

## **Is there a Correlation between the Increasing Mean Age of Women at Childbirth and the Declining Total Fertility Rates?**

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### **Abstracts**

The ageing process of the population in developed countries including the Member States of the European Union (EU) is becoming very important at present; the ageing is of vital concern of each of us. The European year of 2012 “European year for Active ageing and Solidarity between generations” indicates the importance of ageing process in Europe. The ageing can be explained by increased longevity that has been evident for several decades as life expectancy has risen and this development is often referred to as ageing at the top of the population pyramid. On the other hand the ageing is related also to the ageing at the bottom, because the levels of the total fertility rates (TFR) has declined and are very low in all of the EU Member States. The TFR in developed countries is far below its replacement level of 2.1. Ageing from the bottom is typical for all of the EU Member States, because the TFR in some of the Member States fell below the threshold of the lowest-low fertility rate of 1.3 live births per woman. Postponement of childbearing to later ages of mothers demonstrated a gradual change in the curve of age-specific fertility rates, which gradually changes its positive asymmetry in relation to the age of the mothers and at the same time the modal age of the childbearing increased. The family structure is also changing; the families have not only fewer children but more and more children are born outside marriage. The mean age of women at childbirth has increased rapidly, especially the mean age of women at first and second birth orders, which has an impact on declining number of children born to one woman during her reproductive period. The article deals with the correlation and linear regression analysis between the mean age of women at childbirth and the TFR.

Keywords: ageing at the top and at the bottom, linear regression, modal and mean age of women at childbirth

### **1. Introduction**

Ageing from the bottom is typical for all of the EU Member States, because the TFR in some of the Member States fell below the threshold of the lowest-low fertility rate of 1.3 live births per woman. When total fertility rate fell below the replacement level in the majority of European countries in 1970s and 1980s, appropriate demographic terminology was readily available: “low fertility”, “below-replacement fertility” and “sub-replacement fertility soon became the keywords describing European fertility trends (Sobotka, 2004). Total fertility rate represents the mean number of children that would be born alive to a woman during her lifetime if she were to pass through her childbearing years conforming to the fertility rates by age of a given year. This rate is therefore the completed fertility of a hypothetical generation, computed by adding the fertility rates by age for women in a given year (Eurostat, <http://epp.eurostat.ec.europa.eu/tgm/web/table/description.jsp>).

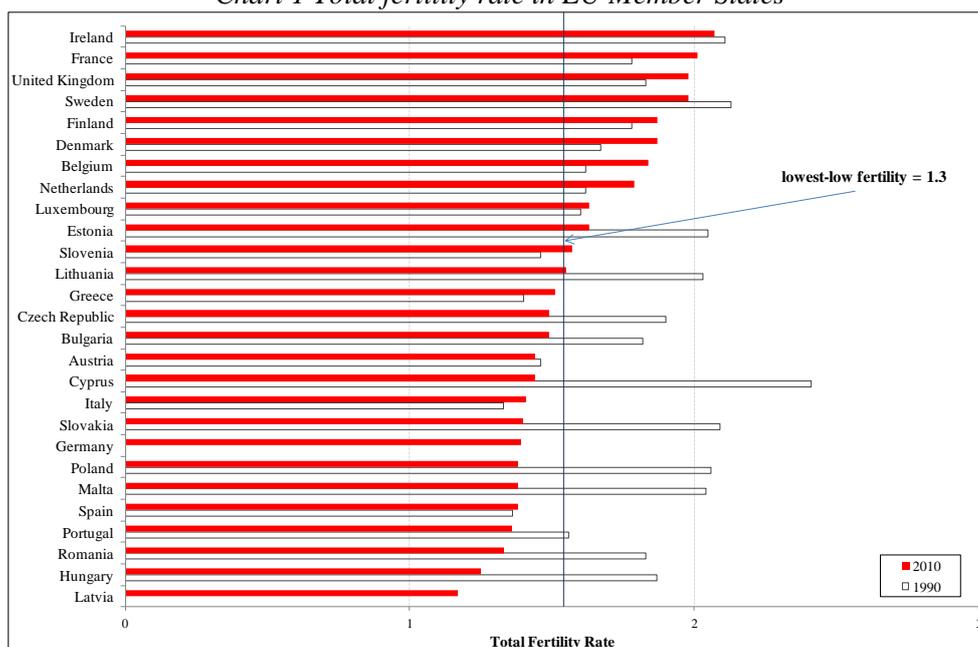
As Caltabiano et al. (2009) stated the postponement of the transition to motherhood is generally characterized by both an increase in average age at first birth, and a decrease in adolescent (ages 15-19) and juvenile (ages 20-26) fertility. In fact, in many European countries (with the exception of Eastern Europe) more than 50% of births are from mothers over the age of 26. Also Sobotka (2004) discovered that the effects

