First World Aging: Scenario Forecasts of Dependency Ratios

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Abstract. Population aging in the first world and its expected consequences are actively discussed in the research community. Effects of aging can be seen in the age structures projected for various countries by UN DESA. However, their «medium» scenario most frequently used by researchers to understand the effects of aging is based on the national-level assumptions (their set being rather fixed and limited in number). In this paper we propose a different approach, where age structures and dependency ratios are projected based on global-level assumptions impacting the demographic dynamics of each particular country. As a first approximation, this approach gives us 4 scenarios of demographic dynamics associated with: 1) the growth of human capital (in particular, an increase in the level of education); 2) stagnation of human capital; 3) a decrease in global integration and migration flows; 4) increased globalization, increased openness of borders and migration flows.

1 Introduction

Obviously, these scenarios will be very differently reflected in the demographic dynamics of countries that have completed the demographic transition and countries that are still in the process of making this transition. Our sample includes 67 countries, which are home to more than 85% of the total world population. They are divided into 2 groups depending on the TFR values in 2015-2020, the ‘demographically developed’ and the ‘demographically developing’ ones (situated below and over this threshold, accordingly).

For these groups, the basic set of 4 scenarios has been significantly expanded. In terms of human capital development, 3 main sets of estimated demographic trajectories were formed:

• optimistic scenario of accelerated dynamics of human capital;
• pessimistic scenario of stagnation of human capital dynamics;
• inertial scenario of human capital dynamics.

These scenarios were based on a wide range of fertility trajectories that we modeled. According to these trajectories, the birth rate in the long term (by 2100) reached 0.9; 1.2; 1.5; 1.8; 2.1; 2.4; 2.7 (depending on the scenario and on which group the country belonged to). Moreover, for each target value, three trajectories were modeled - the immediate start

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of the country's movement towards the “target” indicator; the beginning of the movement with a lag of 5 years (from 2025) and with a lag of 10 years (from 2030). Thus, each of the three scenarios cover 9 trajectories, with 3 ‘target’ fertility values and 3 trajectories of movement to each of the values.

2 Materials and methods

Over the set of resulting scenarios, we constructed a set of migration scenarios. The structure of the gender and age migration profile for each country was estimated according to the current migration structure, according to the current UN data on net migration growth (UN DESA 2020).

- No-migration scenario;
- Inertial scenario (current migration rate continues);
- Doubling migration scenario (country migration flows double by 2100 in absolute terms);
- Quadrupling migration scenario (country migration flows quadruple by 2100 in absolute terms);
- Slow zero-migration scenarios (country migration flows fall to 0 by 2100).

Thus, each set of scenarios for the dynamics of human capital (optimistic, pessimistic and inertial) is associated with a set of demographic trajectories that are characterized by different scenario prerequisites for the dynamics of migration and fertility. For simplicity, we have used the World Population Prospects 2019 (UN DESA 2020) unified average scenario for mortality rates.

Then, the projected dynamics of the elderly dependency ratios were analyzed for the resulting scenarios. However, the ‘traditional’ ratio (proportion of 65+ to 20-64) does not reflect the entirety of the picture, since it is based on a fixed ‘old age threshold’, 65 years, not taking into account the fact that due to an increase in life expectancy in general and healthy life expectancy in particular, it is likely that people in the future will be able to remain active and able to work in ages over 65. So, along with the ‘traditional’ approach it seems appropriate to use an approach where the elderly dependency is estimated taking into account life expectancy [1-6]. This approach uses the concept of ‘old age threshold’, which implies a flexible assessment of when a person is considered elderly - people do not become elderly at their 55th, 60th or 65th birthday (or at the time of retirement) regardless of time, place of residence, health status and other characteristics. Instead, the threshold for old age depends on the characteristics of people, which in turn are determined by the state of health (physical, intellectual, psychological, etc.) [4-6]. In this case, the old age threshold is the age at which the average remaining life expectancy becomes less than 15 years. This age is calculated according to the medium UN forecasts on the dynamics of life expectancy [7-14].

