A Prognosis of the Human Capital of the Population of the Czech Republic

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Introduction

The output of "classical" population projections is usually the sex and age structure of the population in each year of the projected period. This provides no information about the "quality" of the population, e.g. about the present situation and expected development of the professional qualification of the people. As a very simple (and of course very rough) measure of the professional qualification of a person can be regarded its education level.

This paper describes very briefly the methodology of a population projection not only by sex and age, but also by education level and provides the main results of computation of such projection for the case of the Czech Republic.

Methodology

Not only sex and age but also education level of each person is taken into account. Only four following groups of education level are distinguished:

A – primary education (including no education or incomplete education); each newborn child is supposed to belong to this group,

B – secondary lower education (without the school leaving exam),

C – secondary higher education (finished with the school leaving exam),

D – tertiary education.

The computation of the population projection by sex, age and education level of each person is based on the classical multistate component projection method see, e.g., Bogue at al. (1993), Koschin (2005) with simplified model of migration (only immigration at the level of net migration is assumed, emigration is supposed to be zero). The computation is carried out for each sex separately.

We accept only the following changes of education level: A→B, A→C, B→C, C→D. (Relatively many young people having finished the primary school continue to study at a secondary school finished by the school leaving exam. Their education level will then increase from A directly to C.)

Computation of each population projection is based on the initial population structure (in our case also by education level) and the scenario describing the expected development of fertility, mortality and migration. In the case of our projection taking into account also the education level of people also scenario of expected numbers of graduates of particular types of schools is needed.

Latest available data of the population structure of the Czech Republic by sex, age and education level come from the population census in 2001. See ČSÚ (2003). Initial demographic structure for the projection has been so that of 1st January 2001 and the projection has then been computed until 1st January 2051.

Until the end of 2010 the computations were based on real complete data of mortality, fertility and migration and by sample data concerning education level provided by the Czech Statistical Office. Since 2011 two variants of the future development of mortality, fertility and migration have been taken into account.

First variant is a slightly modified variant (the average between the low and the medium variant) of the population prognosis computed by the Czech Statistical Office in 2009 (variant CZSO). See ČSÚ (2009). The second variant assumes that the fertility of the Czech females will (with several years "delay") follow the fertility of the Netherlands' females (variant NL). Netherlands' females fertility is very often used as a pattern of future fertility of Czech females because in this country the transition of the fertility to higher age of females has been finished and the fertility seems to be relatively stable.

The trends of population development were assumed to be the same in both variants but the rate of growths differs. In the variant NL higher increase in fertility, more rapid growth of the life expectancy and higher annual net migration have been assumed than in the variant CZSO.

In both variants further increase of the total fertility rate (TFR) has been supposed, but not as rapid as in previous years. Linear increase in each decade has been supposed with subsequently diminishing increment. Both variants of the projection have assumed continual increasing of the life expectancy as well. We expect (in both variants) that the Czech Republic will remain to be the country of prevailing immigration. (See the Table 1.) And finally the estimate of numbers of persons increasing their education level has been based on the data of Institute for Information in Education. See, e.g. Hulík (2009).

### Table 1. Assumed development of the total fertility rate

Characteristic	Variant	2010	2015	2020	2025	2030	2035	2040	2045	2050
Total fertility rate	CZSO	1.492	1.529	1.565	1.585	1.605	1.613	1.620	1.628	1.635
	NL	1.480	1.535	1.600	1.650	1.700	1.750	1.800	1.825	1.850
Life expectancy males	CZSO	74.4	75.7	76.9	78.2	79.4	80.4	81.4	82.4	83.4
	NL	74.7	76.2	77.6	79.1	80.6	82.1	83.6	85.0	86.5
Life expectancy females	CZSO	80.6	81.7	82.8	84.0	85.1	85.9	86.7	87.6	88.4
	NL	80.9	82.1	83.4	84.6	85.9	87.2	88.4	89.7	91.0
Net migration	CZSO	15 648	20 000	20 000	20 000	20 000	20 000	20 000	20 000	20 000
	NL	15 648	25 000	30 000	35 000	35 000	35 000	35 000	35 000	35 000

This projection is described in more details e.g. in Langhamrová at al. (2009) and in Fiala and Langhamrová (2009), the assumptions concerning immigration are based on Kačerová (2008). More common information concerning the methodology of population projections can be found e.g. in Bogue at al. (1993).

Main results of the projection

According to the variant CZSO the number of inhabitants of the Czech Republic in 2050 will be approximately the same as at present time – about 10.5 millions, the variant NL gives about 11.7 millions of inhabitants in 2050. Despite this relatively high difference in the population size the differences in the population structure by education level are negligible. Therefore we present the results for the latter variant (NL) only. The Figures 1 and 2 show the development of the education level of the population older than 25 years of age. (We can expect that at this age most of the people have finished their formal education career.)

