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# The evolution of fertility over the life course : a comparative study between Romania and Turkey

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# The Evolution of Fertility over the Life Course. A Comparative Study between Romania and Turkey

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## Abstract

The transition of fertility is an important part of the process of economic and social development and modernization of society. The transformations that have occurred in the politics of life, economic and social but also in the way of thinking the population influenced the demographics of the population's behaviour. This is the cumulative result of the manifestation of three phenomena: natality, mortality and migration. The intensity of fertility is determined by the magnitude of the birth rate. The paper presents the results of a study on the analysis and prognosis of fertility evolution in Romania and Turkey during 1980-2100, based on the application of models such as the Bayesian hierarchical series, auto-regression temporal series and time series prognosis. The models used for forecasting were based on the metadata provided by the National Institutes of Statistics and the United Nations. The comparative study follows, on the one hand, highlighting the evolution of fertility phenomenon in Romania versus Turkey in 1980-2018, and on the other hand, comparing forecasts on total fertility between Romania and Turkey between 2018 and 2100 and future projections based on the demographic profiles provided by the National Institutes of Stats' metadata.

## Key words

Fertility, total population, Romania, Turkey, forecasting

**JEL Codes:** C53, J11, J13, M 31

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## 1. Introduction

In the paper, the issue of fertility analysis at a nation's level is one of the important concerns of researchers and practitioners. Fertility is closely related to natality, so the birth rate is determined on the basis of fertility intensity. The evolution of global fertility is influenced by a multitude of demographic factors - the size of the female population, migration and the size of the fertile quota. The increase in the fertile quota can be achieved by increasing the size of the female population within each age group. Modification of the fertile quota due to the occurrence of some demographic transitions can be evidenced by the calculation of general fertility rates. These can be determined by reporting the number of live births brought to the world by women of different age groups. The total fertility rate is the average number of children in a woman.

The issue of evaluation is all the more important as the image of the population fertility evolution in Romania and Turkey in recent decades indicates a continuous decline. However, the number of the population in Romania is decreasing rapidly while in Turkey it is constantly growing. In the last five years, the reduction in the overall fertility rate has been increasing and there are serious concerns. It is therefore necessary to measure its effects and to anticipate the future evolution of fertility by means of predictions through statistical models. Globally, the phenomenon of constant population growth is increasingly visible. If in 2000 the total population of the world amounted to 6,082,966,429 people, on 25 March 2017 their number reached 7,519,028,970 persons. The phenomenon of over-population or sub-population manifested differently in certain areas of the globe is overwhelmingly influenced by the capacity of the procreation man.

In 2016, the world's population growth rate was 1.2%, the fertility rate was 2.45 children born to a woman in 2015. Unlike other continents, Europe currently has over 749.7 million inhabitants. The European countries remain with the oldest population compared to the rest of the world. The population density was 69.7 inhabitants per km in 2017. The countries with the highest population density are: Monaco -16403.6 inhabitants per kmp, Gibraltar (United Kingdom) - 4,697.3, Vatican 2,045.5 and Malta -1257.9. The lowest population density is found in Norway at Svalbard and Jan Mayen (0.046) and Iceland (2.7). The European population represents 10% of the world's population. The fertility rate in Europe was 1.6 in 2017<sup>1</sup>. In Asia, on the basis of estimates made by United Nation, the Asian continent population increased from 3,714,469,832 in 2000 to 4,478,315,164 on May 21, 2017. Asian population accounts for over 59.69% of the total

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<sup>1</sup> <http://www.digi24.ro/stiri/actualitate/social/populatia-romaniei-a-scazut-cu-122-000-de-persoane-anul-trecut-784790>

population on the globe and ranked 1st in the world's regions. In the urban area, 2,209,077,838 people live and work, i.e. almost 49.3% of the Asian population and the average age is 30.7 years. The total fertility rate has decreased from 1.31 children born to a woman in 2000 to 1.50 children born to a woman in 2017<sup>2</sup>.

In Romania, the population variation recorded a decreasing trend, accounting for 19.63 million people on January 1, 2017, decreasing by 6.21% as compared to January 2016. The main causes of these decreases were: the negative natural increase - the number of deaths was higher than the number live births, increasing the aging process - increasing the share of the elderly population over 65, and increasing the international migration balance - the number of emigrants was higher than the number of immigrants (Caldwell, 2004). According to the National Institute of Statistics of Romania, the annual population growth rate in 2017 was more than -0.6% per year. The male population represents 48.8% of the total population compared to the feminine population, which reaches 51.2%. Urban population is the majority with 53.6%. In Romania, the most populated regions are: the North-East region (3.71 million inhabitants), the South-Muntenia region (3.26 million inhabitants), the South-East region (2.81 million inhabitants) the most populous city (1.88 million inhabitants), being at the same time the most powerful commercial and industrial center of Romania. This is followed by the counties of Iasi (0.77 million inhabitants) and Prahova (0.76 million inhabitants)<sup>3</sup>.

Depending on the age group, the proportion of the Romanian population is as follows: between 0-14 years - 15.6% of the total population, between 15-64 years -76.6%, and over 65 years old 17.8%. Population density, calculated by measuring the number of people per square kilometer, is 80 inhabitants per square kilometer. The regions with the largest population per kmp are the North-East region with 101 inhabitants/km and the South-Muntenia region with 98 inhabitants/km<sup>2</sup>. In Romania the fertility rate dropped from 2.22 children born to a woman in 1989 to 1.52 children born to a woman in 2015<sup>4</sup>.

## 2. Literature review

Changing demographic behavior, in general, of fertility evolution, in particular, has been the subject of some studies. They pointed out that a consequence of political, economic and social crises or wars resulted in a significant decrease in population fertility (Rindfuss and Sweet, 1978; Caldwell, 2004; Heuveline and Poch, 2007). Others have shown an increase in fertility shortly after natural cataclysms resulted in the death of a large proportion of the population (Nobles *et al.*, 2015). Evolution of population size considering the effective level of fertility, mortality and migration in some developed or developing countries has been the subject of other studies (Craig, 1994; Jayachandran, 2017). The decline in the fertility quota in some countries is the result of the population's desire to form smaller families composed of two adults and one child (Jayachandran, 2017). In other countries, the decrease in fertility was determined by the increase in the level of education among the female population (Lam *et al.*, 2016) and the decline in the quality of social, educational and health services (Bradatan and Firebaugh 2007; Colleran 2016). The increase in the fertility quota in some regions has occurred on the background of improving women's status, improving health, educating the population, eradicating poverty and increasing the phenomenon of immigration (Kulu, 2005, Yavuz, 2006; Pop-Eleches, 2010).

