Demographic Theories and the Regional Aspect of Population Ageing*

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Abstract. Population ageing is a major demographic trend of our time. The increase in the proportion and number of elderly people requires that the governments of "ageing" countries develop measures to mitigate the effects of demographic ageing reflected in two interrelated aspects: maintaining sustainable socio-economic development and ensuring a decent quality of life for the elderly. At the same time, as the experience of developed and developing countries shows, in order to ensure effective implementation of the measures it is necessary to take into consideration regularities and territorial features of the age structure transformation. The relevance of our research is determined by the need for scientific understanding of the process of demographic ageing taking into account the system nature of its characteristics (global nature and inevitability in terms of the narrowed reproduction of the population)

and the multiplicity of implications for socio-economic development. The aim of our research is to identify the regularities and regional features of population ageing. We carry out the research with the use of general scientific methods (logical and system approaches, structural-functional analysis, generalization), statistical methods (grouping, sampling, comparison, and generalization), as well as graphical and tabular methods of data visualization. The article presents a review of theoretical concepts that define the essence of the process of population ageing and the results of a comprehensive statistical analysis of the main indicators of changes in the age structure in retrospect and in prospect. We conclude that the nature of the process of population ageing is dialectical: on the one hand, it has been proven that there are phases of demographic transition universal for all countries; on the other hand it has been revealed that the specifics of change in the age structure of local areas differ in the time of passage of these phases, intensity of increase in the number of elderly population, as well as the influence of factors that are external in relation to the demographic system (e.g., economic and political situation in the country, wars, disasters, etc.). Areas that have a comparable proportion of the elderly in the population can vary significantly according to quality characteristics of this socio-demographic group. In this regard, there is a practical need to obtain objective and relevant information about the situation in contemporary Russian and Mongolian societies; it is also necessary to develop a set of measures to adjust socio-economic development taking into account the specifics revealed.

Key words: demographic ageing, age structure of the population, older generation.

Introduction

According to demographic forecasts, the process of population ageing in the future will be intense, but it will be uneven in individual regions and countries. The current stage of research is driven by the rethinking and change of scientific paradigms, the generation and development of new methodological approaches in the study of various social strata. The main blocks of scientific issues are related to demography, social institutions and the role of government. In the last decade, developed countries and later, developing countries, have faced significant changes in the age structure of the population caused by declining fertility and mortality: as the share of children and working-age population is decreasing, the share of the elderly is increasing continuously. Science calls this phenomenon "demographic ageing". French demographer A. Sauvy points out that demographic ageing is easy to calculate and forecast, but it is difficult to imagine what consequences it will lead to [19]. In science and journalism, demographic ageing has different definitions, from "quiet revolution" [6] to "silver tsunami" [10], and the estimates of the problem range from the greatest achievements of mankind up to the threats to its existence. Of course, population ageing is one of the global challenges of our time. When studying demographic ageing the emphasis in most cases is placed on strategies and mechanisms for leveling its socio-economic impacts that are reflected in the budget deficit of the pension system, reduction of demand in the labor market, and an increase in the burden on the health system, etc. However, rapid ageing of many countries raises the question about the nature and regularities of this phenomenon: is it similar in all countries, or does it have its specific features?

1. Population ageing in the context of demographic theory

Theoretical generalization of population reproduction regularities has been a subject of debate in demographic science during the last few centuries. One of the first to attempt to describe general patterns of demographic development was made by English scholar Thomas Malthus in his work "An Essay on the Principle of Population" (1798) [11]. The followers of Malthus, while admitting the presence of logical and statistical errors in his work, did not question the very essence of "natural law" and "natural character".

The theory of population in the Marxist ideology stems from the recognition of critical importance of socio-economic factors in the alteration of demographic situation and the establishment of population reproduction regime. K. Marx noted that "... every special historic mode of production has its own special laws of population, historically valid within its limits" [12]. Thus, the Marxist theory of population does not agree with the "natural" and "biological" essence of population growth, which, according to K. Marx, is determined by the development of production mode and changes with the transition to the next socio-economic formation. Population theories of T. Malthus and K. Marx made a significant contribution to the development of demographic science, but in general they reflect only the quantitative aspect of the problem under consideration and pay less attention to qualitative changes (including those related to age structure).

