

# THE USE OF MULTI-TREE CHARTS IN EDUCATION OF ECONOMIC DEMOGRAPHERS

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**Abstract:** *Demographers around the world use the graphic constructions of demographic structures (i.e. the population pyramids) to present the age and sex structure of the population. This paper will present the possibilities of using the Multi-Tree charts in MS Office Excel (various versions) for specific purposes in education of economic, regional and actuarial demographers, because this purpose is necessary in advanced higher education courses. The construction of these charts is difficult and takes a lot of time, but one chart can bring to readers of a research papers much information at one time. In one chart in addition is possible to display either the time development, or several different populations. This paper introduces the Multi-Tree charts using data of the economically active population of the Czech Republic in the years 2000–2011, so it will be presented the time development of demographic structures.*

**Key words:** *multi-tree chart, population pyramid, age and sex structure, time series*

**JEL Classification:** *E24, J64*

## Introduction

The aim of the paper is to provide an alternative view of the construction of demographic pyramids. The general principles that states e.g. Pavlík et al. [6], the age and sex structure of the population is presented by the demographic tree (or population pyramid), in the form of a 2D bar chart with zero central axis. “On the left side of the zero central axis are displayed the absolute numbers (or relative proportions in %) of males, on the right side of this zero central axis are displayed the absolute numbers (or the relative proportions in %) of females.” (Langhamrová, Fiala [5]) Therefore the  $x$ -axis represents the absolute numbers (or relative proportion) of the population by sex. The  $y$ -axis represents the age of the selected population, while the age may be given in years or in the intervals. In the case of using age intervals we call the demographic structure as a reduced demographic structure (Hamilton [3]), the interval is usually chosen at 5 years, but may be higher (for specific or small population, see e.g. Fiala et al. [2]).

Usually, there is displayed one or two observed population in one population pyramid. There are special cases (e.g. for the purposes of demographic projections, see Šimpach [7] or Šimpach, Dotlačilová [8] and Langhamrová, Fiala [4]), when is displayed the current and future population structure in one demographic pyramid,

which help us to compare the appreciable differences (e.g. Park and Yu [9]). In the present paper there will be explained the principle of the construction of population pyramid, in which is displayed in addition to the age and sex of also the development over time – therefore it will involve the alternative representation of the time series. Primary data comes from Eurostat [1] database, concern the numbers of persons in the Czech Republic divided according to the characters of economic activity. The data are observed in the period 2000–2011 and they are the point estimates. For 2012 there have not yet published the complete estimates. There are available the time series for the “total population” (*POP*), “population economically active” (*ACT*) and “employed population” (*EMP*).

## 1 Methodology

Given that the population (*POP*) according to the methodology of International Labour Organisation (ILO) is divided into the population economically active (*ACT*) and economically inactive (*INACT*), using the known time series it is possible to calculate the economically inactive population as

$$INAC_{x,t} = POP_{x,t} - ACT_{x,t} \quad ; \quad x \in \langle 0; \omega \rangle \text{ and } t \in \langle 2000; 2011 \rangle, \quad (1)$$

where  $x$  is the age of  $x$ -years old person,  $\omega$  is the age at which there is no alive person from the population and  $t$  is the time. If a person is economically active, it may be classified (again according to ILO methodology) as a person employed or unemployed. Using the known time series is possible to calculate the population unemployed as

$$UNEMP_{x,t} = ACT_{x,t} - EMP_{x,t} \quad ; \quad x \in \langle 0; \omega \rangle \text{ and } t \in \langle 2000; 2011 \rangle. \quad (2)$$

This gives us the data for four populations that we can now display in the population pyramids using the Multi-Tree charts. Multi-Tree is a special bar chart, where the bars are displayed in contour without padding. In order to highlight the development over time is a good idea to use the appropriate colour spectrum of these contours, either in colour (suitable for on-line publication), or shades of grey (for economical printing). The resulting stripes represent higher or smaller deviations of observed characteristics over time, while the size of these deviations can be subjectively perceived. The wider are the differences between the stripes in the same age (or age interval), the more significant development over time in this age (or age interval) occurred.

