Birth Seasonality Patterns in Central and Eastern Europe during 1996-2012

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ABSTRACT

Fertility is characterised by seasonal and cyclical variations and also by another trend by geographic region and time span. This study aims to identify a birth seasonality model for post-communist Central and Eastern European (CEE) countries and to analyse the features of birth seasonality model by CEE countries during the period 1996-2012. The method used to analyse the seasonal pattern of live births is the decomposition of time series using the moving average filter and the identification of seasonal variation by calculating seasonal factors. The results show that seasonality of live births in CEE countries is characterised by two peaks, one in July and another in September, except the Baltic countries and the Czech Republic.

Key words: birth pattern, seasonality, seasonal factors, similarities, Central and Eastern Europe

JEL classification: C22, J11

INTRODUCTION

Live births present a seasonal pattern with differences by geographic regions under the influence of factors that outline this phenomenon. The study of seasonal pattern of births has been a steady concern of demographic researchers. Cummings (2010) argues that since Quetelet (1835) many researchers have studied the seasonality of births in various countries and periods in order to find reasons for this pattern.

Demographic studies (Lam and Miron, 1994) found that seasonal variations in birth rates differ by geographic regions, for example the European model is different from the American model. Moreover, within the European model there exist specific features by geographic sub-regions.

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The European model of births seasonality is characterised by high birth rates in spring, especially in April, and in early autumn, in September, and by lowest figures in late autumn and early winter (from October to December). This birth pattern is specific to countries with hot summers and cold winters. In the Northern European countries, there are peaks in spring (March to May) and depressions in autumn (October to November). In Southern Europe, the birth peak occurs in summer or late summer (Haandrikman and van Wissen, 2008).

The seasonality of births is influenced by multiple factors. One group of factors is related to physical environmental characteristics (geophysical factors and climatic characteristics such as temperature, light). These factors explain natural cycles. Cummings (2010) shows taking into account diverse cultures and geographical regions that periods of increased conception are preceded by periods of high intensity of light. Roenneberg and Aschoff (1990) and Manfredini (2009) found that births seasonality is greatly explained by temperature and length of photoperiod (PP). Other studies, such as Becker et al. (1986) and Huber and Fieder (2008), believe that seasonality is influenced by a combination of temperature and nutrition, while Bailey et al.(1992) and Doblhammer et al. (2000) argue that the amount of rain could explain the profile of seasonal birth.

Regions with important climate changes show higher seasonality than regions with more stable climate (subarctic and equatorial geographic zones) (Friger et al., 2009). An overview of literature dealing with seasonality explained by latitude and sunlight, climate and temperature, and food supply is presented by Laaidi et al. (2011).

Another group of factors with influence on births seasonality is related to cultural, social, demographic, and economic conditions (festivals, religious rules and calendars, marriage seasonality, seasonal labour migration). These factors explain the artificial cycles. The September births' peak is related to holiday theory, namely, an increase in conceptions around Christmas and the New Year is due to increased amount of time spent by people around winter holidays (Haandrikman and van Wissen, 2008).

In the literature, the hypothesis of birth seasonality is validated using either aggregate (Lam and Miron, 1991; Chatterjee and Acharya, 2000; Bobak and Gjonga, 2001) or individual data (Rizzi and Dalla-Zuana, 2007; Friger, Shoham-Vardi and Abu-Saad, 2009).

Countries of Central and Eastern Europe have a common past in what regards pro-natalist policies implemented during the communist regime. Therefore, it is of interest to verify if fertility in these countries has preserved the model designed by pro-natalist policies or it has registered a specific evolution by countries or group of countries.

The study aims to identify a birth seasonality model for the post-communist Central and Eastern European (CEE) countries and to analyse the differences in birth seasonality between CEE countries and the general European seasonal birth pattern. The method used to analyse the seasonal pattern of live births is the decomposition of time series using the moving average filter and the identification of seasonal variation by calculating the seasonal factors. The results show that the seasonal component of live births in CEE countries is characterised by two peaks, one in July and another in September, except the Baltic countries.

The following section of the paper (Section 2) presents the data and the methodology and Section 3 discusses the main results. The conclusions are included in Section 4.