One of the first scientists who proposed a classification of types of age structure was Swedish demographer A.G. Sundberg, he put forward his theory in 1894 [14], and later, in the 1930s, it was developed by F. Burgdörfer. Demographic ageing was the subject of research of such scholars as E. Rosset ("Aging Process of Population", 1968 [16]), and A. Sauvy ("General Theory of Population", vol. 2, 1977 [19]). However, it was substantiated conceptually in the framework of the dominant theory of population – the theory of demographic transition.

Among the most significant events in the development of demographic transition theory is the publication of the book by A. Landry "La Révolution Démographique" (1934) [22], in which the model of transition was formulated; it includes three phases: primitive (high fertility and high mortality), intermediate (high fertility and relatively low mortality) and modern (low fertility and low mortality; population stabilization). We can see that each phase has specific types of population reproduction, which, in particular, are used in the substantiation of the concept of demographic transition [2]: archetype (first phase), traditional (second phase), and modern/rational (third phase). Researcher N.B. Barkalov interprets demographic transition as a change of historical types of reproduction due to general socio-economic development caused by the development of the productive forces [2]. Such an understanding of conceptual foundations of the phenomenon under consideration explains the presence of specific stages of demographic development in different regions.

W. Thompson, a classical scholar of demographic transition theory [25] was one of the first to reveal the general patterns in demographic development of countries that

differ in many characteristics (including the level of socio-economic development); he also found a chronological sequence of changes in the combinations of fertility and mortality. Thompson also drew attention to possible changes in the structure of society as a result of population ageing (comparing the conservatism of the "old" France and the nonconformism of the "young" United States of America).

The second "birth" of demographic transition theory that occurred in the 1940s was connected with F. Notestein [23]. He designed a model of demographic transition, which includes four stages: 1) high degree of stability (characterized by high levels of death and birth rates; population size is relatively stable); 2) initial growth period (decline in death rate and increase in birth rate; population size is growing slowly); 3) modern growth period (low death rate and decline in birth rate; there is a huge increase in population size due to the accumulation and realization of demographic dividends of the previous years); 4) low degree of sustainability (stabilization of birth and death rate levels and population size) [3]. It should be noted that the proposed classification of demographic transition stages is close to its modern form. In this model, demographic ageing process should begin during the transition from the second to the third stage.

Russian demographic science is developed by a broad range of researchers of demographic transition theory. At different times this area was studied by A.Ya. Kvasha, N.B. Barkalov, A.I. Antonov, V.A. Borisov, A.G. Volkov, L.E. Darskii. We should also note the contribution that researcher A.G. Vishnevskii made to the development of this theory. He published a large

number of works on the subject, and a four-phase model of demographic transition that he designed in 1982 [4; 5] is commonly used in domestic science:

— first phase: death rate is falling faster than birth rate; as a result, there is an increase in the rate of natural increase, which at some point reaches its maximum;

— second phase: death rate continues to fall and decreases to some minimum, while birth rate is declining more rapidly; population increase reduces; however, the so-called demographic dividend is formed: due to the birth rate decline, the share of working age population increases and reaches a certain maximum;

— third phase: death rate increases due to *demographic ageing (increase in the proportion of elderly people)*, at the same time, there is a slowdown in the birth rate decline; birth rate is stabilized approximately at the level of simple reproduction, while death rate remains below this level since the share of young age groups is still large.

— fourth phase: birth and death rates are stabilized at the level of simple reproduction, the increase (decrease) in population size slows down and is set at a constant level.

The models of demographic transition (earlier and contemporary) described above represent the process in stages and identify common and universal laws; and the very concept can be considered as a general theory of population reproduction in the context of the general theory of population [8]. At the same time, one of the main disadvantages of the theory of demographic transition is seen in the lack of explanation of the reasons for the changing nature of population reproduction.

First of all it concerns the postulate concerning the independence of demographic processes acting as independent variables in relation to socio-economic transformations. On this basis the conclusion is made about the universality of demographic transition in all regions of the world, regardless of factors external to the demographic system. At present it is unclear whether it is possible to stabilize the population in the fourth phase of demographic transition at the high level of demographic ageing due to natural reproduction.