of the increasing age at childbearing form a crucial part of the explanation of lowest-low fertility as well as of the relatively large differences in the TFR level between European countries and regions.

According to the Eurostat definition the mean age of women at childbirth is the mean age of women when their children are born. For a given calendar year, the mean age of women at childbearing is calculated using the fertility rates by age as weights, in general reproductive period is between 15 and 49 years of age. When calculated in this way, the mean age is not influenced by a specific population structure and is therefore better for geographical and temporal comparisons (<http://epp.eurostat.ec.europa.eu/tgm/web/table/description.jsp>).

According to the chart 1 it is clear that the change of the TFR between 1990 and 2010 is radical. In 1990 most of the East European countries had a higher TFR than the countries in the western part of Europe. The situation changed dramatically after the velvet revolutions in the Eastern European countries. In 2010 the lowest fertility rates was achieved in Latvia (1.17), followed by Hungary (1.25) and Romania (1.33). The highest levels of TFR were in 2010 reached in Ireland (2.07), France (2.01) and United Kingdom (1.98). So the less developed countries (less developed means in this case the countries with a lower gross domestic product per capita in purchasing power standards) are faced with a dramatically low fertility rates compared to countries in Western Europe.

Chart 1 Total fertility rate in EU Member States



## 2. Analysis methods

For analytical purposes we decided to use the correlation coefficient and linear regression methods to measure whether between the TFR a mean age of women at childbirth exists a statistically significant linear relationship either positive or negative. The correlation coefficient was calculated using statistical package SAS Enterprise Guide 4.2. Using the probability value (p-value) it was tested the significance at the significance level of 0.05. The analysis was done for selected countries from 1980 till 2011. Not all of the EU Member States have the TFR and mean age of women at childbirth data available at the statistical database for the analyzed period of time. (Eurostat, [http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search\\_database](http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database)).

### 3. Correlation analysis of TFR and mean age of women at childbirth

To measure the linear relationship between the TFR and the mean age of women at childbirth the Pearson Correlation Coefficient was used. The European Union has in total 27 Member States. For analysis purposes 14 Member States were chosen. In 7 cases a negative statistically significant correlation was confessed. In 4 Member States a positive statistically significant correlation was proven. In three cases was no statistically significant linear relationship indicated. The outputs, from the statistical analysis of correlation between the total fertility rate and mean age of women at childbirth (in analysis labeled as MA) are presented in the following tables.

Tab. 1 Correlation analysis of TFR and mean age of women at childbirth (MA) from 1980 till 2011

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Hungary - TFR</b>
Hungary - MA	-0.90426 <.0001

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Slovakia - TFR</b>
Slovakia - MA	-0.78342 <.0001

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Austria - TFR</b>
Austria - MA	-0.68826 <.0001

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Czech Republic - TFR</b>
Czech Republic - MA	-0.67732 <.0001

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Greece - TFR</b>
Greece - MA	-0.64669 <.0001

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Italy - TFR</b>
Italy - MA	-0.49948 0.0036

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Bulgaria - TFR</b>
Bulgaria - MA	-0.45044 0.0097

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Lithuania - TFR</b>
Lithuania - MA	-0.24346 0.1794

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Denmark - TFR</b>
Denmark - MA	0.90000 <.0001

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Belgium - TFR</b>
Belgium - MA	0.71848 <.0001

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Finland - TFR</b>
Finland - MA	0.68708 <.0001

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Luxembourg - TFR</b>
Luxembourg - MA	0.48152 0.0053