DATA AND METHOD

Sample and data

The study included the following countries: Hungary, Poland, Romania, Slovenia, Slovakia, Bulgaria, Czech Republic, Croatia and the three Baltic countries: Estonia, Latvia and Lithuania. These eleven countries together with Albania, which is not included in this study, are classified as Central and Eastern European (CEE) countries by OECD (2001).

The variables used in this study represent the number of live births by month and by country during the period 1996-2012. We note by y_t the number of live births in a month *t*.

The data are available from the Eurostat database under *Demography and migration* topic in the *Fertility* section (http://ec.europa.eu/eurostat/data/database).

Method

The identification of the seasonal pattern of live births has been made using the sequence chart that allows identifying visually the trend and the seasonal variation for a time series.

The monthly data have been corrected for the unequal number of days using the following approach (Manfredini, 2009):

$$y_t^* = (\bar{y}_t \times 365)/12 \qquad (1)$$

where:

y_t^* – is the corrected number of births per month under the hypothesis of months of equal length;

$\bar{y}_t$ – is the mean number of births per day in month *t*.

The time series for live births (y_t) can be decomposed, using a multiplicative model, into the following components: C_t– cyclical component; *f(t)* – trend component; S_t – seasonal component; ε_t – error component. The multiplicative model has the following form:

$$y_t = C_t * f(t) * S_t * \varepsilon_t \quad t = 1, \dots, n \tag{2}$$

The estimation of the seasonal component has been made by calculating seasonal factors using the following approach:

1) The estimation of the trend component from the original data by applying a moving average filter (Jaba, 2002; Brockwell & Davis, 2002):

$$\overline{y}_t = (\frac{1}{2} y_{t-p} + y_{t-p+1} + \dots + y_{t-1} + y_t + y_{t+1} + \dots + y_{t+p-1} + \frac{1}{2} y_{t+p}) / d \tag{3}$$

where: $\overline{y}_t$ – is the moving average for month *t*; and *d* – is the period of the seasonal component (the period is 12 months, so *d* is even, *d=2p*).

2) The estimation of seasonal component by calculating the seasonal indices and the seasonal factors.

For a multiplicative model, as considered for the analysed time series, the seasonal indices (i_t) are computed as an average of the ratios $y_t / \overline{y}_t$ (the detrended values of monthly births) using observations only for period *k*, where *k = 1, …, d*.

The seasonal factors ($\hat{S}_k$) (the seasonal means) are obtained by adjusting the seasonal indices, namely, as the ratio of the seasonal index to the geometric mean of the indices:

$$\hat{S}_k = i_k / \sqrt[d]{\prod_{k=1}^{d} i_k} , k = 1, \dots, d \tag{4}$$

The product of the seasonal factors equals 1 ($\prod_{k=1}^{d} \hat{S}_k = 1,\ k = 1, \dots, d$).

Cluster analysis has been used to assess similarities among countries in accordance with the seasonality of live births. Considering seasonal factors calculated for each country by month, the cluster analysis allows identifying homogenous groups of countries taking into account the seasonality of fertility.

The basic criterion for clustering the countries is distance. Countries that are near each other should belong to the same cluster, and countries that are far from each other should belong to different clusters. Distance between two cases has been assessed using the Squared Euclidean distance. It has been calculated as the sum of the squared differences between all the variables of the two countries.

$$d^2(x, y) = \sum_i (x_i - y_i)^2$$

The clusters that merge are made up of more and more dissimilar countries. The decision of the optimal number of clusters is based on researcher's subjective reasons.

The estimation of seasonal effects has been made using SPSS software using the seasonal decomposition procedure.

RESULTS

During the 17 years considered in the analysis, the variation in life births shows different trends by countries. For Romania and Hungary, the downward trend over the entire period is clearly highlighted by the sequence charts (Figure 1).

In all European countries fertility has declined considerably over the past decades, with important consequences on the structure of population age. The ageing of population in these countries will cause an absolute population decline in the future years (Asandului, 2012)

In the CEE countries, the downward trend in fertility is explained by both the demographic transition theory and the social and economic conditions specific to former communist countries. Fertility generally declines during periods of political and social instability (Jemna & Cigu, 2014).

