WILL THE POPULATION OF CZECH ICT SPECIALISTS BE ABLE TO KEEP ITS ECONOMIC AND COMPETITIVE POTENTIAL IN 2060 AND LATER?

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Abstract

The aim of this paper is to estimate the age-and-sex structure of economically active ICT specialists by the highest level of education attained (ISCED 2011) up to the year 2060. Used data come from the final results of the Census 2011, managed by Czech Statistical Office (CZSO). Using the component method and expert scenario of the population projection by CZSO – medium variant we calculate how will look the age-and-sex structure of persons who are relatively young now and who become older one day. Results are not quite positive. The number of these specialists will change, age-and-sex structure will upsize in the top and the average age significantly increases. Will be the distribution of those ICT specialists in 2060 and later sufficient to keep the current level of competitiveness in this sector, economic potential and creation of the innovation? There is an important question, what is better in ICT sector: Young economically active structure full of young (and also ambitious) people or older structure of wise experts and professionals who have decades of experience and practise?

1. Introduction

Czech ICT sector is currently very competitive and performs many innovations in the field of software engineering and information management (Basl, Doucek, 2013). Young and ambitious population structure of ICT specialists working in the Czech Republic allows to implement difficult issues for many private corporations and public institutions and the costs of these implementations are adequate (e.g. in the comparison with more developed Western European countries) (Doucek, Novotný, Voříšek, 2009). Young population structure of these specialists, which is significantly dominated by males than females, (because ICT was always more of a masculine area of interest), gets older one day. Sector annually attracts many applicants for studying and job opportunities in this field (Maryška, Doucek, Novotný, 2012 or Maryška et al., 2012). But there is a certain issue, which is hidden to the public yet. Today's young generation, working in the Czech Republic, will have to work to an older age than previous generations. Retirement age shall be extended and there are speculations that in some sectors could exceed 70 years for male cohort. Many specialists in the field of ICT will probably work in their area of interest until his retirement (Obi, Ishmatova,

Iwasaki, 2013). Although the annual increase in new and young graduates does not weaken (see e.g. Basl, Pour, Šimková, 2008), existing specialists will cause that the population structure of Czech ICT specialists within the next 40–50 years becomes significantly older and highly regressive. Will be then the Czech ICT sector still competitive as today, when practically will work there the same large group of young and beginning specialists and the same large group of wise experts and professionals, who worked in their profession almost 50 years?

The aim of our research is to calculate the estimates of age-and-sex structures of ICT specialists according to highest level of education attained by more sophisticated way, and especially with the impact on the entire population of the Czech Republic. Given that the experts from CZSO construct a fairly accurate population projection in three different scenarios (CZSO, 2013), we calculate on the basis of component method (Keyfitz, 1964, Coale, Kisker, 1986 or Bogue, Anderton, Arriaga, 1993) the estimates of the age-and-sex structures of these economically active persons by highest level of education attained with great precision. The conditions of our calculations are as follows: *(I) selected scenario of the population projection by CZSO is medium variant*. This is because the low and high variant is rather referred to as lower and upper bound. Our calculation *(II) assume the same decline in mortality over time, which is expected by CZSO* (i.e. the increase in life expectancy at birth of males (females) from 74.70 (80.82) years in 2011 to 83.72 (88.61) years in 2060 and linear increase in the total fertility rate from the value of 1.43 in 2011 to 1.56 in 2060. Finally, it is important to note that *(III) our expectations cannot calculate with a dramatic change in the behaviour of immigration and emigration of these specialists*. (The sum of immigrated persons will be the same as the sum of emigrated persons, migration balance will be equal to zero). Census 2011 was processed by the CZSO's methodology and the population projections of the Czech Republic are also calculated by the CZSO's methodology. Our calculations are much more consistent than the estimates, which are corrected each year on the basis of indicators from the other information data sources and mini censuses, because analysed demographical data in this paper contains mostly clear deterministic trend (see e.g. Šimpach, Dotlačilová, 2013b).

