

COMPARISON OF THE LINEAR TRENDS OF EIGHT SELECTED INDICATORS OF THE POPULATION IN THE CZECH REPUBLIC DURING LAST TWENTY TWO YEARS OF SOCIALISM AND FIRST TWENTY TWO YEARS OF MARKET ECONOMY

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Abstract

The article presents the information about a comparison of linear trends in a development of eight indicators concerning a population in the Czech Republic from 1968 to 2010. The indicators are: mid-year population $P(t)$, total increase $I(t)$, natural increase $N(t)$, net migration $M(t)$, live births $B(t)$, total deaths $L(t)$, marriages $W(t)$ and divorces $D(t)$ – the source of all the data is the Czech Statistical Office. There are two periods compared - last twenty two years of socialism (1968-1989) a first twenty two years of the market economy (1989-2010). The linear trends of each indicator in the mentioned periods (socialism, market economy) are further compared with the global trend of the particular indicator in the whole era 1968-2010. Nowadays this period has been considered as worse in comparison with the previous one from the demographical or sociological point of view. But the achieved results mostly indicate different trends than this general meaning is.

Key words: population, indicators, linear trends

JEL Code: C32, J11

Introduction

The development and course of a real life and of historical events in a particular era is set, above all, by the influence of natural powers and laws. These powers and laws are not dependent on the will of the people, or at least, they depend on this will very little. If this refers to a political and economic system of a state and its change, then it is not possible to disregard the effect of human factors. In this article this change refers to the transformation of “real socialism” to a market economy which has begun in the Czech republic in 1989.

In connection with this, it is interesting to study the trends of the eight most important indicators of the population in the Czech Republic and the influence of the differences between these social and political systems on these trends. All calculations are based on the data from the yearbooks of the Czech Statistical Office (follows as CZSO) from the years 1968-2010. The indicators which have been analysed are: mid-year population $P(t)$, total increase $I(t)$, natural increase $N(t)$, net migration $M(t)$, live births $B(t)$, total deaths $L(t)$, marriages $W(t)$, divorces $D(t)$, where $t = 1968, \dots, 2010$.

Specifically, it is an analysis of linear trends of the indicators stated above in the period 1968-2010. These have been compared with the linear trends in the sub-periods 1968-1989 (real socialism) and 1989-2010 (market economy).

1 Methods

For the estimation of parameters α , β of the linear trend $X(t) = \alpha + \beta t$ in time series $X(1)$, $X(2)$, ..., $X(T)$, the least squares method (Cipra, 1986, Cyhelský & Souček, 2009, Ylvisaker, 1962, Mammen, Nielsen & Fitzenberger, 2011) was used. To identify the occurrence of the trend, the null hypothesis $H_0: \beta = 0$ was tested at 5% significance level (Masry, 1999, Miers, 1971). The alternative hypothesis was in all cases $H_1: \beta \neq 0$. For the computation Microsoft Excel (Regsdale, 2000) and Statgraphics Centurion XVI were used.

2 Analysis of Indicators

This section is divided into eight items corresponding to the particular indicators. At first there is always the model of the global linear trend through the whole period 1968-2010. Afterwards the partial models follow, i.e. the model based on the data from years 1968-1989 and then the last model describing the development of the indicator from 1989 to 2010.

2.1 Mid-Year Population $P(t)$

The first indicator is the mid-year population $P(t)$ in the Czech republic (from 1968 to 1989 it was the Czech socialist republic (CSR), afterwards the Czech republic (CR)). To distinguish the researched periods the following indices of the trend functions are used: CSR for the years 1968-1989, CR for the years 1989-2010, the trend function for the whole period 1968-2010 has no index.

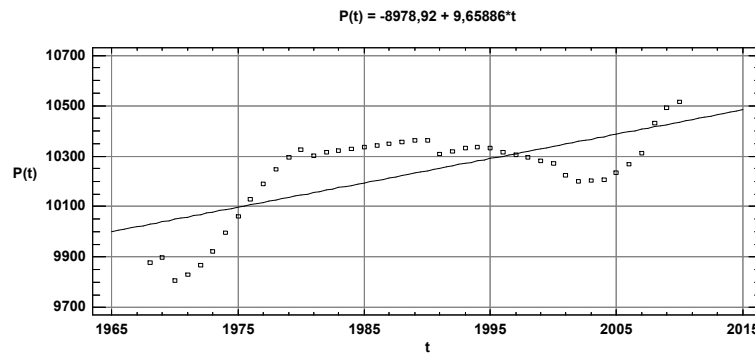
The linear trend $P(t)$ in the whole period ($t = 1968, \dots, 2010$)

$$P(t) = -8978,9 + 9,7t \quad (1)$$

(significance level of the null hypothesis $p = 0,0000$) shows that the mid-year population in the Czech republic had a increasing tendency, on average nearly 10 000 people per year - see Fig. 1. The linear trend $P(t)$ for CSR ($t = 1968, \dots, 1989$)

$$P(t)_{CSR} = -48432,6 + 29,6t \quad (2)$$

Fig. 1: Mid-Year Population 1968-2010



Source: CZSO, own calculations

($p = 0,0000$) indicates the increase nearly 30 000 persons per year during the real socialism (Srb, 2004). The same trend for CR with the market economy ($t = 1989, \dots, 2010$)

$$P(t)_{CR} = 6848,9 + 1,7t \quad (3)$$

thus fluently turned into stagnation subject to its significance level ($p = 0,5333$).