In Romania, the evolution of fertility is characterised by a cyclical pattern with four peaks in the year 1967, 1974, 1981, and 1989 and a general downtrend, followed by a stable low fertility level after 2000 (Jaba et al., 2013).

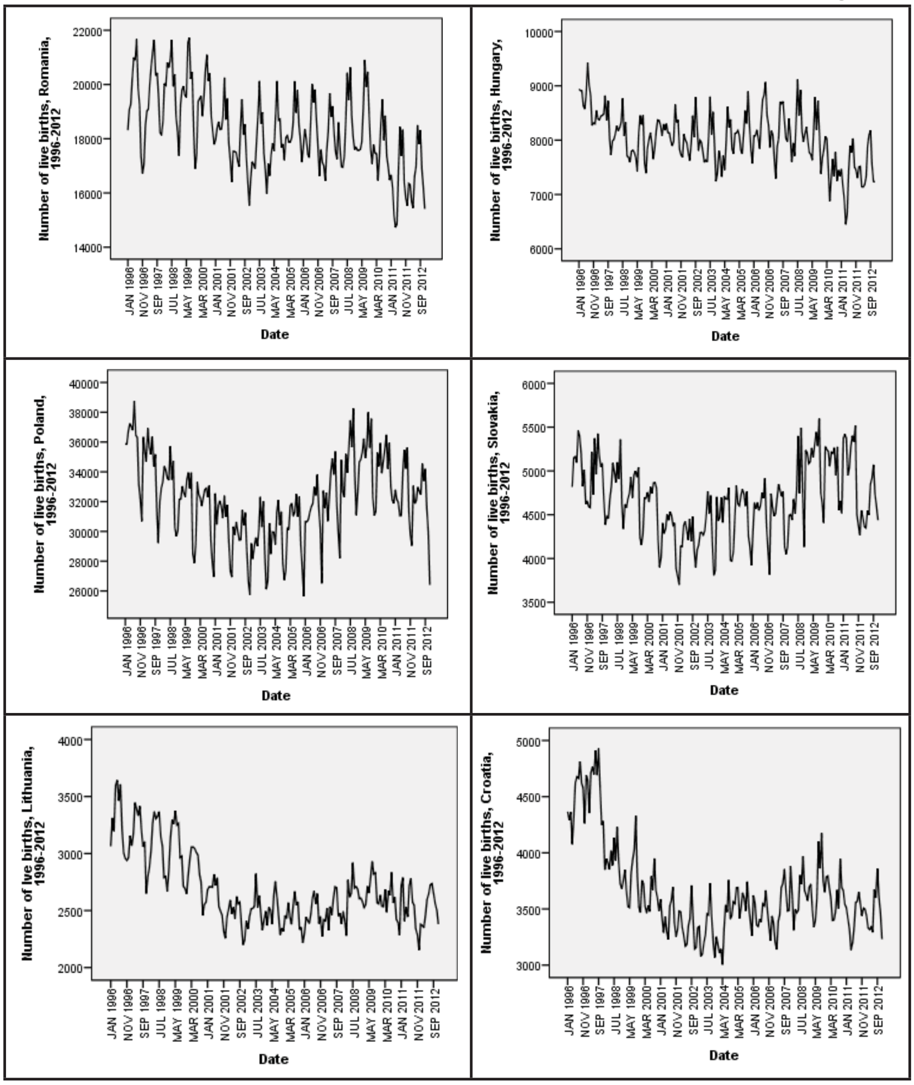
Poland and Slovakia show a similar pattern in that both countries registered a descending trend until 2003, followed by an increase of live births (up to 2009). The reversal of the fertility trend is explained by the recuperation of postponed childbirths and by the ongoing social and economic stabilization (Potančoková et al., 2008). On the other hand, Croatia and Lithuania show a decreasing trend until 2002, after that life births show a rather steady evolution.