2. Materials and Methods

From the results of Census 2011 (CZSO, 2011) we know the total number of persons in the population ($S_{x,t}$) in 5-year age groups (x–$x+h$-1) at time t = 2011 by sex (M - male or F - female) and the number of economically active specialists in the field of ICT by highest level of education attained, also in 5-year age groups (x–$x+h$-1) at time t = 2011 by sex, where x is completed age and h is the width of age interval 5 years. Because the distribution of these specialists by highest level of education attained is very detailed, we summarize these people into 3 groups only according to ISCED 2011 classification system. Specialists will be divided as people without high school diploma (group ED0-2), as people with high school diploma (group ED3-4) and as people with at least bachelor university degree (group ED5-8). All the numbers of economically active specialists are considered in the age interval from 15–19 to 70+ years. Census 2011 has obviously higher intervals for the total number of persons in the population ($S_{x,t}$), i.e. 70–74, 75–79 ... 100+, but because the number of economically active specialists in the highest age group is relatively small, we consider interval 70+ from the groups of variously educated specialists as comparable with the interval 70–74 from ($S_{x,t}$) group. This measure is commonly used in similar analyses and as previously stated Fiala, Langhamrová (2011) or Šimpach, Pechrová (2013), a significant distortion of the results will not happen. Component method of population projection stands on the assumption that the person at the exact age of x will be next year with a certain probability exactly one year older (Keyfitz, 1964, or Bogue, Anderton, Arriaga, 1993). The exceptional situations are when a person dies, emigrates, or in addition someone else immigrates. Empirical data of age-and-

sex specific numbers of ICT specialists in the Czech Republic according to highest level of education attained shows Figure 1.
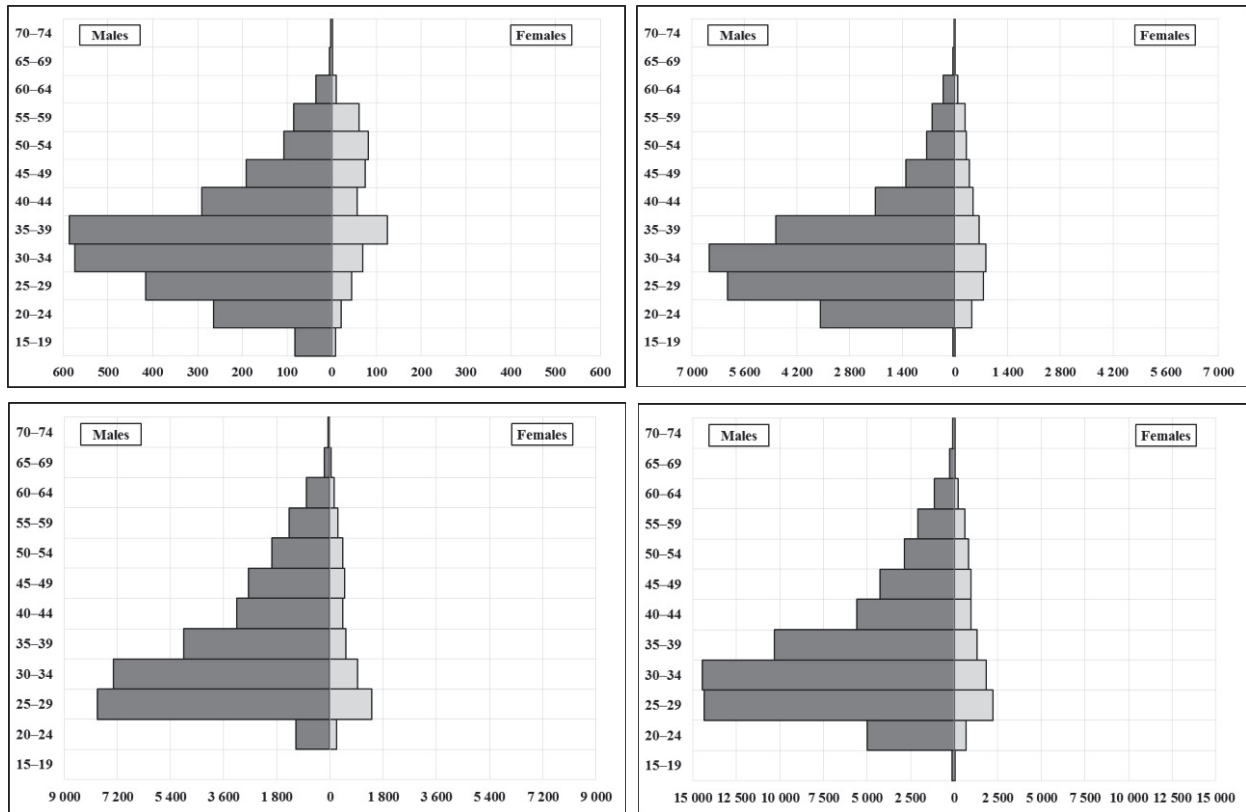
Figure 1: Age-and-sex population structure of ICT specialists educated; at ED0-2 level – top left, at ED3-4 level – top right, and at ED5-8 level – bottom left. Age-and-sex population structure of ICT specialists in total is displayed bottom right. Data source: CZSO (2012), authors' illustration.