Fig. 1. Development of the structure of Czech males older 25 years of age by the education level.
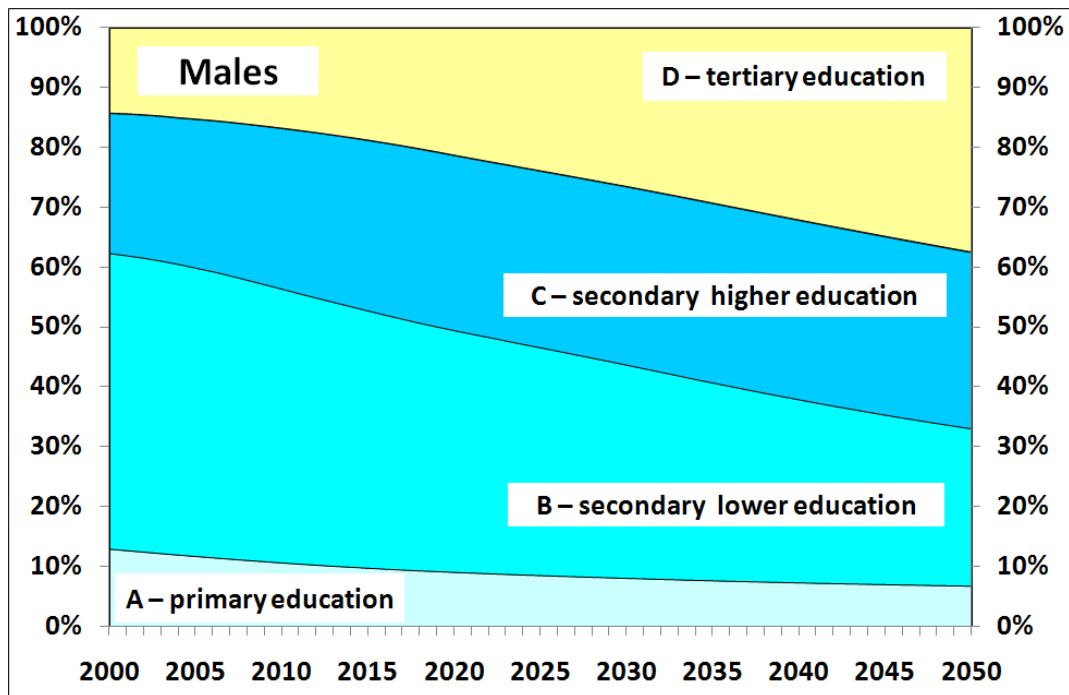
Source: Own calculations

Fig. 2. Development of the structure of Czech females older 25 years of age by the education level.
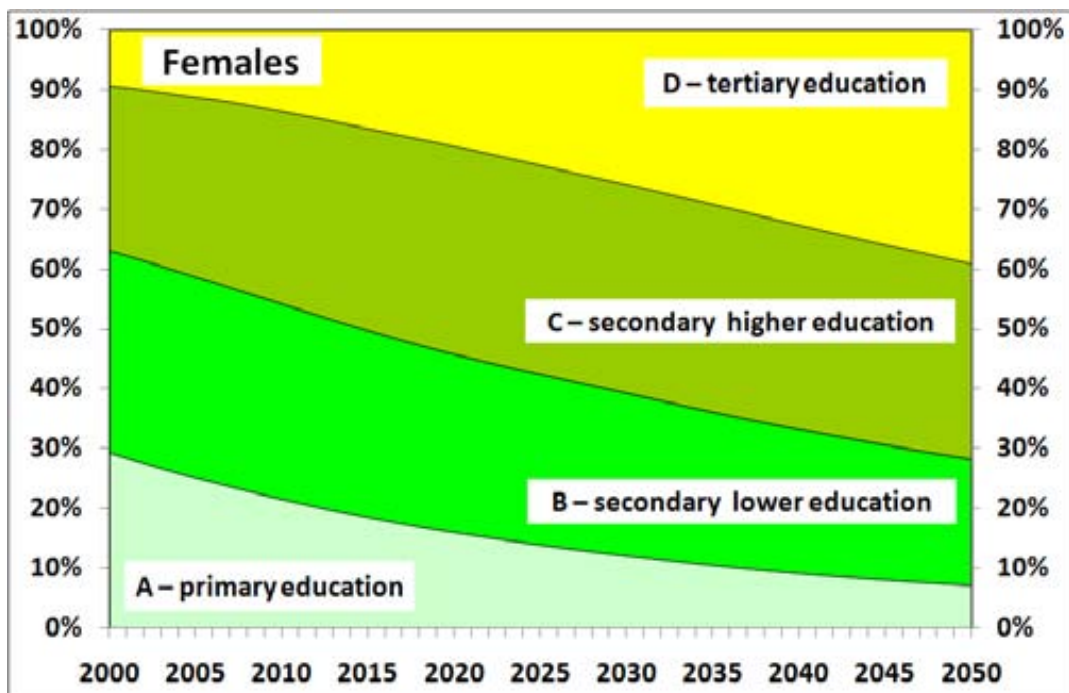
Source: Own calculations