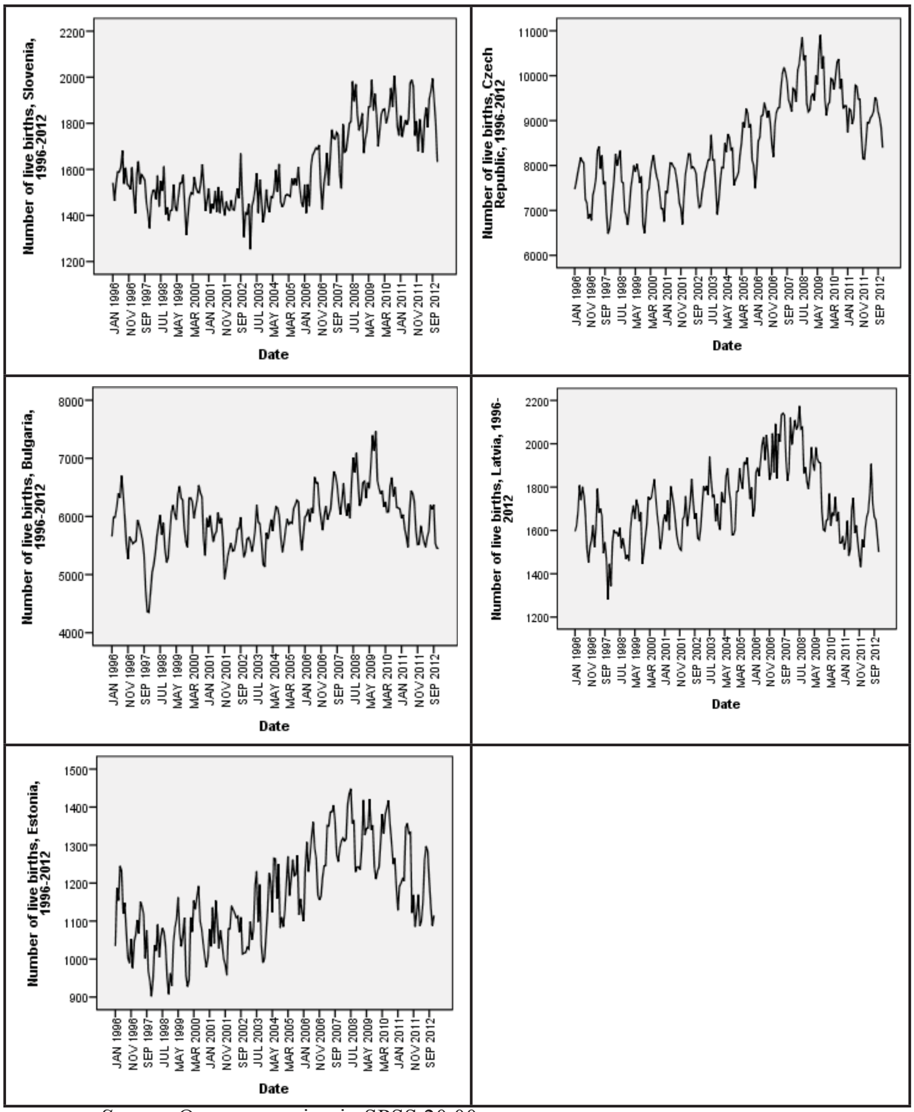
Slovenia, Czech Republic, Bulgaria, Latvia, and Estonia had an upward trend of life births during the period 2003-2008. In Bulgaria, a minimum value is observed in November 1997 (4300 live births), the period October 1997 – February 1998 being characterized by the lowest figures as compared to other years. In Latvia, November 1997 also presents smaller values compared to other figures.

It appears from the graphs of monthly births registered during the period January 1996 – December 2012 that time series show seasonal variation for all the eleven countries.

Monthly life births variation in CEE countries during the period 1996 – 2012

Figure 1





Source: Own processing in SPSS 20.00

The seasonal factors were obtained using the decomposition procedure of the time series considering the multiplicative model. The values of the seasonal factors are presented in Table 1.

For most of the countries, the seasonal profile is defined as bimodal with two peaks in July and September, corresponding to conceptions in October and December, respectively. In Hungary, Poland, Romania, and Bulgaria the highest value is observed in July, while in Slovenia, Slovakia and Croatia, the highest values are observed in September.

This model is explained by the holiday theory that generates artificial cycles in the live births evolution. The September births' peak is related to an increase in conceptions around Christmas and the New Year due to the increased time spent around winter holidays. The fertility model in these countries is also shaped by the outflow of emigrants abroad for work and by their return home around Christmas holidays, the majority of emigrants belonging to the fertile age group.

