COMPARING HEALTHY LIFE EXPECTANCY IN EUROPE ACCORDING TO WHO, EUROSTAT AND FIRST EXIT TIME THEORY.

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Abstract

Healthy life expectancy, in general, describes the health status of a population. The World Health Organization uses for its calculation a method according to which after applying disability weights to health states, the equivalent number of years of good health of a newborn are estimated. Eurostat uses a different methodology based on the Sullivan method. A life table which enables the calculation of life expectancy for each age x_i (or age category *i* in the case of an abridged life table) is constructed. Afterwards, the observed prevalence of the population in healthy or unhealthy conditions is taken into consideration. Exit Time Theory applies a stochastic methodology on mortality data to calculate the number of years a newborn is expected to live without disabilities and in good health. This paper aims to compare comparatively the results of these three approaches and discuss and similarities or dissimilarities existing among them.

Key words: WHO, EUROSTAT, First Exit Time Theory, Healthy life expectancy.

JEL Code: I1, J10, J26

Introduction

The problem of the estimation of the health levels within a population is not a new one. Since the time of Sanders (1964) and Chiang (1965), much effort has been put for the development of several indices or measurements of health (see for example Sullivan, 1971; Torrance, 1976 etc.). One of the modern methods of estimation that serves this purpose is the healthy life expectancy at birth, which represents the number of years of good health that a newborn can expect to live (WHO, https://www.who.int/gho/mortality_burden_disease/life_tables/hale_-text/en/). Out of the several methods which have been developed to estimate it , three of them will be presented and compared within this paper. These are the following: the method presented by World Health Organisation (WHO), the method used by the EUROSTAT and another one which springs from the stochastic theory (First Exit Time Theory).

Thus, the scope of this paper is to comparatively analyse the estimations of healthy life expectancy in the European countries and check the consistency of these methods.

1 A brief overview of the methods

1.1 The Method of the World Health Organization (WHO)

The first step of this method is the calculation of life tables per gender within a population. Afterwards, the necessary for the subsequent calculations Years Lost because of Diseases (YLDs) are used, coming largely from the relevant estimates of the Global Burden of Disease 2016 study. In the latter procedure, the YLDs are *"estimated as the product of prevalence and a disability weight for all mutually exclusive sequelae, corrected for comorbidity and aggregated to cause level"* (Vos et al. 2017). Thus, the healthy life expectancy is simply the result of the subtraction of life expectancy at birth and the YLDs (for the overall estimation procedure see WHO, n.d.).

1.2 The Method of Eurostat

According to this method, Healthy Life Years (HLY) at birth is the estimated years that a neborn is expected to live in healthy conditions. This indicator combines information on mortality and morbidity. Firstly, a life table is constructed, and afterwards, the prevalence of the population in healthy or unhealthy conditions is evaluated. Overall, the Sullivan (1966, 1971) method is applied, while a healthy condition is defined by the absence of limitations in functioning/disability. The indicator is calculated separately for the two genders (see EUROSTAT, n.d.).

1.3 The First Exit Time Theory

The first idea for applying a stochastic method in order to model a life table and assess an estimation of the health state of a population comes from Jansen and Skiadas (1995). In such approaches, a first exit time model is developed, that contains two primary components, i.e. a stochastic parent process, which in this case is human health, and a barrier that indicates a stopping condition for this process, which now is the human death. Thus, human health follows a stochastic and therefore unpredictable path for each individual, and death occurs when health status falls below that barrier. This process can be modelled, in a way that after applying a mathematical procedure solely on life table data, an assessment of healthy life expectancy can be made. Details of this process and of the employed mathematical calculations can be found in Skiadas and Skiadas (2018a; 2018b), while various variations of this method have been published elsewhere (see for example Zafeiris and Skiadas, 2017).

