HOW PROBABLY WILL THE STRUCTURE OF CZECH HOUSEHOLDS LOOK LIKE IN THE FUTURE: FORECAST BASED ON PROBABILISTIC POPULATION PROJECTION

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Abstract

The Czech Republic underwent many significant not only demographic changes during the last decades. All these changes are fully reflected in current demographic behaviour – low fertility level, high proportion of children born out of marriage, rising variability of family forms, etc. As a consequence rapid changes in household structure are also observable and could be expected for the future. This paper introduces the results of the latest households forecast in the Czech Republic – according to the number and type of selected housekeeping households in the Czech Republic for the period 2010–2100 and the variant of population projection. The main data sources are the 2011 Population and Housing Census held in the Czech Republic and probabilistic population forecast from United Nations (World Population Prospects, Revision 2012).

Key words: housekeeping households, Czech Republic, forecast

JEL Code: J10, J110, J120

Introduction

The Czech Republic is one of the rapidly changing and developing countries significantly influenced by its communist history during the second half of the 20th century. From the 1990s it is possible to observe many important changes in most of the spheres of human behavior, including demographic reproduction. More children are born outside marriage, overall fertility decline and people live longer what is obvious from the higher values of the life expectancy at birth. With no doubts, all these changes have impact on the family. Therefore, in this paper we focus on changes observable in the number and structure of the housekeeping households which is a statistical unit capturing forms of housing, housekeeping and family forms.

Recent household projections are more often based on probabilistic approach which is considered to be more realistic. One of the first household stochastic forecasts was calculated for the Netherlands (DeBeer and Adlers, 1999). Since then few other household projections

was published, e.g. for Russia (Sherbov and Ediev, 2007), for Norway (Keilman and Alho (2010) and for Finland and Denmark (Christiansen and Keilman, 2013). Taking into account requirements of the probabilistic approach, the aim of this paper is to apply the basic approach on the borderland between deterministic and stochastic methods on data for the Czech Republic. In the first part historical development of household structure in the Czech Republic is described briefly, and then the main results of the latest household projection are introduced.

1 Housekeeping households in the Czech Republic since 1961

It is not the aim of the paper to describe the development of housekeeping households in detail, but to provide an overview which influenced by nature the results of the household projection. The initial population and household structure is a very important factor of any population or household forecast. In the Czech statistics the housekeeping household is defined as a unit of a small group of persons who share the same dwelling and the costs of living, mainly housing and food. In the Czech data also dwelling and census households are recognized, but considering the methodology of the latest census in the Czech Republic only selected types of housekeeping households are taken into account.

The most important feature of household structure in the period 1961–2011 is the stable increase in the total number of housekeeping households in the Czech Republic, especially in the one-person households – this type of household's forms already almost one third of all the overall households. On the other side, one-couple families which have still the highest share from all studied types of housekeeping households form only around one half of the households. The increase in the number of lone-parent households is apparent also in the period 1961–2011. These changes were significantly more visible from the 1990s with the overall transformation of the society and also changes of individual values. The household structure unquestionably reflects the changes in demographic reproduction resulting into the population ageing. The process of changes in household structure is described using concrete values in the Tab. 1 or one can find it in the article of Habartová *et al*. (2014).

Tab. 1: Households by 1961–2011 censuses (thousands)

Census year	Housekeeping households	One-couple families	Lone-parent families	One-person households	One-couple families	Lone-parent families	One-person households
	In thousands				In % of Housekeeping households		
1961	3035	2405	250	515	79.24	8.24	16.97
1970	3365	2488	307	669	73.94	9.12	19.88
1980	3791	2557	325	939	67.45	8.57	24.77
1991	3984	2513	434	1090	63.08	10.89	27.36
2001.00	4216	2334	576	1276	55.36	13.66	30.27
2011[1)]	4375	2193	612	1422	50.13	13.99	32.50

1) one-couple and lone-parent families without families in households consisting of three or more families
Source: CZSO 2014

2 Methodology

Household projection in a really simplified way consists of two parts: population projection and application of household data. For this paper population projection for the Czech Republic published by the United Nations is employed. The household data are from the Population and Housing census held in the Czech Republic in 2011. Due to changes in census methodology (e.g. newly usual residence is utilized) the data of other censuses could not be involved into our calculations and as already mentioned only housekeeping households could be studied. The household projection is based on headship rate method which firstly used the US National Resource Planning Committee in the first half of the 20th century.