## 3. Methodology of research

### 3.1. Objectives of research

In the study, the delineated decision-making issue addresses "*How will the fertility rate and demographic profiles show between 2018 and 2100 in Romania and Turkey?*" Given the decisional issue, the purpose of the quantitative research was determined by identifying the evolution of the fertility rate and the demographic profiles in the two analyzed countries.

The main objectives of the study were:

- the evolution of total population variation in Romania versus Turkey;
- population trend for the age group 0-14 in the two countries;
- the dynamics of the total fertility rate in the two states;
- the movement of a woman / man's life expectancy in Romania and Turkey;
- identification of projections of demographic profiles for Romania and Turkey by 2100.

<sup>2</sup> <http://www.worldometers.info/world-population/asia-population/>

<sup>3</sup> [http://www.insse.ro/cms/files/publicatii/Evolutia%20natalitatii%20si%20fertilitatii%20in%20Romania\\_n.pdf](http://www.insse.ro/cms/files/publicatii/Evolutia%20natalitatii%20si%20fertilitatii%20in%20Romania_n.pdf)

<sup>4</sup> <http://www.worldometers.info/world-population/asia-population/>

4. Results and discussions

In Romania, after 1989, the decrease of the population weight was due to several factors such as: introducing the first steps to repeal legislation on the ban on abortion and contraception, increasing social issues, the application of the phenomena of poverty and emigration that has been linked to the decrease in birth rates. In this context, Romania has aligned itself with the European general trend. According to forecasts based on data provided by the United Nations, the Department of Economic and Social Affairs, Population Division, between 1950 and 2100, the proportion of the population will continue to decrease to an average of 11 million people (Figure 1A).

In Turkey, the increase in the population variation was slow but continued, reaching 81.13 million people in January 2018, 6.5% versus 2010. According to the metadata published by the Turkish Institute of Statistics (TÜİK), the annual growth rate of the population in 2017 was over 1.24% per year. Official data shows that 40.5 million (50.2% of the total) represent the male population in Turkey while the female population was 40.3 million (49.8%). Over 92.5% of the population of Turkey live in cities comparative with 7.5% living in villages. Istanbul remains the most populous city in Turkey, with over 15 million people (representing 18.6% of the total population), followed by the capital Ankara (5.5 million people), Izmir (4.3 million inhabitants) Bursa (2.9 million inhabitants), Antalya (2.3 million inhabitants).

