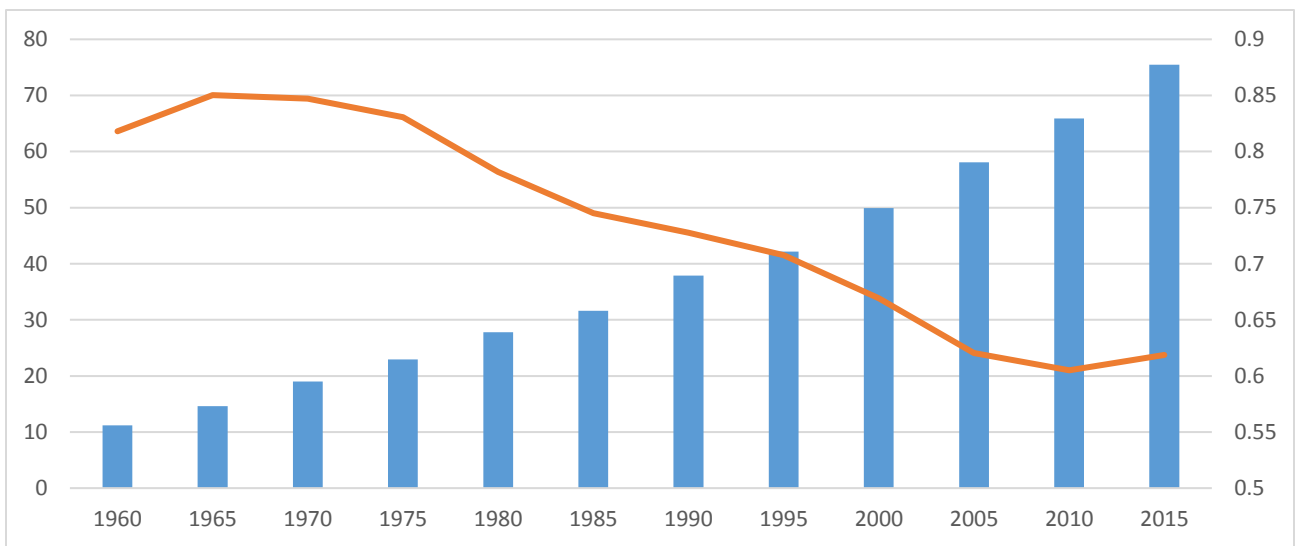
In graph 5 you can see the distribution of countries by the size of population age groups. On the vertical axis is shown the number of countries in which one of the following age groups predominates: 0-14, 15-59 or 60+.



Graph 5. Change in the age structure of the world's population from 1950-2100.

Source: author's calculations based on UN data (<http://data.un.org/>)

In graph 5 you can see that the population age composition has significantly changed over the last 65 years. In 1950 the population group younger than 14 years was predominant in terms of size while now the largest group in almost all countries is the population group of active working age (15-59 years). In accordance with the UN forecast, the population group older than 60 years will become the largest as early as 2100. Such changes in population composition can also have specific economic consequences. In particular, a reduction of the demographic load ratio is to be expected which may lead to an increase in disposable income. As we see in graph 6, the demographic load ratio has been continuously declining for the past 50 years and stabilized at a level of 0.6 only in 2010 while the GDP has exhibited the opposite trend.



Graph 6. Dynamics of changes in GDP in US dollars at the rate of 2010 and the demographic load ratio. The aggregate data for all countries of the world.

Source: author's calculations based on UN data (<http://data.un.org/>)

We see continuous GDP growth which is explained by inflation, an increase in labor productivity due to technological development and institutional factors. However, in our opinion, part of the economic growth could be attributed to the decrease in demographic load. The demographic load ratio is the ratio between the number of children (0-14 years) and elderly people (60+) relative to the working age population (15-60). Therefore, as the number of potential workers per potential dependent increases, so does the probability of an increase in labor productivity and population living standards overall. This hypothesis requires verification so we made an attempt to econometrically verify the existence of an influence of population age structure on the rate of economic growth.

Object of the Research

According to the previous part of this paper, the data tells us that there are some huge demographic trends connected with people ageing. Moreover, there are some interesting signs, that Economic performance is not fully interpreted by currently applied economic factors, such as technical progress, macroeconomic shocks, inflation, labor efficiency and human capital investments. We do believe there is a space for demographic determinants of economic success. Our hypothesis is that population structure of the country affects its economic performance. Thus we are going to prove this connection for such a purpose we want to count the hidden GDP.