Initial assumptions for projection of ICT specialists shows Table 1 for males' and Table 2 for females' cohorts. According to Fiala, Langhamrová (2011) and Šimpach, Pechrová (2013) methodology, in our projection we supposed that each population (and profession as well) has its own saturation point in particular age group which achieves and which also will not exceed in the future. These saturation points, calculated as the proportion of economically active persons (and specialists according to particular level of education attained) to the total population by age group are highlighted in the Table 1 for males and in Table 2 for females. At the same time we are assuming that each specialist works in his / her profession until he / she dies or until he / she reaches the retirement age. (Retirement was generally set at the value of 60 years both for males and for females in the group of people educated at ED0-2 level (without high school diploma), respectively at the value of 64 years both for males and for females in the group of people educated at ED3-4 level (with high school diploma) and ED5-6 level (at least bachelor university degree), the sum of emigration and immigration of specialists in ICT sector is considered equal to zero). Because of this assumption the proportion of economically active male specialists in each cohort after the saturation point will remain at the level of 0.1276% (ED0-2), 1.5634% (ED3-4) and 2.0326% (ED5-8) until he reaches the retirement age and at the level of 0.0287% (ED0-2), 0.2094% (ED3-4) and 0.3932% (ED5-8) until she reaches the retirement age. Lower value of retirement age for ED0-2 persons was set because these persons work from younger age and can therefore enter into retirement earlier.

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| Age	S	ED0-2	ED3-4	ED5-8	ED_TOT	ED0-2 (%)	ED3-4 (%)	ED5-8 (%)	ED_TOT (%)
15–19	297 860	82	53	0	135	0,0275	0,0178	0,0000	0,0453
20–24	354 381	264	3 572	1 151	4 993	0,0745	1,0080	0,3248	1,4089
25–29	387 292	416	6 055	7 872	14 361	0,1074	1,5634	2,0326	3,7081
30–34	463 655	574	6 534	7 345	14 467	0,1238	1,4092	1,5842	3,1202
35–39	459 293	586	4 757	4 957	10 310	0,1276	1,0357	1,0793	2,2448
40–44	364 367	290	2 115	3 159	5 575	0,0796	0,5805	0,8670	1,5301
45–49	356 929	191	1 313	2 766	4 274	0,0535	0,3679	0,7749	1,1974
50–54	338 051	107	756	1 973	2 840	0,0317	0,2236	0,5836	0,8401
55–59	369 091	85	600	1 389	2 080	0,0230	0,1626	0,3763	0,5635
60–64	353 635	36	313	802	1 155	0,0102	0,0885	0,2268	0,3266
65–69	250 635	5	48	207	260	0,0020	0,0192	0,0826	0,1037
70–74	163 771	3	19	71	93	0,0018	0,0116	0,0434	0,0568
TOTAL	4 158 960	2 642	26 150	31 705	60 575	0,0635	0,6288	0,7623	1,4565

Table 1: Males' economically active ICT specialists in absolute numbers and proportions in % by particular level of education. Data source: CZSO (2012), authors' calculations and illustration.