2.1 World population prospects: Revision 2012

Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat issues world population projection every two years. The UN population projection encompasses not only estimates of total number of people living all over the world, but also the estimates for each country are involved. Therefore, for the purpose of the article data published in the United Nation Population Division the World Population Prospects, Revision 2012 for the Czech Republic in the period 2010–2100 are utilized. Population data are in five-age groups and in five-year period. In the methodology of the forecast the United Nations adopted a probabilistic approach to project fertility, mortality and population for all countries. The total fertility rate and female and male life expectancy at birth were projected using Bayesian hierarchical models estimated via Markov Chain Monte Carlo. They are then

combined with a cohort component model which yields probabilistic projection for any quantity of interest. More details could be found in United Nations (2014).

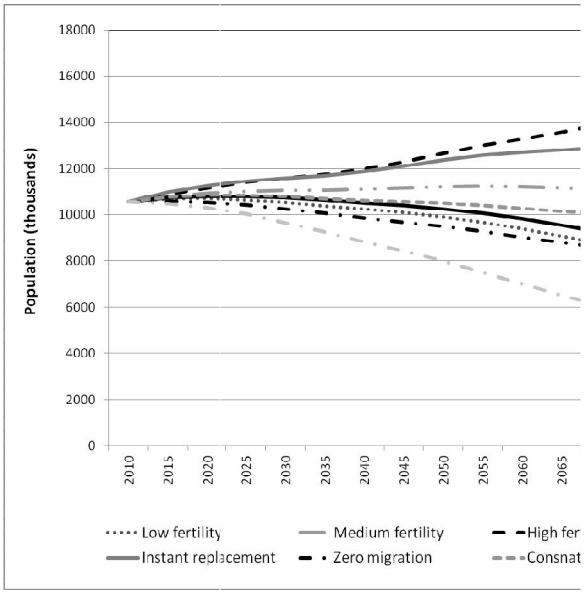
Results of the population projection of the World Population Prospects, Revision 2012 are published in eight variants. Their assumptions in terms of fertility, mortality and migration are briefly described in Tab. 2 and assumed development of the total number of people in the Czech Republic in the period 2010–2100 according the given variants in Fig. 1. The range among the variants is relatively broad in the final year of the projection. Between the most optimistic and pessimistic variant the difference equals to 12.7 million people in 2100. It seems a lot, but these variants are not so probable and it has to be considered that accuracy of the estimates declines with the length of the projected period. In addition, it is necessary to take into account that although the Population Division works with censuses and vital statistics provided by the Czech Republic, for the comparability the data are transformed and are not necessarily identical to those issued by the Czech Statistical Office.

Tab. 2: Description of variants of the population projection

	Assumptions		
Projection variant	*Fertility*	*Mortality*	*International migration*
Low fertility	Low	Normal	Normal
Medium fertility	Medium	Normal	Normal
High fertility	High	Normal	Normal
Constant-fertility	Constant as of 2005-2010	Normal	Normal
Instant-replacement-fertility	Instant-replacement as of 2010-2015	Normal	Normal
Constant-mortality	Medium	Constant as of 2005-2010	Normal
No change	Constant as of 2005-2010	Constant as of 2005-2010	Normal
Zero-migration	Medium	Normal	Zero as of 2010-2015

Note: Copied from the United Nations (2013)

Fig. 1: Population estimates by variants, the Czech Republic, 2010–2100



Source: PD DESA UN 2014

2.2 Household projection

For the household projection we used the method described in detail by Habartová *et al.* (2014). The base of the calculation is the traditional method of headship rates. All the headship rates were calculated from the detailed data from the Czech Population and Housing census 2011 – more specifically, the headship rates are proportions of the population classified according to age and sex which are heads of households of a particular type, i.e.