Approaches Review

In this section we will conduct an econometric verification of the model of A. Mason and R. Lee [23] on the assessment of the first demographic dividend.

This model analyzes a closed economy, in which all income is distributed between investments and consumption, and the investments are proportional to the GDP:

$$C = (1 - s)Y \quad (1)$$

C is consumption, s is the normal level of savings and Y is the GDP. The use of the per capita values enables us to review the influence of a change in population age structure on per capita consumption:

$$\frac{C}{N} = (1 - s) \frac{Y}{L} \frac{L}{N} \quad (2)$$

where L is the number of working age people, N is the total size of the population.

If we take logarithms of the right and left sides of equation (2), we get the following:

$$\ln\left(\frac{C}{N}\right) = \ln(1 - s) + \ln\left(\frac{Y}{L}\right) + \ln\left(\frac{L}{N}\right) \quad (3)$$

According to equation (3), given constant levels of interest rates and labor productivity, the growth of per capita consumption is caused by the increase in the share of the working age population in the total population.

This model (3) was verified on the basis of data for 102 countries over the past 10 years. Using panel data structure we obtained the results presented in table 1.

<u>Dependent variable</u> $Ln\left(\frac{C}{N}\right)$	<u>Model 1: Pooled</u> <u>MLS</u>	<u>Model 2: Fixed</u> <u>Effects</u>	<u>Model 3:</u> <u>Random Effects</u>
const	0,132*** (0,023)	0,312** (0,151)	0,198 (0,192)
$Ln\left(\frac{Y}{L}\right)$	0,911*** (0,002)	0,956*** (0,013)	0,946*** (0,013)
$Ln(1 - s)$	-0,266*** (0,064)	0,065 (0,089)	0,0548 (0,194)
$Ln\left(\frac{L}{N}\right)$	0,488*** (0,015)	1,180*** (0,110)	0,924*** (0,126)
Test for the difference of constants in groups	-	1,275e-224	-
Breusch-Pagan test	-	-	0
Hausman test	-	-	9,363e-007
Number of observations	1020	1020	1020

Table 1. Results of model verification

Source: author's calculations

The test results show that a model with fixed effects was the best which is in line with the theory of panel data analysis in the case of country-specific data. Almost all of the validations proved to be significant at a level of 1%. The positive influence of the growth of labor productivity on the rate of per capita consumption growth was an expected outcome. It should be noted that the variable of interest to us, i.e. the rate of

growth of the working age population share, produces a significant positive influence on the rate of growth of per capita consumption which confirms that there is a connection between population age composition and economic growth rate.

The sample of countries analyzed is not homogenous. The countries differ in geographic location, level of economic development as well as population age composition. In order to verify how significant the difference is between countries with a predominantly elderly or young population, we divided the countries into two groups: countries in which the share of the elderly (older than 65 years) for the past year was over 12% and other countries in which the population was predominantly young. To check for the presence of structural differences between the data for the two groups, we performed a Chow test whose results are presented below.

The Chow test for structural changes at the 36:10 point

X-square (4) = 325,1 p-value 0,0000

F-statistics: $F(4, 1010) = 81,275$ p-value 0,0000

According to the results of the Chow test, there is a structural change present in the sample, i.e. the sample is not homogenous. The boundary between the countries with a predominantly young population and the countries with a predominantly old population was selected as the point of change, which confirms the hypothesis that population age composition has a significant effect on a country's economic dynamics.

In order to check the consistency of the obtained results, we broke down the initial sample by two characteristics: territorial ownership and economic development level.

