THE RELATION BETWEEN LIFE EXPECTANCY AND COMPUTER FACILITIES OF CZECH HOUSEHOLDS

The Simplified View of the Growth in Living Standards in the Czech Republic During the Last 20 Years

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Abstract: The increasing living standard is generally accepted as one of the main causes of extending of life expectancy of the population in the last 20 years. The achieved living standard is affected by many factors and express it numerically is possible by various indicators. Based on the study of some economic time series, it was considered that computer facilities of Czech households, which can be simply expressed is related to the increasing living standard, which can be quantitatively expressed much more difficult. This rule will not be valid forever, however, for young and emerging Czech Republic is currently applying. Using by computer facilities of Czech households there will be constructed a simple model that attempts to explain the evolution of life expectancy of males or females by parabolic regression. It will be shown that the results correspond very well with logical reflections about the evolution of life expectancy, published in the literature.

Keywords: life expectancy; living standard; parabolic regression; computer facilities of Czech households

1 INTRODUCTION

The living standard, quality medical care and easy availability of water and food are often mentioned factors, affecting the extending of life expectancy (see Langhamrová et al. 2011). After the establishment of an independent Czech Republic, this growing trend began to accelerate, and therefore there is the question about "how far these values can grow"? Lee (2006) in his study deals with other countries than the Czech Republic and he tries to estimate the linear trend in life expectancy with very sophisticated techniques. The increase in life expectancy due to increasing living standard has a parabolic trend, because human potential is more or less at each person limited from above. About this limitation talk Oeppen and Vaupel (2002), who also discussed about the limits in life expectancy in their studies.

As well as life expectancy is limited from above the living standard, because from a certain point in time the marginal contribution of living standard will have no more effect on human health and the natural evolution. Based on these initial assumptions there was examined, whether is possible to express the relationship between life expectancy of males, or females and the growth of living standard. There is an annual survey data for life expectancy, published by CZSO (Czech Statistical Office). For the living standard and its quantification, there are different variables. The data for the purpose of this paper was downloaded from the CZSO database describing the evolution of computer facilities of Czech households. This only one explanatory variable will be used in the model in this paper, because in "computer facilities" of Czech households is hidden a large number of various information. The household who decides to buy a computer must have a connection to electricity and have enough money to make computer stayed in operation. Computer equipped household must also be able to work with a computer, i.e. not only be able to turn on and turn off, but to control its graphical interface and to control its installed software. Today, more and more PC itself is not enough and it is necessary to be connected to the Internet. These conditions create more and more requirements for households that own PCs, and these requirements involve the need for learning in the field. Because people are educated, gain experiences and these help them not

only in their private life but also in their professional life. As time goes on, PCs are more advanced and more demanding on the knowledge of their users and these users are more advanced in their knowledge. Better knowledge brings a higher probability to find a job, save valuable time, make more money and also make the life more enjoyable. All these factors contribute in one direction to the growth of living standard, and therefore we can say, that computer facilities of Czech households very closely correspond with the rising of living standard.

Annual observed data for the subsequent analysis was taken from an internet database of CZSO. The time series of life expectancy of males or females are expressed in years, the time series of computer facilities of Czech households is expressed as a percentage, it means that each year there was estimated how many percent of Czech households already have a computer in its equipment. The data for Computer facilities of Czech households are grouped. I.e. that in model for both males and females will be used the same explanatory variable. It is a certain simplification. Unfortunately, the data are published only for the households as a whole. In the future, the more sophisticated analysis should be prepared, that attempts to separate the data for Czech households and the results will be much more accurate.

2 ASSUMPTIONS

After displaying the fitted values of life expectancy of males (see Figure 1) or females (see Figure 2) on the computer facilities of Czech households using the least squares method (see e.g. Hušek, Pelikán, 2003), raises the question about the shape of regression model.

The model must be optimal, i.e. it must explain the greatest amount of variance and also must be very simple. Both figures show that there will be appropriate to choose parabolic shape of the model in the form

$$Y = b_0 + b_1 x + b_2 x^2 , \qquad (1)$$

and the concrete form for the purpose of this paper is

$$ex\_M = m_0 + m_1 PC + m_2 PC^2 \qquad (2)$$

for males, or

$$ex\_F = f_0 + f_1 PC + f_2 PC^2 \qquad (3)$$

for females.