Obviously, these scenarios will be very differently reflected in the demographic dynamics of countries that have completed the demographic transition and countries that are still in the process of making this transition. Our sample includes 67 countries, which are home to more than 85% of the total world population [8-18]. They are divided into 2 groups depending on the TFR values in 2015-2020, the ‘demographically developed’ and the ‘demographically developing’ ones (situated below and over this threshold, accordingly).
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3 Results and discussion
The analysis of our calculations allows us to draw some important conclusions about the projected dynamics of the age structure of the population of aging Western countries in general and the dynamics of the predicted demographic load by the elderly in particular. First of all, it should be noted that none of the countries in the selected region is able to avoid a very significant increase (at least almost 2 times, for a number of countries and scenarios - 2.5 or even 3 times) the ratio of the elderly population (65 years and older) and the working-age population (20-64 years old) under any migration scenario, even under an optimistic scenario of human capital dynamics, which suggests different options for increasing birth rates, as well as under inertial scenarios of the development of human capital (and the corresponding trajectories of the dynamics of fertility) and, of course, under the pessimistic scenario. This is partly an expected result, since all countries of the selected region have already completed the demographic transition, and some of them also encountered the phenomenon of lowest-low fertility, with their TFR falling significantly below 2 children per woman. In all countries of the region, in all scenarios, a large increase in demographic burden by the elderly is projected.

Differences in migration scenarios play a rather small role here. For example, in the UK, with “zero migration”, the ratio of the population in elderly and working ages, according to the optimistic scenario of the dynamics of human capital, will increase from the current level of 32.1 to 62.7-75.0. If net migration increases 4 times by the end of the century compared to its current value, the ratio of the population in elderly and working ages will go up to 57.6-64.5. Thus, the upper limit of the forecast range is reduced by more than 10 units, which, it would seem, is significant - however, in this case, the country is practically unable to avoid doubling the indicator. A similar situation is observed in Germany, where the birth rate is lower - with “zero migration”, the ratio of the population in old and working ages, according to the optimistic scenario of human capital dynamics, will increase from the current level of 36.7 to 67.8-81.7, and under the scenario a 4-fold increase in migration inflow by the end of the century compared to its current value - up to 67.1-73.5. Thus, the upper limit of the forecast range is reduced by about 8 units (the lower limit remains unchanged) - however, in this case as well, the value of the considered indicator in the country almost doubles. There are countries where these two scenarios give almost the same results - for example, Sweden. Thus, for the countries of this region, neither an increase in migration inflows, nor an increase in the birth rate set forth in the scenarios, make it possible to avoid a colossal increase in the ratio of the population in the elderly and the working age.

The projected dynamics of the demographic burden of older people in post-socialist countries has a lot in common with the Western countries discussed above. None of the post-socialist countries is able to avoid a very significant increase (at least almost 2 times, for certain countries and scenarios - 2.5 or even 3 times) in the ratio of the elderly population (65 years and older) to the working-age population (20-64 years old) under any migration scenario and/or human capital dynamics scenario. The birth rate dynamics will certainly have an impact on the ratio of the elderly to the working-age in the long run - for example, in Russia with “zero migration” this indicator (currently 24.9) is projected in the range of 46.7-55.9 with fertility trajectories associated with the optimistic scenario for the development of human capital, and 54.9-68.3 with fertility trajectories associated with the pessimistic scenario. Differences in migration scenarios turn out nearly insignificant here as well. In Russia, with “zero migration”, the values of the ratio of the population in old and working ages, according to the optimistic scenario of human capital dynamics, will increase from the current level of 24.9 to 46.7-55.9; with a 4-fold increase in migration inflow by the end of the century compared to its current value - up to 49.4-57.8. The most catastrophic
situation is in Romania, where the forecast values in a number of scenarios reach such values that they are practically devoid of empirical meaning. The fact is that Romania is a vivid example of the combined effect of three unfavorable demographic factors - low fertility, an aging population structure and a strong migration outflow (which additionally affects the age structure, since the bulk of the migration outflow is made up of people of working and child-bearing age). On the other hand, it can be seen that the forecast demographic burden of the elderly by 2100 in many post-socialist countries - Armenia, Belarus, Russia, Ukraine - is lower than in Western countries - however, this is hardly worth considering a sign of demographic success, since to a large extent this is due to lower life expectancy and higher mortality (especially male) under the age of 65 years (fixed threshold of old age).

4 Conclusions

None of the aging Asian countries that we have viewed is able to avoid a very significant increase (at least 2 times, for a number of countries and scenarios - 4-6 times) between the elderly population (65 years and older) and the working-age population (20-64 years) under any migration scenario, even with an optimistic scenario of the dynamics of human capital, which implies various options for increasing birth rates. This result can also be largely considered expected, since it is in this region that one of the lowest birth rates in the world is observed - for example, 1.0 children per woman in South Korea. However, even countries with higher birth rates (for example, Thailand with its 1.5 children per woman, China with 1.7 children per woman or Japan with 1.4 children per woman) are projected to experience a tremendous increase in this indicator [11, 12].

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