<u>Dependent variable</u> $Ln\left(\frac{C}{N}\right)$	<u>East Asia and the Pacific</u>	<u>Europe and Central Asia</u>	<u>Latin America and the Caribbean</u>	<u>Middle East and North Africa</u>	<u>South Asia and sub-Saharan Africa</u>
const	0,493 (0,325)	0,322 (0,197)	0,542** (0,218)	0,499 (0,386)	0,912*** (0,238)
$Ln\left(\frac{Y}{L}\right)$	0,903*** (0,017)	1,00*** (0,017)	0,944*** (0,017)	0,918*** (0,031)	0,933*** (0,026)
$Ln(1 - s)$	1,600*** (0,368)	-0,384* (0,221)	-0,029 (0,137)	1,672*** (0,449)	0,079 (0,117)
$Ln\left(\frac{L}{N}\right)$	0,846*** (0,265)	1,719*** (0,181)	1,290*** (0,090)	1,047*** (0,182)	1,565*** (0,154)
Test for the difference of constants in groups	5,272 e-042	4,988 e-039	6,400 e-051	1,600 e-022	2,121 e-045
Number of observations	170	200	250	110	290

Table 2. Results of model verification according to data by region

Source: author's calculations

<u>Dependent variable</u> $Ln\left(\frac{C}{N}\right)$	<u>Developed</u>	<u>Developing</u>
const	-0,376 (0,243)	0,324** (0,159)
$Ln\left(\frac{Y}{L}\right)$	0,974*** (0,012)	0,956*** (0,014)
$Ln(1 - s)$	-0,388* (0,203)	0,069 (0,091)
$Ln\left(\frac{L}{N}\right)$	0,496** (0,219)	1,195*** (0,112)
Test for the difference of constants in groups	2,377 e-067	1,227 e-194
Number of observations	100	920

Table 3. Results of verification of the model in terms of the level of economic development of the country

Source: author's calculations

As you can see from tables 2 and 3, the result that we obtained, i.e. the significant influence of the rate of growth of the working age population on the rate of growth of per capita consumption, is consistent even when the sample is changed with respect to territorial ownership and economic development level. However, it is worthwhile to point out that this model has a number of deficiencies. In order to perform a more accurate assessment, control variables, e.g. the quality of institutions, need to be used. This deficiency was partially compensated for by a consistency check of the results, however, this is not enough. Another deficiency of the model may be the selection of an information source. As was pointed out at the Lomonosov 2017 conference, there

have been cases when the data presented on the UN website did not correspond with the data provided by the national statistical agencies of various countries. However, the reason for making this choice was that we tried to ensure data comparability for all the countries in the sample.

The econometric assessment of the influence of demographic parameters on economic dynamics appears to be one of the most convenient ways for verifying the assumption of the presence of a significant connection between countries' demographic and economic characteristics. J. Gribble and J. Bremner's [18] study demonstrated that along with demographic parameters, another precondition for the Asian economic miracle was the social policy pursued in these countries. Using the methods of panel data analysis, David Bloom and David Canning [7] demonstrated that life expectancy, economic transparency, population homogeneity and high quality institutions have a positive influence on the rate of economic development. The construction of a model that describes reality with maximum precision will enable us not only to reveal the presence of a connection between the values but also determine the nature of this connection and make a quantitative assessment. However, it is virtually impossible to take into consideration all of the parameters that can influence the nature of this connection. The National Transfer Accounts (NTA) project founded by Lee and Mason offered an alternative way of assessing the influence of demographic parameters on the economies of countries. It developed a unique methodology for calculating a single household's contribution to the formation of macroeconomic parameters. The NTA makes it possible to assess how much individuals produce, consume, and redistribute in the form of transfers as well as how much they retain as savings.

The data collected within the framework of the NTA project allowed A. Prskawetz, J. Sambt et.al. [25] to calculate a number of ratios that had not been used previously but made it possible to study the influence of the aging of the population on a country's economic dynamics. The NTA separates the data collected on households

from data on individuals. There are two methods for transitioning to data on individuals: regression (a regression is done for distributing households' expenses among various age groups) and Deaton's equivalent outlay method. In his method, Deaton proposed a ratio of 0.4 for children under the age of 4, 0.4-1 for children of 4 to 20 years, and over 1 for adults.

In this article, A. Prskawetz and J. Sambt attempted to analyze the distribution of resources on the basis of the NTA data. A special feature of their study was the introduction of the economic characteristics of each age group (by years) which made it possible to take into consideration the differences in the countries' economic cycles. Moreover, economically active and passive population groups were determined on the basis of actual data and not by means of averaging and the introduction of limits. The support ratio was used as the primary analysis tool and was improved by accounting for population age characteristics. As a result, the authors demonstrated that a decline in the support ratio is characteristic of European countries. An assumption about a positive influence of population aging on economy was also refuted as transfers and not savings still remain the primary source of income for the older population groups. Despite this deep analysis, the study also has its deficiencies such as the use of a constant population age composition while population age composition changes. Population aging is one of the main demographic challenges of modern times that many countries, including Russia, are facing.