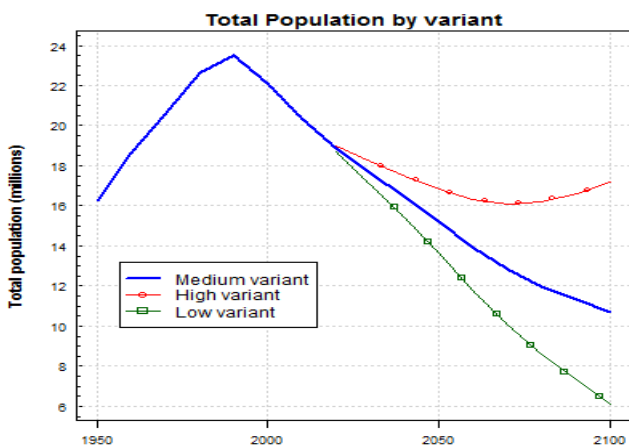


Figure 1A. Total population by variant in Romania

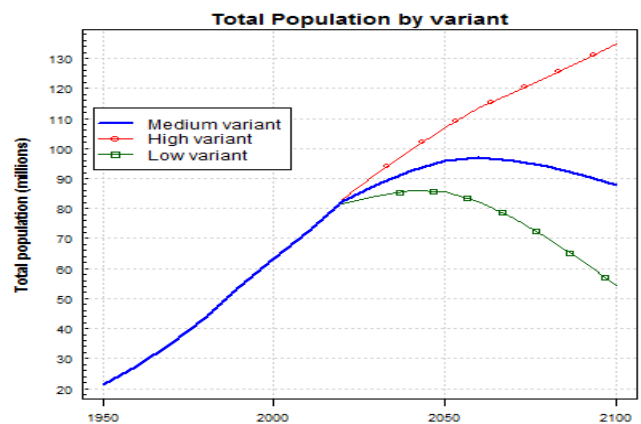


Figure 1B. Total population by variant in Turkey

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

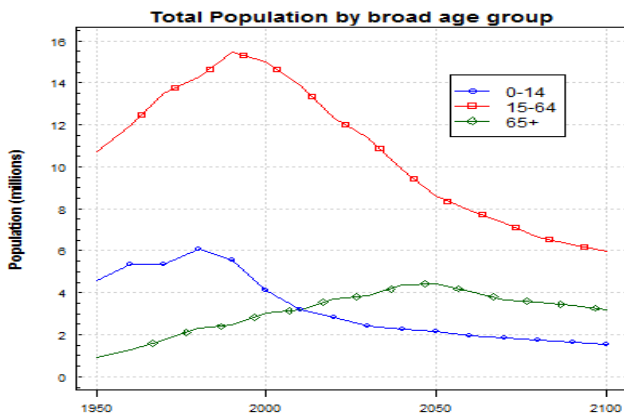


Figure 2A. Total population by broad age group in Romania

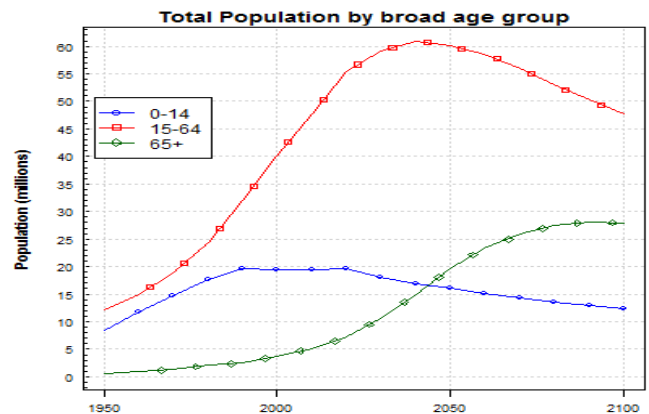


Figure 2B. Total population by broad age group Turkey

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

At the end of 2017, depending on the age group, the Turkish population was grouped as follows: the population under 15 - 23.6%, between 15-64 years - 67.9% (about 55 million people) and over 65 years of 8.5%. Population density, calculated by measuring the number of people per square kilometer, increased to 105 in 2017 compared to 104 in 2016. The regions with the highest population density were Istanbul (with 2,892 people / km<sup>2</sup>), Kocaeli (by 521) and Izmir (356). According to World Bank data, total fertility rate in Turkey has declined from 3.18 children born to a woman in 1989 to 2.01 children born to a woman in 2015. Since 2000, in Turkey, the variation in the total population has been positive and increasing, according to United Nations projections, by the Department of Economic and Social Affairs, Population Division, the total population variation will reach a maximum of 100 million inhabitants during the period 2055-2065 for later to fall to 89 million by 2100 (Figure 1B).

If in Romania projections based on UN estimates indicate a sharp fall in the population of age group 0-14, the situation in Turkey is the opposite, waiting for rapid growth by the end of 2050. Therefore, in Romania, the decline will continue demographics and will increase the phenomenon of aging populations. Instead, Turkey will continue to remain the smallest European country and the average age could fall below 29.7 years on 1 January 2018 (Figures 2A and 2B).

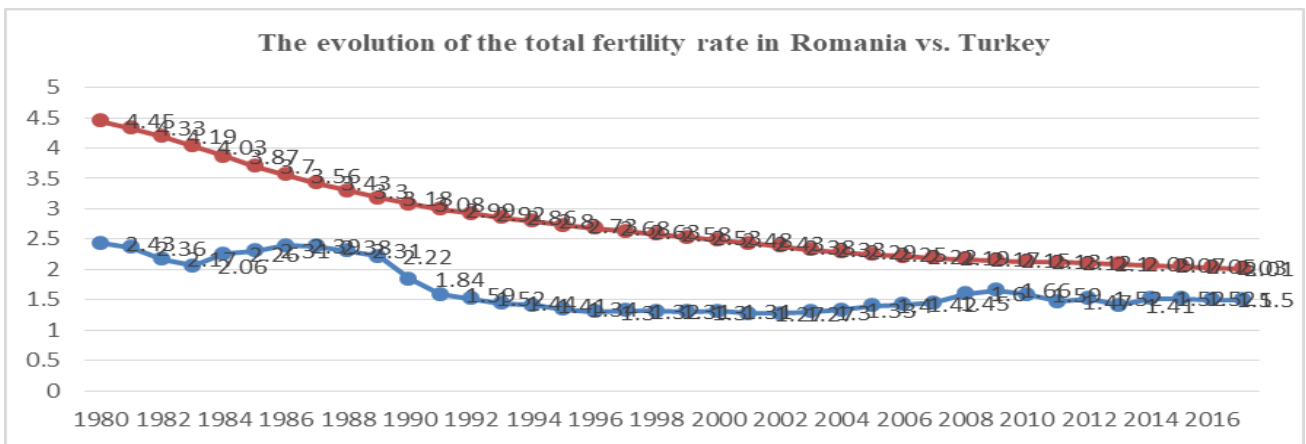


Figure 3. Evolution of the total fertility rate in Romania vs. Turkey

Source: Made by author

In Romania, the total fertility rate decreased by 61.72% in 2017 compared to 1980 and by 65.84% compared to 2008, In Turkey, the total fertility rate decreased by 45.16% in 2017 compared to 1980 and with 48.76% compared to 2008 (Figure 3). The construction of the diagram was based on the metadata provided by the National Institutes of Statistics.

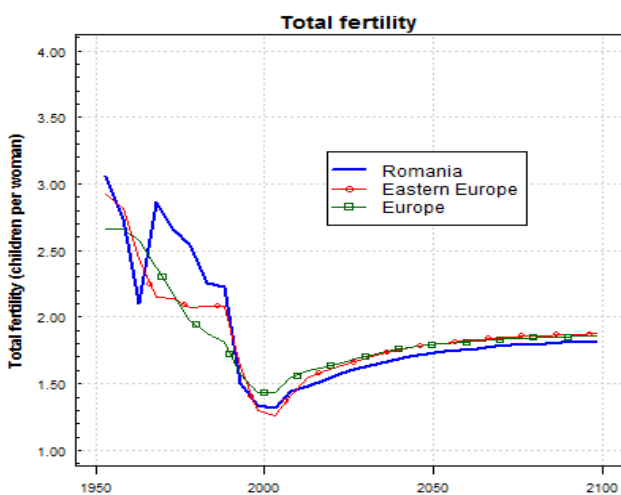


Figure 4A. Total fertility in Romania

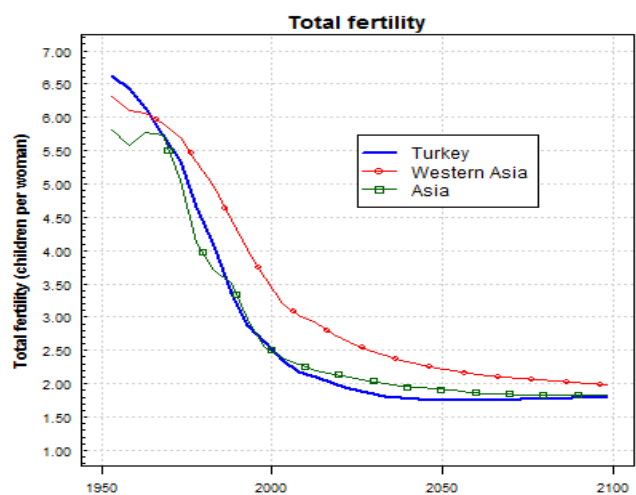


Figure 4B. Total fertility in Turkey

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

Figures 4A and 4B show that both estimates and projections of total fertility rates in the two countries follow the general trends in the two continents.