2.2 Total Increase I(t)

It can be said that the global linear trend $I(t)$ of the total increase of the population represents a stagnation

$$I(t) = 1104,8 - 0,5t \quad (4)$$

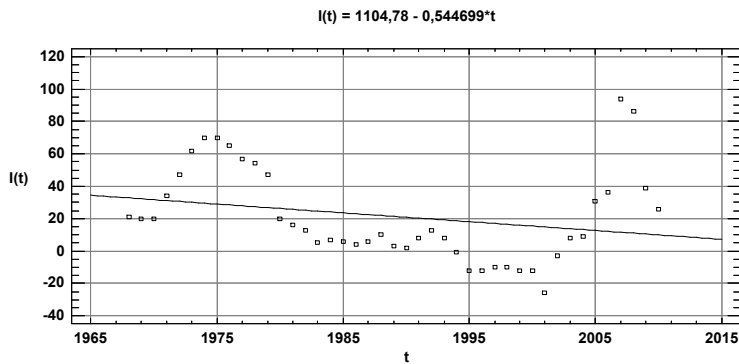
($p = 0,1255$). From the partial models

$$I(t)_{CSR} = 4209,2 - 2,1t \quad (5)$$

$$I(t)_{CR} = -5361 + 2,7t \quad (6)$$

($p = 0,006$ and $p = 0,0052$) respectively, it is clear that the epoch of the real socialism meant a decrease of the total increase $I(t)$, on average yearly more than 2 000 people. Conversely, after 1989 there has been a significant increasing trend of this indicator when the total increase has been getting greater nearly at 3 000 people every year – see Fig. 2.

Fig. 2: Total Increase 1968-2010

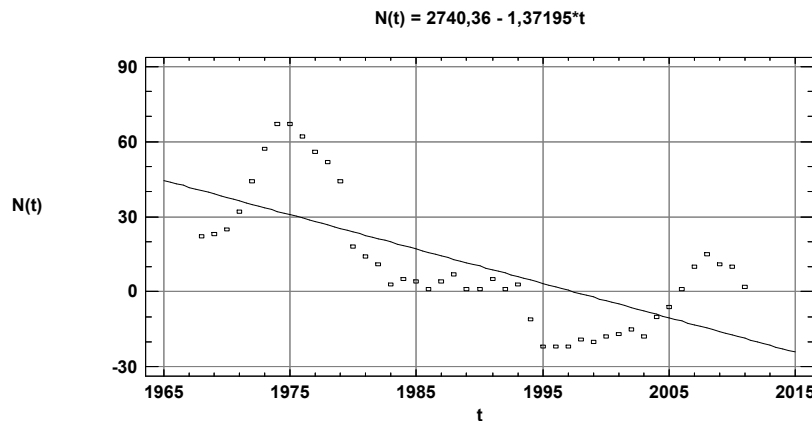


Source: CZSO, own calculations

2.3 Natural Increase $N(t)$

The linear trend of the natural increase $N(t)$ of the population in the Czech republic is decreasing as it shows the following model

Fig. 3: Natural Increase 1968-2010



Source: CZSO, own calculations

$$N(t) = 2876,2 - 1,4t \quad (7)$$

($p = 0,0000$), more than 1 000 inhabitants yearly – see Fig. 3. Comparing the submodels

$$N(t)_{CSR} = 4484,5 - 2,3t \quad (8)$$

$$N(t)_{CR} = -1013,5 + 0,5t \quad (9)$$

($p = 0,0022$ and $p = 0,2155$) their parameters give the following information that the reason of the decrease in $N(t)$ comes from the socialist era $N(t)_{CSR}$, whereas the next model $N(t)_{CR}$ corresponds to the stagnation after 1989.