Age	S	ED0-2	ED3-4	ED5-8	ED_TOT	ED0-2 (%)	ED3-4 (%)	ED5-8 (%)	ED_TOT (%)
15–19	282 322	8	4	0	12	0,0028	0,0014	0,0000	0,0043
20–24	333 971	21	451	213	686	0,0063	0,1350	0,0638	0,2054
25–29	359 138	45	752	1 412	2 212	0,0125	0,2094	0,3932	0,6159
30–34	435 335	69	813	933	1 821	0,0158	0,1868	0,2143	0,4183
35–39	432 522	124	639	535	1 301	0,0287	0,1477	0,1237	0,3008
40–44	343 645	57	476	438	973	0,0166	0,1385	0,1275	0,2831
45–49	342 704	75	382	489	949	0,0219	0,1115	0,1427	0,2769
50–54	336 610	82	300	420	803	0,0244	0,0891	0,1248	0,2386
55–59	386 841	61	273	257	593	0,0158	0,0706	0,0664	0,1533
60–64	391 152	10	80	129	219	0,0026	0,0205	0,0330	0,0560
65–69	302 702	2	11	26	39	0,0007	0,0036	0,0086	0,0129
70–74	220 356	2	3	0	5	0,0009	0,0014	0,0000	0,0023
TOTAL	4 167 298	556	4 186	4 852	9 615	0,0133	0,1004	0,1164	0,2307

Table 2: Females' economically active ICT specialists in absolute numbers and proportions in % by particular level of education. Data source: CZSO (2012), authors' calculations and illustration.

3. Results and Discussion

We show the current age-and-sex specific population structure of Czech ICT experts by highest level of education connected with the predictions of these structures in 5-year age intervals (actual on 31st December) up to the year 2060 using multi-tree charts. Time evolution is displayed by colour shading when the current values are represented by light shade, the farthest future is represented by the darkest one. It is important to note that our projection does not take into account any scenario that would result in a significant change in the proportion of male's and female's ICT experts in the Czech Republic. In the case that begin a lobby in the future that would persuade the female population to be more focused on studying ICT, our model does not take account of this. As well as we are not able to influence the potential restrictions in the number of students in the field of ICT e.g. by Ministry of education, youth and sports, or a significant increase in the number of students and graduates. Restrictions would have the consequences that the future populations would have far more regressive form than populations presented in Figure 2. On the other hand a significant increase in the number of students and graduates would make more widen the current progressive structure.
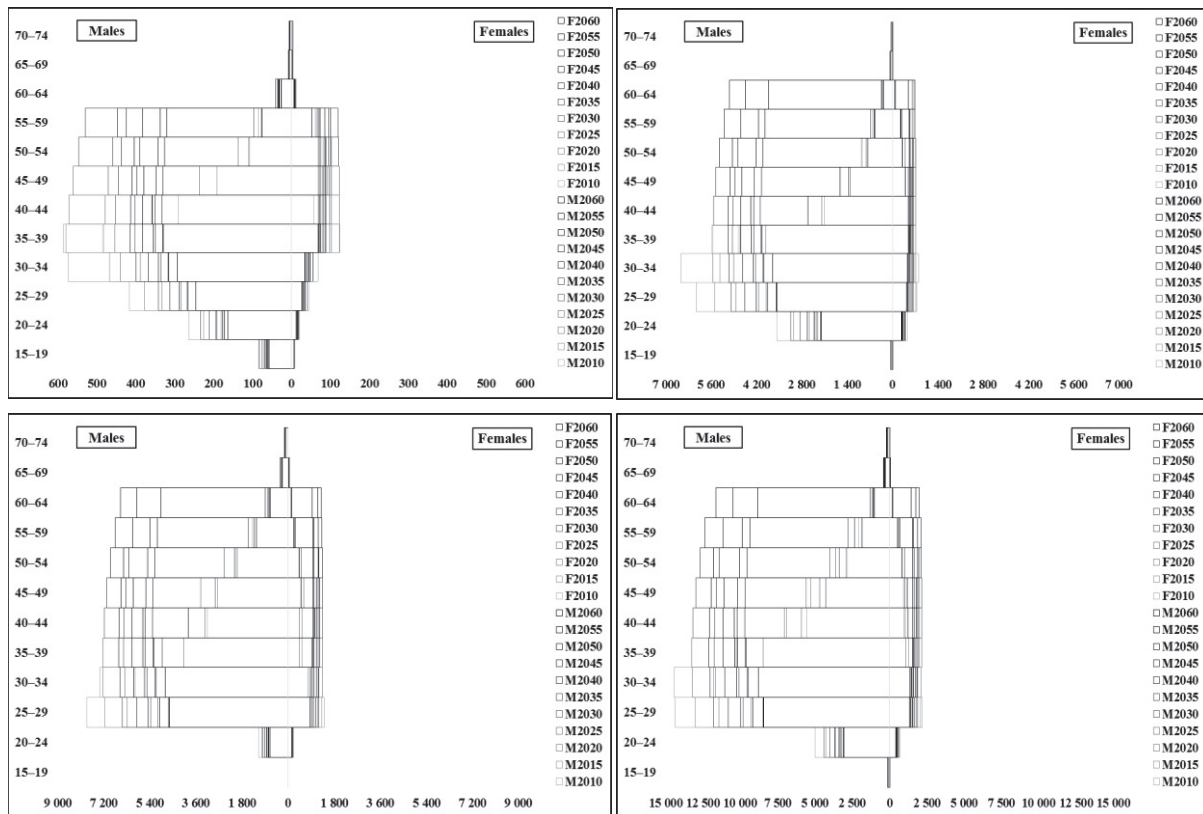
Figure 2: Projection of age-and-sex population structure of ICT specialists educated; at ED0-2 level – top left, at ED3-4 level – top right, and at ED5-8 level – bottom left. Age-and-sex population structure of ICT specialists in total is displayed bottom right. Source: authors' calculations and illustration.