According to the studies [7; 9; 15], demographic processes in many countries have features that contradict the classical notion of demographic transition. According to M.A. Klupt [9], demographic transition can have different properties if there is more than one modernity, but several of them: Western European, Russian, Chinese, etc. In contrast to the theory of demographic transition (stagewise and formalized) the scientist proposes a concept based on the theory of multiple modernities. According to this concept, any demographic phenomenon (in our case, population ageing) has its own specific features in a separate area; these features can be formed due to historical, geographical, political, socio-economic, institutional and other factors.

Probably, the two theories should not be seen as oppositional, but rather, as researcher N.V. Zvereva points out [8], they are theories of different levels. The stagewise approach used in the theory of demographic transition allows us to speak of it as "vertical", while M.A. Klupt's institutional theory is closer to "horizontal", which explores the features of demographic development at the local level and with parallel trajectories.

Combining two considered concepts, we can distinguish several types of "demographic transitions": the "French" type (simultaneous and gradual reduction of birth and death rates; demographic explosion does not occur in this case), the "English" type (birth rate remains high at the first stage, despite the reduction in death rate, which leads to demographic explosion), and the "Japanese-Mexican" type (along with the reduction of death rate, birth rate increases, leading to significant population growth) [13]. Accordingly, the transition to the third stage also occurs in a variety of scenarios: in the first case it is an early but gradual ageing, in the third case it is a late but much faster ageing. The very difference in the intensity of this process has formed the basis of territorial differentiation by the level of demographic "old age" in some countries, which we can observe at the present stage.

The social aspect of population ageing is the most difficult one to assess and measure. The increase in the proportion and size of the older population made it necessary to carry out scientific research in sociology and social gerontology, the subject of which is the elderly person and their role in public life [1; 17; 20; 21]. The problems of gerontosociology, population ageing in terms of its impact on the social situation of the elderly and streamlining intergenerational relations are examined in the works of Russian scientists such as V.D. Al'perovich, V.G. Dobrokhleb, M.E. Elyutina, T.Z. Kozlova, E.F. Molevich, A.K. Solov'ev, E.E. Chekanova, N.P. Shchukina, etc. They disclose the specifics of changes in the social situation of the elderly expressed in the attitude of society toward their economic status, in negative stereotypes

Table 1. Proportion of the population 60 years of age and older in world regions: fact and forecast

World region	Proportion of elderly people (60 years of age and older) in the total population, %		
	1950	2015	2070
World	8.0	12.3	24.4
Developed countries	11.6	23.9	32.8
Developing countries	6.5	10.7	26.6
Least developed countries	5.3	5.5	14.1
High-income countries	11.2	22.1	32.9
Countries with income above average	7.2	13.4	33.5
Countries with average income	6.7	10.5	25.7
Countries with income below average	6.1	8.1	21.4
Low-income countries	5.0	5.2	12.6
Africa	5.3	5.4	12.4
East Africa	4.9	4.8	12.8
Central Africa	5.9	4.5	10.2
North Africa	5.4	8.0	20.2
South Africa	6.0	7.5	20.6
West Africa	5.1	4.5	9.4
Asia	6.6	11.6	29.1
East Asia	7.4	16.7	38.9
Central Asia	9.7	7.9	20.8
South Asia	5.8	8.4	26.1
Southeast Asia	6.0	9.3	25.4
West Asia	6.8	7.9	22.8
Europe	11.8	23.9	33.5
Eastern Europe	9.1	21.5	29.3
Russian Federation	7.7	20.0	25.2
Northern Europe	15.0	23.4	31.8
Southern Europe	11.1	26.2	39.6
Western Europe	14.9	26.0	35.4
Latin America and the Caribbean	5.7	11.2	32.6
The Caribbean	6.1	13.3	30.4
Central America	5.3	9.3	31.8
South America	5.7	11.7	33.2
North America	12.4	20.8	30.3
Oceania	11.2	16.5	26.0
Australia/New Zealand	12.6	20.4	30.6
Melanesia	5.7	5.8	15.4
Micronesia	5.1	9.7	24.9
Polynesia	3.9	9.8	26.3
Sources: World Population Prospects: the 2015 revision. Available at: http://esa.un.org/unpd/wpp/; authors' calculations.			

concerning the elderly, in the phenomenon of ageism, etc., and in the analysis of social well-being and behavior of old and very old people.