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>United Kingdom - TFR</b>
United Kingdom - MA	0.23982 0.1862

Pearson Correlation Coefficients, N = 32 Prob >  r  under H0: Rho=0	
	<b>Sweden - TFR</b>
Sweden - MA	+0.03364 0.8550

A very strong negative correlation was mostly discovered in East European countries. The highest negative correlation coefficient was in Hungary ( $r = -0.904$ ,  $p < 0.0001$ ),

followed by Slovakia ( $r = - 0.783$ ,  $p < 0.0001$ ), Austria ( $r = - 0.688$ ,  $p < 0.0001$ ), Czech Republic ( $r = - 0.677$ ,  $p < 0.0001$ ), Greece ( $r = - 0.647$ ,  $p < 0.0001$ ), Italy ( $r = - 0.499$ ,  $p = 0.0036$ ), Bulgaria ( $r = - 0.45$ ,  $p < 0.0097$ ). A negative but not statistically significant correlation between the analyzed variables was confessed in Lithuania. It means that in the 7 mentioned countries of EU does exist a strong negative relationship between the TFR and mean age of women at childbirth. The negative correlation was typical for the new Member States of the EU.

In four cases the correlation between two variables was positive, namely in: Denmark ( $r = 0.9$ ,  $p < 0.0001$ ), Belgium ( $r = 0.718$ ,  $p < 0.0001$ ), Finland ( $r = 0.687$ ,  $p < 0.0001$ ), and Luxembourg ( $r = 0.482$ ,  $p = 0.0053$ ). No statistically significant correlation was discovered in following countries: Lithuania, United Kingdom and Sweden. According to this only very simple and not complex analyses is clear that a negative correlation is typical for less developed countries (Hungary, Slovakia, Czech Republic, Bulgaria) and in countries with more economic problems (Greece, Italy).

A positive correlation between the two selected variables is typical in more stable a developed societies like Denmark, Belgium, Finland, Luxembourg. A positive correlation was not achieved in "new" EU Member States but only in EU countries that was part of the European Union before the enlargement in 2004 and 2007. It means that the negative correlation between the TFR and the mean age of women at childbirth is not typical for all of the EU Members but mainly for the countries in Eastern Europe and in the countries with a lower economic stability, a lower level of economic and living standard (measured using the GDP per capita in PPS, higher unemployment rate, lower social expenses etc.). Also according Frejka and Sobotka (2008) in Western and Northern Europe, fertility quantum was slightly below replacement but in Southern, Central and Eastern Europe, fertility quantum as measured by the period total fertility rate and its tempo-adjusted version was markedly below replacement; in many countries it was around 1.5, and in some populations it was as low as 1.3 to 1.4 births per woman.

#### **4. Some evidence from Slovakia including regression analysis of TFR and mean age of women at childbirth**

Age specific fertility rates shown in chart 2 reflect the changes in reproductive behavior of women in Slovakia in selected years. The age-specific fertility rate measures the annual number of births to women of a specified age or age group per 1,000 women in that age group. Unless otherwise specified, the reference period for the age-specific fertility rates is the calendar year (United Nations Web Services Section, 2010).

According to Mazzuco and Scarpa (2011) it has been recently observed that patterns of fertility of some developed countries show a deviation from the classical bell shaped curve. Some countries, such as Ireland and UK, exhibit an almost bi-modal shape of age-specific fertility rates that classical fertility models cannot adequately fit. The distribution shape in Slovakia in 1980 and 1990 shows a positive skewness, with the bulge, representing the modal value at the age of 22 years (1980) and 21 years in 1990, it means that the highest fertility was concentrated at the beginning of the reproductive age of women.

The shape of the distribution was still positive in 1995 with a modal value of 22 years. After 1995 the distribution shape of the age specific fertility rates undergo a significant change, the distribution in Slovakia is still unimodal. The modal value of the age specific fertility increased in selected years as follows: 28 years in 2005, 30 years in 2010 and 2011. The change of the distribution of age specific fertility rates shows a typical postponed childbearing in Slovakia. First of all the bulge of the shape shifts to the right, it moves to older age groups and the bulge is not so significant anymore.