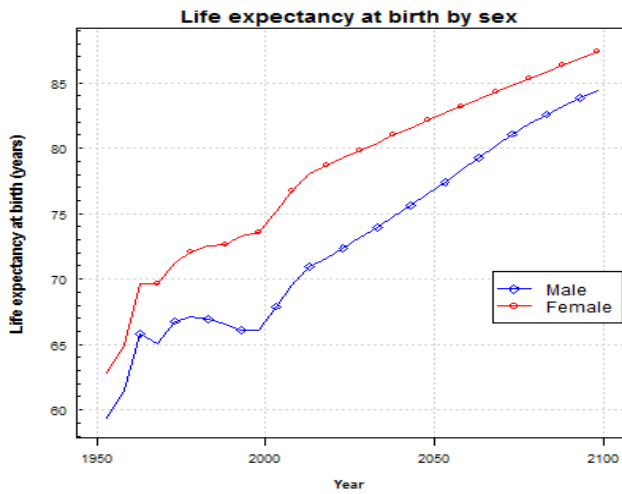


Figure 5A. Life expectancy at birth by sex in Romania

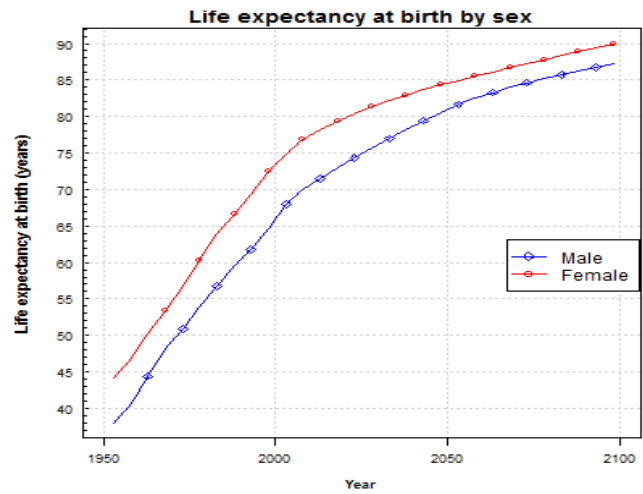


Figure 5B. Life expectancy at birth by sex in Turkey

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

Life expectancy at birth is the indicator that gives a real picture of the health of a country's population. Compared to World Health Rankings data, in Romania the life expectancy of a woman is 79 years old and a 71.6 year old man. Romania has a gap of over 8 years in this chapter compared to other European countries and ranks 72th in Word Rank with a total life expectancy of 75.2<sup>5</sup>. Figure 5A shows the smallest levels of life expectancy at birth among men between 1980 and 2000. The gap between women's and men's life expectancy at birth is significant, reaching 6-8 years. Estimated values for 2001-2100 do not indicate a major recovery in the situation. However, this would only be possible in the context of the development of favorable social and economic changes in Romania.

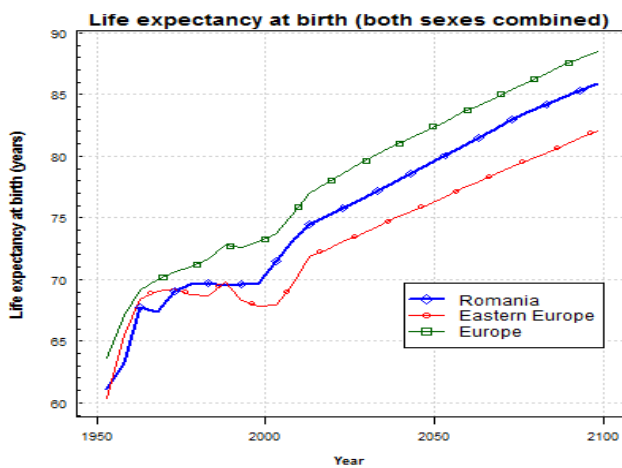


Figure 6A. Life expectancy at birth in Romania (both sexes combined)

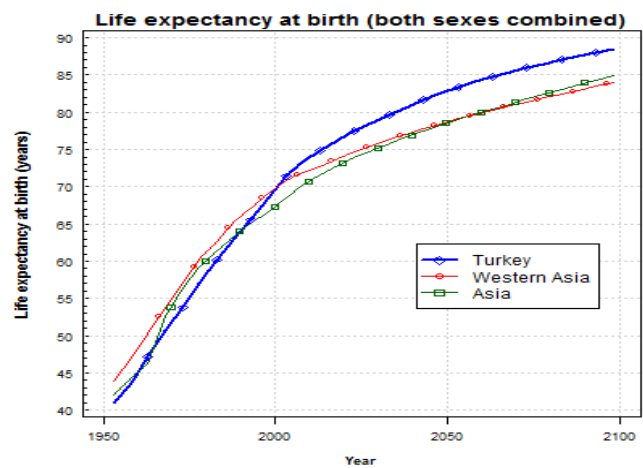


Figure 6B. Life expectancy at birth in Turkey (both sexes combined)

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

<sup>5</sup> United Nations Desa Population Division, <https://population.un.org/wpp/Graphs/DemographicProfiles/>

In 2018, life expectancy in Turkey is 73.3 years among men and 79.4 years among women. It ranks 52th in the world rankings with a total life expectancy of 76.4 years. Projection of the estimated values for the period 2018-2100 indicates a more pronounced increase in women's life expectancy compared to men, the gap between them decreasing to less than 5 years (Figure 5B). The projection of total life expectancy at birth in Romania indicates an evolution that fits the European trend and Eastern Europe (Figure 6A). In the same time horizon, total life expectancy at birth in Turkey does not harmonize after 2000 with either the trend in Europe or Asia and Western Asia. In figure 6B, it is visible that the increase in life expectancy in Turkey more than 5 years over that in Asia.

The figures below show the demographic profiles in Romania and Turkey based on United Nations metadata for the period 1950-2100. All values used after 2017 are estimates and helped to build projections (medium variation) by 2100. With the dotted lines, an excessive male or female population was indicated in certain age groups on each country. The data required for the analysis were estimated in millions and represents the population of each age group per country.