Another information about the expected future population development of Czech ICT specialists by highest level of education attained provide summary graphs with the total number of these specialists (see Figure 3), which show a rising trend until 2050, when (according to our scenario) the ICT sector become saturated. This dramatic situation may not occur if the industry will lose more people than we expect. The probability that ICT specialist completely changes his / her profession is very small (see also e.g. Maryška, Doucek, Novotný, 2012). Interesting conclusions shows also Figure 4, where are calculated the weighted average ages of ICT specialists by sex and highest level of education attained. The relatively high average age of females with ED0-2 education (without high school diploma) is mainly due to the relatively small number of these females in the analysed group (only a few hundred) and older age in general. According to the top-left graph in Figure 1, they are probably the females who worked in this sector even before 1989, where did not need a high school diploma for some reason and currently remain in the sector. The saturation point of the lowest education specialists will probably occur already in 2035 due to early retirement. If we compare specialists aging as a whole – without distinction of education attained, in the case of the male population an average age will grow from 35.87 to 44.58 years and in the case of the female population from the value of 37.84 to 45.01 years. This is a very important increase over time.
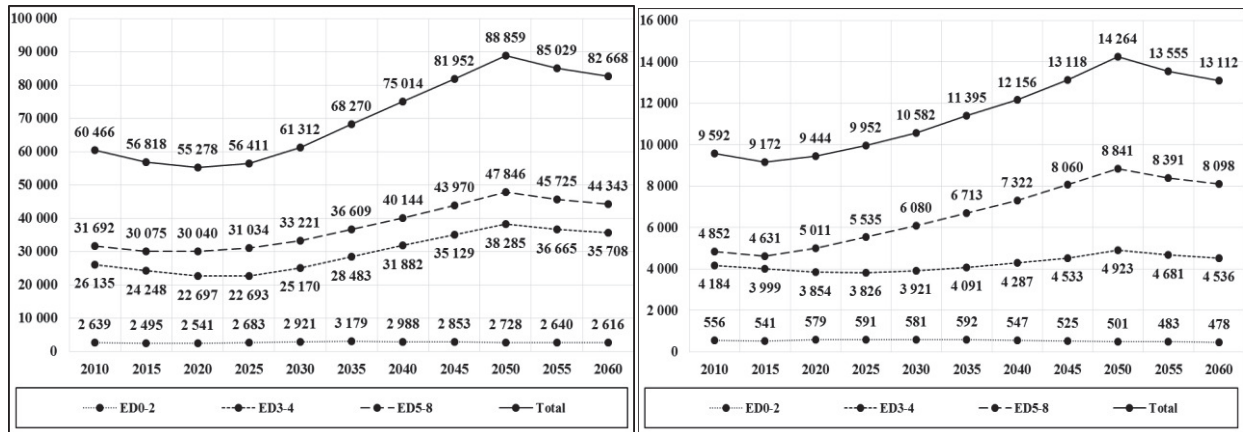
Figure 3: Projection of total numbers of ICT specialists by the highest ISCED 2011 level of education attained.