## 2 Results and Discussion

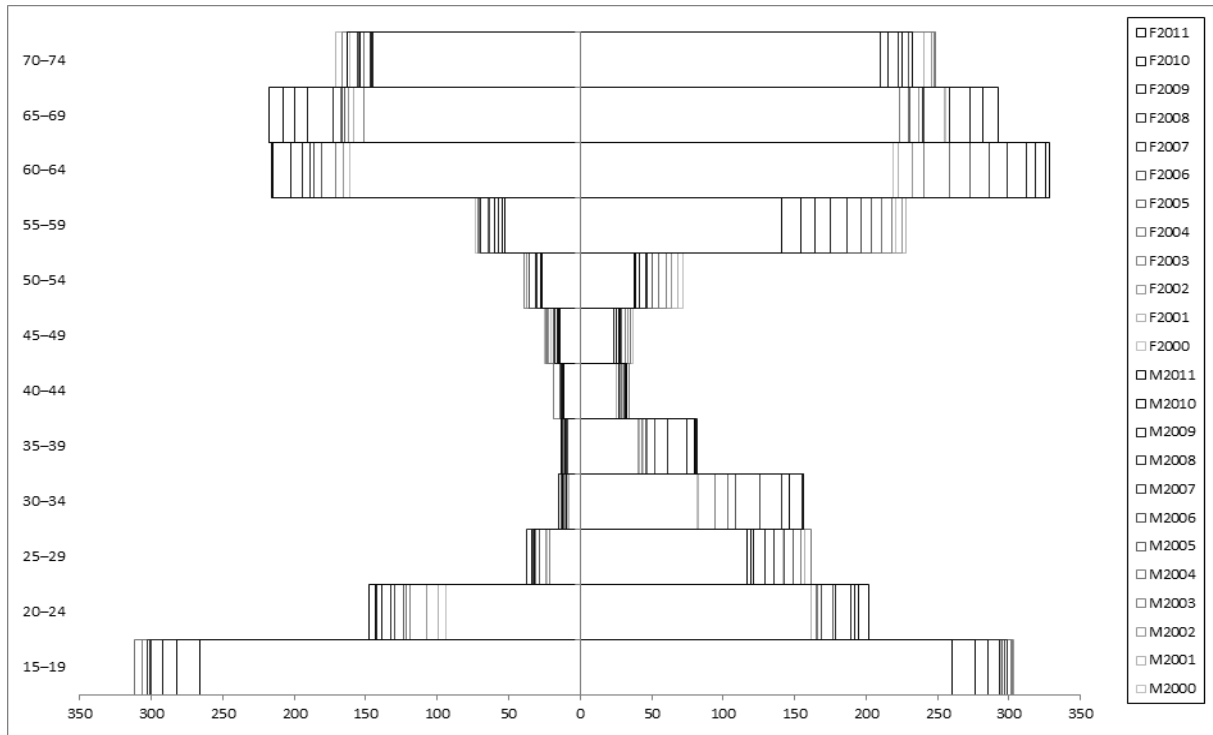
From the data matrices there were constructed Multi-Tree charts, displaying the age and sex time-structure of the economically active population (see Figure 1), the structure of the economically inactive population (see Figure 2), the structure of the employed population (see Figure 3) and finally the structure of the unemployed population (see Figure 4), all in 1,000 persons. The evolution over time of the each numbers of persons is represented by the black and white spectrum of stripes. It may be noted the similarities of Multi-Trees of economically active persons and persons employed as from an economic perspective the most of potentially economically