$$r_{t,\boldsymbol{i}}^{h,D} = \frac{P_{t,\boldsymbol{i}}^{h,D}}{P_{t,\boldsymbol{i}}}$$

where $r_{t,\boldsymbol{i}}^{h,D}$ is the headship rate in time *t* with characteristic *i* (sex, age, etc.), $P_{t,\boldsymbol{i}}$ is the total number of persons with given characteristics *i* in time *t* and $P_{t,\boldsymbol{i}}^{h,D}$ are the persons with the same characteristics *i* who are at time *t* the head of household of type *D*. The household projection is calculated based on assumption of the constant headship rates over all projected period. It is necessary to notice, that the headship rates are applied on population data which are modified according to the ratio of population living in the housekeeping households. Although majority of the Czech population reside in households i.e. 97.7 % of males and 98.5 % of females in 2011, a part of the population is living in so-called institutional households or is homeless.[1] Therefore, data has to be adjusted. In our case we assume the constant rates by sex and age of the population living in the housekeeping households over all studied period. The household projection in the article is focused only on the estimates of

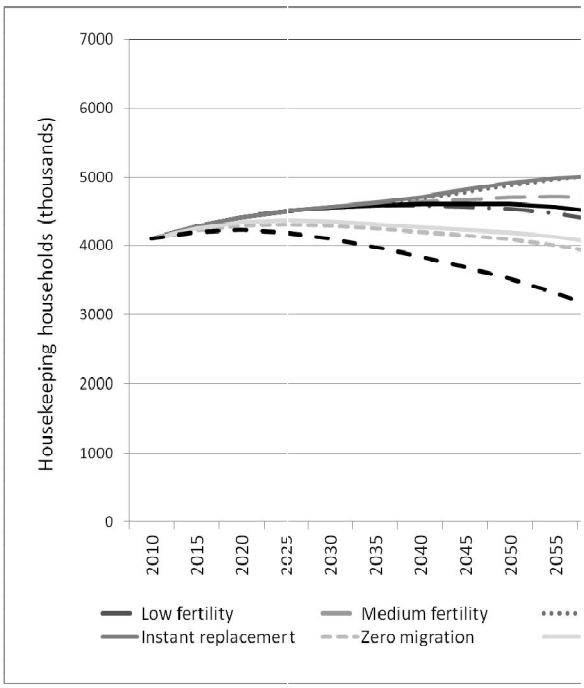
[1] 11 496 homeless persons were counted within the Czech Population and Housing Census 2011.

housekeeping household structure by the type of household, but the size of the households can be also estimated. In that case, the modification of the classical approach, proposed by Ediev (2007) should be applied. The aim of application of this modification is to get consistent results according to the structure of the estimated number of households (see Ediev, 2007 or Habartová *et al.* 2014). Due to number of projected variants and limited range of the article the projected household size is not included in this paper.

3 Results

For the household projection we used all the eight variants of the population projection described briefly above. It gives us the opportunity comparing the effect of particular assumptions of the variants for the estimated household structure in combination with the real household structure in 2011. The total estimated number of households could be observed in Fig. 2. From the graph it is clear that the range of results is relatively wide. According to the most optimistic variant (the high fertility variant) the total number of housekeeping households could rise to more than 6 millions. On the other side, the most pessimistic variant leads to estimates only around 2 millions of households by the end of this century. However, the "pessimistic" variant cannot be taken as unlikely, as the high fertility one for the Czech Republic, because the lowest variant reflects the theoretically possible development if nothing changes and the population development remains at the same level as documented in the years 2005–2010). That means that the total fertility rate will equal to 1.43 children per woman, the life expectancy at birth will be 73.6 years for males and 80 years for females for the all studied period, and the migration remains at the same level ca 60 thousands migrants in each five years and from the 2050 will decline to 0.