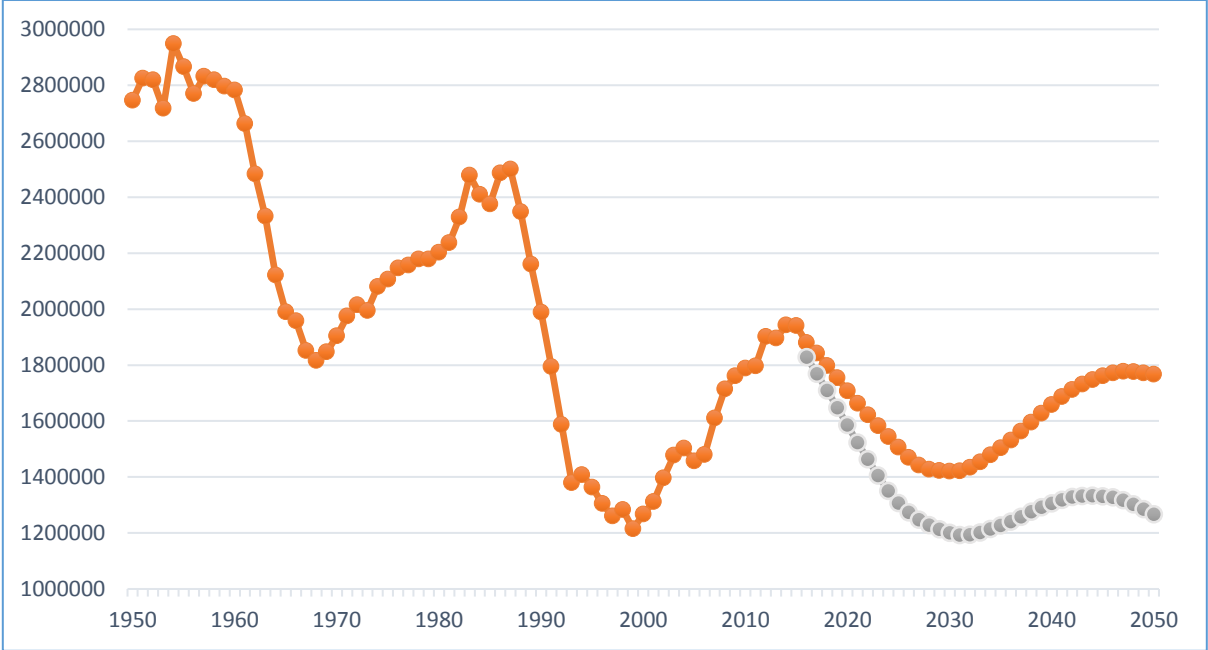
In spite of the large amount of data that the NTA collects, economic resources produced inside households are still not accounted for. The development of the NTTA (National Time Transfer Accounts) methodology for calculating transfers of time across generations and genders solved this problem. A detailed description of this methodology is given in Gretchen Donehower's *Incorporating Gender and Time Use into NTA: National Time Transfer Accounts Methodology*. Services rendered inside households such as taking care of relatives, cooking, making purchases, cleaning and

many others have not been assessed in monetary terms until now and are not included in a country's GDP, thereby significantly reducing the estimate of the product produced on the country's territory. According to Lili Vargha, Róbert Iván Gál's [17] assessment in 2002, the share of non-reimbursable work done inside households amounted to 53.7% of Hungary's GDP, 54.7% of Italy's GDP and 56.9% of Germany's GDP. There is no doubt that the size of this parameter depends on the country, its culture, traditions and customs. Thus, Lili Vargha, Róbert Iván Gál demonstrated that there are significant differences with regard to distribution of housework inside households. For example, in Italy all generations of men are recipients of housework services performed by women. The situation in Sweden is different – men along with women make a significant contribution to managing a household. Thus, it should be expected that Russia with its traditional patriarchal family structure, which the young generation has recently been moving away from towards relationships based on partnering, would occupy a position somewhere between Italy and Sweden. The calculation of the NTTA makes it possible not only to assess economic results that could not be assessed at the macrolevel but also to determine if gender specialization exists and whether society imposes restrictions that do not allow women to fulfill their full potential from a professional standpoint. The NTTA enables us to uncover individuals' gender and age characteristics in more detail due to accounting for transfers of time inside households. Children and old people need better care and sometimes are not able to independently provide for themselves. Therefore, accounting for time transfers received by these population groups will enable us to assess the cost of births and aging of a population more completely.