**Fig. 1: Structure of economically active population – total, in 1,000 persons**



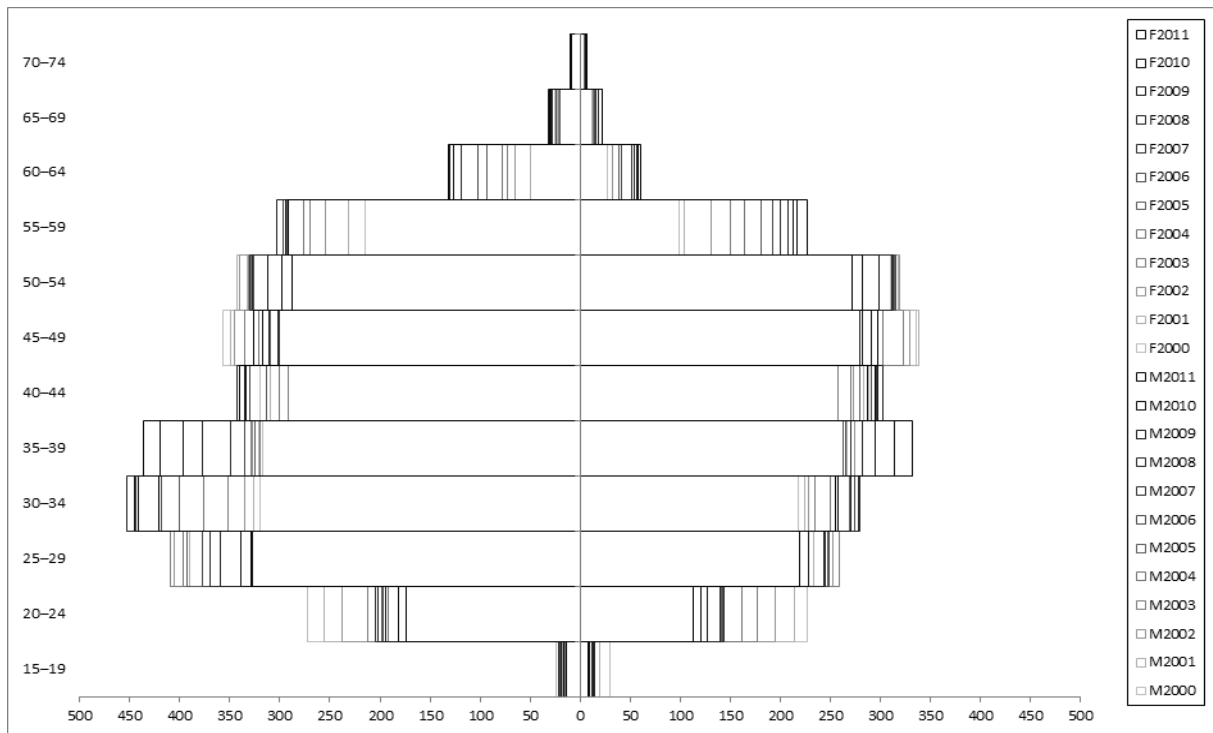
*Source: author's construction*

**Fig. 2: Structure of economically inactive population – total, in 1,000 persons**



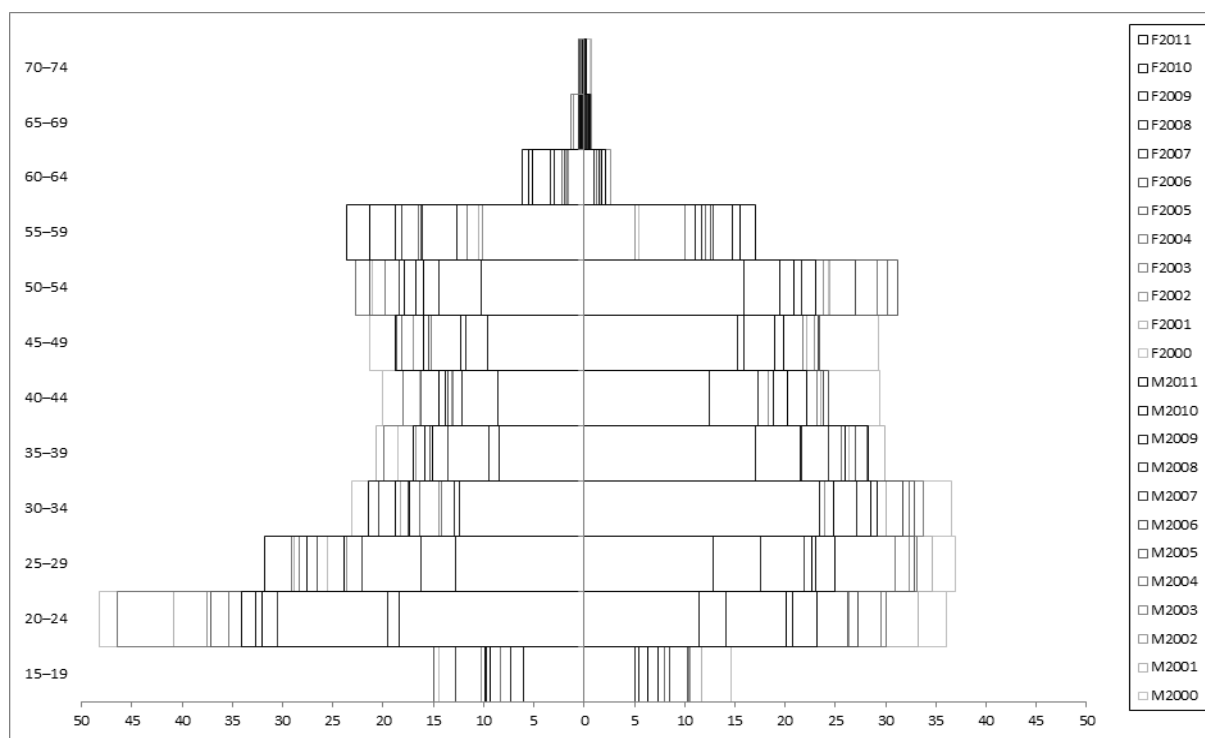
*Source: author's construction*

**Fig. 3: Structure of employed population – total, in 1,000 persons**



*Source: author's construction*

**Fig. 4: Structure of unemployed population – total, in 1,000 persons**



*Source: author's construction*

active persons “trying to have their job”. High numbers of economically inactive persons aged 15–19 is due to secondary and higher education (the university education is still in progress within the age group 20–24 years). From the elderly (60+) the economic inactivity of persons starts to increase again, in case of females starts to increase in a further 5 years earlier. Higher numbers of economically inactive females (right part of the chart), especially in the production age (25–39 years in Figure 2) is due to parental leave, during which a person is not classified as an unemployed person, but an economically inactive.

The numbers of unemployed persons have undergone the great changes in the considered 12 years. A significant shift occurred for males within the age group 20–24 years. The more is the shade of grey lighter, the older is the record of the numbers of people. The dark values represent the presence and it is clear that the numbers of unemployed young men decreased in this age group. Decreased the numbers in other age groups of unemployed males and females, (especially in the lower age groups), and increased the numbers of unemployed males and females in the higher age groups. The biggest changes in the numbers of unemployed persons toward worse registered in the past 12 years the numbers of males aged 50–59 years. This was due to the restructuring of the Czech economy, because these are the males who worked in industry and engineering in times of past regime, and this sector due to lack of competitiveness began reduced after the revolution. Finding a suitable job for these males is, unfortunately, more and more difficult.

## Conclusion

The classical demographic pyramids in the form, as were used in the past, of course, still serve to their purposes. The paper should introduce a superstructure of the pyramid, which is helpful to use especially for the purposes of economic demography, where we work with the time-development in the longer term. Given that the resolution of monitors and printers is very high this day, there is not a problem display as well as 20 populations in one chart (i.e. the development in the period of 20 years). In special cases it is possible to display in one chart e.g. more similar populations (in absolute numbers), or more dissimilar populations (in relative shares in %), because the absolute numbers of persons could not be compared with each other.

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