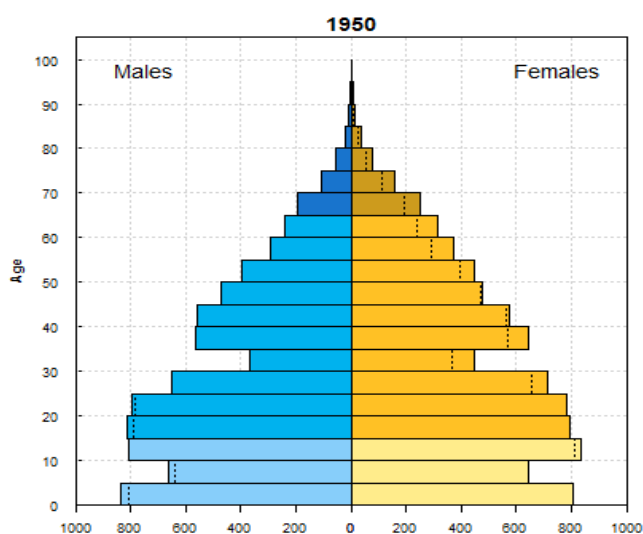


Figure 7A. Populations pyramids in Romania in 1950

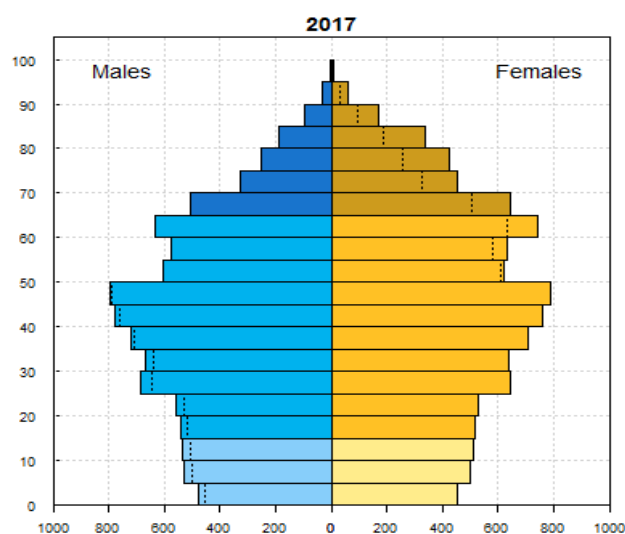


Figure 7B. Population pyramids in Romania in 2017

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

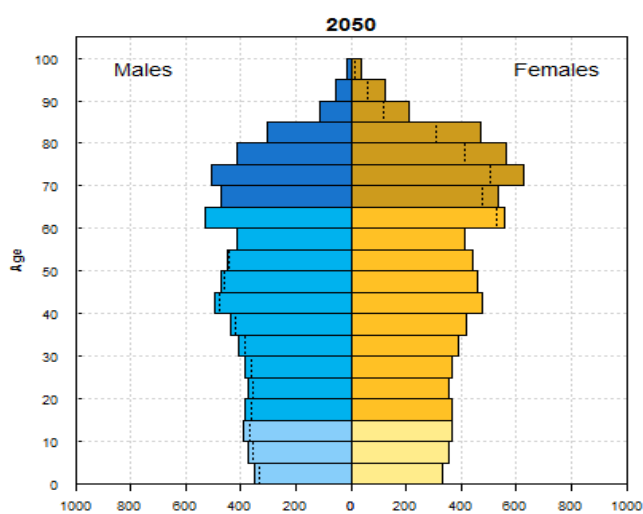


Figure 7C. Populations pyramids in Romania in 2050

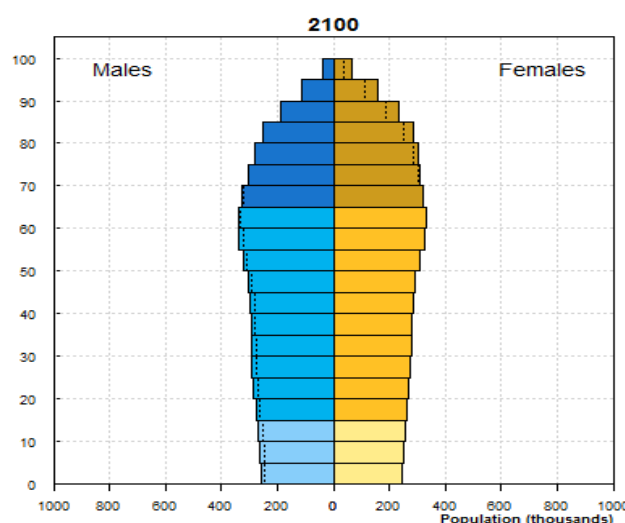


Figure 7D. Population pyramids in Romania in 2100

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision

In Romania, the projection of the estimated values indicates a rapid fall in population by 2100. In 1950 the male population recorded an excess for the age groups between 0-20 years and the female population for the 20-45 age groups. In 2017, dotted lines showed a majority female population over the age group of "over 60 years" (Figure 7A and 7B). In 2050 there is an accelerated aging among the population and a majority among the female population for the age group over 50 years. In 2100, the female population remains the majority and in excess for the "over 70s" group. In 2050 there is an accelerated aging among the population and a majority among the female population for the age group over 50 years. In 2100, the female population remains the majority and in excess for the "over 70s" group.

In Turkey, the projection of estimated values indicates a broad population increase by the year 2100. In 1950 the male population recorded an excess for the age groups between 0-20 years and the female population in the 50-80 age groups. In 2017, dotted lines showed a female population over the age group of "over 40 years" and an excess of the male population by age group 0-30.