Fig. 2: The total number of selected housekeeping households by variants, the Czech Republic, 2010–2100



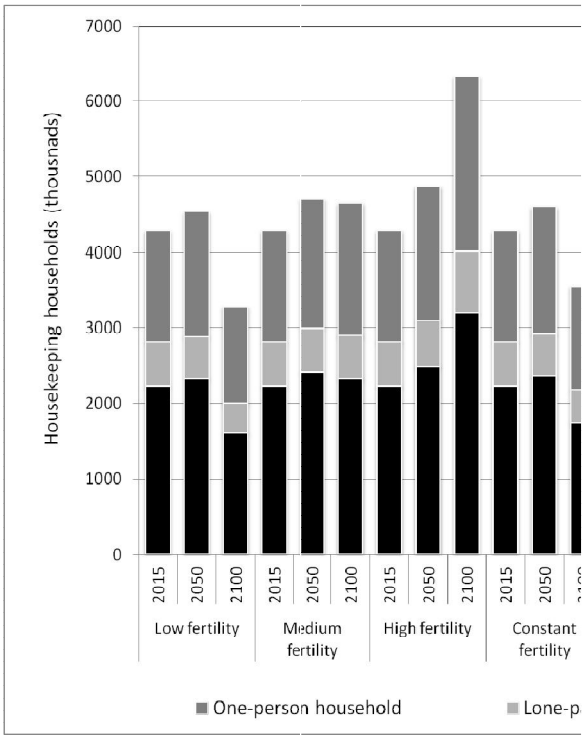
Source: PD DESA UN 2014, CZSO 2014, own calculation

According to all the variants (except for the "no change" variant) it could be expected, that the total number of households will increase in the future decades – according to most of the variants the number of households could reach values near 5 millions by the middle of the century. In later years, i.e. in the second half of the 21st century, we can expect rather a decrease in the total number of households (unless the fertility level does not increase significantly).

The medium or low fertility variants could be taken as probably the most realistic ones. According to these variants again we could expect an increase in the total number of households in the Czech Republic, above all during the first half of the 21st century. Then rather a decrease seems to be probable.

However, estimation of the total number of households is only one particular question which could be answered using the introduced household projection. Probably more important question deals with the inner structure of the households. For simplicity and for illustration, in this paper we use only the classification according the most important types of housekeeping households – the one-person households, lone-parent families and one-couple families. As mentioned above, the projection could be done and presented similarly also according to the structure defined by the size of the households.

Fig. 3: The overall number of selected housekeeping households by variants, the Czech Republic, selected years, absolute numbers

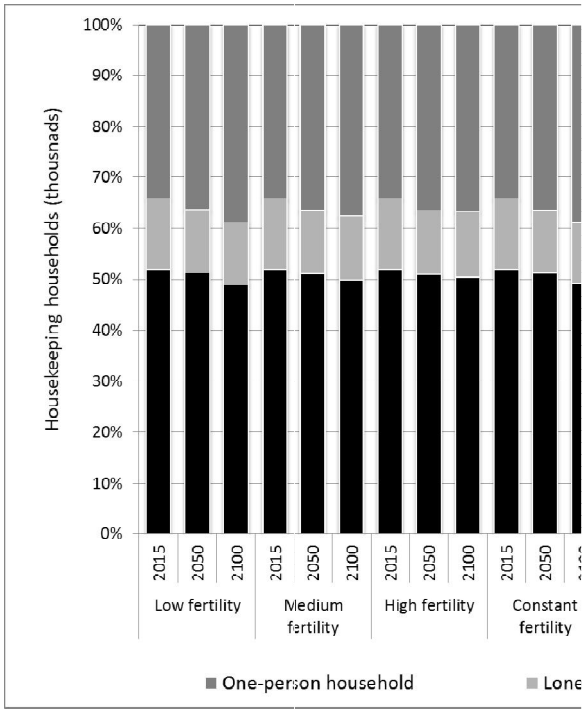


Source: PD DESA UN 2014, CZSO 2014, own calculation

In the Fig. 3 the differences in the total number of households logically correspond with the results shown in the Fig. 2. However, we can better follow the differences according to the main types of households. Using more optimistic variants (high fertility or instant replacement), we could expect above all the increase in one-couple family households by the half of the century – as a consequence of higher expected fertility levels and younger population structure as a whole. In later years this could lead to the increase also in the number of one-person families as a consequence of population aging. In both those variants the proportion of one-couple families could decrease only to values around 50 %, proportion of one-person households in those variants could overcome 35 % by the end of the century (Fig. 4).