Under conditions of population aging and the growth of the care economy the size of which is to a significant extent produced inside a household, the assessment of the influence of the demographic factor on countries' economies is becoming relevant. The size of the care economy can also change along with a change in the "price" of a

child if the quantity of children is replaced by their quality as well as with an increase of investments into the child’s human capital.

A more comprehensive assessment of the cost of children’s upbringing and the support of senior citizens appears to be especially important for Russia as the issue of a decreasing birth rate in the country has been acute for a long time. As we see in graph 6, a decrease in the birth rate is expected in the coming years to 2031 even in light of the demographic policy pursued by Russia. This drop in the birth rate will not be fully compensated for by subsequent growth.



Graph 6. Birth numbers 1950-2050. (2016-2050 Middle and low forecast options, Rosstat).

In addition, as we know, a very irregular population distribution and composition pyramid is characteristic for Russia. Large and small generations give way to each other relatively frequently. The difference in time between the largest and smallest generations is approximately 12-15 years. This circumstance can have its “price” in terms of demographic influence on the economy (the price of the adjustment of social

systems and households' economies for a fast change of generations among countries with a population exceeding a certain threshold value).

Accounting for the cost of time transfers for taking care of relatives will make it possible to provide a fairer assessment of demographic trends. As a rule, the recipients of these time transfers are children and elderly people. For example, a drop in the birth rate is seen by society and politicians as a negative trend which in the future will lead to a decrease in the rate of economic growth because of a reduction in the labor force. However, if you take the cost of the upbringing of children into consideration, then the negative effect of the drop in the birth rate on a country's economic dynamics is no longer so obvious.

Work plan

This section will describe the basic principles that will be used for calculating the National Time Transfer Accounts (NTTA). Let me remind you that such accounts include activities inside households. The benefit from these activities is received not only by the individual who performs these activities but also everyone who lives together with him or her. Housecleaning, washing dishes, baby-sitting and many other activities fall under the category of the NTTA. The cost of such services provided within a single household is not accounted for in the GDP in any way.

In order to calculate the National Time Transfer Accounts we will use a methodology that was developed by Gretchen Donehower in 2013. The author outlines a few possible approaches to calculating the NTTA and describes an algorithm which we will use in our study. In this section, we will describe the main stages of this algorithm and analyze the accessibility of data for calculating the NTTA of the Russian Federation.

First of all, we need to define the primary source of data. In order to calculate the NTTA, we need data as to how time within the day is distributed among different types of activity: labor time, leisure time and time spent on in-house needs every day. According to the methodology described in Gretchen Donehower's study in 2013, ideally the source of data should meet all of the following requirements:

- It should be representative at a national level.
- The data should be broken down to gender and age for each household member.
- The data should account for weekends and public holidays.
- The questionnaire should include data for a minimum of one household member with regard to the distribution of a full 24-hour working time fund.

<i>Semester</i>	1 semester	2 semester	3 semester	4 semester
<i>Tasks</i>	Literature review. Methodology analysis	Data science. Analysis of available data and data testing	Modelling. Estimations of NTTA in Russia and Comparison with European Countries	Quality analysis. Results analysis. Comparison of results and hypothesis
<i>Financing</i>	MSU, Faculty of Economics	MSU, Faculty of Economics	MSU, Faculty of Economics	MSU, Faculty of Economics

Table 4. Work Plan on Each semester

Source: Author's estimations

Data Description

For the purposes of our study we will use a selective observational study of the use of the 24-hour work time by the population. This observational study was performed by the Federal Service for National Statistics in 2014¹. 10 thousands households, residents of all subjects of the Russian Federation, participated in this study. In our view, it serves as confirmation that the questionnaire was representative at a national level.