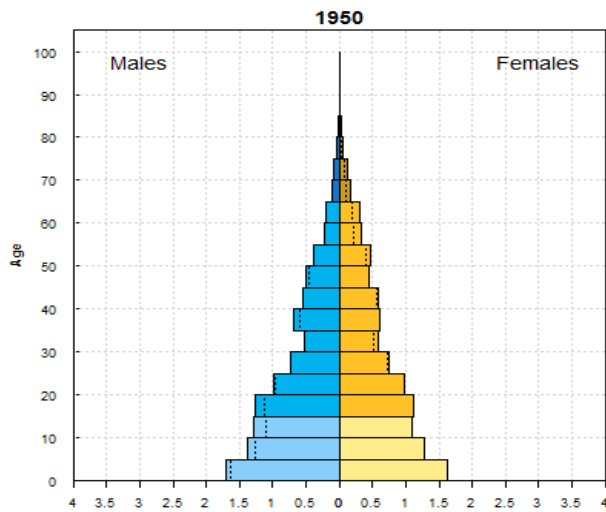


Figure 8A. Populations pyramids in Turkey in 1950

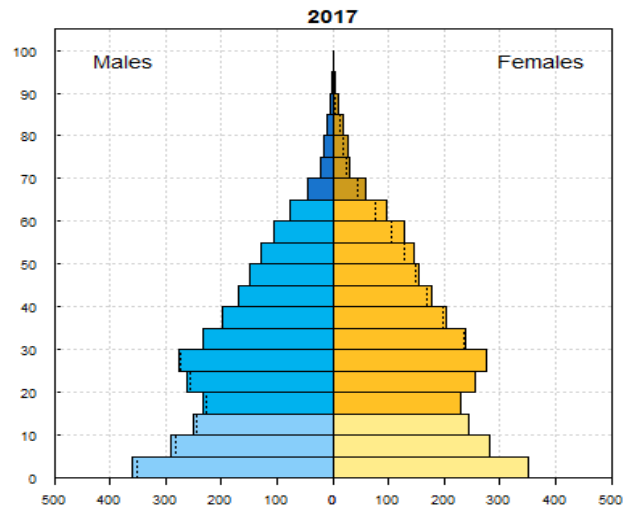


Figure 8B. Population pyramids in Turkey in 2017

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

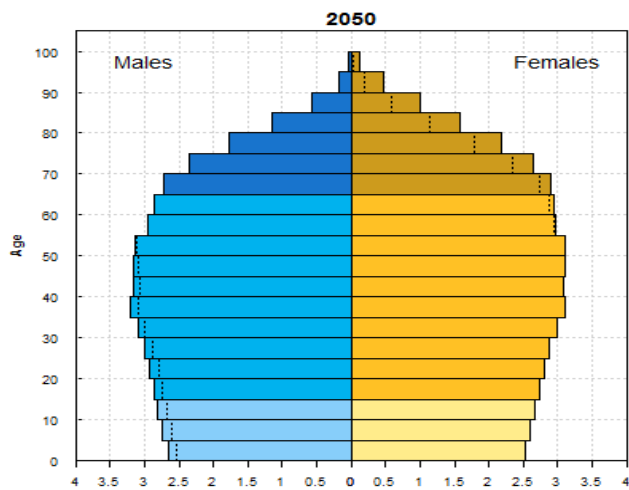


Figure 8C. Populations pyramids in Turkey in 2050

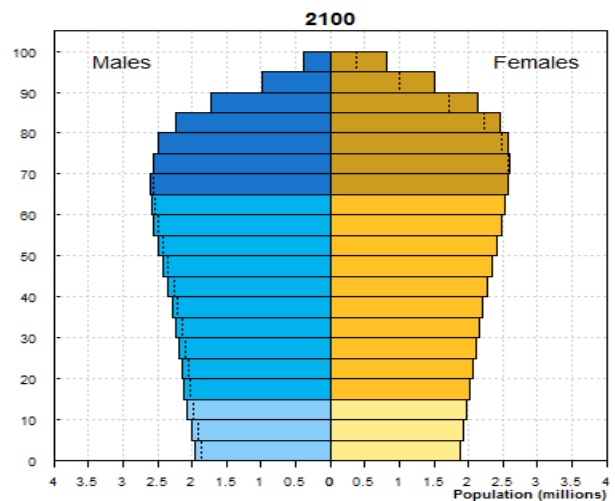


Figure 8D. Population pyramids in Turkey a in 2100

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.



In 2050, there is an excess in the male population for the age groups of 0-50 years and among the female population for age groups over 60 years of age. In 2100, the female population remains the majority and excess for the "over 70s" group. The dotted line indicates the excessive male or female population in certain age groups.

The diagram originates in the Bayesian hierarchical modeling of total fertility. The data needed to build this chart represent fertility estimates following the revision of the prospects of the population of Romania in 2017. The chart uses two scales, the order of the time is expressed in years, and the Total Fertility Rate (TFR) abbreviations are displayed between 1.00 and 2.00 on the vertical axis reflect only a small selection of probable total fertility trajectories in Romania between 1950 and 2100. The solid red line indicates a median projection framed between 1.5 and 2.00 on the TFR scale in the 2000-2100 range. This is framed above and below the 80% and 95% projection intervals shown in the diagram as dotted red lines.

In the case of Romania, fertility variants with a high age correspond to +/- 0.5 children are disposed around the median trajectory being presented in the form of discontinued blue lines that easily pass over a TFR of 2. The horizontal green dotted line represents the level replacement of 2.1 copies per woman and is presented for reference only (Figure 9). The data used for chart plotting in Figure 9 are fertility estimates following a revision of the prospects of the population of Turkey in 2017. Between 1.00 and 3.00, several grid lines reflecting a small selection of the probable total fertility trajectories in Turkey between 1950 - 2100. In this case, the red line continues to indicate a median projection framed between 1.00 and 2.50 on the TFR scale in the 2000-2100 range. This is framed above and below the 80% and 95% projection intervals shown in the diagram as dotted red lines.

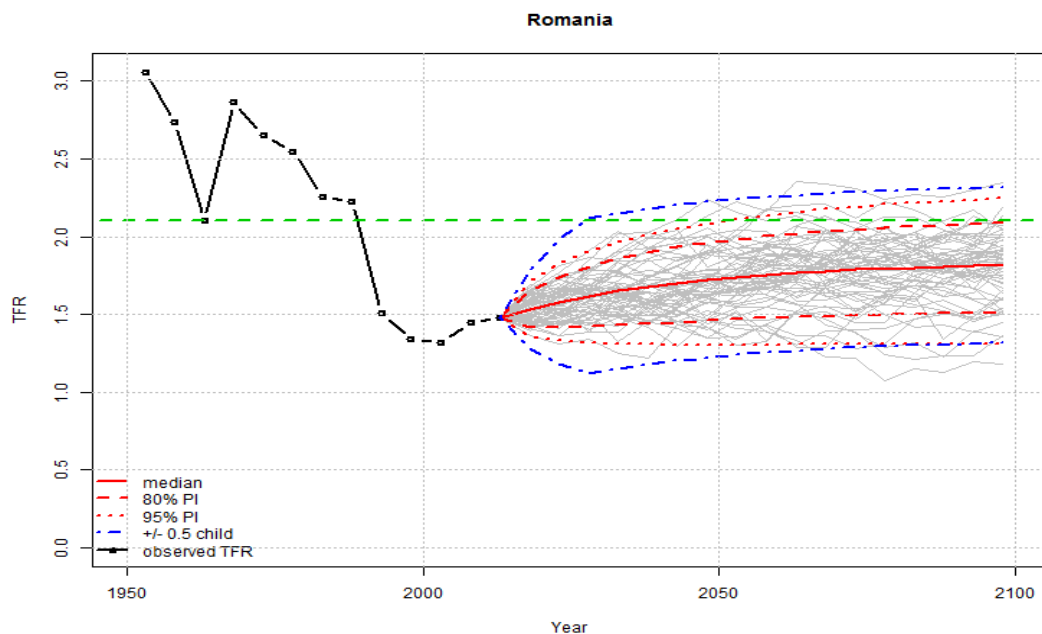


Figure 9. Projection Fertility in Romania

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

In the case of Turkey, fertility variants with a high age correspond to +/- 0.5 children are disposed around the median trajectory being presented as discontinuous blue lines that easily reach a 2.50 TFR (Figure 10).