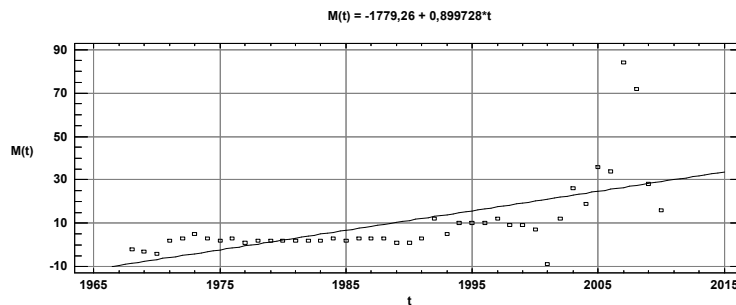
2.4 Net Migration $M(t)$

The fourth indicator in our research is the net migration $M(t)$. The general trend is described by the model

$$M(t) = -1779,3 + 0,9t \quad (10)$$

($p = 0,0000$), so the migration has been increasing up to 1 000 persons per year – see Fig. 4. Very interesting results are provided by the submodels corresponding to the socialism

Fig. 4: Net Migration 1968-2010



Source: CZSO, own calculations

$$M(t)_{CSR} = -294,4 + 0,1t \quad (11)$$

($p = 0,0303$) and capitalism

$$M(t)_{CR} = -4363,2 + 2,2t \quad (12)$$

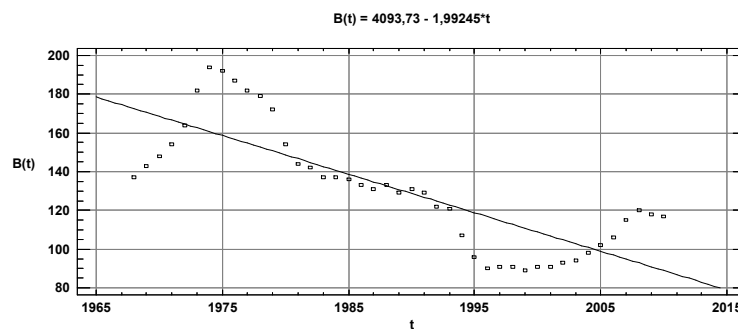
($p = 0,0013$) in the Czech republic (Srb, 2004). Using 95% power of the test of alternative hypothesis it is possible to accept that the number of inhabitants was increasing during the era of socialism 1968-1989 by net migration $M(t)$. But the difference is only 100 persons per year, so it is a negligible change related to the more than 10 000 000 inhabitants. If 99% power of the test is used, the conclusion rather indicates stagnation of increment of this indicator in 1968-1989. Of course, people in socialist states could not move abroad and, at the same time, also in the opposite direction nearly nobody came. After the „velvet revolution“ in 1989 this stagnation has turned out into the increase, about 2 000 persons per year.

2.5 Live Births $B(t)$

The statistics of live births $B(t)$ give the model

$$B(t) = 4093,7 - 2,0t \quad (13)$$

Fig. 5: Live Births 1968-2010



Source: CZSO, own calculations

($p = 0,0000$), which implies the decrease of the live births, approximately 2 000 children every year (Vavroň, 2012) – see Fig. 5. The partial linear trends are

$$B(t)_{CSR} = 3495,3 - 1,7t \quad (14)$$

$$B(t)_{CR} = 1177,9 - 0,5t \quad (15)$$

($p = 0,0195$ and $p = 0,2945$). So, the change of the political system converted the decrease of $B(t)_{CSR}$ into stagnation of $B(t)_{CR}$.

2.6 Total Deaths $L(t)$

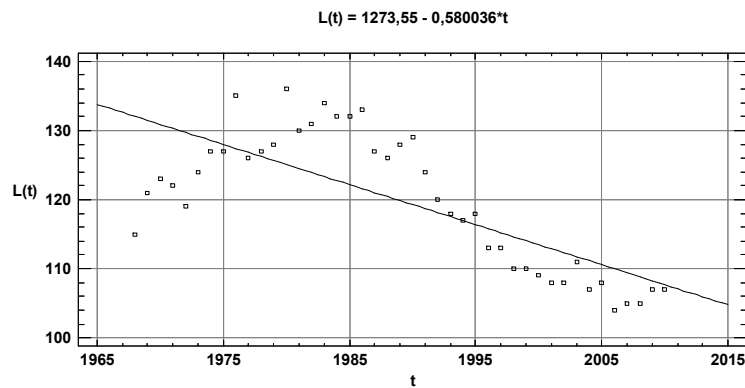
The number of the total deaths $L(t)$ has been decreasing on average since 1968 as it flows from the model

$$L(t) = 1273,6 - 0,6t \quad (16)$$

($p = 0,0000$) and from Fig. 6. It has been decreasing since 1968 (-600 persons per year). However, the trends in the submodels

$$L(t)_{CSR} = -939,5 + 0,5t \quad (17)$$

Fig. 6: Total Deaths 1968-2010



Source: CZSO, own calculations

($p = 0,0009$) and

$$L(t)_{CR} = 2182,2 - 1,0t \quad (18)$$

($p = 0,0000$) are countervailing (Srb, 2004). In socialism there was a increasing trend (+600 persons per year). Contrary, in capitalism it has been decreasing (-1 000 persons per year).