A systematic and comprehensive nature of population ageing differentiates the understanding of its essence in scientific concepts. Demographic science explores the basis, the reasons for the transformation of the age structure of the population, while economics and sociology study its consequences. The necessity of using an interdisciplinary approach is due to the complexity of population ageing that goes beyond its perception as a process of increasing the proportion and size of the older population. It is important to understand to what extent scientific concepts correspond to real statistical indicators of population ageing and to the dynamics of change in the age structure of the population in the regions of the world.

2. Statistical analysis of demographic characteristics of ageing in the world

Despite the presence of a single vector in the change in the proportion of elderly people, regions of the world are currently differentiated by level of demographic ageing. In 2015, the "oldest" countries included Europe and North America (average of 24 and 21% of the elderly, respectively; *Tab. 1*). However, according to a UN forecast, by 2070, the Asian and South American regions will almost "catch up" with the countries of Europe and North America concerning the share of the population over 60 years of age, and Eastern Asia, along with Southern Europe, will become one of the "oldest" world regions (39% of elderly people). The African continent is the "youngest" territory, where the proportion of elderly people is on average 5%.

In the second half of the 20th century and in the beginning of the 21st century, the number of elderly people in the world was growing and it continues to grow at a faster pace than the total population. To confirm this statement, let us consider the periods when population size doubled, to find out how many years it will take for the figure to increase twice. The time interval from 1950 to 2015 was used in the calculations *(Fig. 1)*.

The data presented in Figure 1 indicate that in developed countries (Sweden, UK, Germany, France) the period when the size of elderly population doubled is several times shorter than the period when the size of total population doubled. Although in developing and least-developed countries, two of these indicators are approximately equal, the size of elderly population doubles several times faster than in the countries of Western and Northern Europe that have already "grown old".

The population in some regions is still relatively young. For example, in 2017 in Africa, the proportion of children under 15 accounted for 41% of the population, and we should add to their number the 19% of young people 15–24 years of age[1]. Countries of Latin America and Asia, which experienced a larger decline in birth rate, have a smaller proportion of children (25 and 24%, respectively) and youth (17 and 16%, respectively). In the total population of these three regions in 2017, there are 1.8 billion children and 1.1 billion young people. However, the number of people 60 years of age and older is growing faster than in the number of people in younger age groups and

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[1] World Population Prospects. The 2017 Revision Key Findings and Advance Tables. Available at: https://esa.un.org/unpd/wpp/Publications/Files/WPP2017_KeyFindings.pdf

Figure 1. Periods when total population and population 60 years of age
and older doubled in some countries (1950–2015), years
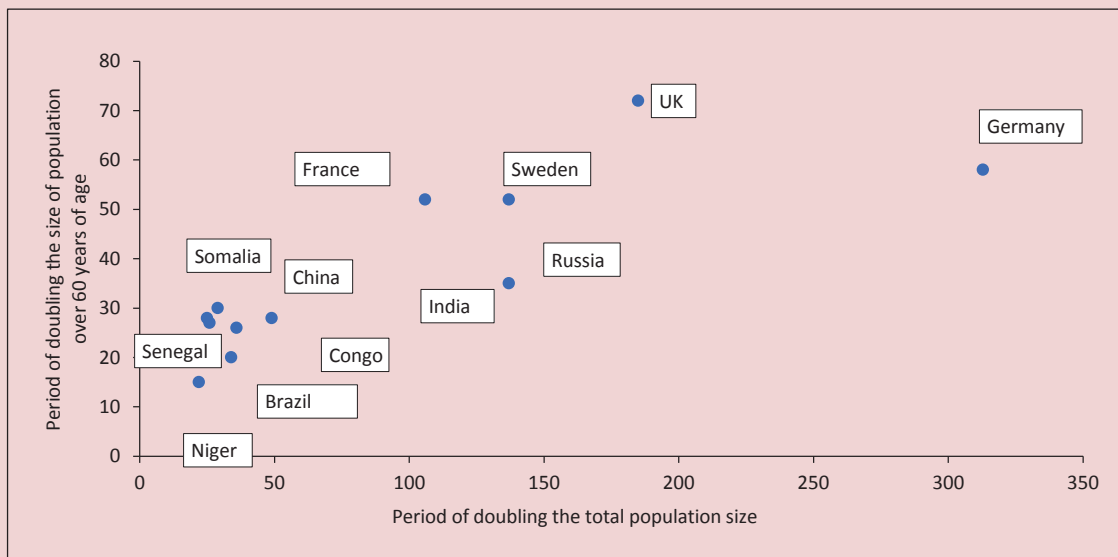
Sources: World Population Prospects: the 2015 revision. Available at: http://esa.un.org/unpd/wpp/; authors' calculations.