Most births occur in July and June in the Czech Republic, Estonia, Latvia and Lithuania. The findings for the Czech Republic for the period 1996-2012 are in contrast with the findings of Bobak and Gjonca (2001) that showed that most births occurred in March to May.

Table 1. Seasonal factors for live births in CEE countries considering the multiplicative decomposition model of time series

	Czech Republic	Hungary	Poland	Romania	Slovenia	Slovakia	Bulgaria	Estonia	Croatia	Latvia	Lithuania
January	0.9580	1.0031	1.0166	0.9737	0.9992	0.9970	0.9899	0.9555	1.0129	0.9689	0.9744
February	0.9914	0,9935	0,9913	0,9810	0,9725	1,0097	0,9948	0,9933	1,0020	0,9839	0,9823
March	1,0086	0,9743	1,0131	0,9742	0,9772	1,0051	0,9859	1,0359	0,9560	1,0389	1,0081
April	1,0436	0,9648	1,0165	0,9637	0,9833	1,0226	0,9796	1,0136	0,9489	1,0085	1,0189
May	1,0432	0,9546	1,0081	0,9853	1,0128	1,0150	0,9881	1,0333	0,9592	1,0248	1,0250
June	***1,0617***	1,0053	1,0295	1,0401	1,0104	1,0392	1,0304	**1,0665**	0,9786	1,***0542***	***1,0430***
July	**1,0711**	**1,0706**	**1,0751**	**1,1091**	***1,0598***	***1,0611***	**1,0795**	***1,0600***	***1,0431***	**1,0692**	**1,0917**
August	1,0240	1,0296	1,0267	1,0405	1,0205	1,0275	1,0522	1,0187	1,0299	1,0194	1,0237
September	1,0238	***1,0660***	***1,0672***	***1,0682***	**1,0663**	**1,0727**	***1,0511***	1,0303	**1,0956**	1,0126	1,0199
October	0,9444	0,9940	0,9550	0,9903	0,9986	0,9390	0,9751	0,9359	1,0195	0,9503	0,9523
November	0,9190	0,9686	0,9041	0,9515	0,9502	0,9013	0,9261	0,9337	0,9806	0,9297	0,9377
December	0,9112	0,9758	0,8970	0,9224	0,9490	0,9098	0,9473	0,9233	0,9737	0,9397	0,9230

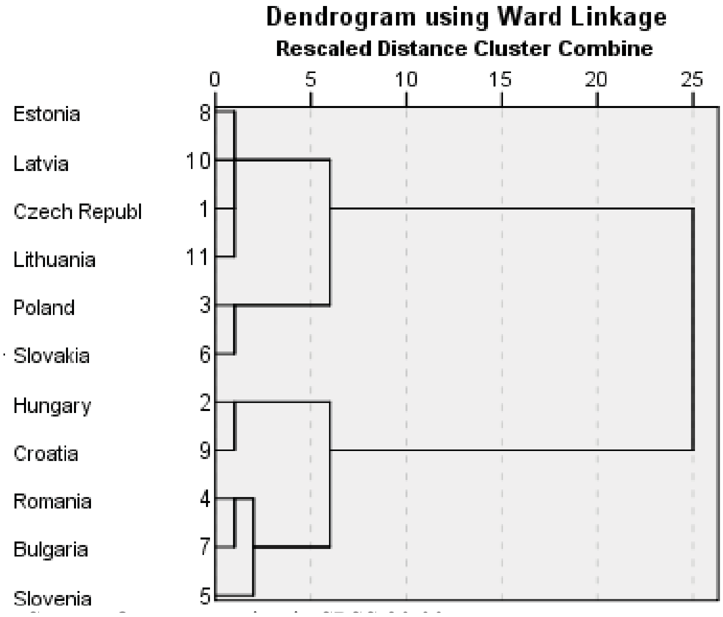
Source: Own processing in SPSS 20.00

The number of births decreases in late autumn and early winter, thus, the lowest values are noticed in November and December corresponding to conceptions in February and March. However, in Croatia, the lowest values of live births are observed during the spring months.