At the end of the year 2000 the proportion of males with tertiary education has been only about 14 %, at the same time only about 10 % of females have had tertiary education level. Until 2050 the proportion of tertiary educated people is expected to grow to almost 38 % for males and even to 40 % for females. The proportion of males with secondary higher education will in the first half of this century slightly grow from 23 % to 28 %, for females the proportion will grow from 28 % to 32 %.

At the end of 2000 the most numerous education group has been the secondary lower education – almost 50 % of males and 34 % of females. Until 2050 these proportions are supposed to radically drop to about 27 % for males and 21 % for females. The proportion of males having only primary education has been about 13 % at the end of 2000. It is assumed to drop to about 7 % until 2050. For the proportion of females with primary education we expect similar development: decrease from 28 % to 7 %.

The results confirm that the education level of Czech population will increase, at the same time the gap between males and females in the education level will diminish.

The future development of the human capital in the Czech Republic depends mainly on the number of young people finishing the primary or the secondary education. The children start to attend the school usually at the age of six, the length of the primary education is 9 years, so they finish it at the age of 15. The main group of applicants for the secondary education is thus the group of young people at the age of 15. The standard lengths of higher secondary education (finished by the school leaving exam) is 4 years and so the main group of applicants for the tertiary education is the group of young people at the age of 19.

The Table 2 shows the present number of young people at the age mentioned above and the expected development ot the people of these age categories. The number of the people at the age of 15 will drop by more than 11 % in the next years. (The reason of this drop is the rapid gap in natality in the late nineties.) On the other hand in the middle of the 20th the number will be about 18 % higher than today. This increase will be followed by a drop again, in 2050 the number of the people at the age of 15 will be about 10 % lower than today (low variant) or approximately at the present level (high variant).

The development of the number of the people at the age of 19 follows of course the development of the previous age category with "delay" 4 years. The expected drop in next ten years will be almost 30 %. And despite the following increase the number of people at the age of 19 will probably never return to the present level. Even in 2030 (when the age 19 years will be reached by the relatively numerous generations born in the second half of the first decade of this century) the number of 19 years' people will remain lower by about 8 % in comparison with the present time. And in 2050 it will be more than 30 % lower (low variant) or than 20 % lower (high variant) than today.

Table 2. Development of the number of young people at the age of 15 and 19 years

Year	Complete age of 15 years				Complete age of 19 years			
	variant CZSO		variant NL		variant CZSO		variant NL	
	number of persons	difference with respect to 2010 (%)	number of persons	difference with respect to 2010 (%)	number of persons	difference with respect to 2010 (%)	number of persons	difference with respect to 2010 (%)
2010	102 383	0.0	102 383	0.0	131 948	0.0	131 948	0.0
2015	90 691	-11.4	90 793	-11.3	95 844	-27.4	96 165	-27.1
2020	102 561	0.2	102 905	0.5	94 053	-28.7	94 940	-28.0
2025	120 151	17.4	120 879	18.1	108 238	-18.0	109 764	-16.8
2030	112 693	10.1	114 607	11.9	120 188	-8.9	122 204	-7.4
2035	105 215	2.8	110 247	7.7	112 565	-14.7	116 544	-11.7
2040	94 715	-7.5	103 248	0.8	104 858	-20.5	111 807	-15.3
2045	87 690	-14.4	98 950	-3.4	94 096	-28.7	104 359	-20.9
2050	90 476	-11.6	105 137	2.7	88 966	-32.6	101 965	-22.7

Source: Own calculations

Importance of education for possible reducing the economic consequences of population ageing

A person with higher education will find implementation on the labour market more easily and therefore has a higher income. At the same time we can assume that its production is somewhat higher than the production of a person with lower education. It is very difficult to measure the level and quality of education, but as a very rough guide it is possible to use the length of education expressed in years.

A number of the analyses carried out show that each year of additional education (on average for the population as a whole) represents an increase in production of around 3–6 %. At the same time this increase is higher in the more economic developed countries than in the less economic developed countries (one of the possible explanations is just the quality of education). See, for instance Koschin (2005). The Czech Republic is one of the advanced countries and we therefore will suppose that increasing the length of education of a person by 1 year in the Czech Republic means an increase in production of this person of 5 %.