increases at a rate of about 3% per year. The older generation itself is ageing. Globally, the number of persons 80 years of age and older will increase from 137 million in 2017 to 425 million by 2050 and will reach 909 million in 2100. In the coming decades, many countries are likely to face difficulties with the functioning of healthcare systems, pension provision and social security for the growing elderly population, if these spheres are not adapted to demographic change.

The results of a correlation analysis *(Fig. 2)* show that there is a fairly strong positive correlation (r=0.57) between per capita GDP expressed in U.S. dollars (the natural logarithm of these values was used in the calculations) and the share of the population over 60 years of age in the countries of the world. In general, this proves a conceptual statement about the presence of parallel pathways in socio-economic and demographic development.

The dependency ratio − the number of children (0−14 years old) and elderly people (60 years of age and older) per 1,000 population 15−59 years of age is the most frequently used indicator that determines the degree of impact of changes in the age structure on economic and social development *(Tab. 2)*.

The data presented in the table suggest that the dependency ratio in the world declined in 1950−2015, but it will have increased again by 2070. However, the change in this indicator is very uneven in some territories:

1. In developed countries, the dependency ratio somewhat increased in 1950−2015, and it will increase substantially to 2070.

2. In developing countries, the dependency ratio, having shown a dramatic decline in 1950−2015, will return to the previous level to 2070.

3. In the least developed countries, the dependency ratio, having increased slightly in 1950−2015, will decline significantly to 2070.

Figure 2. Correlation between GDP per capita and the share
of the people over 60 years of age in the countries of the world

$y = 3.4324x - 17.423$ $r = 0.57$
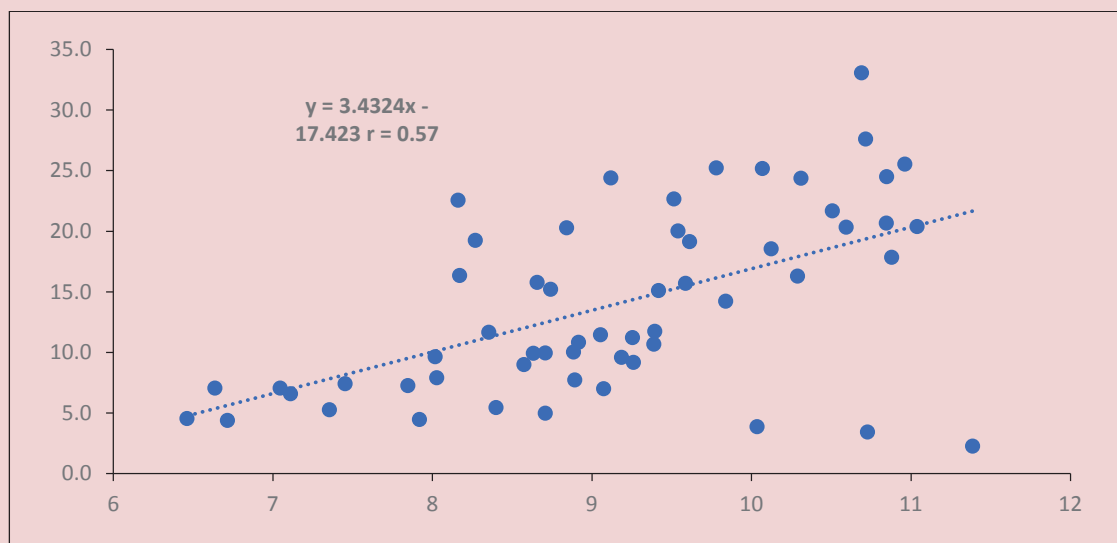
Sources: World Population Prospects: the 2015 revision. Available at: http://esa.un.org/unpd/wpp; The World Bank. Available at: http://data.worldbank.org/; authors' calculations.