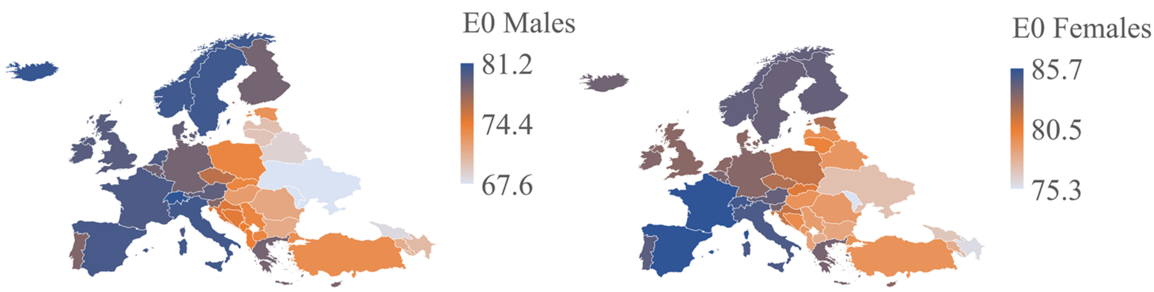
2 Data and methods

Data were collected by the World's Health Organization (https://www.who.int/gho/countries/ag, https://apps.who.int/gho/data/view.main.HALEXREGv?lang=en). They are related to life expectancy at birth and healthy life expectancy according to the estimations of the relevant method. For Eurostat, data derive by the online database (https://ec.europa.eu/eurostat/data/database) and in addition to the estimates of Healthy life Expectancy they refer to the midyear population and to the number of deaths per age and gender. These data were used for the stochastic analysis, the findings of which represent own calculations. All results and the subsequent analysis refer to the year 2016.

3 Results

Before discussing any results, the well-known heterogeneity of the countries of Europe in terms of political, economic and social development needs to be taken into consideration. This heterogeneity is marked impressively in the mean duration of life in each of them, i.e. in the life expectancy at birth (e0, Figure 1).

Fig. 1: Life expectancy at birth. Europe, 2016.