We can estimate the overall production in the Czech Republic as the sum of the production of individual persons where we make the average value of the production of an individual with a total legnth of education of v years equal the value 1.05^{v-v_0}, where v_0 is the length of education regarded as standard.

Statistics show that at present in Europe the average length of education is around 12 years and so let us select this length as standard (this is roughly the length of education of a person with lower secondary education). A person with primary education therefore has a length of education 3 years shorter, a person with higher secondary education roughly a year longer and a person with tertiary education roughly 5 years longer than standard. (We are taking the average length of university studies to be only 4 years because the 3-year bachelor courses of study are also considered as university studies.)

We often characterize the economic burden imposed on society by seniors as the old-age-dependency ratio defined as the ratio of the number of persons of post-productive age to the number of persons of productive age

$$OADR_{clas} = \frac{S_{III}}{S_{II}},$$

where S_{II} is the number of persons of productive age, S_{III} is the number of persons of post-productive age. This index, then, assumes that not only consumption, but also production depends only on the number of persons of the appropriate age.

Let us compare the values of this "classical" index with a modified index, where in the denominator there is not the sum of persons of productive age, but the sum of the total production calculated with regard to the assumptions stated above

$$OADR_{mod} = \frac{S_{III}}{1{,}05^{-3} \cdot S_{II,prim} + S_{II,\sec-l} + 1{,}05 \cdot S_{II,\sec-h} + 1{,}05^5 \cdot S_{II,univ}},$$

where $S_{II,prim}$, $S_{II,sec-l}$, $S_{II,sec-h}$, $S_{II,univ}$ is the number of persons of productive age with primary, secondary lower, secondary higher and university education, respectively.

The Fig. 3 shows the comparison of the development of both indexes. The increase in the dependency of seniors would, taking into account the rising level of education, be lower than according to the index calculated in the classical manner. The value of the "classical" index in 2050 would be almost 90 % higher than in 2000; in the modified index the increase is only 60 %. In this there was taken into consideration as the measure of qualification and the level of production only the normally registered "standard" formal education. Postgraduate studies and various forms of lifelong education were not taken into account at all.

Fig. 3 Old-age-dependency ratio
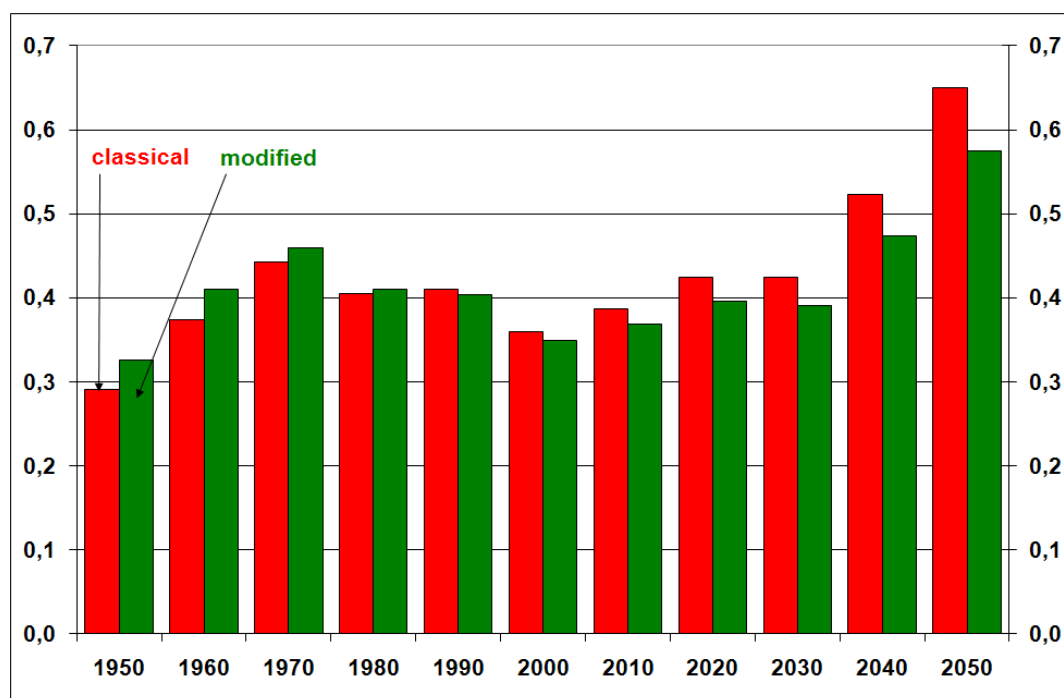
Source: Own calculations based on data from the Czech Statistical Office

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