Table 2. Dependency ratio in the regions of the world: fact and forecast (per 1,000 people)

World region	Dependency ratio		
	1950	2015	2070
World	734.6	621	785
Developed countries	639.4	673	941
Developing countries	773.3	576	802
Least developed countries	868.6	833	673
High-income countries	651.9	649	940
Countries with income above average	751.8	520	952
Countries with average income	767.0	585	790
Countries with income below average	783.6	644	713
Low-income countries	890.1	911	660
Africa	873.7	866	658
East Africa	919.9	931	662
Central Africa	888.8	999	649
North Africa	825.0	672	698
South Africa	813.1	600	654
West Africa	874.0	937	646
Asia	760.4	563	826
East Asia	732.0	504	1080
Central Asia	735.7	586	661
South Asia	780.1	612	752

World region	Dependency ratio		
	1950	2015	2070
Southeast Asia	807.5	559	753
West Asia	811.6	612	741
Europe	617.8	657	945
Eastern Europe	604.0	598	823
Russian Federation	601.1	582	734
Northern Europe	631.0	696	918
Southern Europe	634.0	686	1117
Western Europe	619.7	708	1012
Latin America and the Caribbean	850.3	585	913
The Caribbean	837.2	623	868
Central America	922.4	611	888
South America	829.3	571	929
North America	656.0	653	895
Oceania	695.7	665	799
Australia/New Zealand	658.6	648	882
Melanesia	857.9	720	629
Micronesia	697.7	648	793
Polynesia	972.9	656	834
Sources: World Population Prospects: the 2015 revision. Available at: http://esa.un.org/unpd/wpp/; authors' calculations.			

At the first glance it may seem that in all the three cases, the trends have a fundamentally different nature; however, that is not so. In fact, these are just different stages of demographic transition, and the main factors are the decline in birth rate and the formation of the so-called demographic dividend (the state of the age structure of the population, when as a result of declining birth rate the proportion of able-bodied population tends to a maximum, and the proportion of dependent groups – to a minimum).

As mentioned earlier, regions of the world are essentially differentiated by the level of ageing. In particular, this applies to Europe and Asia, typical representatives of which are Russia and Mongolia, respectively. Let us refer to international statistics on the age structure of population in world regions in comparison with the data on the Russian Federation and Mongolia *(Tab. 3)*.

The data in Table 3 shows that the age structure in Russia and Mongolia have common features with average indicators in their region, but at the same time they are substantially different. Russia has completed the implementation phase of the demographic dividend (like most of Europe), and the proportion of elderly people in the population already exceeds 20%. Mongolia, by contrast, has a much large proportion of children and a low proportion of elderly people; these facts allow us to consider Mongolia as a relatively "young" country that enters a phase of demographic "bonus" caused by declining birth rates.

Table 3. Age structure in world regions, Russia, and Mongolia in 2017, percentage of total population

Region, country	Age structure of population			
	0-14	15-24	25-59	60+
World	26	16	46	13
Africa	41	19	35	5
Asia	24	16	48	12
Europe	16	11	49	25
Latin America and the Caribbean	25	17	46	12
North America	19	13	46	22
Oceania	23	15	45	17
Mongolia	30	15	49	7
Russian Federation	18	10	52	21

Source: World Population Prospects. The 2017 Revision Key Findings and Advance Tables Available at: https://esa.un.org/unpd/wpp/Publications/Files/WPP2017_KeyFindings.pdf

In the long term the dynamics of the age structure in Russia and Mongolia will experience the impact of demographic ageing *(Fig. 3, 4)*. And in Mongolia the ageing of the age structure will occur at a more rapid pace due to the current trends of declining birth rate and a later entry into the third phase of demographic transition.