2.7 Marriages $W(t)$

This indicator has a global decreasing linear trend

$$W(t) = 2651,2 - 1,3t \quad (19)$$

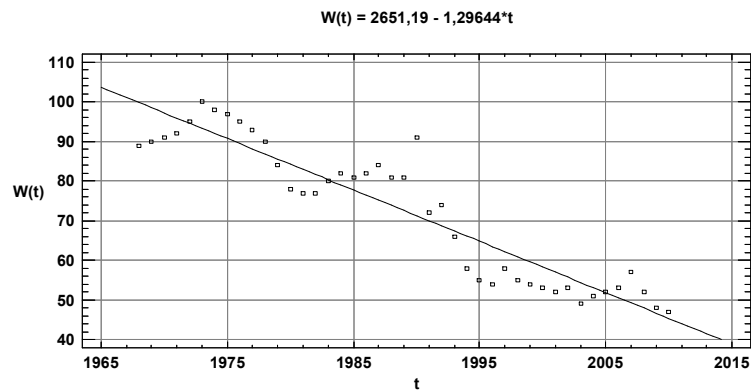
($p = 0,0000$), where the slope is, in fact, 1 300 marriages less year by year. In the partial models ($p = 0,0000$),

$$W(t)_{CSR} = 1685,8 - 0,8t \quad (20)$$

$$W(t)_{CR} = 2843,7 - 1,4t \quad (21)$$

($p = 0,0000$) this decrease was accepted as well and it is nearly two times greater in the period of market economy than in the socialism (Rychtaříková, 1995). This decrease is evident from Fig. 7.

Fig. 7: Marriages 1968-2010



Source: CZSO, own calculations

2.8 Divorces $D(t)$

The divorces $D(t)$ has a very slight increasing linear trend according the model

$$D(t) = -412,6 + 0,2t \quad (22)$$

($p = 0,0000$) in general. The bigger proportion of the divorces appeared in the communist period

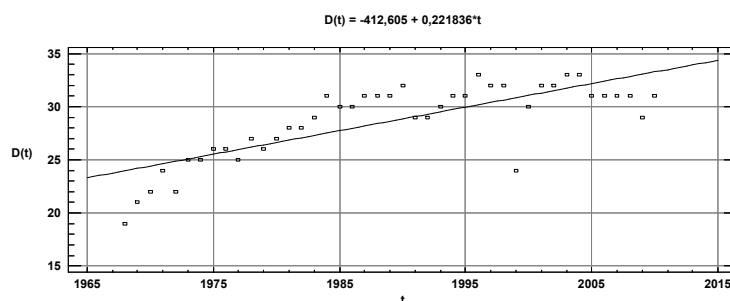
$$D(t)_{CSR} = -1001,3 + 0,5t \quad (23)$$

($p = 0,0000$), conversely, since 1989, where the trend function is

$$D(t)_{CR} = -18,6 + 0,02t \quad (24)$$

($p = 0,7133$), the number of divorces has been stable, i. e. stagnating (Srb, 2004) – for details see Fig. 8.

Fig. 8: Divorces 1968-2010



Source: CZSO, own calculations

Conclusion

The findings stated above can be summarized this way: all researched indicators show a positive development during the renaissance of capitalism from 1989 to 2010 except of the mid-year population $P(t)$ and number of marriages $W(t)$. The mid-year population at first had grown from 1968 to 1989 and then it has been stagnating since 1989. The number of marriages had a decreasing trend in the last twenty two of socialism and then after 1989 this development became stronger. In Table 1 there are all estimates of the slopes for all indicators in every period. The estimates denoted by $\{*\}$ have the significance level of the test of null hypothesis less than 5%, so such parameters are statistically significant, i. e. there is a linear trend. Further, indicators denoted by $\{+\}$ have a positive development in the second researched period 1989-2010. If we use a sports terminology, we can say that the period of market economy in the Czech republic “won” 6:2 from the point of view of the population indicators.

Tab. 1: Summary of the estimates – slope of the linear trend

Period	Indicator							
	$P(t)$	$I(t)^+$	$N(t)^+$	$M(t)^+$	$B(t)^+$	$L(t)^+$	$W(t)$	$D(t)^+$
1968-2010 – global trend	9,7*	-0,5	-1,4*	0,9*	-2,0*	-0,6*	-1,3*	0,2*
1968-1989 – trend in CSR	29,6*	-2,1*	-2,3*	0,1*	-1,7*	0,5*	-0,8*	0,5*
1989-2010 – trend in CR	1,7	2,7*	0,5	2,2*	-0,5	-1,0*	-1,4*	0,02

Source: CZSO, own calculations

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