Individuals older than 12 years participated in the questionnaire. The questionnaire includes data for each individual and the household that he or she belongs to. A number of tools are used for providing data:

- a household questionnaire;
- an individual questionnaire for people who are 15 years of age or older;
- a diary of time use for people who are 12-14 years old;
- a diary of time use for people who are 15 years of age or older.

The selective observational study of the use of the 24-hour work time by the population contains data for each individual included in the sample. There are also data for each individual's age, gender and household that he or she belongs to.

Moreover, the questionnaire contains data on the distribution of individuals' time on work days, pre-weekend days, weekend days and holidays which satisfies the requirements of the methodology. The questionnaire provided to the participants includes data on the use of the 24-hour work time, which meets the final requirement for the quality of the data source.

¹ http://www.gks.ru/free_doc/new_site/population/urov/sut_fond/survey0/index.html

Main Propositions and Hypothesis

The next stage is to determine the activities that can be included in the NTTA. The selective observation of the use of the 24-hour work time by the population comprises the following activity categories:

- (paid) employment;
- study in educational institutions;
- developing a personal household plot;
- housekeeping;
- taking care of children and their upbringing;
- spending leisure time and providing for proper rest.

Employment is paid. Accordingly, individuals' incomes are included in the GDP. Instruction of individuals in educational institutions is a paid service. Costs for education in the Russian Federation are financed from the federal budget and are included in the GDP as a component of the federal expenditure or are included in the GDP as a paid service. The categories of interest to us are developing a personal household plot, housekeeping, and taking care of children and their upbringing. These activities generate benefits for household members. Gretchen Donehower's article also sets out the main categories included in the NTTA. According to the international classification of activity types for the statistics on the use of time, the following activity groups are defined (the 24-hour work time is subdivided into these categories):

1. Care of oneself
2. Work in organizations
3. Work outside of organizations
4. Other activities generating income
5. Housework
6. Taking care of children, the elderly and sick household members

7. Social activities for the benefit of other households
8. Studying
9. Cultural and entertainment activities
10. Use of mass media

Categories 5, 6, 7 are included in the calculation of the NTTA.

In order to compare time transfers to the national transfer accounts as well as with the values of the macroindicators, it is necessary to have their monetary valuation. The NTTA methodology describes a method for an expert replacement. The idea is that time transfers are assessed by the market price for the time of the professionals who perform this work under a labor contract. There is no doubt that this approach has its drawbacks: e.g. while doing housework, not all individuals may do it as efficiently as professionals who have experience in doing it. However, it is worthwhile to point out that the use of an average salary for each activity type within the framework of a national economy can smooth out the results. In our study we plan to use the data from the Statistical Bulletin of the Federal State Statistics Service *Data on the Salaries of Employees of Organizations by Personnel Category and Professional Groups of Laborers* for October 2015.

The subjects of this selective observational study on salary were the employees of organizations that perform the following types of economic activity:

- agriculture, hunting and forestry;
- extraction of mineral resources;
- processing production;
- production and distribution of electricity, gas and water;
- construction;

- wholesale and retail trade, servicing of automobiles, motorcycles, household and personal appliances;
- hotels and restaurants;
- transportation and communications;
- real estate transactions, lease and provision of services;
- education;
- healthcare and provision of social services;
- activities for organizing leisure and entertainment, cultural events and sports.

For the purposes of our study, data on the salaries of professionals in the areas of education, healthcare and social services as well as on the salaries of those working in the organization of leisure and entertainment are especially interesting. These are, for the most part, the last three categories.

Now we can formulate some hypothesis, which we are going to study within the research:

- NTTA has a significant effect on the economy, which is not considered in GDP
- Population structure affects the NTTA amount
- NTTA in Russia are higher than in European countries due to national specifics

Conclusion

Using Gretchen Donehower's methodology and the abovementioned data sources, we can calculate the NTTA for Russia. It will enable us not only to make a more comprehensive assessment of the GDP but also answer many other questions:

- How much does the upbringing of children really cost and what is the real nature of the influence of birth trends on the economy?
- What is the role of senior citizens? Are they recipients of time transfers or not?
- Is there a mismatch between women's and men's contributions to household production?
- Does Russia differ from other countries in terms of the distribution of individuals' time?

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