Considering the demographic dynamics of Russia, its indicators should be compared not only at the level of countries, but also at the level of regions of the Russian Federation due to the presence of significant territorial differences within the country. At the beginning of 2017, the Tula Oblast was the oldest constituent entity of the Russian Federation (the share of people over 60 years of age is 25% there), and Yamalo-Nenets Autonomous Okrug and the Chechen Republic are the youngest regions (6 and 7%, respectively)[2]. The ratio between the maximum and minimum values is about 4:1. In general, the Russian Federation is characterized by intense ty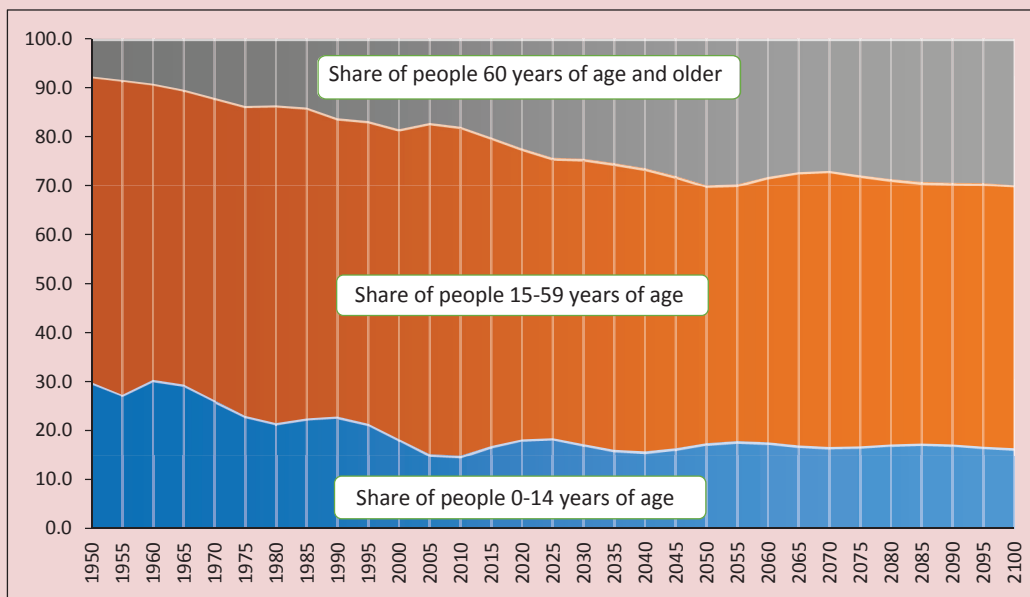pe of ageing (like most developing countries), which, however, has its own characteristics and is not uniform. In the context of narrowed population reproduction the age structure in all constituent entities of the Russian Federation in the future will continue to "grow older". In Russia and in the majority of the developed world, intensive demographic ageing has changed the positive tendency toward the formation of "favorable" age structures that were typical of the population of these regions during the 20th century. The current age structure in developed countries becomes one of the main obstacles from the point of view of many aspects of social and economic development.

Conclusion

Let us sum up some results. The study that we have conducted shows that demographic ageing is a global (all regions of the world are subject to "ageing") and irreversible phenomenon (in the context of narrowed reproduction the population will continue to "age"). The data for developed countries suggest that the pace of population ageing at some point begins to decline, which allows us to make an assumption about a certain maximum

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[2] The calculations and analysis of specifics of Russian population ageing were carried out according to the data of the Unified interdepartmental information-statistical system. Available at: http://fedstat.ru/indicators/start.do

Figure 3. Age structure of population in Russia in 1950–2100 (medium forecast scenario)

Source: World population prospects 2017. Available at: https://esa.un.org/unpd/wpp/Graphs/DemographicProfiles/

Figure 4. Age structure of population in Mongolia in 1950–2100 (medium forecast scenario)