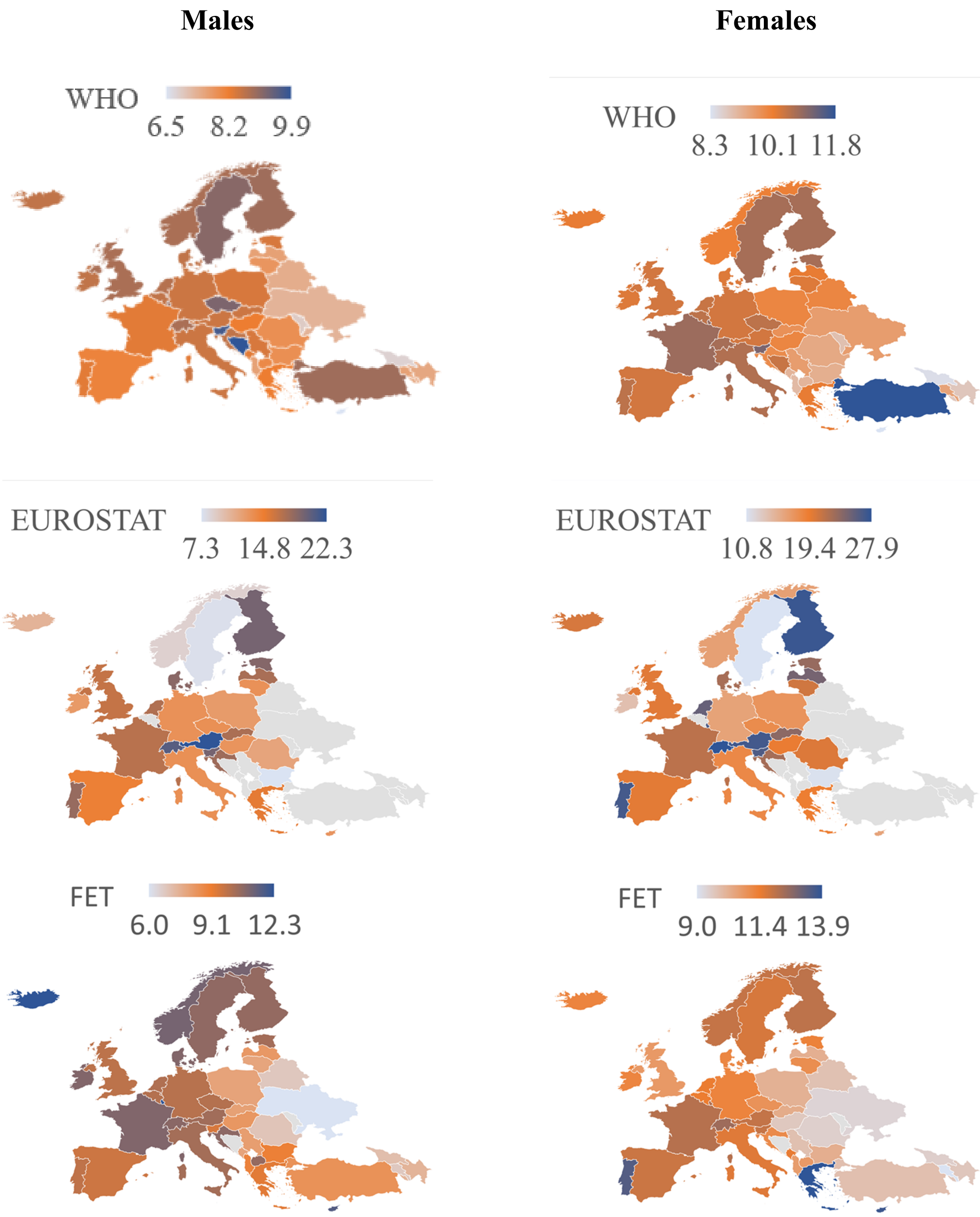


Source: World Health Organization, https://www.who.int/gho/countries/ag

For the year 2016, males' e0 range is 13.6 years (from 67.6 to 81.2 years,) and females' e0 is 7.4 years (from 75.3 to 85.7 years) in all Europe. Additionally, a discrete spatial pattern emerges in both genders. There is a clear division of the eastern part of the continent, mainly ex-communist countries, except for Greece (a full member of the European Union and Eurozone). Life expectancy at birth is much lower there, and the differences become larger in countries like Ukraine and Armenia. Therefore, the health levels should vary a lot among the

European countries, representing the high variability in the prevalence of the diseases, health and social security systems and other agents, some of them named within the first paragraph of this session.

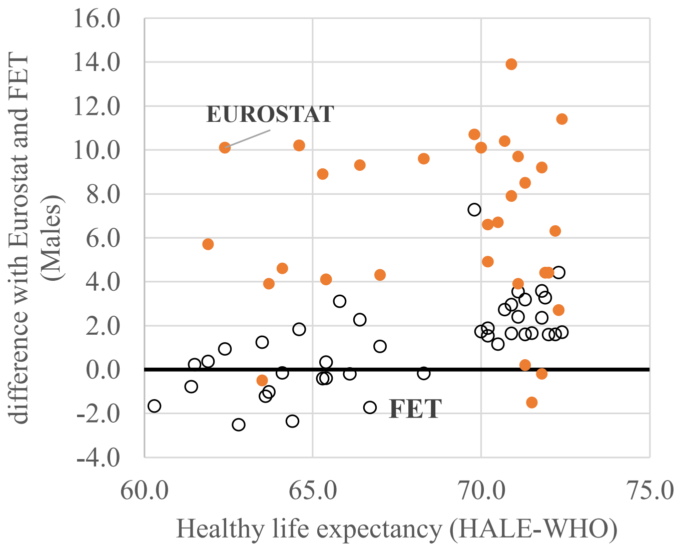
Fig. 2: Healthy years lost. Europe, 2016. WHO, EUROSTAT, First Exit Time Theory (FET)

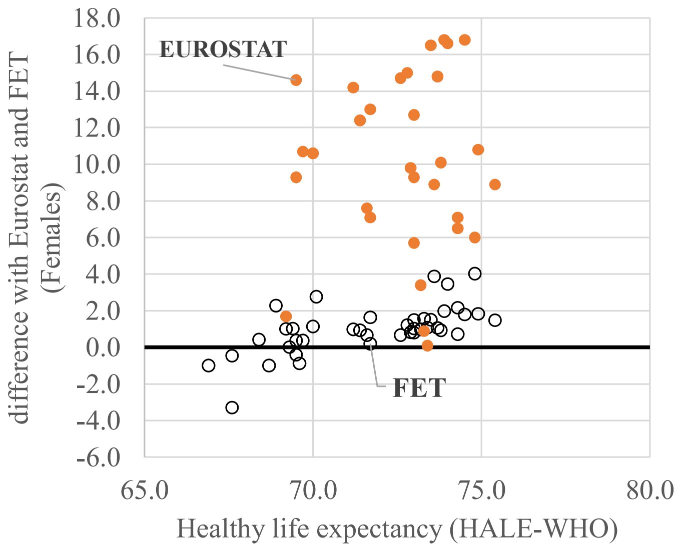


Source: World Health Organization: https://apps.who.int/gho/data/view.main.HALEXREGv?lang=en, EUROSTAT: https://ec.europa.eu/eurostat/data/database, FET: own calculations Based on EUROSTAT Data.

It is not surprising then that the healthy years lost are incredibly different between European countries (Figure 2). What is surprising is the existing differences between the three methods in the estimation of the healthy years lost. The WHO estimations range 3.4 years, and the applied stochastic method gives a range of 6.3 years. The most diverse results come from Eurostat. A more precise examination of the differences in the resulting healthy life expectancy at birth (HALE) is seen in Figure 3, where the differences between WHO estimations and the other methods are being presented.

Fig. 3: Differences of WHO HALE minus the relevant estimations of EUROSTAT and First Exit Time Theory (FET). Europe, 2016.