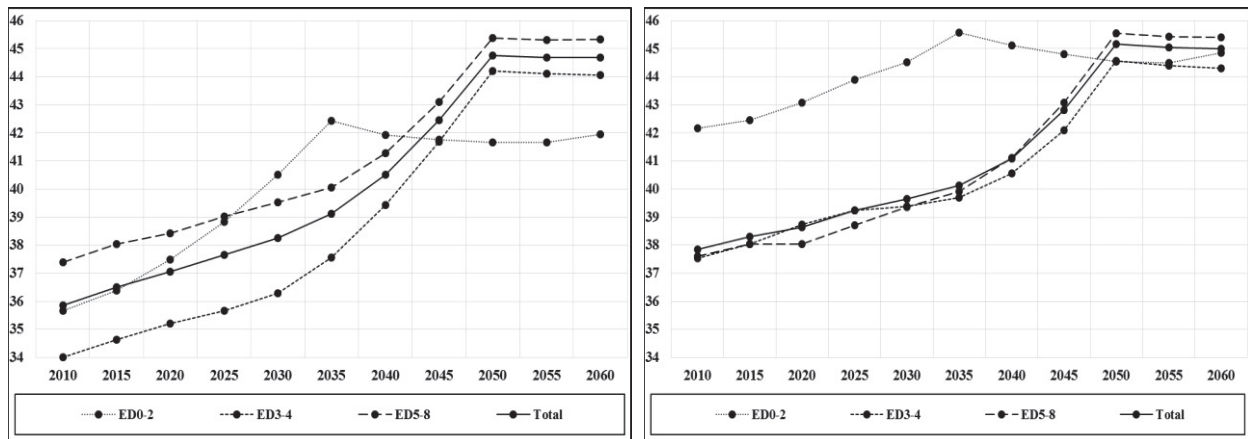**Source: authors' calculations and illustration.**

Figure 4: Projection of average ages of ICT specialists by the highest ISCED 2011 level of education attained.

Source: authors' calculations and illustration.

4. Conclusion

Our paper was aimed to show the future form of age-and-sex specific structures of the Czech economically active ICT specialists by their highest level of education attained and to highlight the future higher absolute numbers of these specialists together with a higher average age. Young cohorts that are now very numerous and create the basis of the population pyramids, grow old one day and they will be at the top of the pyramid. Interest in study of ICT does not weaken. ICT is still highly respected and popular sector by the young participants. But if everyone will have to work until an advanced age and probably will not change the field of interest, mentioned population structures of these experts change their character and this issue changes the whole potential of the Czech ICT sector. It is true that the sector will be filled with plenty of wise, experienced and highly skilled senior specialists during the time, but it changes the proportion between young and old as well. While today is one senior specialist the leader of many junior specialists, within the next 50 years could be this proportion very close to 1:1. The question to which we do not know the answer is associated with keeping competitiveness and economic potential of the ICT sector. We are not able to explicitly prepare on the mentioned population change. It is a fact that occurs one day. Who will be in the year 2060 and later the leader in innovation and the main creator of ICT economic

potential? A group of variously educated young junior specialists, or almost as large group of wise and experienced senior specialists? Let us remind in the conclusion that migration between regions or international immigration is an important factor that can affect results of this study (see e.g. paper by Šimpach, Dotlačilová, 2013a). The future challenge for further research could be applications e.g. a modified gravity model or model of human capital and the results would be used for comparison with the study.

5. Acknowledgements

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