By applying the cluster analysis, the eleven CEE countries are grouped into clusters according to values of seasonal factors. Using the information provided by the dendrogram plot (Figure 2), we set the appropriate number of clusters to keep the two clusters, each of them divided into two smaller sub-clusters.

The dendrogram seasonal model of life births in CEE countries by clusters during the period 1996 – 2012

Figure 2



Source: Own processing in SPSS 20.00

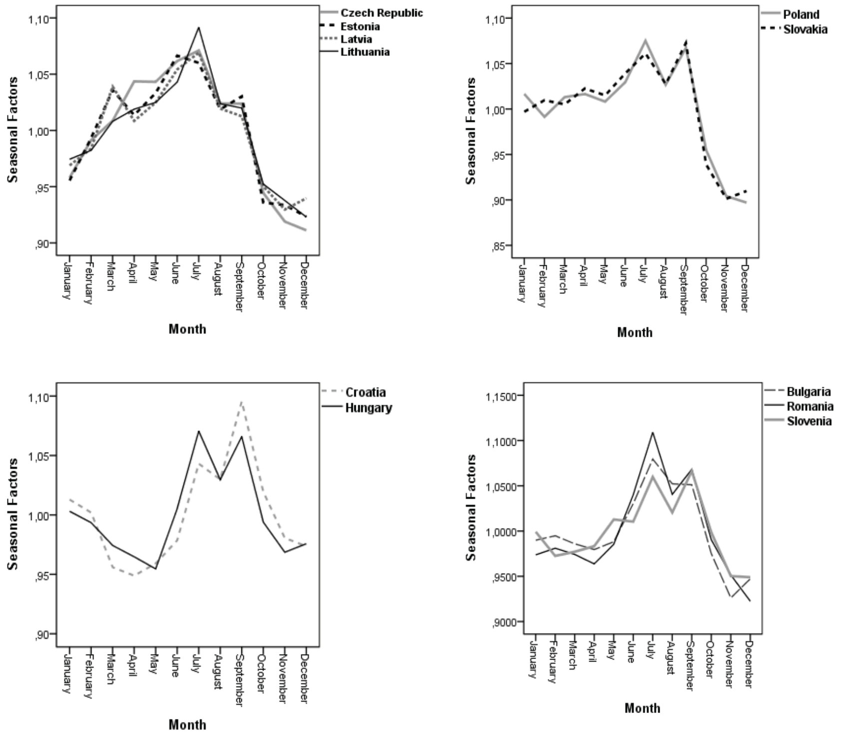
The two clusters and their sub-clusters are:

- Cluster 1 is formed of:
  - o Sub-cluster 1: Czech Republic and the Baltic states;
  - o Sub-cluster 2: Poland and Slovakia;
- Cluster 2 is formed of:
  - o Sub-cluster 3: Croatia and Hungary;
  - o Sub-cluster 4: Bulgaria, Romania and Slovenia.

Countries in the same cluster and sub-cluster show a similar seasonality pattern of monthly live births during the observed time span (Figure 3).

Seasonal model of life births in CEE countries by sub-clusters during the period 1996 – 2012

Figure 3



Source: Own processing in SPSS 20.00

This birth seasonal model in CEE countries is different from the European seasonal model characterised by high birth rates in spring. In most CEE countries, the highest number of births is observed in July.

Conclusions

This study analyses monthly live births in CEE countries during the period January 1996 – December 2012. The main objectives of this study were to identify the birth seasonality pattern for the observed countries and to assess the characteristics of birth seasonality model by country.

Previous studies on the seasonality of births showed that seasonal pattern of births is explained by two main factors: natural cycles (geophysical factors and climatic characteristics) and artificial cycles (cultural, social, demographic, and economic factors).

The method used to analyse the seasonal pattern of live births is the decomposition of time series using the moving average filter and the identification of the seasonal variation by calculating seasonal factors.

The analysis of life births variation in CEE shows different trends, by countries. Moreover, for all the CEE countries, monthly births show seasonal variation. For most of the countries, the seasonal profile is defined as bimodal with two peaks in July and September. This birth pattern is different from the European seasonal pattern characterised by high birth rates in spring.

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