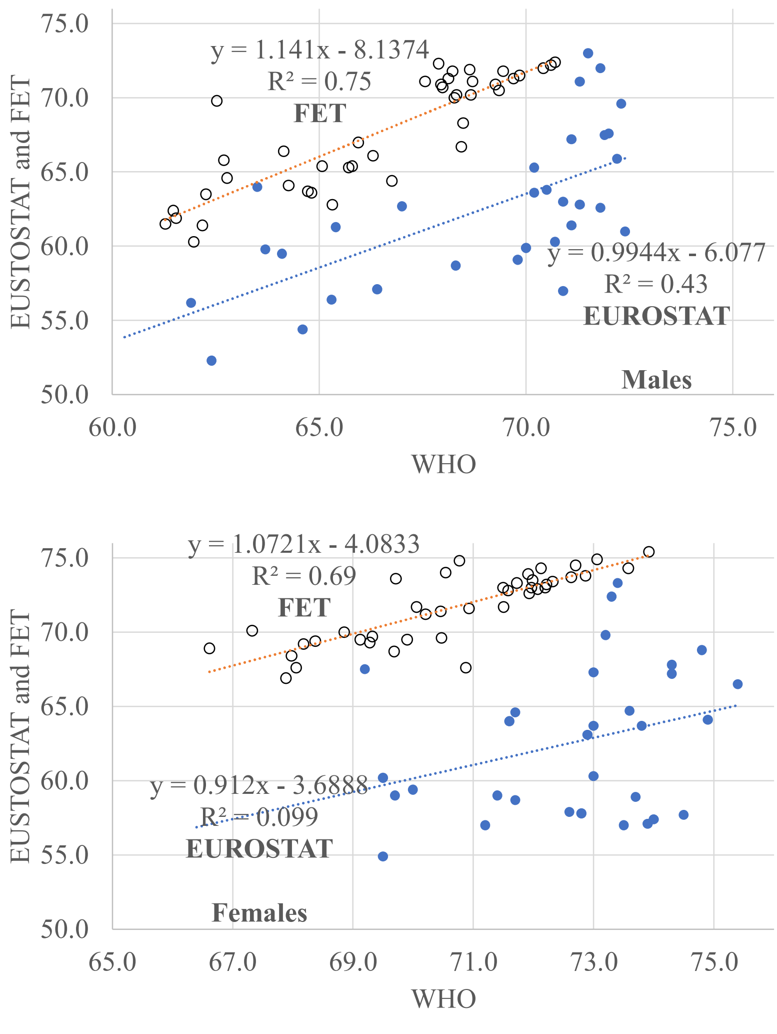




Source: World Health Organization: https://apps.who.int/gho/data/view.main.HALEXREGv?lang=en, EUROSTAT: https://ec.europa.eu/eurostat/data/database, FET: own calculations Based on EUROSTAT Data.

Obviously enough, the stochastic method‘s results are in accordance with those of the World Health Organization. In females, for most of the countries, FET gives either very similar estimations with the method used by WHO or, with a few exceptions for some smaller countries, the differences are less than ±2 years. The differences between the two methods are more significant in males, a sign that perhaps some adjustments need to be done in the stochastic approach. On the contrary, the differences between Eurostat and the other methods are enormous, a fact which raises important questions about the effectiveness of the technique used by the Eurostat.

Fig. 4: Healthy life expectancy at birth. Europe, 2016. WHO, EUROSTAT, First Exit Time Theory (FET)



Source: World Health Organization: https://apps.who.int/gho/data/view.main.HALEXREGv?lang=en, EUROSTAT: https://ec.europa.eu/eurostat/data/database, FET: own calculations Based on EUROSTAT Data.

Another aspect that needs to be clarified is the relationship between the World Health Organization estimations concerning HALE (HALE-WHO) and the relevant figures of Eurostat and the stochastic method (FET) (Figure 4). Both HALE-WHO and healthy life expectancy calculated by FET seem to be connected systematically in a linear way, even if the coefficient of determination R^2 of the linear relationship is not perfect. In males, it is 75% and in females 70%. On the contrary, Eurostat estimations have either no relationship with the ones acquired by the WHO, as seen in the case of females, or this relationship is very low, as presented in males.

Conclusion

In this paper, we compared the estimations of healthy life expectancy by the application of three different methods.

The method of the World Health Organization is complicated, and besides the data needed for the construction of the life tables of a population, it requires additional data from the Global Burden of Disease Study. Analogously, Eusrostat's method requires data about any limitations in functioning/disability of the members of a population, besides the ordinary data for the estimation of life expectancy at birth. The only method which is based solely on lifetable data is the one constructed for the stochastic point of view. Thus, it was found to be the most straightforward and timeless consuming method.

Between them, the methods of WHO and FET are in accordance with each other, despite some minor discrepancies. On the contrary, the Eurostat method gives more distant and thus less reliable estimations on healthy life expectancy at birth.

Overall, special caution must be given by the researchers for testing the applicability of the methods used and the consistency of the results in their effort to estimate the health levels of a population, as this problem is still open for further investigation.

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