Source: World population prospects 2017. Available at: https://esa.un.org/unpd/wpp/Graphs/DemographicProfiles/
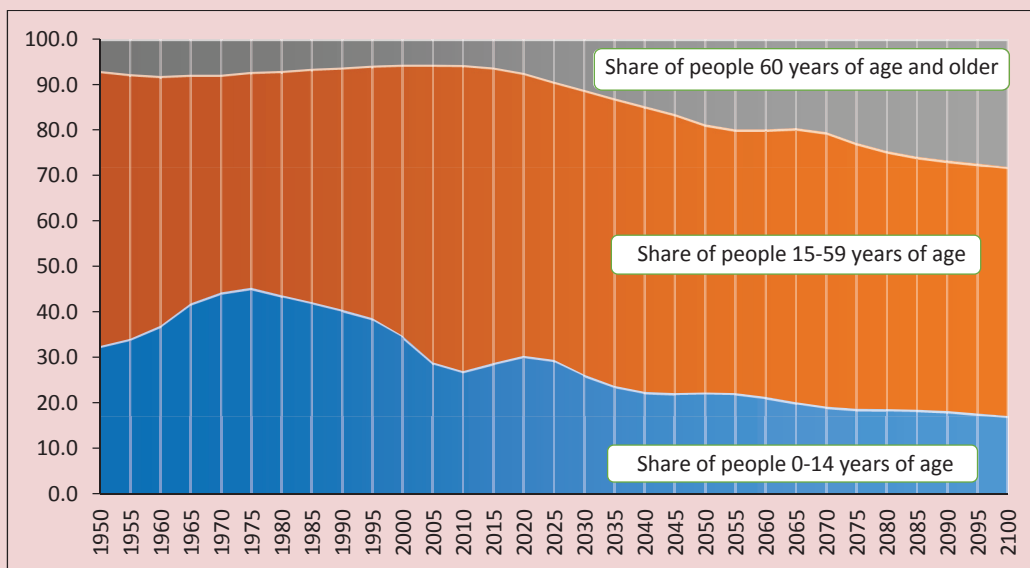
percentage of the elderly in the total population, after which, probably, the population stops "ageing". The theory of demographic transition suggests that population ageing will cease when the size and structure of the population stabilizes after the fourth phase of the transition. So far, none of the world countries has finished the "transition" to the stable population, so it is still premature to say that the ageing process at the global level has come to an end.

Our analysis suggests that, in general, most of the provisions of the demographic transition theory are naturally reflected in practice: the obtained data allow us to speak about the presence of a single vector of changes in the age structure of the population of the world regions in the direction of increasing the proportion of elderly people. However, despite the passage of the same phases of demographic transition, the ageing rate of the population differs markedly in different regions of the world, which confirms the existence of differentiation processes of change in the age structure. This conclusion is located at the intersection of the theories of demographic transition and the institutional theory of demographic development: on the one hand, we cannot deny the existence of the phase of demographic transition common for all countries; on the other hand — it is impossible not to take into account peculiarities of the process of changing demographic structure on the local territory (in particular, the time of passing through the phase, the intensity of changes in the age structure, etc.), and the impact of factors that are external in relation to the demographic system (e.g., economic and political situation in the country, war, disaster, etc.).

In the context of demographic ageing, special importance is attached to a practical need to obtain objective relevant information about the situation in modern Russian and Mongolian societies; and at the same time it is necessary to work out a scientific understanding of socio-demographic change and develop the author's own theoretical and methodological tools.

The features and characteristics of the population in a country must be taken into account when designing a strategy for socio-economic development in the context of population ageing. The results of the analysis suggest that the measures that may be efficient for developed countries, will fail in the developing and in the least developed countries due to the fact that in these countries, the period of implementation of the demographic dividend and doubling of the number of elderly people is much shorter. The awareness of the universality and irreversibility of population ageing makes it relevant to perceive it not as a "problem" or "challenge", but as an "opportunity" (implementation of the second demographic dividend), a natural phenomenon that has not only negative but also positive sides. Taking into consideration economic and social dynamics associated with population ageing is important for achieving sustainable development goals [24] by 2030, relating to reducing the risk of poverty, improving health and well-being in all age groups, achieving gender equality and ensuring full and productive employment and decent work for all. With the intensification of the process of demographic ageing (in Russia and Mongolia, as well), the significance of theoretical and applied research in this area also increases.

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