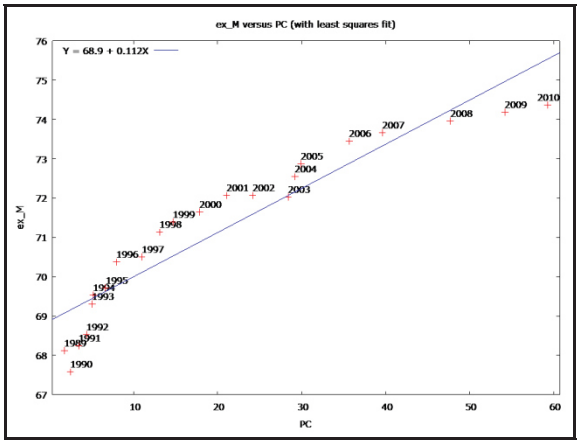

Figure 1: Life expectancy of males versus computer facilities of Czech households.
Source: CZSO. Output: GRETL System, own construction

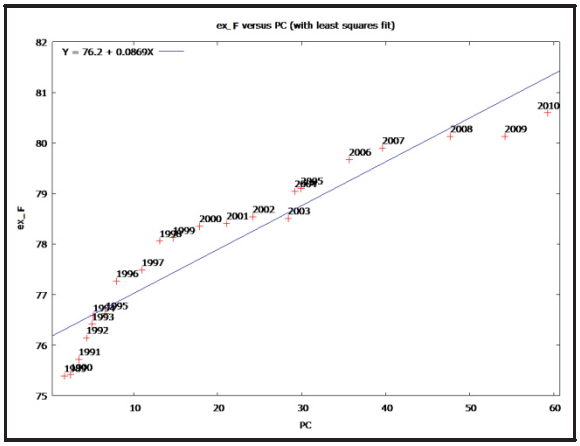

Figure 2: Life expectancy of females versus computer facilities of Czech households.
Source: CZSO. Output: GRETL System, own construction

3 PARABOLIC REGRESSION MODELING

Using by STATGRAPHICS statistical software there were estimated the unknown model parameters by ordinary least squares method. Furthermore, by example published by Hindls et al. (2007) there was examined the analysis of variance, whether exists the statistical significance between the life expectancy of males, or females and computer facilities of Czech households. Finally with the help of analysis of variance there was examined the individual statistical significance of explanatory variables in model, i.e. significance of PC a PC^2.

3.1 Life expectancy of males

From the output shown in Table 1 is clear that all parameters included in the model are at the 5% significance level statistically significant. Therefore, we can express the form of equation (2) as

$$ex\_M = 67.9279 + 0.2285\ PC - 0.0020613\ PC^2. \quad (4)$$

Table 1: Estimated parameters for ex_M

Param.	*Estimate*	*St. Error*	*T Statistic*	*P-Value*
C	67.9279	0.21256	319.533	0.0000
PC	0.22851	0.019962	11.4475	0.0000
PC^2	-0.00206	0.000351	-5.86962	0.0000

Source: STATGRAPHICS

The proportion of variance of dependent variable, expressed by an index of determination R^2 (see Hušek, 2007) is 0.958996 and its adjusted version by the degrees of freedom *adj*.R^2 is 0.954679. Durbin and Watson statistic indicates the absence of autocorrelation at the 5% significance level.

There is shown an analysis of variance in Table 2, which has confirmed the existence of dependence between the life expectancy of males and computer facilities of Czech households. It is clear that the relationship exists at the 5% significance level.

Table 2: Analysis of Variance

Source	*Sum of Sq.*	*Df*	*Mean Sq.*	*F-Ratio*	*P-Value*
Model	91.0719	2	45.5359	222.18	0.0000
Resid.	3.89402	19	0.204949		
Total	94.9659	21			

Source: STATGRAPHICS

Additional analysis of variance for each variable included to model has to confirm the statistical significance of explanatory variables. In Table 3 we can see that the null hypothesis of independence was rejected at 5% significance level.

Table 3: Further ANOVA for Variables in the Order Fitted

Source	*Sum of Sq.*	*Df*	*Mean Sq.*	*F-Ratio*	*P-Value*
PC	84.0109	1	84.0109	409.91	0.0000
PC^2	7.06097	1	7.06097	34.45	0.0000
Model	91.0719	2			

Source: STATGRAPHICS

3.2 Life expectancy of females

As in the previous sub section is the output from the software shown in Table 4. There is possible to express the estimated parameters to the function (3) as

$$ex\_F = 75.4678 + 0.168298\ PC - 0.001425\ PC^2. \quad (5)$$

All estimated parameters are at the 5% significance level statistically significant. The proportion of variance of dependent variable, expressed by R^2 is 0.962611 and its adjusted version by the degrees of freedom *adj*.R^2 is 0.958676. Durbin and Watson statistic indicates the absence of autocorrelation is significant at the 5% significance level.