Figure 11 shows the fertility projection in Romania between 1950 and 2100 using another diagram, namely the decline curve. The gray lines illustrate the selection of the double logistic probability trajectories shown in the diagram. The black spots located according to the order between values 1 and 3 indicate the decrease in total fertility during 5 years and the fertility transition periods specific to phase II, ie the shift from high fertility to low.

The median projection is the solid red line, and the 80% and 95% projection intervals are displayed as dashed and dotted red lines. Phase I refers to data specific to the pre-fertility transition period starting in 1950), and Phase III reflects data from the low fertility post-transition period that was modeled by a self-regressive temporal series. Probabilistic Projections of Total Fertility indicate a slow but slow decrease in TFR by 2100 in Romania (Figure 11).

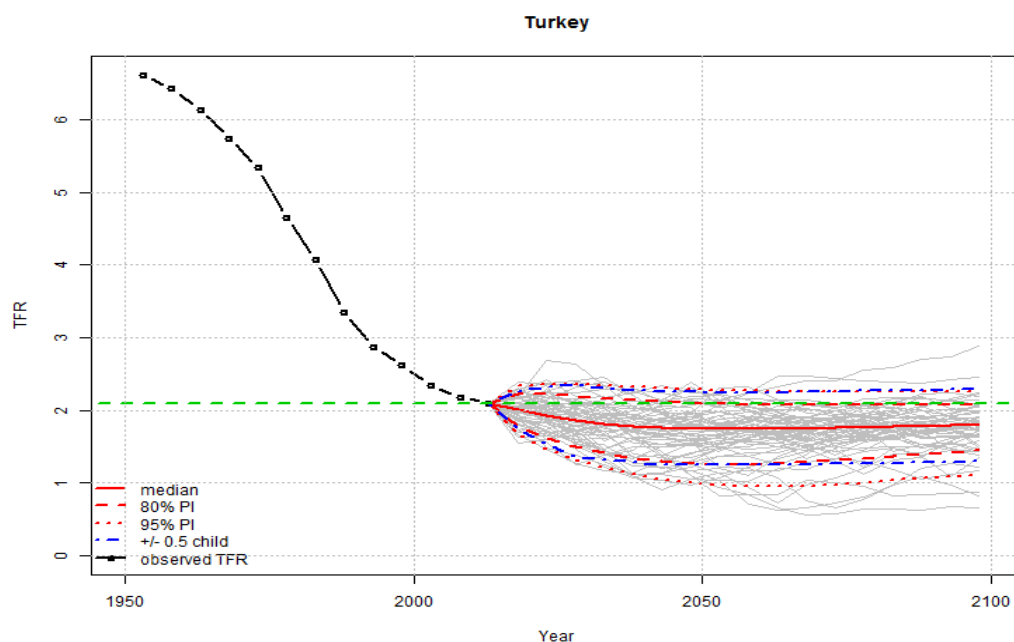


Figure 10. Projection Fertility in Turkey

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

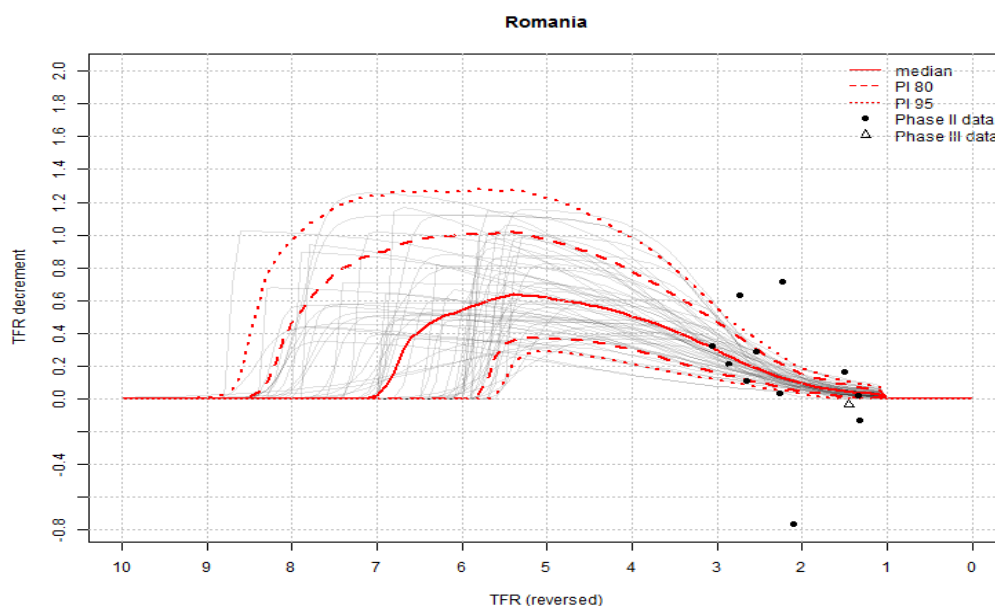


Figure 11. Probabilistic Projections of Total Fertility using WPP 2017 fertility estimates in Romania

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

Figure 12 illustrates the projection of fertility in Turkey between 1950 and 2100 using the curve diagram of decline. And here the selection of double logistic probability trajectories is illustrated by gray lines. Probabilistic Projections of Total Fertility indicate this time a progressive and very rapid decline in TFR by 2100 in Turkey.