According to the less optimistic variants (low fertility or constant fertility), it could be expected not only the decrease in the total number of households, but also a significant increase in the proportion of one-person households – to nearly 40 % by the end of the 21st century. However, also according to the medium fertility variant we could expect an increase in the proportion of one-person households. This type of households could reach more than 1.7 millions around the year 2050.

Fig. 4: The overall number of selected housekeeping households by variants, the Czech Republic, selected years, relative structure



Source: PD DESA UN 2014, CZSO 2014, own calculation

Conclusion

It is clear, that in this short paper it is not possible to present fully the results of the household projection based on the probabilistic population forecast prepared by the United Nations. However, it was shown, that the results of the household projection are closely related to the used population forecast or to a particular variant of the forecast.

Except for the importance of the used population forecast, or its particular variant, it should be mentioned, that we did not use any other specific assumptions implemented in the calculations. However, clearly the development cannot be the same according to human behavior and personal tendencies in all the supposed variants. These specific assumptions could be implemented into the forecast as a next step of the work.

Based on the results presented in this paper as well as in previous papers (e.g. Habartová *et al*., 2014), it could be concluded, that the total number of households could be expected to grow in the nearest decades and this growth will likely be caused by the increase in the proportion and total number of one-person households. This is not only the consequence of population aging, where it could be supposed that more seniors and older

people live longer time alone, but also the consequence of changes of personal values as well as social trends. Part of the increasing number of one-person households is created by the households of young persons as well. This could be taken as a consequence of declining fertility and marriage levels and fertility postponement observable not only in the Czech Republic, but also in other transitional populations nowadays.

For the second half of the 21st century it could be expected that the total number of households will likely be decreasing. Only those demographic conditions, which today could be taken as unrealistically optimistic, could theoretically lead to an increase in the total number of households.

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References

Christiantsen, S.G., Keilman, N. "Probabilistic household forecasts based on register data - the case of Denmark and Finland." *Demographic Research*, 2013, 28: 1263-1302.

Czech Statistical Office (CZSO). "Sčítání lidu, domů a bytů 2011". *2014*. <http://notes.czso.cz/sldb2011/eng/redakce.nsf/i/home>.

DeBeer, J., Adlers, M." Probabilistic population and household forecast for the Netherlands." Hague: Paper for the European Population Conference EPC99, 30 August – 3 September 1999.

Ediev, D. M. "On Projecting the Distribution of Private Households by Size". Vienna Institute of Demography, *Working Papers*, *2007* (4).

Habartová, P., Hulíková Tesárková, K., Sivková, O. "Prognóza počtu a velikosti vybraných typů hospodařících domácností v České republice pro období 2013–2040". *Demografie*, *2014*, 56: 21–36. <http://www.czso.cz/csu/2014edicniplan.nsf/t/A1002EE02A/$File/130053_14-01.pdf>.

Keilman, N., Alho, J. "On future household structure". *Journal of the Statistical Society*. 2010. 173: 117-143.

Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (PD DESA UN). „*World Population Prospects: The 2012. Revision." 2014.* <http://esa.un.org/unpd/wpp/index.htm> .

Scherbov, S., Ediev, D. *"Probabilistic household projections based on an extension of headship rates method with application to the case of Russia."* Joint Economic Commission for Europe–EUROSTAT Work Session on Demographic Projections, Bucharest, Oct. 10th–12th 2007, working paper 16. Geneva: Economic Commission for Europe.

United Nations. "World Population Prospects The 2012 Revision Volume I: Comprehensive Tables". *United Nations, New York, 2013*. <http://esa.un.org/wpp/Documentation/pdf/WPP2012_Volume-I_Comprehensive-Tables.pdf>.

United Nations. " World Population Prospects The 2012 Revision : Methodology of the United Nations Population Estimates and Projections". *United Nations, New York, 2014*. <http://esa.un.org/wpp/Documentation/pdf/WPP2012_Methodology.pdf >.

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