Table 4: Estimated parameters for ex_F

Param.	*Estimate*	*St. Error*	*T Statistic*	*P-Value*
C	75.4678	0.164623	458.429	0.0000
PC	0.168298	0.015458	10.8874	0.0000
PC^2	-0.001425	0.000272	-5.23993	0.0000

Source: STATGRAPHICS

Table 5 confirms the existence of dependence between the life expectancy of females and computer facilities of Czech households at the 5% significance level.

Table 5: Analysis of Variance

Source	*Sum of Sq.*	*Df*	*Mean Sq.*	*F-Ratio*	*P-Value*
Model	54.4994	2	27.2497	221.72	0.0000
Resid.	2.33515	19	0.122902		
Total	56.8345	21			

Source: STATGRAPHICS

Based on results of additional analyzes of variance, shown in Table 6, we can reject the null hypothesis of independence of the explanatory variables in the model.

Table 6: Further ANOVA for Variables in the Order Fitted

Source	*Sum of Sq.*	*Df*	*Mean Sq.*	*F-Ratio*	*P-Value*
PC	51.1249	1	51.1249	415.98	0.0000
PC^2	3.37452	1	3.37452	27.46	0.0000
Model	54.4994	2			

Source: STATGRAPHICS

4 CONCLUSION

The most important graphical outputs are shown in Figure 3, respectively in Figure 4, where the resulting parabolic regression curve is placed through the fitted values of life expectancy of males, respectively females, depending on computer facilities of Czech households. In each figure there

are marked the 95% confidence intervals for each curve (the outer curves). Given that each year are published the new estimates of life expectancy, respectively estimates of computer facilities of Czech households, it is possible to recalculate models.

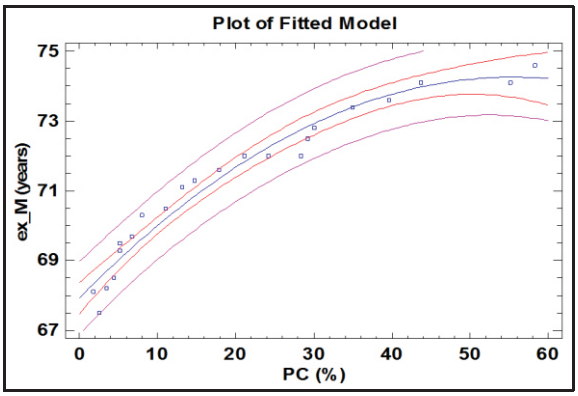

Figure 3: Parabolic regression for life expectancy – males, Source: STATGRAPHICS, own construction

Because in 2010 the computer facilities of Czech households increased at the 60 %, it is inductively possible to estimate, how the life expectancy will develop after the increasing at the 70, 80 or 90 %. This opinion results from the shape of parabolic regression curve.

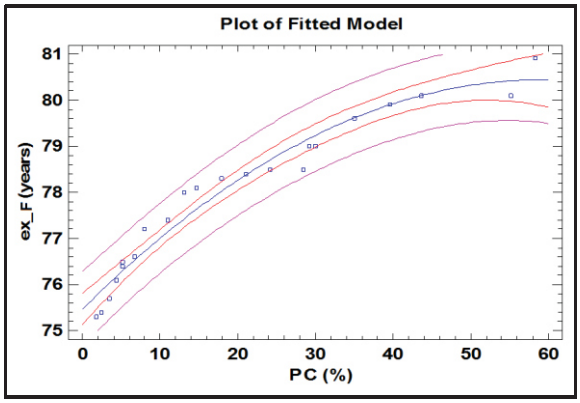

Figure 4: Parabolic regression for life expectancy – females, Source: STATGRAPHICS, own construction

These outputs correspond with the statement referred e.g. by Langhamrová et al. (2011), talking about the development of life expectancy in the future. In the future the life expectancy will moderately grow, but slower than living standard. This increase in life expectancy will be stopped one day and it is possible, that it will stop before achievement 90% of computer facilities of Czech households, which can be described as 90% "satisfaction" with the achieved living standard.

The model that has been found, tries to explain the relationship between the computer facilities of Czech households and life expectancy. It is important to note that there is no two-way causality. Computer facilities actually may affect the life expectancy, but we can't reverse this claim. The importance of the model is based on relatively weak assumptions, but there will be built a better model during next research in the future, based on several factors. The deficiencies that are included in this model will most likely resolved in the future so that there will be constructed the additional model that provides other balanced values of life expectancy and from these two models there will be constructed the final estimates.

The approach which was introduced is although very simplified, but we can say that the conclusions correspond with the logic of the considered problem.

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