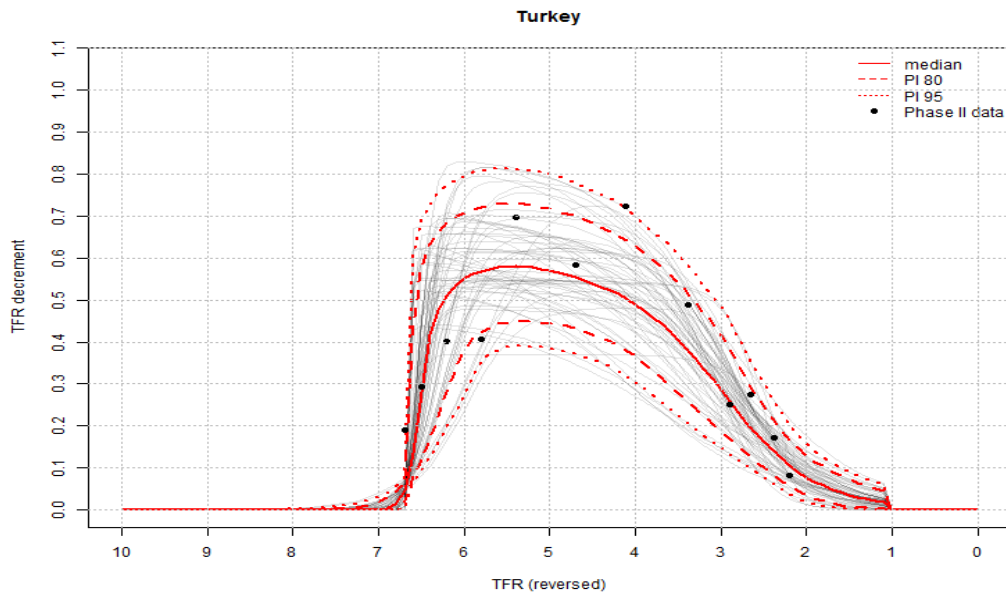


Figure 12. Probabilistic Projections of Total Fertility using WPP 2017 fertility estimates in Turkey

**Source:** United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision.

As can be seen in Figure 13, the total fertility rates based on probabilistic data in Romania and Turkey have a downward trend. If in Romania the total fertility rate becomes negative only after 2067 in Turkey, it reaches an earlier negative threshold, i.e. starting with 2046.

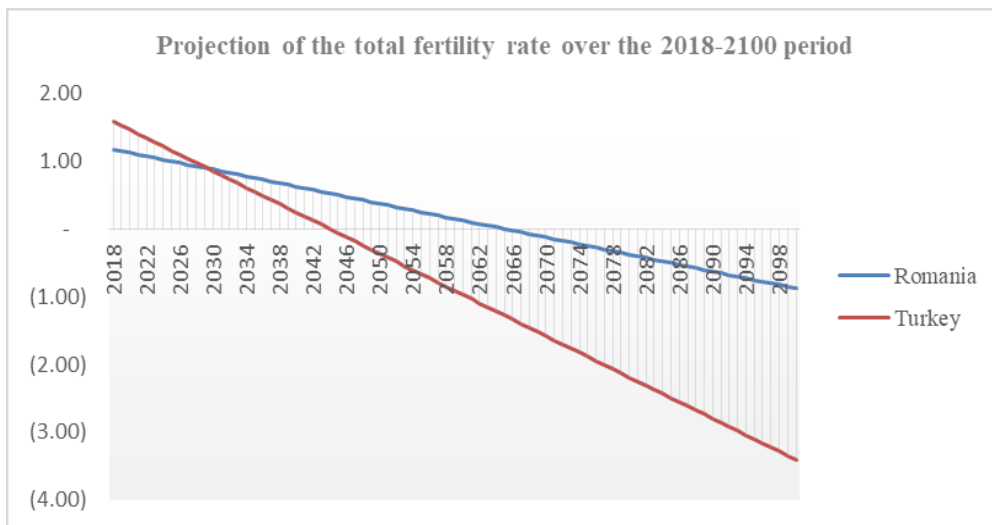


Figure 13. Projection of the total fertility rate in Romania vs. Turkey

**Source:** Made by author

## 5. Conclusions

After 1989, Romania saw a decrease in the share of the population, in line with the general European trend. According to the forecasts, between 1950 and 2100 the population will continue to decline to about 11 million people.

In Turkey, starting in 2000, the variation in the total population will continue to grow, reaching about 100 million inhabitants in 2065, then falling to 89 million by 2100. According to projections based on UN estimates, by the end of 2050 in Romania population in the 0-14 age group will decrease compared to Turkey where it will grow faster, generating an average age of about 29 years.

The total fertility rate has diminished in both countries. In Romania, the total fertility rate declined by 61.72% between 1980 and 2017, compared to Turkey where it dropped by 45.16%. Therefore, the projections of total fertility rates in the two countries follow the general trends on the two continents. Compared with Romania, where the life expectancy of a woman is 79 years in Turkey, it is slightly higher, i.e. 79.4 years. Life expectancy among Romanian men is 1.7 years lower than that of Turkish men (73.3 years).

Projection of the estimated values for the period 2018-2100 indicates in Turkey a more pronounced increase in women's life expectancy compared to men, the gap between them decreasing to less than 5 years. Based on UN-provided metadata for the period 1950-2100, projections of demographic profiles for Romania and Turkey were developed using Bayesian Hierarchical Modeling and Decline Curves. Thus, in Romania the projection of the estimated values indicates a rapid decrease of population by 2100, while in Turkey it indicates a large population growth.

The diagram resulting from the use of the Bayesian hierarchical modeling of total fertility indicates in Romania a small selection of probable total fertility trajectories ranging between 1.00 and 2.00 on the vertical axis between 1950 and 2100 and a median projection between 1.5 and 2.00 on the TFR scale in the 2000-2100 range. In Turkey, the selection of probable total fertility trajectories indicates a wider selection between the 1.00 and 3.00 ranges on the vertical axis between 1950 and 2100 and a median projection between 1.00 and 2.50 on the TFR scale in the 2000-2100 range.

In the "Declining Curves" Diagram, probabilistic projections of total fertility indicate a gradual but slow decrease in TFR by 2100 in Romania and a very rapid decline in TFR in Turkey. Total fertility rates based on probable data in Romania and Turkey have a downward trend. In Romania, the total fertility rate becomes negative after 2067, while in Turkey it reaches a negative threshold starting with 2046.

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