Chart 2 Age specific fertility rates in Slovakia

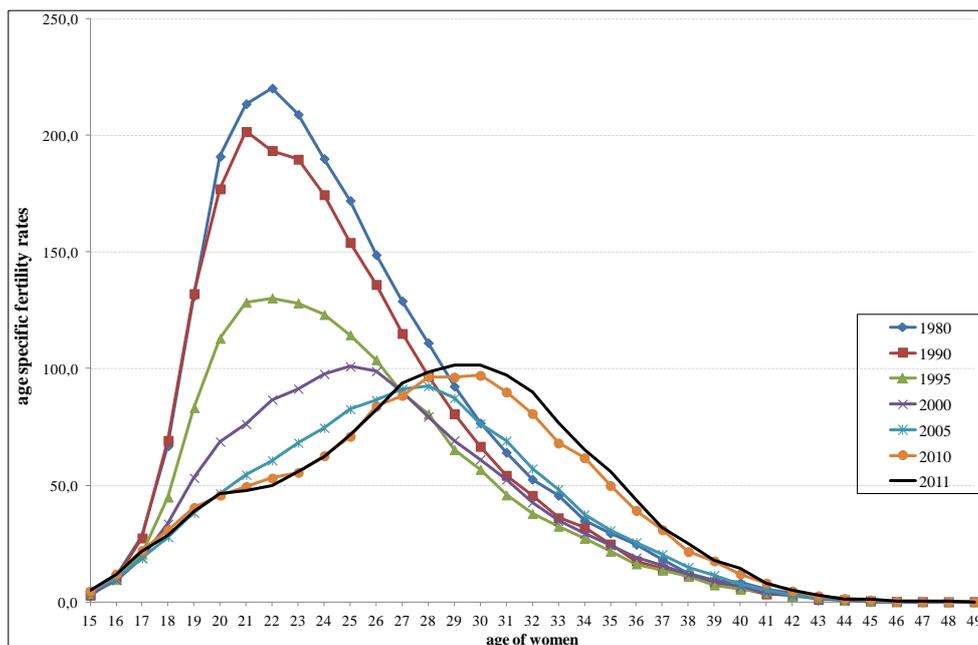


Chart 3 Regression analysis of TFR and mean age of women at childbirth in Slovakia (1980-2011)

**Linear Regression Results**  
The REG Procedure  
Model: Linear\_Regression\_Model  
Dependent Variable: Slovakia - TFR

Number of Observations Read	32
Number of Observations Used	32

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	3.49129	3.49129	47.67	<.0001
Error	30	2.19720	0.07324		
Corrected Total	31	5.68850			

Root MSE	0.27063	R-Square	0.6137
Dependent Mean	1.70031	Adj R-Sq	0.6009
Coeff Var	15.91643		

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	8.57980	0.99756	8.60	<.0001
Slovakia - MA	1	-0.26174	0.03791	-6.90	<.0001

The simple linear regression model (see chart 3) that measured the relationship between the dependent variable - TFR and one explanatory variable – mean age of women at childbirth in Slovakia is statistically significant. According to the estimated slope of the regression line it is visible that an increase in mean age by one year will cause a decline of TFR on average by -0,262. The slope of the regression is negative

that was clear also from the negative value of the correlation coefficient between the analyzed variables in Slovakia. Hopefully the negative relationship will not last for a long period of time. The TFR could increase in Slovakia when the economic recession ends and the socio-economic indicators will be more positive.

## 5. Conclusions

Significant socio-economic changes in Slovak society after 1990, affected also changes in the reproductive behaviour of the population. Ageing from the bottom is typical for all of the EU Member States, because the total fertility rates (TFR) of the Member States declined to a level well below the replacement level of 2.1 children per women. Also in Slovakia the TFR has already for a long period of time fallen below the threshold of replacement level, while between 2000 and 2007, the total fertility fell below the threshold of the lowest-low fertility rate of 1.3 live births per woman. Postponement of childbearing to later ages of mothers demonstrated a gradual change in the curve of age-specific fertility rates, which gradually changes its positive asymmetry in relation to the age of the mothers and at the same time the modal age of the childbearing increased. A negative statistically significant correlation was discovered between TFR and mean age of women at childbirth in less developed Eastern and Southern European countries.

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